ESSAYS ON INTERNATIONAL TRADE:
SUBSIDIES, TARIFFS AND THE WORLD TRADE ORGANIZATION

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ESSAYS ON INTERNATIONAL TRADE:
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The essays that compose this dissertation investigate the economic distortions caused by subsidies and tariffs under the prism of negotiation and litigation processes at the World Trade Organization (WTO). Chapter 1, *Potential Impacts of the WTO Doha Round on the Cotton Sector*, assesses the price, production and trade effects of reforming cotton subsidies and tariffs under alternative scenarios. While the WTO Doha Round could have a positive impact on world cotton prices and contribute to the expansion of cotton production and exports in developing countries, the likelihood of such an outcome is dependent on the depth of global subsidy reductions. The poor record of internal policy reforms in subsidizing countries and the failure of the US to comply with WTO recommendations in the *US Upland Cotton* dispute highlight the importance of trade negotiations in addressing the profound distortions that characterize the world cotton market.

Chapter 2, *International Experience with Agricultural Export Taxes,* analyzes the evolution in the use of agricultural export taxes by developing countries, with a primary focus on Argentina, Indonesia and Thailand. Empirical evidence indicates that export taxes are ultimately self-defeating. While they may generate government revenue and curb domestic prices in the short run, they shift economic incentives, discourage the adoption of improved inputs, and adversely affect yield and output in the long run. Argentina, in particular, turned a blind eye on comparative

advantage and eluded development opportunities by heftily taxing agricultural exports for most of the last 100 years.

Finally, Chapter 3, *Measurement of Ethanol Subsidies and Associated Economic Distortions: An Analysis of Brazilian and US Policies*, is the only systematic, detailed and quantified comparative examination of ethanol support in the US and Brazil. US ethanol support reached US$57 billion in 2002-2011 and was vulnerable to litigation under the WTO dispute settlement mechanism, as it depressed world prices, slashed imports, reduced production overseas, and significantly increased the US share of the world market. By contrast, Brazilian support reached US$ 27 billion in the same period and was not susceptible to WTO litigation, as it did not cause adverse effects to the interests of other countries.

BIOGRAPHICAL SKETCH

Mario de Queiroz Monteiro Jales received his Bachelor of Arts in International Relations and French from Claremont McKenna College in 1999. Subsequently, he earned a Master of Arts in Latin American Studies from Stanford University in 2000 and a Master of Science in Foreign Service from Georgetown University in 2002.

Mario was project director and senior researcher at Brazil's Institute for International Trade Negotiations (ICONE), research analyst at the Inter-American Development Bank (IDB) and coordinator of the Brazilian Studies Program at Georgetown University. He has worked in consultancy projects for a number of international institutions, including the World Bank, the Organization for Economic Cooperation and Development (OECD), and the Food and Agricultural Organization of the United Nations (FAO). His research focuses on trade, development, agriculture, international negotiations, and the interaction of economics and international law.

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TABLE OF CONTENTS

LIST OF ABBREVIATIONS

AA	Agreement on Agriculture
AMS	Aggregate measurement of support
ANP	Brazilian National Petroleum, Natural Gas and Biofuels Agency
ASCM	Agreement on Subsidies and Countervailing Measures
ATB	Anti-trade bias
BPAB	Bioenergy Program for Advanced Biofuels
C-4	Cotton Four group
CAFTA-DR	Dominican Republic-Central America-United States Free Trade Agreement
CAP	Common Agricultural Policy
CBI	Caribbean Basin Initiative
CCP	Counter-cyclical payment
CGE	Computable general equilibrium
CIDE	Economic Domain Integration Contribution
CIF	Cost, insurance and freight
COFINS	Social Security Financing Contribution
CPI	Consumer price index
CPKO	Crude palm kernel oil
CPO	Crude palm oil
CSE	Consumer support estimate
DDA	Doha Development Agenda
DOE	United States Department of Energy
DP	Direct payment
DSB	Dispute Settlement Body
DSU	Dispute Settlement Understanding
EC	European Commission
EIA	United States Energy Information Administration
EPA	United States Environmental Protection Agency
ETSAP	Energy Technology Systems Analysis Program
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FAPRI	Food and Agricultural Policy Research Institute
FDI	Foreign direct investment
FOB	Free on board
GATS	General Agreement on Trade in Services
GATT	General Agreement on Tariffs and Trade
GDP	Gross domestic product
GE	General equilibrium
GSM	General sales manager
GSSE	General services support estimate
HS	Harmonized Commodity Description and Coding System
IBAMA	Brazilian Institute for the Environment and Renewable Natural Resources
ICAC	International Cotton Advisory Committee
ICMS	Tax on the Circulation of Goods and Services

ICTSD	International Centre for Trade and Sustainable Development
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
LDC	Least-developed country
LDP	Loan deficiency program
MAPA	Brazilian Ministry of Agriculture, Livestock and Supply
MDIC	Brazilian Ministry of Development, Industry and Foreign Trade
MFN	Most favored nation
MLA	Market loss assistance payment
MPD	Market price differential
MPS	Market price support
MTBE	Methyl tertiary butyl ether
NAFTA	North American Free Trade Agreement
NFIDC	Net food importing developing country
NPR	Nominal protection rate
NRA	Nominal rate of assistance
OECD	Organization for Economic Cooperation and Development
PFC	Production flexibility payment
PIS	Social Integration Program Contribution
PSE	Producer support estimate
RAM	Recently-acceded member
RBD	Refined, bleached and odorized
RBOB	Reformulated blendstock for oxygenate blending
RFS	Renewable Fuel Standard
ROW	Rest of the world
RRA	Relative rate of assistance
SCGP	Supplier credit guarantee program
SEPTC	Small Ethanol Producer Tax Credit
SFP	Single farm payment
SLIRAM	Small low-income recently-acceded member
TC	Technical change
TEC	Technical efficiency change
TFP	Total factor productivity
TRIPS	Trade-Related Aspects of Intellectual Property Rights
TRQ	Tariff-rate quota
TSE	Total support estimate
UNICA	Brazilian Sugarcane Industry Association
USDA	United States Department of Agriculture
USITC	United States International Trade Commission
VAT	Value-added tax
VEETC	Volumetric Ethanol Excise Tax Credit
VRAM	Very recently-acceded member
WTO	World Trade Organization

CHAPTER 1

POTENTIAL IMPACTS OF THE WTO DOHA ROUND ON THE COTTON SECTOR

1.1. Introduction

Cotton has proved to be one of the most politically sensitive issues in the Doha Round of multilateral negotiations at the World Trade Organization (WTO). Substantial subsidies provided by developed countries – primarily the United States and the European Union – have continued to depress world prices and undermine the viability of otherwise competitive producers in the developing world. Cotton-exporting West African countries in particular have championed reform of the existing system. Collectively known as the Cotton Four (C-4), Benin, Burkina Faso, Chad and Mali have denounced the deleterious effects of cotton subsidies on poverty and food security at the farm level and called for the establishment of a mechanism to phase out support for cotton with a view to its total elimination. The issue came to dominate the 2003 Cancún Ministerial Conference, with the failure of developed countries to make significant concessions widely seen as a contributing factor to the breakdown of the meeting. The 2004 Framework for Establishing Modalities in Agriculture (WTO, 2004a) and the 2005 Hong Kong Ministerial Declaration (WTO, 2005a) recognized the vital importance of cotton for developing countries and established a mandate to address it "ambitiously, expeditiously and specifically" within the agricultural negotiations. Nevertheless, the issue has subsequently languished due to little concrete engagement by subsidizing countries. In the absence of any counter-proposal from the US or EU, the December 2008 Revised Draft Modalities for Agriculture (WTO, 2008a) reproduce the C-4 submission.

In parallel to the efforts to address cotton subsidies through the Doha negotiations, countries have also sought to reduce trade distortion in the agricultural sector through the Dispute

Settlement Body (DSB) of the WTO. The *United States Upland Cotton* dispute initiated by Brazil has led to significant developments in WTO jurisprudence on subsidies in general, as well as specific findings about the illegality of various US cotton subsidies under existing WTO rules. Despite successive DSB rulings against certain aspects of US cotton subsidies, Washington has hitherto failed to bring cotton payments into conformity with WTO obligations.[1] Meanwhile, unilateral domestic policy reforms in the EU and US have had limited if any impact on world cotton markets. The 2003-2004 reform of the EU Common Agricultural Policy (CAP) and subsequent amendments changed the guaranteed minimum price for cotton to a mix of coupled and allegedly decoupled payments.[2] In the US, the 2008 Farm Bill kept cotton subsidies largely unchanged and indicated an unwillingness to comply with the DSB panel rulings or the mandates from the Hong Kong Ministerial Declaration.

Cotton was brought to the spotlight in the Doha Round due to its unique development dimension. Three characteristics set it apart from other agricultural products. First, cotton is the single most important agricultural export commodity for least developed countries (LDCs) as a

[1] On 8 September 2004, the DSB panel found that certain United States' domestic support programs in respect of cotton resulted in serious prejudice to Brazil's interests in the form of price suppression in the world market, and that three United States export credit guarantee programs were in violation of WTO export subsidy disciplines. On 3 March 2005, following an appeal by the United States, the Appellate Body upheld the panel's findings. As a result, the United States was asked to withdraw its export credit guarantee programs and user marketing payments by 1 July 2005, and to take appropriate steps to remove the adverse effects of certain domestic subsidies or withdraw these subsidies by 21 September 2005. On 18 December 2007, a compliance panel found that the United States had failed to comply with the DSB recommendations and rulings relating to the original panel's findings. On 2 June 2008, following yet another appeal by the United States, the Appellate Body upheld the compliance panel's findings.

[2] As long as EU cotton subsidies are only partially decoupled, cotton areas in Greece and Spain are expected to remain relatively significant. Rozakis *et al.* (2008) find that in the absence of the so-called decoupled payments, farm income among a significant share of Greek cotton producers would turn negative, thus leading towards abandonment of activities. According to the European Commission (2007), full decoupling would reduce the relative profitability of cotton: gross margins would fall well below those for other crops and become negative in almost all instances. Without specific coupled incentive to produce cotton, cotton areas would decline dramatically: "In Spain it would be expected that the cotton area would fall to zero. In Greece there would be a decline in the cotton area; only cotton grown extensively under agri-environmental programs would be expected to continue." In addition, studies that are not specific to the cotton sector have suggested that European farm operators, to a large extent, do not treat the new decoupled payments as fully decoupled (Hennessy and Thorne, 2005; Howley *et al.*, 2009). As a result, these subsidies are believed to maintain a strong supply inducing effect on agricultural production, although less so than the previously fully coupled payments.

group (Figure 1.1). LDC cotton export earnings were higher than the combined value of bean, sugar, tea, cashew nut and cocoa exports in 2004-2007. The share of cotton in total agricultural export receipts in 2004-2007 was as high as 80 percent in Burkina Faso, 74 percent in Mali, 59 percent in Benin and 51 percent in Chad (Figure 1.2). Cotton is also an important agricultural export for non-LDC developing countries, most notably in Central Asia. Moreover, cotton is the second most important agricultural export for India, a non-LDC that is home to one third of the world's poor.

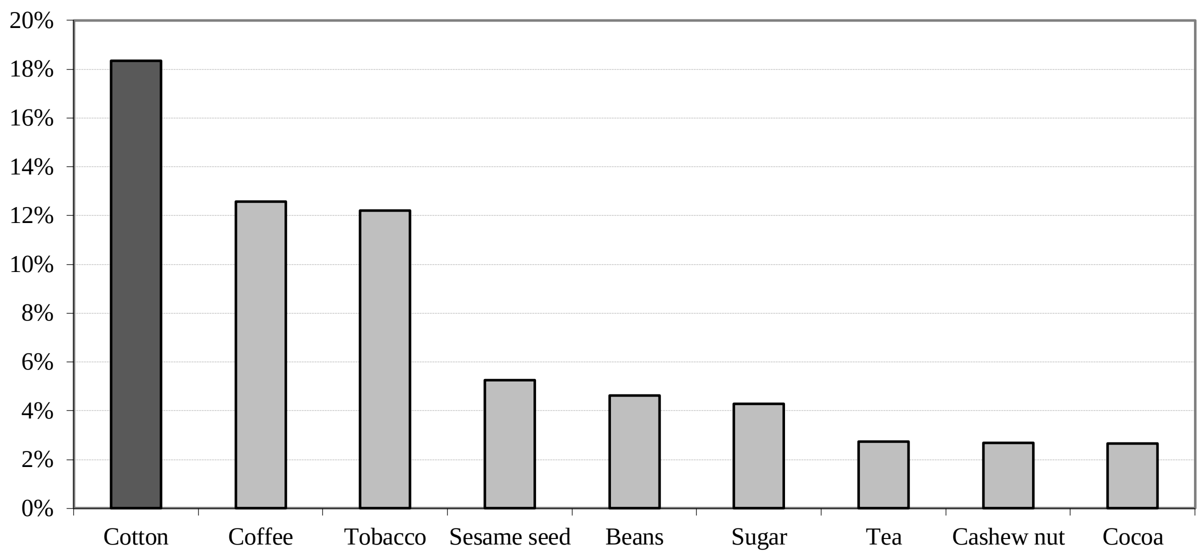

Figure 1.1: Shares of LDC combined agricultural export receipts, 2004-2007

Source: Author. Based on FAO (2010).

Second, cotton is one of the few sectors in which LDCs account for an important share of world exports. Figure 1.3 depicts the shares of LDCs, other developing countries and developed countries in world export quantities in 2003-2007 for eight key subsidized agricultural commodities. The share of LDCs in world export quantities is highest for cotton (11 percent), followed by peanuts (3.5 percent). For corn, rice, sorghum, soybeans, sugar and wheat, the share of LDCs in world export quantities is less than 1 percent.

Third, cotton is a highly subsidized commodity in developed countries. While other agricultural products, such as cocoa and coffee, are also important export commodities for LDCs, they are not subject to subsidization in the developed world. Trade-distorting support for cotton in the United States corresponded to approximately 50 percent of the domestic production value in 1998-2007. In years with lower world prices, as in 1999 and 2001, US cotton subsidies were equivalent to 70-90 percent of the value of production. In the EU, cotton subsidies were on average 67 percent as large as the value of production in 1998-2005, with a peak of 140 percent in 2003. Since 2006, so-called decoupled payments account for 65 percent of EU cotton subsidies.

The present chapter assesses the likely implications for exporting and importing countries from a trade deal in cotton. It estimates the price, production and trade effects of reforming cotton subsidies and tariffs under five alternative scenarios, with a primary focus on the WTO Doha Round. The special cotton provisions of the December 2008 Revised Draft Modalities are contrasted with the general agricultural provisions in the same text, the DSB panel recommendations in the *United States Upland Cotton* dispute, and internal policy reforms in key subsidizing countries.

The chapter is divided into five sections in addition to this introduction. The economic model used to assess the likely implication of policy reforms in the cotton sector is described in Section 1.2. The data and parameters used in the model, including production and consumption levels, import tariffs, tariff-rate quotas, subsidies, and price elasticities of supply and demand are described in Section 1.3. Section 1.4 describes five alternative reform scenarios. Section 1.5 presents the simulation results and analyzes their sensitivity to the choice of supply and demand elasticities. Finally, Section 1.6 summarizes the main findings and concludes.

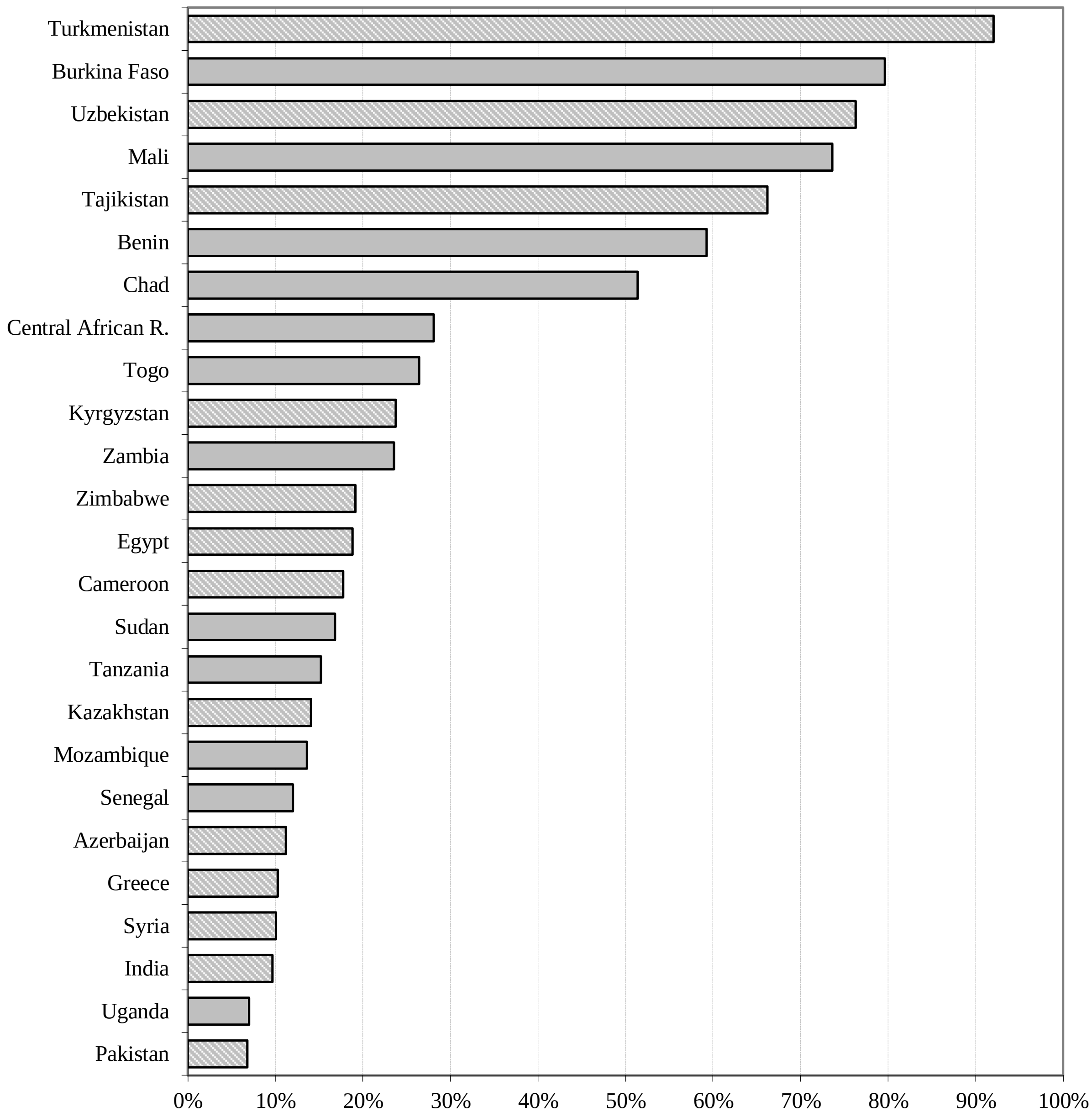

Figure 1.2: Share of cotton in total agricultural export receipts, by country, 2004-2007

Notes: LDCs are indicated by solid bars. Non-LDCs are indicated by crosshatched bars.
Source: Author. Based on FAO (2010).

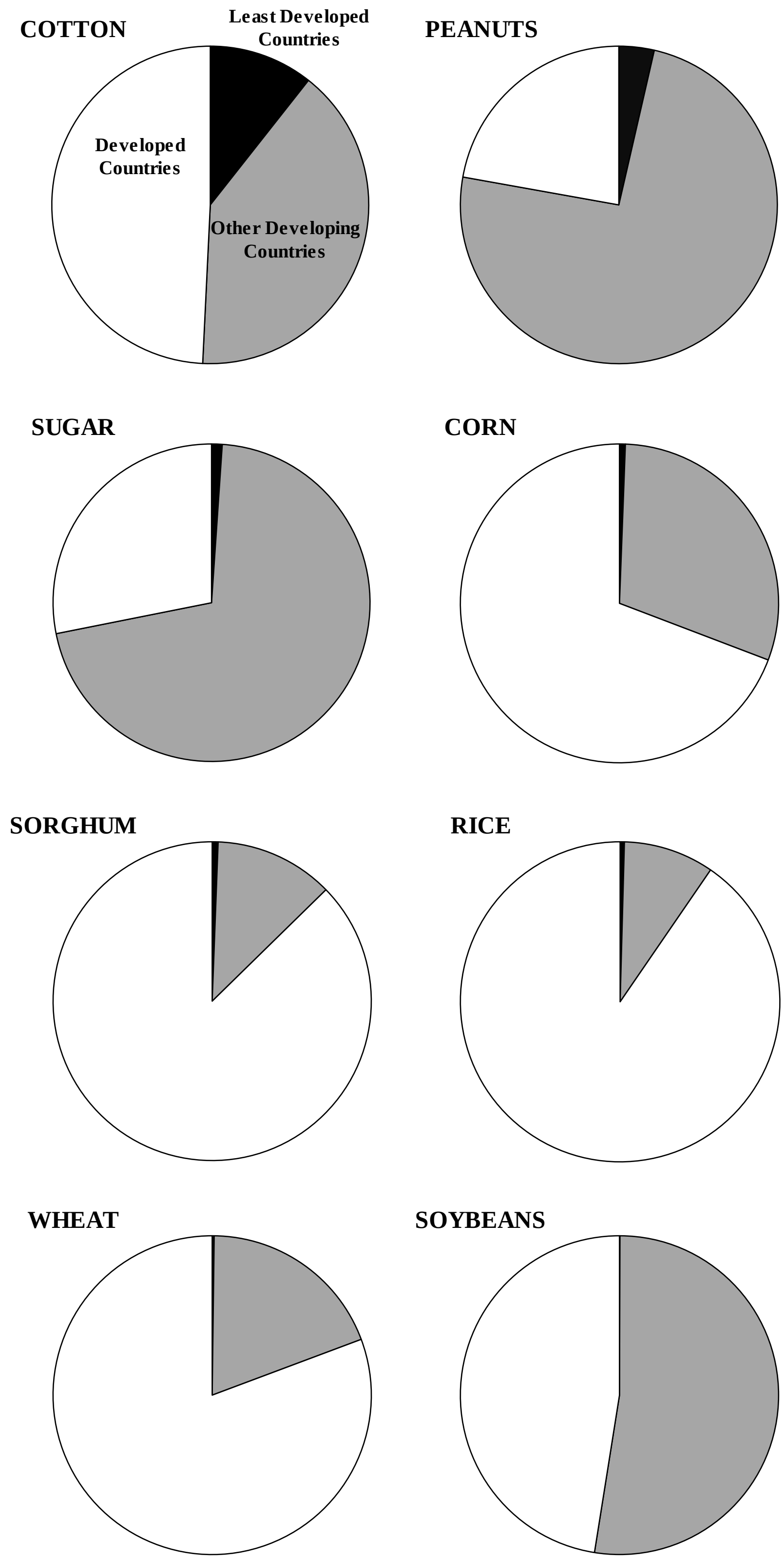

Figure 1.3: Shares of world export quantities, by product and country category, 2003-2007

Source: Author. Based on FAO (2010).

1.2. Modelling Framework

A single commodity, multi-country, non-spatial, partial equilibrium model of trade is used to quantify the price, production and trade effects of reducing cotton subsidies and tariffs. The structure of the model is similar to that of other partial equilibrium models used to assess the impact of policies on agricultural trade, such as the ones in Vanzetti and Graham (2002), Tokarick (2003), Poonyth *et al.* (2004), Sumner (2005), Alston *et al.* (2007) and Cabral and Jales (2008). For each scenario, the model simulates the prices and quantities that would have obtained in a base year had the policy reforms implied by the given scenario been retroactively applied to that year.

There are three important assumptions behind the model. The first two are common to the majority of global trade models of the cotton sector. First, the model assumes perfect price transmission between world and domestic markets. In reality, price transmission may be less than perfect due to transportation and transaction costs, exchange rates, economies of scale and governmental intervention (Conforti, 2004). Second, cotton prices are assumed to be the only factor that influences cotton supply and demand. Factors such as rainfall, income, access to credit and infrastructure are not reflected in the model. Finally, cotton is assumed to be a homogeneous product. This implies that full substitution is assumed between domestic and imported cotton, as well as among imports from different sources. The degree of homogeneity of most traded cotton is such as to warrant the perfect substitution assumption; the existence of only little border distortion also warrants the perfect price transmission assumption for most countries (Poonyth *et al.*, 2004).

The fact that the model is non-spatial implies that it is not solved for trade flows between specific pairs of countries. Spatial models are especially suitable for markets where trade preferences play an important role, such as sugar or bananas. They allow the modelling of policies that apply distinct regimes to imports from different countries (Anania, 2009). Since preferential trade plays a minor role in the cotton sector, the added benefit of adopting the more complex spatial framework is close to nil. In 2004-2008, at least 93 percent of world cotton imports occurred at a most-favored nation (MFN) basis. Of the remaining 7 percent of world imports that *may* have occurred at a preferential basis, 6.95 percent were imported by countries that will not be required to change cotton applied tariffs in the Doha Round.[3] If these countries were applying distinct policy regimes to imports from different countries, they will continue to do so after the Doha Round. Therefore, the balance between preferential and non-preferential policy regimes may potentially change for only 0.05 percent of world cotton imports, which is only a negligible fraction of the market.

The model is based on supply and demand relationships for cotton. Change in cotton supply in country i is given by:

$$d \ln S_i = \eta_i d \ln(P + T_i + U_i) \tag{1.1}$$

where
$$T_i = \begin{cases} 0 & \text{if country } i \text{ is a net exporter of cotton} \\ \hat{T}_i & \text{if county } i \text{ is a net importer of cotton} \end{cases}$$

$\hat{T}_i$: Specific applied tariff on cotton in country i,

U_i: Price wedge caused by cotton subsidies in country i,

η_i: Price elasticity of supply for cotton in country i, and

P: World price of cotton.

The price wedge caused by cotton subsidies in country i is given by:

[3] Several countries will not be required to reduce cotton applied tariffs in the Doha Round for one of the following three reasons: (i) they are exempt from tariff reductions given their status as least developed countries (LDCs), very recently acceded members (VRAMs) or small low-income recently acceded members (SLIRAMs); (ii) they have significant tariff overhang for cotton; or (iii) they are not members of the WTO. See Subsection 1.4.1 and Table 1.1 for more detail.

$$U_i = \sum_j u_i^j \gamma_i^j \tag{1.2}$$

where: u_i^j : Per unit value of subsidy *j* in country *i*, and

γ_i^j : Degree to which subsidy *j* provides a production incentive in country *i* relative to revenue from the market.

Equation 1.1 may be expressed as:

$$d \ln S_i = \eta_i \left(\frac{1}{P + T_i + U_i} dP + \frac{1}{P + T_i + U_i} dT_i + \frac{1}{P + T_i + U_i} dU_i \right) \tag{1.3}$$

where per unit producer gross receipts in country *i* are given by $R_i = P + T_i + U_i$.

Defining α_i^T as the share of T_i in R_i and α_i^U as the share of U_i in R_i, equation 1.3 may be rewritten as:

$$d \ln S_i = \eta_i \left(\left(1 - \alpha_i^T - \alpha_i^U\right) d \ln P + \alpha_i^T d \ln T_i + \alpha_i^U d \ln U_i \right) \tag{1.4}$$

where

$$\alpha_i^T = (T_i / P + T_i + U_i)$$

$$\alpha_i^U = (U_i / P + T_i + U_i)$$

Change in cotton demand in country *i* is given by:

$$d \ln D_i = \varepsilon_i d \ln(P + T_i) \tag{1.5}$$

where

$$T_i = \begin{cases} 0 & \text{if country } i \text{ is a net exporter of cotton} \\ \hat{T}_i & \text{if county } i \text{ is a net importer of cotton} \end{cases}$$

$\hat{T}_i$: Specific applied tariff on cotton in country *i*,

ε_i: Price elasticity of demand for cotton in country *i*, and

P: World price of cotton.

Equation 1.5 may be expressed as:

$$d \ln D_i = \eta_i \left(\frac{1}{P + T_i} dP + \frac{1}{P + T_i} dT_i \right) \tag{1.6}$$

where per unit consumption expenditure in country i is given by $C_i = P + T_i$.

Defining β_i^T as the share of T_i in C_i, equation 1.6 may be rewritten as:

$$d \ln D_i = \varepsilon_i \left((1 - \beta_i^T) d \ln P + \beta_i^T d \ln T_i \right) \tag{1.7}$$

where $$\beta_i^T = (T_i / P + T_i)$$

Change in world cotton supply is given by the sum of the changes in national supply in every in country i:

$$d \ln S_{WORLD} = \sum_i d \ln S_i = \sum_i \theta_i \eta_i \left((1 - \alpha_i^T - \alpha_i^U) d \ln P + \alpha_i^T d \ln T_i + \alpha_i^U d \ln U_i \right) \tag{1.8}$$

where θ_i is the share of country i in world cotton production and $\sum_i \theta_i = 1$.

Change in world cotton demand is given by the sum of the changes in national demand in every in country i:

$$d \ln D_{WORLD} = \sum_i d \ln D_i = \sum_i \lambda_i \varepsilon_i \left((1 - \beta_i^T) d \ln P + \beta_i^T d \ln T_i \right) \tag{1.9}$$

where λ_i is the share of country i in world cotton consumption and $\sum_i \lambda_i = 1$.

World supply must equal world demand in equilibrium. Thus:

$$\sum_i \theta_i \eta_i \left((1 - \alpha_i^T - \alpha_i^U) d \ln P + \alpha_i^T d \ln T_i + \alpha_i^U d \ln U_i \right) \tag{1.10}$$

$$= \sum_i \lambda_i \varepsilon_i \left((1 - \beta_i^T) d \ln P + \beta_i^T d \ln T_i \right)$$

Solving for the change in world price yields:

$$d \ln P = \sum_i \frac{\theta_i \eta_i}{A} \left(\alpha_i^T d \ln T_i + \alpha_i^U d \ln U_i \right) - \sum_i \frac{\lambda_i \varepsilon_i}{A} (\beta_i^T d \ln T_i) \tag{1.11}$$

where $$A = \sum\nolimits_i \left(\lambda_i \varepsilon_i (1 - \beta_i^T) - \theta_i \eta_i (1 - \alpha_i^T - \alpha_i^U) \right)$$

Equation 1.11 indicates the effect on the world price of changes in cotton subsidies and tariffs. Changes in domestic supply and demand in country i are obtained by substituting $d \ln P$ back into equations 1.4 and 1.7. Changes in net exports are obtained by subtracting demand from supply.

The model comprises 28 countries or groups of countries, including 12 net cotton exporters (Australia, Benin, Brazil, Burkina Faso, Chad, India, Kazakhstan, Mali, Syria, Turkmenistan, US and Uzbekistan) and 16 net cotton importers (Bangladesh, China, Colombia, EU, Hong Kong, Indonesia, Iran, Japan, Mexico, Pakistan, Singapore, South Korea, Taiwan, Thailand, Turkey and a rest of the world (ROW) aggregate). The countries that are explicitly included in the model represent a very significant portion of world cotton markets. They accounted for 95 percent of world production, 94 percent of world consumption, 91 percent of world exports and 87 percent of world imports in 2004-2008.

Simulations cover ten base years between 1998 and 2007, a period that not only provides a wide variance in prices and subsidy levels but also reflects recent trends in supply and demand forces. This analytical time period is longer and more current than the time periods evaluated in previous partial equilibrium models of world cotton markets. The wide range of cotton world prices allows the comparison of the effects of trade policy instruments in years of prevailing low and high prices. Since most previous models are based on pre-2001 data, the current model enriches the debate by incorporating data that reflect recent trends in cotton policies, prices, production, consumption and trade.[4]

[4] Poonyth *et al.* (2004) uses average production, consumption and trade data for 1996-2000 and subsidy data for 1997-1999. Sumner (2003) uses actual data from marketing years 1999-2001 (figures for 2002-2007 are projections). Schmitz *et al.* (2007) uses data for crop years 1999-2000 to 2003-2004. In Alston *et al.* (2007), the baseline is defined using 2004-2005 data.

1.3. Data

Production, consumption, import and export data were obtained from the International Cotton Advisory Council (ICAC), the United Nations Commodity Trade Statistics (COMTRADE) and the United States Department of Agriculture (USDA). World prices were obtained from ICAC. Data on domestic support and export subsidies were obtained from official government notifications submitted to the WTO Committee on Agriculture. Tariffs were obtained from the WTO Consolidated Tariff Schedules (CTS) database, the WTO Integrated Data Base (IDB) and official national-level sources. Price elasticities of supply and demand were obtained in Sumer (2003) and Poonyth *et al.* (2004).

Production and Trade

A lot has changed in world cotton markets in the last decade. While annual global cotton production was relatively stable at 20 million metric tons in 1998-2003, it soared to approximately 26 million metric tons in 2004-2007, due in large part to remarkable output expansion in China, India and Brazil (Figure 1.4). Between 1998 and 2007, cotton production in these countries increased by 80 percent, 85 percent and 210 percent, respectively. As a result, the shares of individual countries in world cotton production have changed considerably over time. Figure 1.5 compares the average shares of the ten largest cotton producers in 1995-1998 and 2004-2007. China, India and Brazil were the only countries that experienced an expansion in their participation in world cotton production. The combined share of these three emerging economies rose from 42 percent in 1998 to 57 percent in 2007. Meanwhile, the share of all other developing countries declined from 35 percent to 25 percent, and that of developed countries from 23 percent to 18 percent.

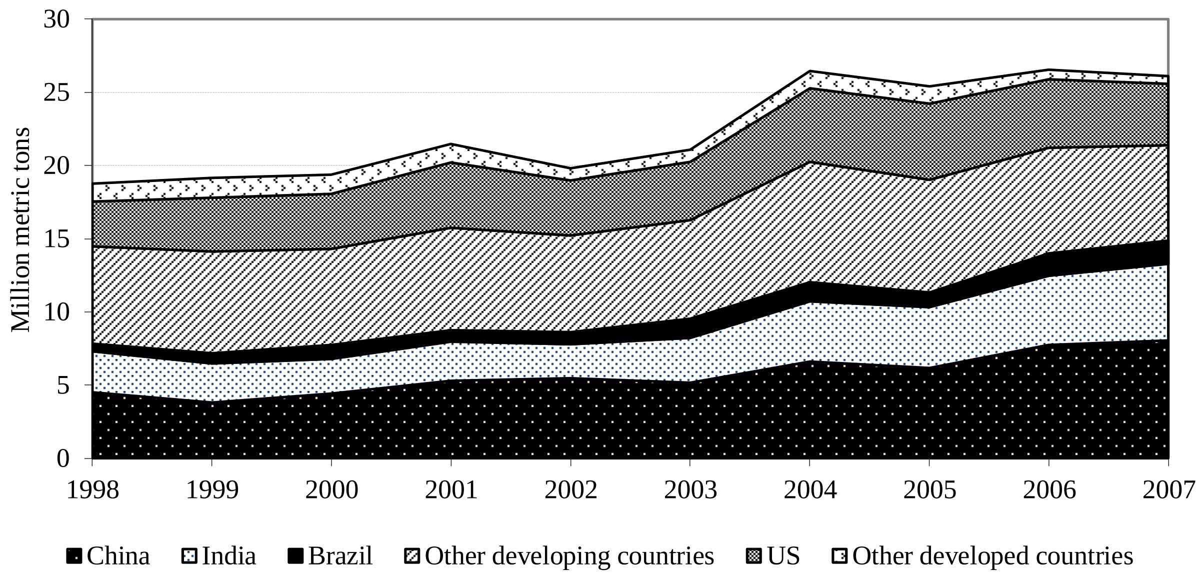

Figure 1.4: Composition of world cotton production, 1998-2007

Source: Author. Based on FAO (2010).

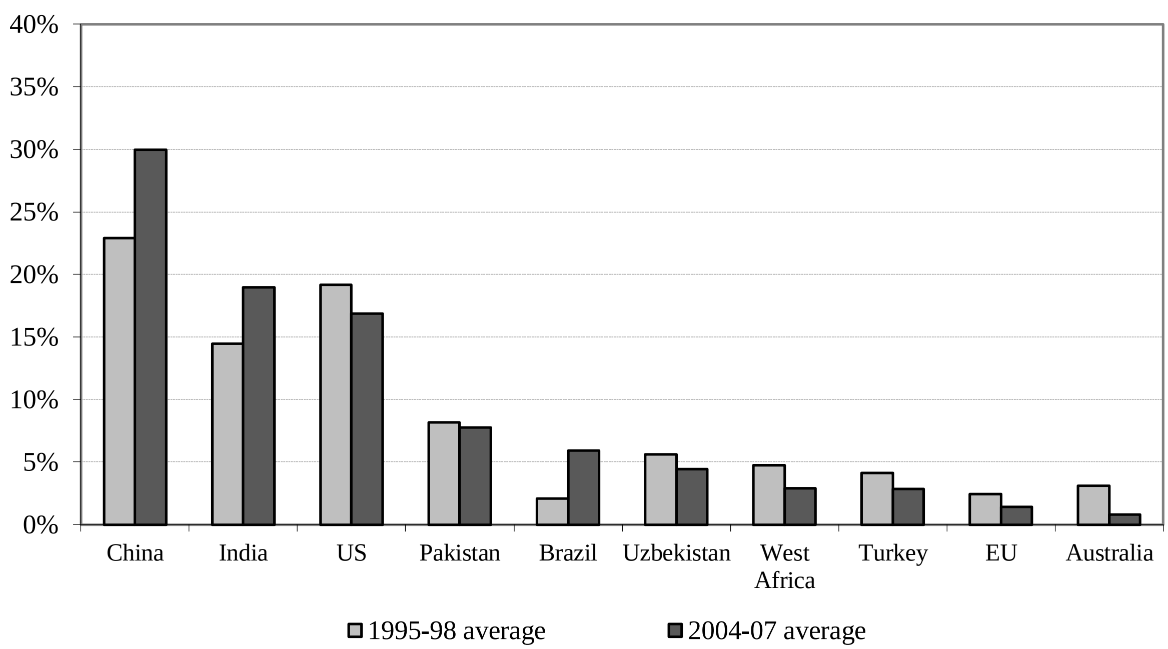

Figure 1.5: Shares of world cotton production, by main producers, 1995-1998 and 2004-2007

Source: Author. Based on FAO (2010).

The composition of world cotton demand by individual countries has also changed remarkably (Figure 1.6). First and foremost, Chinese consumption almost tripled from 4 million metric tons in 1998 to 11 million tons in 2007. Second, developed country demand retracted from 4 million metric tons to 1.7 million metric tons in the same period. Finally, while cotton consumption in other Asian developing countries increased by nearly 50 percent in this period, demand in non-Asian developing countries remained mostly unchanged. As a result of these changes in domestic demand, China's share in world cotton consumption nearly doubled from 21 percent in 1998 to 40 percent in 2007 (Figure 1.7). Other Asian developing countries with rising textiles and clothing sectors also increased their shares in world cotton demand, most notably Bangladesh, Vietnam and Pakistan. Meanwhile, the combined share of developed countries in world cotton consumption fell from 23 percent to only 6 percent.

Changes in supply and demand forces around the globe have led to significant adjustments in trade patterns. The sharp fall in domestic consumption and the large levels of domestic and export subsidies in the US have allowed this country to significantly expand its exports (Figures 1.8 and 1.9). In contrast, traditional exporters in Central Asia and Africa have lost market share. India and Brazil, which not long ago were net cotton importers, are now among the world's largest exporters. Substantial changes have also occurred in the import side. While developed countries accounted for 30 percent of world cotton imports in 1998, their share fell to 7 percent in 2007. In contrast, Asian developing countries now account for more than 75 percent of world cotton imports (Figures 1.10 and 1.11). An accurate model of cotton trade must reflect trends in cotton production, consumption and trade by incorporating the most recent data available.

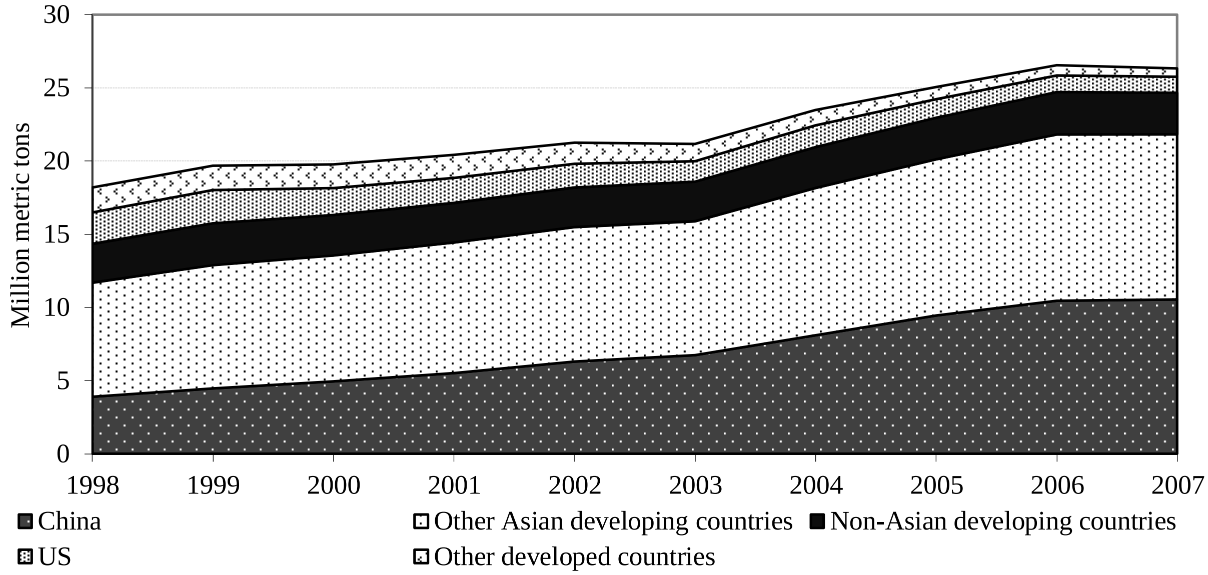

Figure 1.6: Composition of world cotton consumption, 1998-2007

Source: Author. Based on FAO (2010).

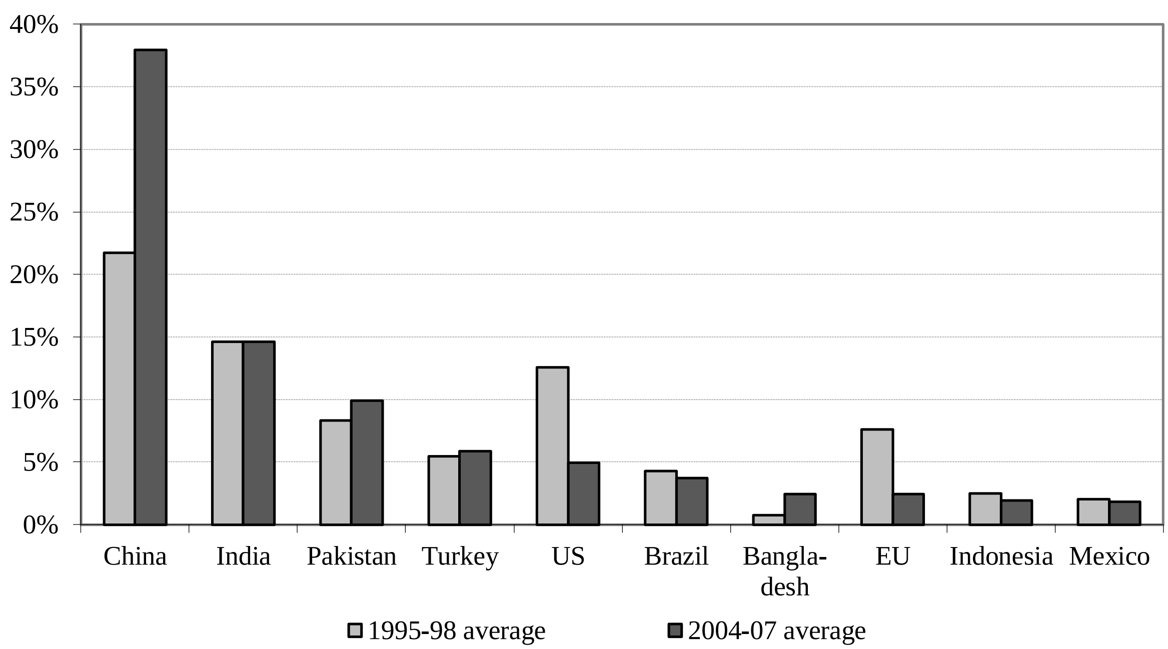

Figure 1.7: Shares of world cotton consumption, by main consumers, 1995-1998 and 2004-2007

Source: Author. Based on FAO (2010).

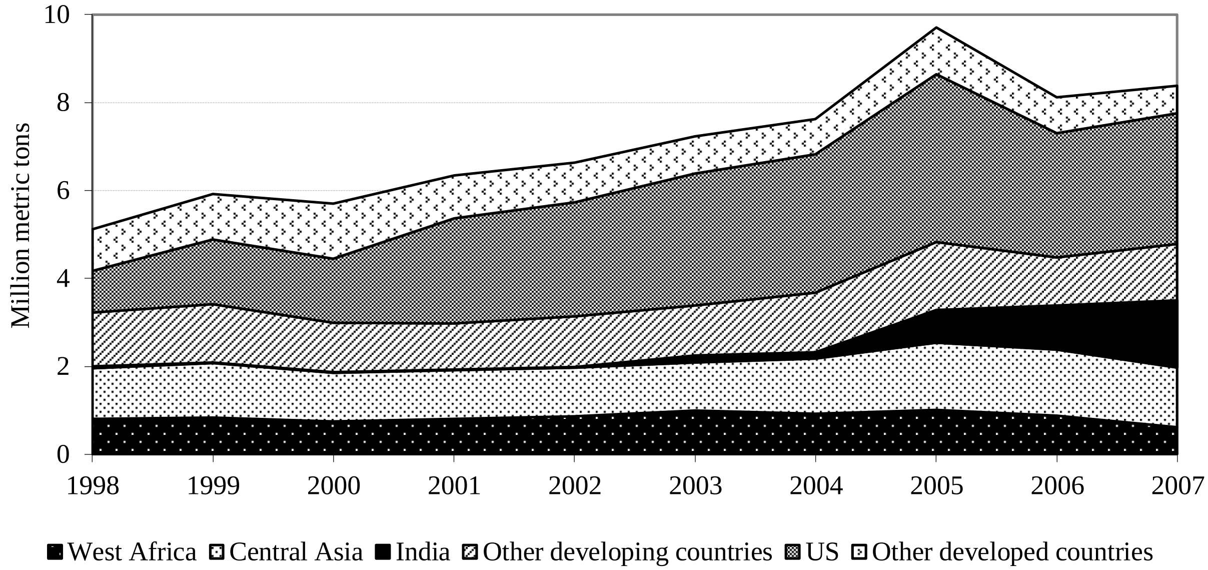

Figure 1.8: Composition of world cotton exports, 1998-2007

Source: Author. Based on FAO (2010).

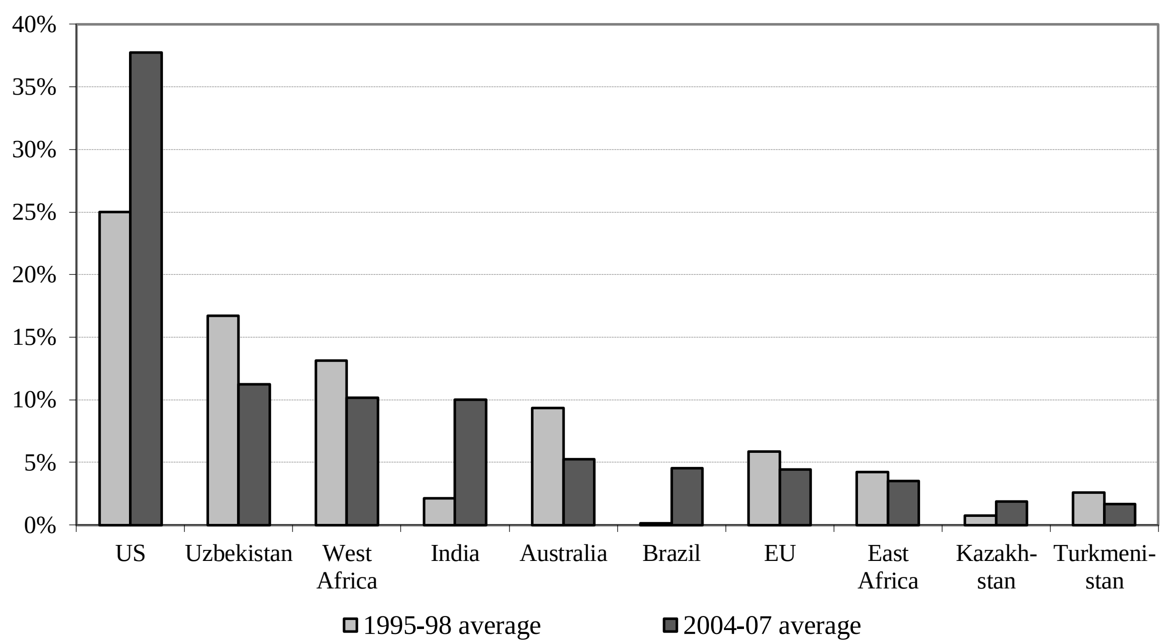

Figure 1.9: Shares of world cotton exports, by main exporters, 1995-1998 and 2004-2007

Source: Author. Based on FAO (2010).

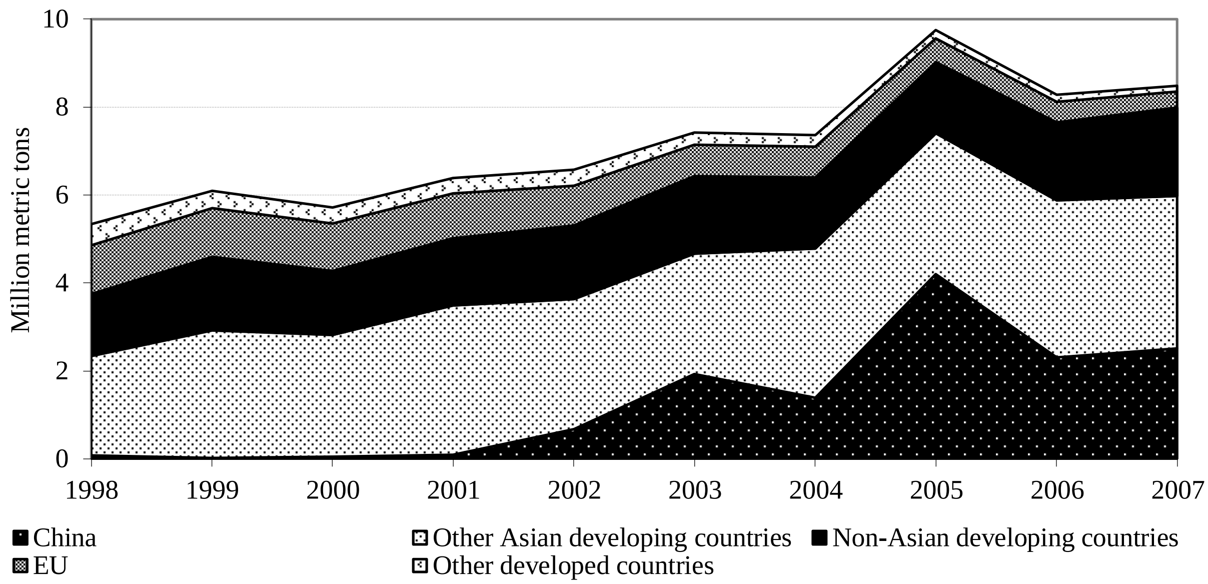

Figure 1.10: Composition of world cotton imports, 1998-2007

Source: Author. Based on FAO (2010).

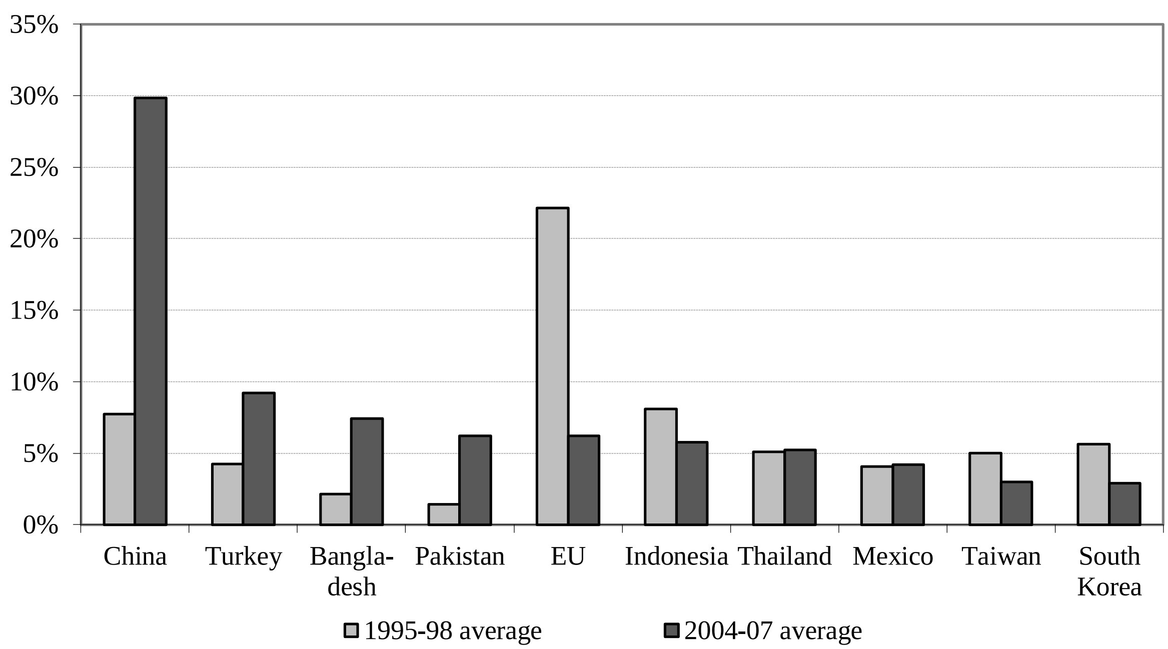

Figure 1.11: Shares of world cotton imports, by main importers, 1995-1998 and 2004-2007

Source: Author. Based on FAO (2010).

Tariffs

MFN applied tariffs were collected for every country and year between 1998 and 2007. Compared to other agricultural commodities, cotton is subject to relatively low import tariffs. Countries that imported cotton in 2004-2008 are classified under six different categories in Table 1.1, according to their most recent applied tariff rate on uncarded cotton (HS 5201). Of the 94 countries listed in Table 1.1, only two – the US and China – would be required to change applied tariffs according to the December 2008 Revised Draft Modalities.[5]

Category I comprises countries that provide duty-free access to cotton imports at an MFN basis. This is the largest of the six groups in terms of both the number of countries (47) and their share of world cotton imports in 2004-2008 (63 percent). Notable importers in this group include Turkey, Bangladesh, Pakistan, Indonesia and Thailand. All developed countries, except the US, are also in this group. Category II consists of 36 countries that apply tariffs that are larger than zero, but not larger than 10 percent, including India, most of South America, and a number of other developing countries and transition economies. Together, they account for 5.5 percent of world imports. Category III consists of countries that apply tariffs that are larger than 10 percent but not larger than 30 percent. The four countries in this category – Haiti, Iran, Nigeria and South Africa – account for 1.2 percent of world imports. Categories IV and V are each made of only one country, namely China and the US, both of which apply tariff-rate quotas (TRQs) to cotton imports. The key distinction between these two categories is that while China is the world's largest cotton importer, the US accounts for only 0.05 percent of world imports. Finally, Category VI includes five non-WTO members for which recent tariff rates are not available (Ethiopia, Iraq, North Korea, Somalia and Uzbekistan). Together they account for only 0.3 percent of world imports.

[5] For purposes of this chapter, the 27 member states of the European Union are counted as one country.

Table 1.1: MFN applied tariffs on cotton, by importing country category

Category	Applied MFN tariff on cotton (*t*)	Importing countries	Share of world cotton imports (2004-2008)
I	$t = 0\%$	*Armenia Australia Bangladesh Belarus Canada Costa Rica Croatia Dominican Rep. Egypt El Salvador European Union Georgia Guatemala Honduras Hong Kong Iceland Indonesia Israel Japan Jordan Kazakhstan Kenya Kyrgyzstan Lebanon Macau Macedonia Malaysia Mauritius Mexico Moldova Myanmar New Zealand Norway Pakistan Panama Philippines Russia Serbia Singapore South Korea Sri Lanka Switzerland Taiwan Thailand Tunisia Turkey Vietnam*	*63 percent*
II	$0\% < t \leq 10\%$	*Albania**** Algeria # Angola** Argentina* Azerbaijan # Bahrain* Benin** Bolivia* Brazil* Burkina Faso** Cambodia** Cameroon* Chile* Colombia* Congo* Congo, DR # Côte d'Ivoire* Cuba* Ecuador* Ghana* Guinea-Bissau** India* Madagascar** Mali** Morocco* Mozambique** Niger** Paraguay* Peru* Rwanda** Saudi Arabia*** Senegal** Togo** Ukraine*** Uruguay* Venezuela**	*5.5 percent*
III	$10\% < t \leq 30\%$	*Haiti** Iran # Nigeria* South Africa**	*1.2 percent*
IV	**IQ:** $0\% \leq t \leq 3\%$ **EQ:** $t \leq 24\%$	*United States*	*0.05 percent*
V	**IQ:** $t = 1\%$ **EQ:** $3\% \leq t \leq 40\%$	*China*	*30 percent*
VI	**tariff unavailable**	*Ethiopia # Iraq # North Korea # Somalia # Uzbekistan #*	*0.3 percent*

Note 1: Import tariffs for cotton, not carded or combed (HS 5201).
Note 2: IQ and EQ stand for intra-quota tariff and extra-quota tariff, respectively.
Note 3: Only countries that imported cotton in 2004-2008 are listed above. Countries are classified in categories according to their applied tariffs in the most recent year for which data are available (2008 or 2009 for most large countries).
Note 4: Reasons why specific countries would not be required to change applied tariffs on cotton:

- * Country where tariff overhang is greater than required Doha Round tariff cut.
- ** LDCs are exempt from tariff cuts in the Doha Round.
- *** VRAMs are exempt from tariff cuts in the Doha Round.
- **** SLIRAMs are exempt from tariff cuts in the Doha Round.
- \# Country is not a WTO member.

Source: Author.

Subsidies

Cotton is a highly subsidized commodity in developed countries. Between 1998 and 2007, the US and the EU provided nearly 3 billion USD per year in support to domestic cotton producers, three-quarters of which was provided by the US alone. Support varied significantly from year to year (Figure 1.12), due in large part to the counter-cyclical nature of certain US support programs. Cotton was among the most highly subsidized farm commodities in both sides of the Atlantic. Figures 1.13 and 1.14 present trade-distorting domestic support as a share of the production value for key agricultural products in the US and the EU. The average level of subsidization in the US cotton sector in 1998-2007 – 50 percent of the production value – was twice as high as in any other sector except rice. In years with lower world prices, US cotton subsidies were equivalent to 70-90 percent of the value of production. In the EU, cotton subsidies were on average 67 percent as large as the value of production in 1998-2005, with a peak of 140 percent in 2003. Since 2006, 65 percent of EU cotton subsidies have given in the form of allegedly decoupled payments.

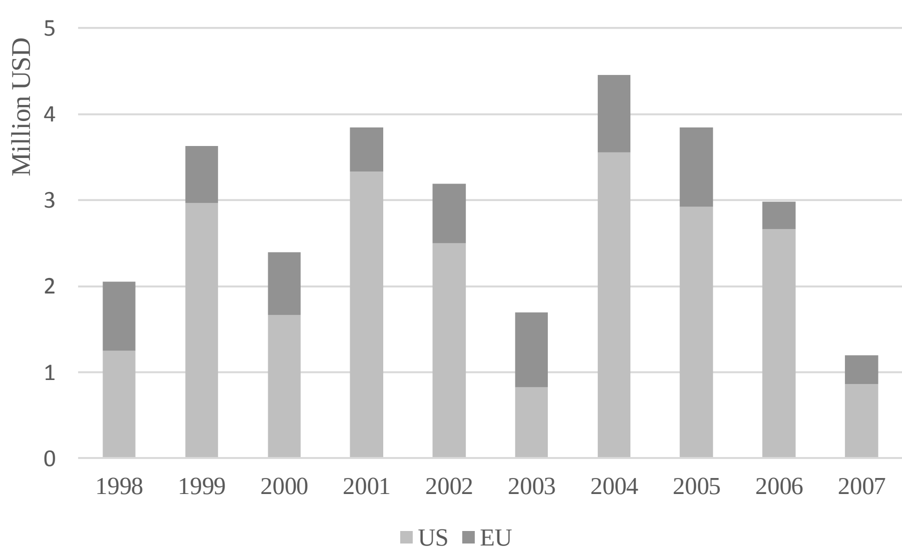

Figure 1.12: Trade-distorting domestic support for cotton in the US and the EU, 1998-2007

Source: Author. Based on data from WTO notifications and USDA.

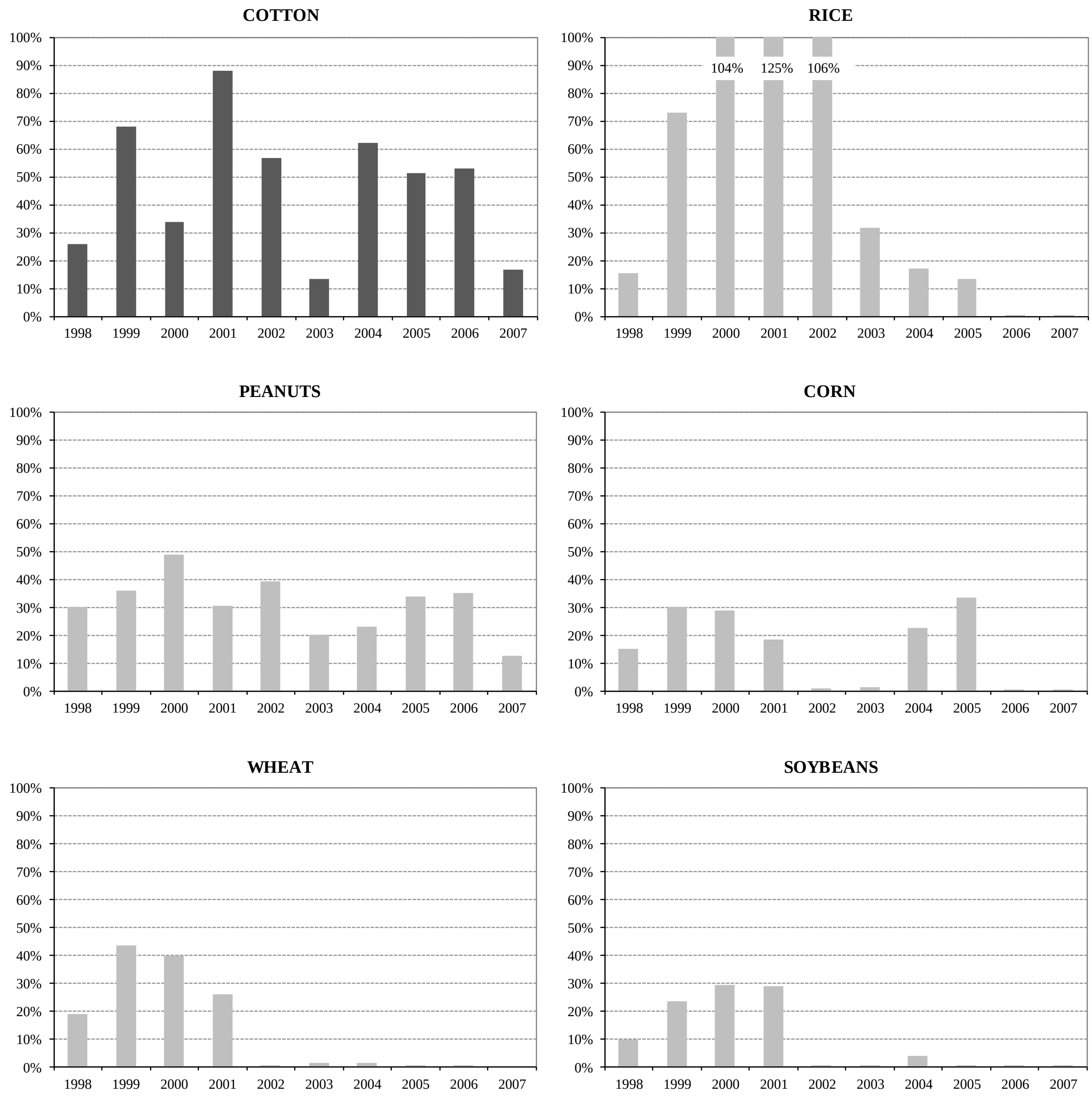

Figure 1.13: US trade-distorting support for cotton as a share of production value, 1998-2007

Note: Trade-distorting support is defined as the sum of notified AMS or *de minimis*, Market Loss Assistance (MLA) payments, and Counter-cyclical Payments (CCP).

Source: Author. Based on data from WTO notifications and USDA.

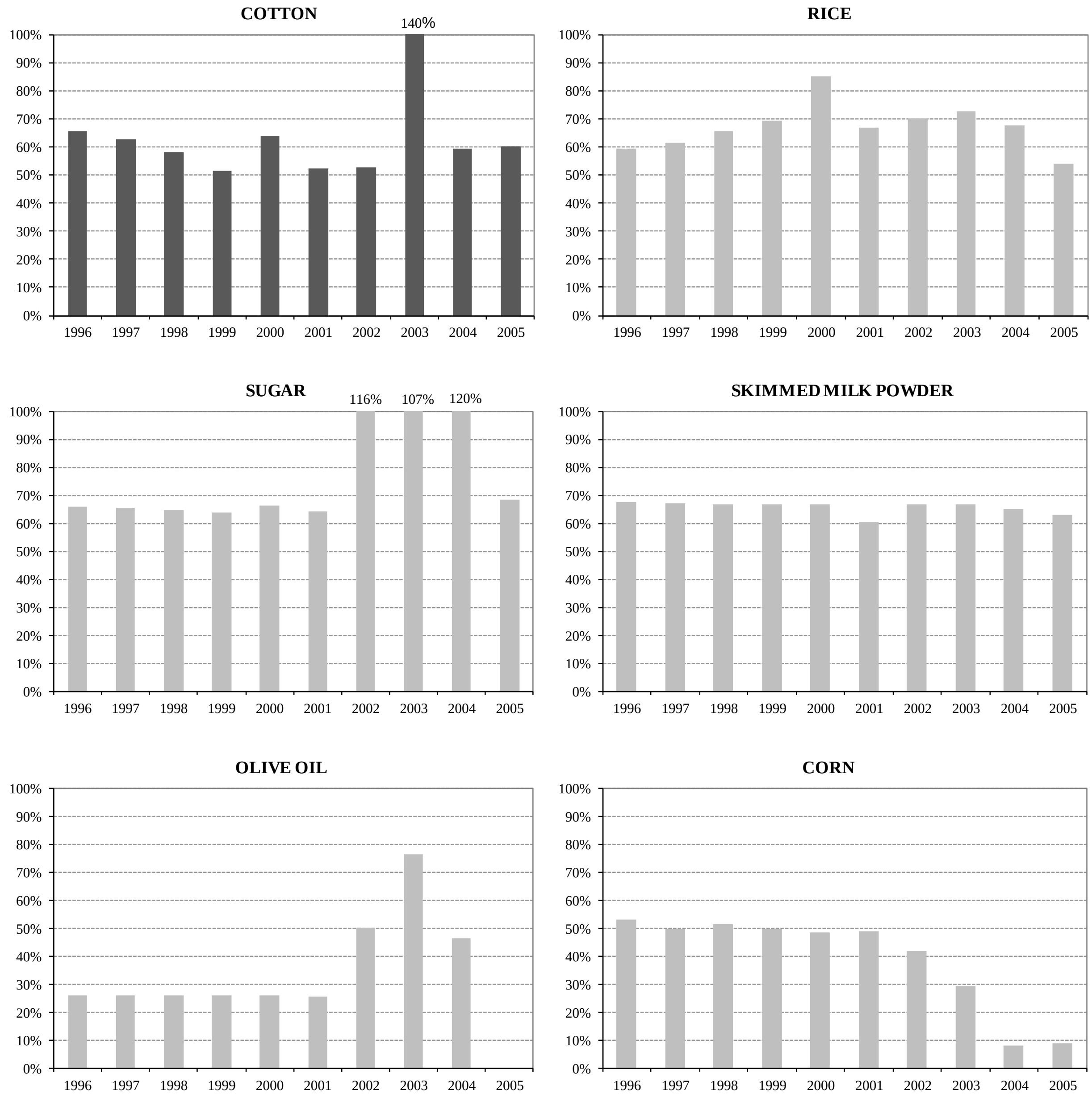

Figure 1.14: EU trade-distorting support for cotton as a share of production value, 1998-2005

Note: Trade-distorting support is defined as the sum of notified AMS or *de minimis*, and Blue Box payments.
Source: Author. Based on data from WTO notifications.

The model incorporates cotton subsidies as officially notified to the WTO Committee on Agriculture. Table 1.2 lists the countries that have notified trade-distorting domestic support (AMS, *De Minimis* and Blue Box) for cotton in 1998-2007, along with corresponding annual subsidy levels expressed in millions of USD. The eight countries that notified cotton subsidies are classified into three groups: major subsidizers (US and EU), lesser subsidizers (Brazil, China, Colombia and Mexico) and past subsidizers (Israel and South Africa). The distinction between major and lesser subsidizers is based on the average per unit level of subsidization. Countries that have officially discontinued support for cotton are classified as past subsidizers.

Table 1.2: Cotton trade-distorting domestic support, as notified to the WTO, 1998-2007 *(Million USD)*

	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Brazil	55	35	55	52	28	18	27	*103*	*130*	*290*
China	-754	345	423	216	*324*	*500*	*475*	*433*	*469*	*459*
Colombia	1	2	1	3	9	0.1	11	*7*	*6*	*8*
EU	804	664	729	513	690	864	896	924	*357*	*372*
Israel	0	0	5	0	0	0	0	0	0	*0*
Mexico	3	2	1	1	33	11	38	*27*	*25*	*30*
South Africa	0	0	5	0	0	0	0	0	0	*0*
US	1,251	2,966	1,662	3,333	2,499	826	3,553	2,922	2,659	806
US - Amber	935	2,353	1,050	2,810	1,187	435	2,238	1,621	1,365	208
US - Blue	316	613	613	523	1,312	392	1,315	1,301	1,294	598
Total	2,114	4,014	2,882	4,119	3,582	2,221	4,999	4,416	3,646	1,965

Note 1: Figures in italics are estimates.
Note 2: US Blue Box figures correspond to MLA in 1998-2001 and CCP in 2002-07. Although the US did not notify MLA and CCP as Blue Box payments, these types of payments are expected to be included in the New Blue Box.
Note 3: Total does not include negative AMS for China in 1998.
Source: Author. Based on data from WTO notifications.

The latest year for which a domestic support notification is available varies from country to country: 2007 for the US; 2006 for Israel and South Africa; 2005 for the EU; 2004 for Brazil, Colombia and Mexico; and 2001 for China. For the EU, estimates for 2006 and 2007 are calculated based on observed production levels and payment rates established in the 2003 reform of the CAP. For Brazil, estimates for 2005, 2006 and 2007 are obtained from the shadow domestic support notification constructed by Nassar and Ures (2009). For Israel and South Africa, it is assumed that official cotton subsidies remain at zero in 2007. For China, Colombia and Mexico, the average notified amounts of the three most recent years are used.

Table 1.3 lists the five countries that reserved the right in the Uruguay Round to subsidize cotton exports, along with the levels of export subsidies officially notified to the WTO. Four of the five countries have refrained from providing export subsidies to cotton in 1998-2007. The only exception is Israel, which provided 886,000 USD export subsidies in 2001. In addition, the WTO DSB has found that the US illegally subsidized cotton exports during the implementation period of the Uruguay Round by means of user marketing payments and export credit guarantees.

Table 1.3: Cotton export subsidies, as notified to the WTO, 1998-2007
(Million USD)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Brazil	0	0	0	0	0	0	0	*0*	*0*	*0*
Colombia	0	0	0	0	0	0	0	*0*	*0*	*0*
Israel	0	0	0	0.886	0	0	0	*0*	*0*	*0*
South Africa	0	0	0	0	0	0	0	*0*	*0*	*0*
Venezuela	0	0	0	0	0	0	0	*0*	*0*	*0*
Total	0	0	0	0.886	0	0	0	*0*	*0*	*0*

Note: Figures in italics are estimates.
Source: Author. Based on data from WTO notifications.

Elasticities

Price elasticities of supply and demand are drawn from the existing literature and are assumed to be constant over time. Because there are uncertainties with regard to any elasticity estimates utilized in empirical modelling, alternative simulations are run with the different sets of elasticities reported in Sumner (2003)[6] and Poonyth *et al*. (2004). These elasticities are summarized in Table 1.4. The impact of the choice of elasticities on results is discussed in Subsection 1.5.4.

Table 1.4: Price elasticities of supply and demand in selected countries, by source

Country	Price Elasticity of Supply (ε)		Price Elasticity of Demand (η)	
	Sumner (2003)	Poonyth *et al*. (2004)	Sumner (2003)	Poonyth *et al*. (2004)
Australia	0.30	0.80	-0.47	-0.60
Bangladesh 1/	0.30	1.20	-0.20	-0.60
Benin 2/	0.30	0.80	-0.25	-0.60
Brazil	0.40	1.20	-0.31	-0.60
Burkina Faso 2/	0.30	0.80	-0.25	-0.60
Chad 2/	0.30	0.80	-0.25	-0.60
China	0.14	1.20	-0.26	-1.00
Colombia 3/	0.30	0.80	-0.65	-1.30
European Union	0.60	0.80	-0.16	-0.60
Hong Kong 6/, 8/	0.20	0.80	-0.46	-0.60
India	0.13	1.20	-0.20	-0.80
Indonesia 1/	0.30	0.80	-0.20	-0.60
Iran 4/	0.30	0.80	-0.20	-0.60
Japan	0.20	0.74	-0.33	-0.60
Kazakhstan 5/, 7/	0.30	0.80	-0.20	-0.60
Mali 2/	0.30	0.80	-0.25	-0.60
Mexico	0.50	1.00	-0.14	-1.30
Pakistan	0.30	1.20	-0.24	-1.00
South Korea	0.20	0.80	-0.31	-0.60
Syria 4/	0.30	0.80	-0.20	-0.60
Taiwan	0.20	0.80	-0.46	-0.60
Thailand 1/	0.30	0.80	-0.20	-0.60
Turkey	0.30	1.20	-0.25	-0.60
Turkmenistan 5/	0.30	1.20	-0.20	-0.60
United States	0.42	0.80	-0.20	-0.60
Uzbekistan	0.30	0.80	-0.25	-0.60
ROW	0.20	0.20	-0.20	-0.20

Notes:
1/ "Other Asia" in Sumner (2003).
2/ "Africa" in Sumner (2003).
3/ "Other Latin America" in Sumner (2003).
4/ "Other Middle-East" in Sumner (2003).
5/ "Uzbekistan" in Sumner (2003).
6/ "Taiwan" in Sumner (2003).
7/ "Uzbekistan" in Poonyth *et al.* (2004).
8/ "Taiwan" in Poonyth *et al.* (2004).
Sources: Sumner (2003) and Poonyth *et al.* (2004).

[6] The elasticities reported in Sumner (2003) are taken from the model reported in Babcock *et al.* (2002) and Fang and Babcock (2003).

1.4. Reform Scenarios

In order to assess the likely implications of a multilateral trade deal for cotton, five scenarios are investigated in this chapter. The first two scenarios represent alternative reform packages in the context of the WTO Doha Round. The following three are benchmarks to which the potential outcomes of the Doha Round can be contrasted, namely the hypothetical complete implementation of DSB panel recommendations the in the *US Upland Cotton* dispute, the actual measures taken by the US in response to this dispute, and recent internal policy reforms in the US and EU. The key features of these scenarios are detailed below.

1.4.1. Scenario A: December 2008 Revised Draft Modalities

Scenario A is based on the Revised Draft Modalities for Agriculture (WTO 2008a), presented by the chair of the Special Session of the WTO Committee on Agriculture on 6 December 2008. The cotton-related provisions in this text are identical to those in the previous Revised Draft Modalities for Agriculture (WTO 2008b), presented on 10 July 2008. Modalities texts are assessments drawn from WTO member countries' positions and are intended to reflect possible areas of agreement among the membership. Although not binding, modalities texts provide a good indication of the direction in which the negotiating process is going.

The December 2008 modalities draft contains provisions on each of the three pillars of the agricultural negotiations: domestic support, market access and export competition. The following subsections describe the key provisions from each of these pillars that are modelled in Scenario A.

Domestic Support

In terms of domestic support, five provisions in the December 2008 Revised Draft Modalities are especially important for cotton: (i) the reduction in the Final Bound Total AMS; (ii) the product-specific AMS cap; (iii) the overall blue box cap; (iv) the product-specific blue box cap; and (iv) the reduction in the *de minimis* level of support.

The Final Bound Total AMS is subject to a tiered formula of reduction: where current commitment is greater than USD 40 billion, the rate of reduction is 70 percent; where it is greater than USD 15 billion and less than or equal to USD 40 billion, the rate of reduction is 60 percent; and where it is less than or equal to USD 15 billion, the rate of reduction is 45 percent. For developing countries with Final Bound Total AMS levels above USD 100 million, the reduction rate is 30 percent. Developing countries with Final Bound Total AMS levels at or below USD 100 million are not required to undertake a reduction. Although additional exemptions also apply to net food importing developing countries (NFIDC), very recently-acceded members (VRAM) and small low-income recently-acceded members with economies in transition (SLIRAM), they have no practical effect as not a single country in these groups has notified AMS support for cotton.[7]

The reduction in the Final Bound Total AMS is important for the cotton sector for two reasons. First and foremost, the formula establishing the product-specific AMS cap for cotton depends directly on the size of the cut that a given country applies to its overall AMS commitment. Second, the reduction in the Final Bound Total AMS may impose additional indirect restrictions on product-specific AMS support if the new Final Bound Total AMS is inferior to the sum of all product-specific AMS caps to which a country may be entitled.

Product-specific AMS caps for cotton are obtained by following a two-step process. First,

[7] There are only four NFIDCs with AMS commitments (Jordan, Morocco, Tunisia and Venezuela), none of which have notified AMS support for cotton. There are only four VRAMs with AMS commitments (Macedonia, Saudi Arabia, Ukraine and Vietnam), none of which have notified AMS support for cotton. Finally, the only SLIRAM with an AMS commitment (Moldova) has not notified AMS support for cotton.

a base level of support is defined as the average cotton AMS notified in 1995-2000.[8] Second, a stringent cut is applied to this base level. The relative size of the cut is determined by a formula that depends on the rate of reduction applied to the Final Bound Total AMS.[9] According to this formula, countries that reduce their Final Bound Total AMS by 70 percent, 60 percent, 45 percent and 30 percent shall reduce their cotton AMS base levels by 84.3 percent, 82.2 percent, 85.7 percent and 71.9 percent, respectively. The cotton AMS reduction formula has the incongruent outcome of demanding a slightly larger percentage cut from developed countries that have the lowest Final Bound Total AMS. However, this outcome has no practical effect, as none of the countries in this group (*i.e.,* Australia, Canada, Iceland, New Zealand, Norway and Switzerland[10]) notified AMS for cotton in 1995-2000.

Caps are introduced on overall and product-specific expenditures in the new blue box. For developed countries, overall blue box expenditures are capped at 2.5 percent of the average total value of agricultural production in 1995-2000. For developing countries, overall blue box expenditures are capped at five percent of the average total value of agricultural production in either 1995-2000 or 1995-2004, whichever is higher. The overall blue box cap may impose

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[8] In terms of establishing product-specific AMS caps for cotton, the December 2008 Revised Draft Modalities for Agriculture do not provide special treatment for the US or developing countries. This is in contrast with the special provisions that apply to these countries in the case of product-specific AMS for all other agricultural products. For the US, the product-specific AMS limits for products other than cotton shall be the resultant of applying proportionately the average product-specific AMS in the 1995-2004 period to the average product-specific total AMS support for the Uruguay Round implementation period (1995-2000) as notified to the Committee on Agriculture. Developing countries shall establish their product-specific AMS limits for products other than cotton by choosing one of the following methods, and scheduling all their product-specific AMS commitments in accordance with the method chosen: (a) the average product-specific AMS during the base period 1995-2000 or 1995-2004 as may be selected by the Member concerned, as notified to the Committee on Agriculture; (b) two times the Member's product-specific *de minimis* level provided for under Article 6.4 of the Uruguay Round Agreement on Agriculture during the base periods referred to in sub-paragraph (a) above; or (c) 20 percent of the Annual Bound Total AMS in the relevant year during the Doha Round implementation period.

[9] Paragraph 54 of the December 2008 Revised Draft Modalities for Agriculture establishes that WTO members with an AMS commitment shall reduce their base levels of AMS support for cotton according to the formula given by $R_c = R_g + \frac{(100-R_g)*100}{3*R_g}$, where *Rc* is the specific reduction applicable to cotton (as a percentage) and *Rg* is the general reduction in AMS (as a percentage). Base levels of support shall be calculated as the arithmetic average of the amounts notified for cotton in 1995-2000.

[10] Switzerland notified AMS support for fiber crops in 1999-2006. The notifications do not specify the specific fiber crops that are supported. Since Switzerland did not produce cotton in this time period, it is assumed that the domestic support for fiber crops in Switzerland did not apply to cotton.

additional restrictions on product-specific spending in a given country only if it is inferior to the sum of the monetary value of product-specific blue box caps.

Product-specific blue box caps for cotton are also established according to a two-step process: first, a base level is established; second, a cut is applied to this level. For all WTO members other than the US, base levels are defined as the average value of blue box support provided to cotton and notified in 1995-2000. For the US only, the base level is obtained by the multiplication of three factors: (120 percent)*(overall blue box cap)*(share of cotton in total legislated maximum permissible expenditure under the 2002 Farm Bill).[11] The reduction rates applied to cotton blue box base levels are straightforward: 66.7 percent in the case of developed countries and 44.4 percent in the case of developing countries.

De minimis support levels are reduced by 50 percent in developed countries and 33.3 percent in developing countries with Final Bound Total AMS. Developing countries without a Final Bound Total AMS are not required to cut their *de minimis* levels. Exemptions also apply to NFIDCs, VRAMs, SLIRAMs and developing countries that allocate almost all their AMS support for subsistence and resource-poor producers.

Market Access

The key provisions for cotton in the market access pillar are: (i) the tiered formula for tariff reduction; (ii) the selection and treatment of sensitive products; (iii) the selection and treatment of special products; and (iv) the extension of duty- and quota-free access for cotton exports from LDCs.

[11] The December 2008 Revised Draft Modalities presents two options for the first factor in this multiplication: either 110 percent or 120 percent. The higher percentage is used in Scenario A because it is the less ambitious of the two.

The tiered formula for tariff reduction is implemented as described in Paragraphs 61 and 63 of the modalities draft.[12] Special and differential treatment is provided for developing countries in the form of lower reduction rates and higher thresholds in each tier. Tariff cuts for recently-acceded members (RAMs) are moderated by eight percentage points. LDCs, VRAMs and SLIRAMs are exempt from tariff reductions.

Of the 94 countries that imported cotton between 2004 and 2008, only the US and China will be required to change applied tariffs on cotton according to the December 2008 Revised Draft Modalities (see Table 1.1). Applied tariffs in the other 92 countries will not be affected by the Doha Round for one of six reasons: (i) cotton imports are already subject to duty free treatment (47 countries); (ii) the tariff overhang is greater than the required tariff cut (20 countries); (iii) LDCs are exempt from tariff cuts (13 countries); (iv) VRAMs are exempt from tariff cuts (2 countries); (v) SLIRAMs are exempt from tariff cuts (1 country); and (vi) non-WTO countries are not subject to WTO rules (9 countries).

Cotton is not selected as a sensitive product by any developed or developing country. Except for the US, all developed countries already provide duty-free access to cotton at a most-favored nation (MFN) basis.[13] For these countries, virtually all cotton tariff lines were bound at

[12] According to Paragraphs 61 and 63 of the December 2008 Revised Draft Modalities, developed and developing countries shall reduce their final bound tariffs in accordance with the following tiered formulae (where *t* stands for the import tariff expressed in *ad valorem* equivalent terms):

Developed Countries	
Tier	**Cut**
$0 < t \leq 20\%$	50%
$20\% < t \leq 50\%$	57%
$50\% < t \leq 75\%$	64%
$t > 75\%$	70%

Developing Countries	
Tier	**Cut**
$0 < t \leq 30\%$	33.3%
$30\% < t \leq 80\%$	38%
$80\% < t \leq 130\%$	42.7%
$t > 130\%$	46.7%

[13] The following developed countries provide duty-free access to cotton imports at an MFN basis: Australia, Canada, the European Union, Iceland, Japan, New Zealand, Norway and Switzerland.

zero during the Uruguay Round.[14] Therefore, there is no rationale for choosing cotton as a sensitive product in these countries. Although the US has positive tariffs and four separate tariff-rate quotas (TRQs) for cotton, it is assumed that Washington will not select cotton as a sensitive product. This is due in part to the fact that existing US cotton TRQs are consistently under-filled, despite the relatively low levels of in-quota tariffs (between zero and 3 percent in *ad valorem* equivalent terms). Moreover, quota volume expansion would not be very significant since cotton consumption in the US has fallen by 70 percent in the last decade. Furthermore, given the limit in the number of tariff lines that may be selected as sensitive, other agricultural products are likely to take precedence over cotton in the US, including sugar, dairy and orange juice. Using a formula that takes into account (i) the importance of a good in domestic demand, (ii) the cut in prices implied by the tiered formula, and (iii) the extent to which treatment as a sensitive product reduces the size of a tariff cut, Blandford *et al.* (2008) conclude that cotton would not figure in the list of sensitive products of the US. In a study at the more detailed 8-digit level of the harmonized commodity description and coding system (HS), Ibañez, Rebizo and Tejeda (2008) also conclude that cotton is unlikely to be selected as a sensitive product in the US.

Cotton is not selected as a special product by any developing country, except China. This assumption is derived from the fact that applied tariffs for cotton are already low in most developing countries. Of the top fifteen developing country importers of cotton, all but China currently provide duty-free MFN access to cotton. Sun (2008) and Tian (2009) identify cotton as one of the agricultural products that Chinese authorities are most likely to select for special treatment in the Doha Round. As a special product, cotton in China would be exempt from tariff reduction and quota expansion. Even if China were not to select cotton as a Special Product, the

[14] The only exceptions are the bound tariffs for cotton waste in Australia (2 percent) and Iceland (11 percent). Nonetheless, current applied tariffs for cotton waste are zero in both countries.

large tariff overhang would be enough to prevent any effective cut in the applied tariff. China has unilaterally expanded its cotton TRQ volume year after year in order to allow additional imports at the lower in-quota tariff rate. While the current bound tariff is set at 40 percent *ad valorem*, the applied tariff has seldom exceeded 10 percent in recent years.[15]

Finally, developed countries are required to grant duty- and quota-free access to cotton exports from LDCs. In practice, this measure will have little impact on market access opportunities for LDCs. First, as most developed countries already provide duty- and quota-free access to cotton imports at an MFN basis, this provision will not represent any special concession to LDCs. Second, although Washington will be required to change its current import regime to accommodate this special cotton provision, US cotton import demand is expected to be trivial at best. The US is not an important importer or consumer of cotton. Rather, it is the world's largest exporter, with an astounding market share of 40 percent in 2004-2007. In contrast, the US accounted for only 0.05 percent of world cotton imports in the same period. This share is expected to decrease even further due to the dramatic contraction in US cotton consumption. The dwindling of the domestic textile industry has led to a decline of 70 percent in US cotton consumption in the last decade. Current US cotton TRQs are consistently under-filled in spite of zero or low in-quota tariffs.

Export Competition

Scenario A takes into account: (i) the complete elimination of export subsidies for cotton; and (ii) the elimination of the subsidy component of export financing support (export credits, export credit guarantees and insurance programs).

[15] If China were to apply the Doha Round tiered formula, it would have to cut its over-quota tariff by 30 percent (percentage cut applicable to second-tier bound tariffs from RAMs). The current bound tariff of 40 percent would be replaced by a new bound tariff of 28 percent, which is still substantially higher than applied levels.

1.4.2. *Scenario B: Cotton Treated as a Standard Product*

Scenario B is also based on the modalities draft, except that it ignores the special cotton provisions and instead subjects cotton to the general disciplines applicable to standard agricultural products. The specific differences between Scenario A and Scenario B are twofold. First, in Scenario B, cotton AMS and blue box caps are established by following only the first step of the two-step processes described in Scenario A. As a result, cotton AMS and blue box caps are identical to their respective base levels. In contrast, in Scenario A, cotton AMS and blue box caps result from the application of stringent cuts to base levels.

Second, in establishing base levels for product-specific AMS, the US and developing countries are required under Scenario A to use the average AMS support notified in 1995-2000. In contrast, in Scenario B, the US and developing countries have access to the standard flexibilities contained in Paragraphs 23-25 and Paragraphs 27-28 of the draft modalities text.[16]

In terms of domestic support, the general provisions of Scenario B are less ambitious than the special cotton provisions of Scenario A. In terms of market access and export competition, Scenario B is identical to Scenario A. As a result, Scenario B implies a lower overall degree of reform than Scenario A.

Scenario B should be interpreted as a floor for cotton policy reform in the Doha Round. Any outcome of the negotiations for cotton must necessarily be more ambitious than Scenario B. In the Framework for Establishing Modalities in Agriculture (WTO, 2004a), the WTO General Council recognized the vital importance of cotton for developing countries and established a

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[16] For the US, the cotton AMS is the resultant of applying proportionately the average cotton AMS in 1995-2004 to the average product-specific total AMS support notified in 1995-2000. For developing countries, the cotton AMS caps is the highest of the following values: (i) the average notified cotton AMS during the base period 1995-2000 or 1995-2004, as may be selected by the country concerned; (ii) two times the country's *de minimis* level during either 1995-2000 or 1995-2004, as may be selected by the country concerned; or (iii) 20 percent of the Annual Bound Total AMS in the relevant year during the Doha Round implementation period

mandate to address it "ambitiously, expeditiously, and specifically, within the agriculture negotiations" in relation to all trade-distorting policies affecting the sector in all three pillars of market access, domestic support and export competition. In the Hong Kong Ministerial Declaration (WTO, 2005a), the WTO General Council reaffirmed its commitment to ensure having an explicit decision on cotton within the agriculture negotiations, including that trade distorting domestic subsidies for cotton must be reduced more ambitiously than under whatever general formula is agreed for other agricultural products.

1.4.3. Scenario C: Hypothetical Full Implementation of DSB Recommendations in US Upland Cotton Dispute

Scenario C models the hypothetical implementation by the US of the DSB recommendations in the *US Upland Cotton* dispute, namely (i) the withdrawal of prohibited subsidies and (ii) the removal of the adverse effects of subsidies found to cause serious prejudice (WTO, 2004b; WTO, 2005b).

Two variations of Scenario C are presented. In Scenario C1, the first recommendation is implemented by simulating the elimination of user marketing payments (Step 2), the Supplier Credit Guarantee Program (SCGP), the Intermediate Export Credit Guarantee Program (GSM 103) and the Export Credit Guarantee Program (GSM 102). Since the DSB is silent regarding the exact steps the US must take to remove the adverse effects of subsidies found to cause serious prejudice, the second recommendation is implemented by limiting the combined annual value of marketing loan program payments (MLP), market loss assistance payments (MLA) and counter-cyclical payments (CCP) so that their negative impact on the world price of cotton is not greater than 2 percent. Cabral *et al.* (2009) estimate this value to be USD 600 million.

Scenario C2 is identical to Scenario C1, except that MLP, MLA and CCP are limited so that their negative impact on the world price is not greater than 4 percent. Cabral *et al.* (2009) estimate this value to be USD 1,360 million.

1.4.4. Scenario D: Actual Incomplete Implementation of DSB Recommendations in US Upland Cotton Dispute

Scenario D models the insufficient measures actually taken by the US in response to the DSB recommendations in the US Upland Cotton dispute. Although the US has withdrawn part of its prohibited subsidies (Step 2 payments, SCGP and GSM 103), it has done nothing to remove the adverse effects of subsidies found to cause serious prejudice to other WTO members.

In September 2006, the DSB agreed to Brazil's request for the establishment of a panel pursuant to Article 21.5 of the Dispute Settlement Understanding (DSU) concerning the alleged failure of the US to implement the recommendations and rulings of the DSB. In June 2008, the DSB concluded that, notwithstanding changes in US agricultural programs, Washington had failed to bring its cotton subsidies into conformity with WTO obligations (Cross, 2009; WTO, 2007; WTO, 2008c). In August 2009, the DSB authorized Brazil to take countermeasures against the US, including cross-retaliation in intellectual property rights and services (WTO, 2009a; WTO, 2009b).

1.4.5. Scenario E: Internal Policy Reforms in the US and EU

Scenario E abstracts from multilateral negotiations and litigations and focuses on internal policy reforms in key subsidizing countries, namely the 2008 Farm Bill in the US and the 2003-2004 CAP reform in the EU.

The following changes in US cotton subsidies brought about by the 2008 Farm Bill are incorporated in Scenario E: (i) payment acres for direct payments are reduced from 85 percent to 83.3 percent of a farm's base acreage for the covered commodity; (ii) the target price for counter-cyclical payments is reduced from USD 0.724 per pound to USD 0.7125 per pound; (iii) storage payment rates are reduced by 10 percent; and (iv) Upland Cotton Economic Adjustment Assistance payments are introduced, providing USD 0.4 per pound to domestic users of cotton for all documented use of upland cotton regardless of its origin.[17]

Scenario E also incorporates changes in EU cotton subsidies introduced by the 2003-2004 reform of the CAP and subsequent amendments.[18] The previous guaranteed minimum price system was replaced by a combination of coupled and allegedly decoupled payments. In the reformed support scheme, 65 percent of the subsidies provided in the 2000-2002 reference period are extend as decoupled aid. Another 35 percent are linked to cotton production in the form of area payments. Coupled payment rates and eligible areas vary according to the EU country contemplated: EUR 805.6 per hectare for 250,000 eligible hectares in Greece; EUR 1,400 per hectare for 48,000 eligible hectares in Spain; EUR 556 per hectare for 360 eligible hectares in Portugal; and EUR 805.6 per hectare for 3,342 eligible hectares in Bulgaria. In addition, Spain has introduced a supplementary environmental area coupled payment at a rate of approximately EUR 350 per hectare (Arriaza and Gómez-Limón, 2007).

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[17] Although the 2008 US Farm Bill provided further legal basis to the discontinuation of Step 2 payments and the SCGP and GSM 103 export credit guarantee programs, these policy changes are not included in Scenario E. Instead they are taken into account in Scenario D, which considers the steps taken by Washington to comply with the DSB panel recommendations in the US Upland Cotton dispute. The Step 2 subsidy program was repealed by the Deficit Reduction Act of 2005, which took effect on 1 August 2006, almost two years before the 2008 Farm Bill. Furthermore, Scenario E does not take into account the establishment of the Average Crop Revenue Election (ACRE) program given its novelty and the shortage of relevant data. Distance is lacking to properly assess this new instrument.

[18] In September 2006, the Court of Justice of the European Communities annulled the cotton support scheme of the 2003-2004 CAP reform after a legal challenge made by the Spanish government. According to the Court judgment, the European Commission had failed to conduct a complete impact study before the policy initiation. As a result, the European Commission carried out an impact assessment study in 2007 and the European Council adopted a revised reform of the support scheme for cotton in 2008.

1.5. Results

Simulation results indicate that the December 2008 Revised Draft Modalities would have a significant positive impact on world cotton prices and contribute to the expansion of cotton production and exports in developing countries. The poor record of internal policy reforms in key subsidizing countries and the failure of the US to comply with DSB rulings and recommendations highlight the importance of multilateral trade negotiations in addressing the profound distortions that characterize the world cotton market.

This section is divided into four subsections. Estimated impacts of alternative reform scenarios on cotton prices, production and trade are discussed in Subsections 1.5.1, 1.5.2 and 1.5.3, respectively. Because there are uncertainties with regard to any elasticity estimates utilized in empirical modelling, alternative simulations are run with a different set of supply and demand price elasticities. The results of this sensitivity analysis are described in Subsection 1.5.4.

1.5.1. Impact on the World Price

World price effects for each scenario and year are summarized in Figures 1.15 and 1.16. Average price increases are highest under the December 2008 Revised Draft Modalities, followed by the scenarios in which Washington hypothetically implements the DSB recommendations in the *US Upland Cotton* dispute. Impacts from the measures actually taken by the US in response to the *US Upland Cotton* dispute or from recent internal policy reforms in the US and EU are negligible.

The substantial variance in results on a year-by-year basis is due in large part to the counter-cyclical nature of a considerable share of notified cotton subsidies. As depicted in Figure 1.17, world prices and total notified Amber Box support fluctuated significantly between 1998 and 2007. The data provide corroborating evidence of the counter-cyclical nature of cotton domestic support:

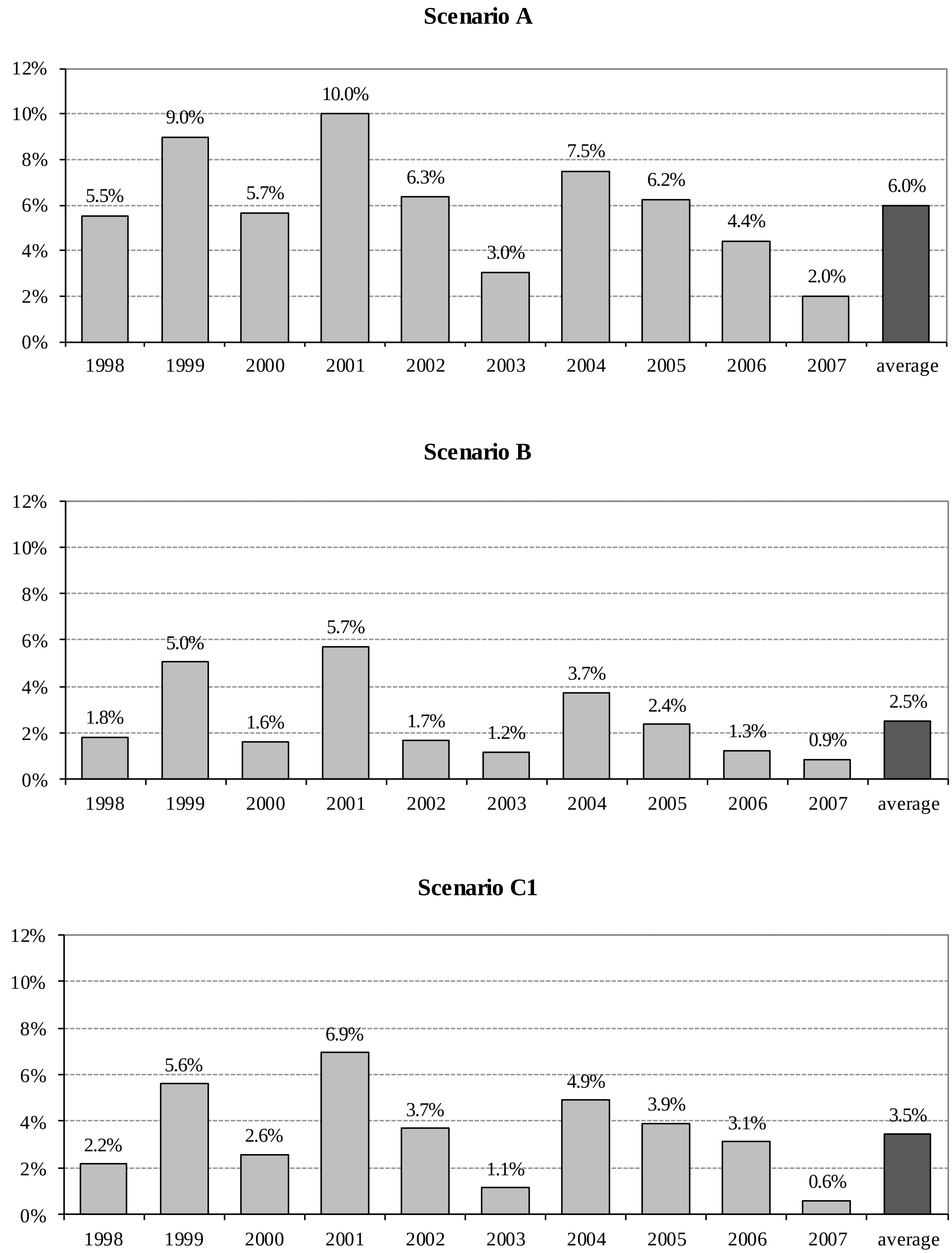


Figure 1.15: Estimated impact of alternative scenarios on the cotton world price, 1998-2007

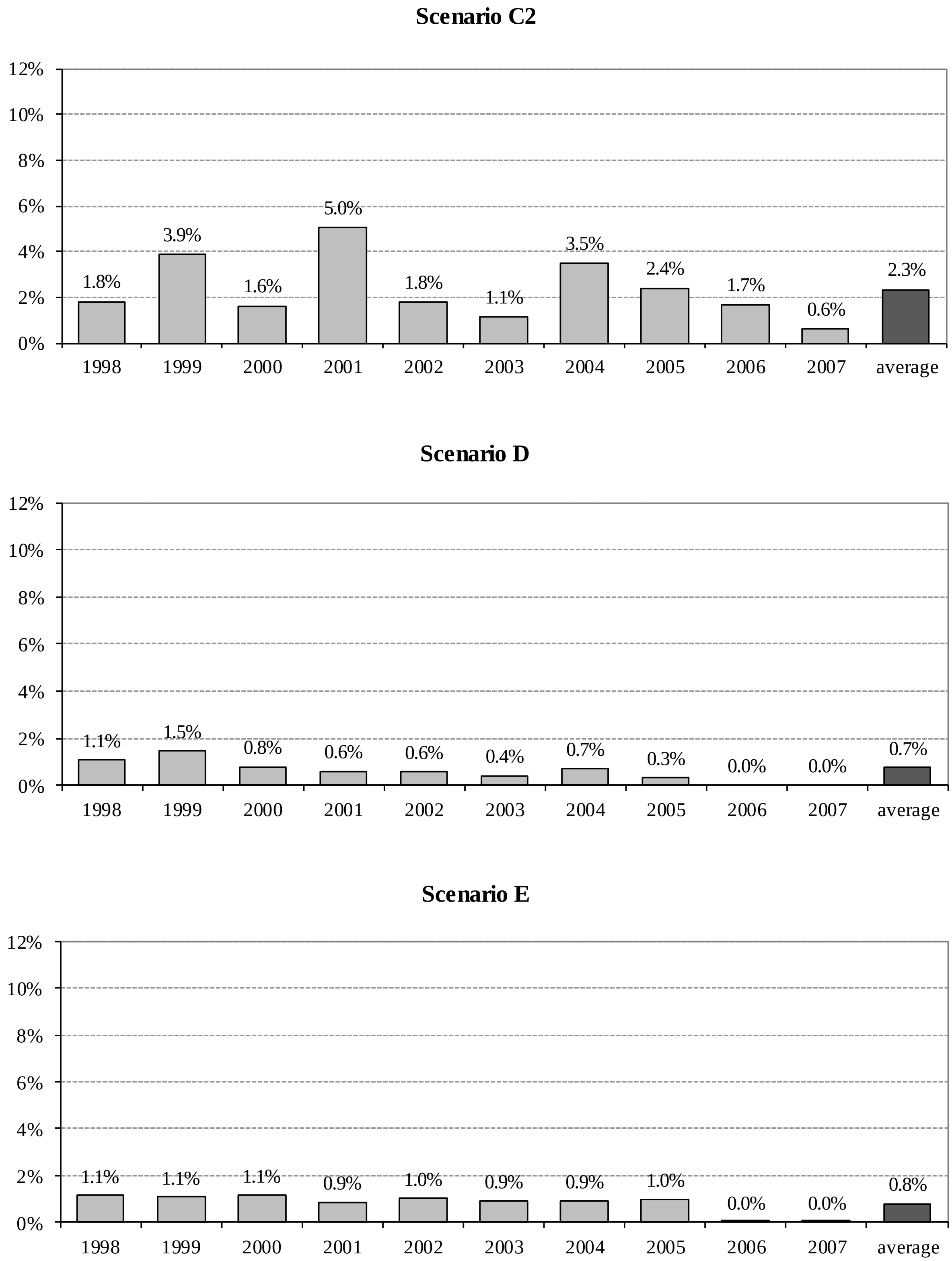


Figure 1.15 (cont.): Estimated impact of alternative scenarios on the cotton world price, 1998-2007

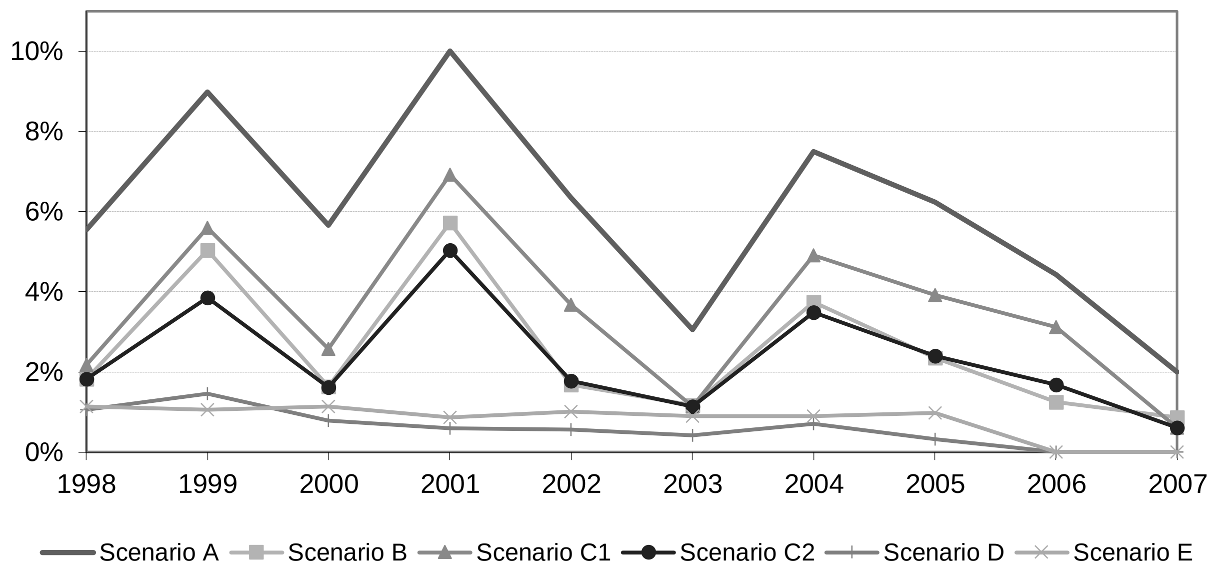


Figure 1.16: Estimated impact of alternative scenarios on the cotton world price, 1998-2007

Source: Author's calculations.

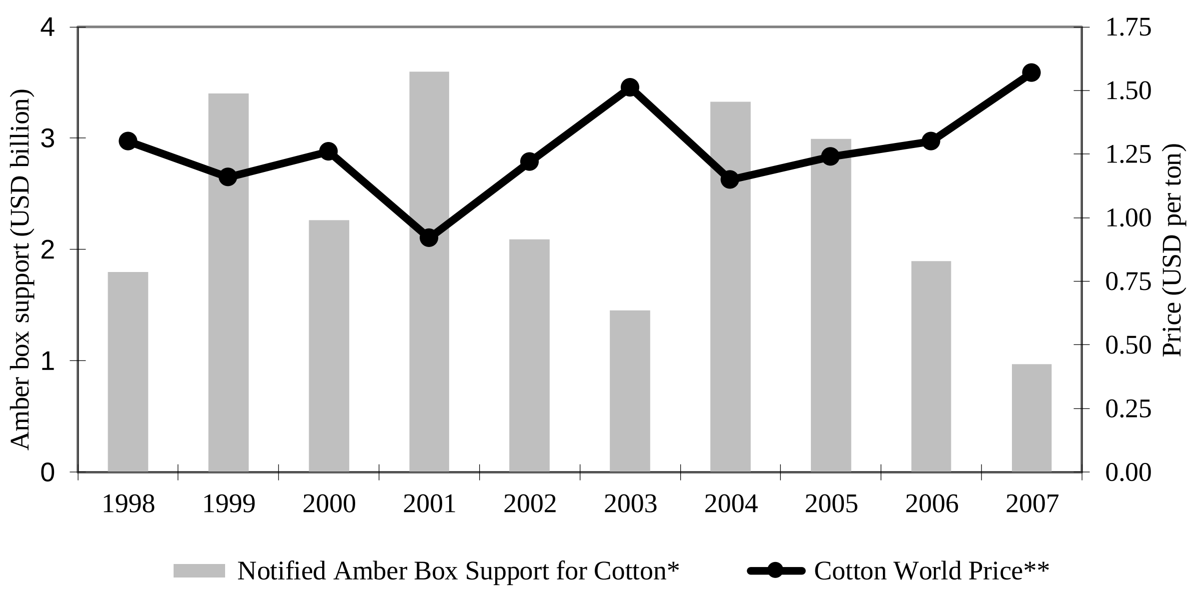


Figure 1.17: Cotton World Price and Amber Box Expenditures Notified to the WTO, 1998-2007

* Notified amber box support includes estimates for Brazil, China and Mexico in 2005, 2006 and 2007.
** Cotton world price is given by the Cotlook A Index.
Sources: ICAC and WTO.

while years with the highest world prices (*i.e.,* 2003 and 2007) had the lowest levels of subsidies, years with the lowest prices (*i.e.,* 1999, 2001 and 2004) had the highest levels of subsidies. The years with the lowest world prices are also those in which policy reforms would have had the most significant effect on world prices. Since WTO members are especially concerned about the adverse effects of subsidies during periods of low world prices, it is important to pay special attention to simulation results for years such as 1999, 2001 and 2004.

Doha Round Scenarios

The two Doha Round scenarios result in an increase in the world price of cotton. However, the magnitude of the price rise varies significantly across scenarios. As expected, world price impacts in Scenario A (December 2008 Revised Draft Modalities) are substantially greater than in Scenario B (cotton treated as a standard product).

Had cotton subsidies and tariffs been reduced in 1998-2007 as described in Scenario A, the world price of cotton would have increased on average by 6 percent, with a range between 2 percent and 10 percent. However, had cotton been treated as a standard product (Scenario B), the average world price increase would have been only 2.5 percent. The price effect in Scenario B is approximately two-fifths as large as in Scenario A. This difference is due mainly to the size of caps on US trade-distorting domestic support for cotton in each scenario: US$510 million in Scenario A (US$143 in AMS and US$367 in the blue box) versus US$2,240 million in Scenario B (US$1,140 million in AMS and US$1,100 million in the blue box). Since US trade-distorting support for cotton was on average US$2,248 million per year in 1998-2007, it comes as no surprise that cuts in US subsidies are not very significant in Scenario B. Discarding the special cotton provisions from the modalities text and treating cotton as a standard product would greatly reduce the potential of the Doha Round to deliver lower subsidy levels and higher world prices for cotton.

US Upland Cotton Dispute

While the full implementation of the DSB recommendations in the *US Upland Cotton* dispute would have a small to moderate impact on the world price of cotton, the limited measures actually taken by the US in response to the dispute would have a negligible effect.

On average, the insufficient reforms implemented by the US (Scenario D) would cause the world price of cotton to rise by only 0.7 percent in 1998-2005, with a range between 0.3 and 1.5 percent. However, if the US hypothetically withdrew all prohibited subsidies and limited the combined annual value of MLP, MLA and CCP so that their negative impact on the world price was not greater than 2 percent (Scenario C1), the world price of cotton would rise on average by 3.5 percent, with a range between 0.6 and 7 percent. If the combined value of MLP, MLA and CCP was instead limited so that their negative impact on the world price was not greater than 4 percent (Scenario C2), the world price would increase on average by 2.3 percent, with a range between 0.6 and 5 percent. On average, the price increases resulting from Scenarios C1, C2 and D correspond to three-fifths, two-fifths and one-tenth, respectively, of the average price increase resulting from Scenario A.

Domestic Reforms in the US and EU

Had the 2008 US Farm Bill and the 2003-2004 EU CAP reform been simultaneously implemented in 1998-2007 (Scenario E), the world price of cotton would have increased on average by 0.8 percent. This impact would be due almost exclusively to reductions in EU cotton subsidy levels. When the 2008 US Farm Bill is considered alone, no impact on the cotton world price is observed.

1.5.2. Impact on Production

The reduction of cotton subsidies and tariffs as described in Scenarios A through E would lead to small reductions in the total volume of world cotton production in 1998-2007. Nonetheless, due to the accompanying rise in the world price of cotton, the value of production at a global level would increase. Figure 1.18 summarizes the estimated impacts of alternative policy reform scenarios on world prices, production and production value. Bars represent the average impact in the 1998-2007 period; vertical lines indicate the range of results. Scenario A causes the greatest average increase in the world price of cotton (6 percent), the most pronounced decline in world production volume (1.3 percent), and the greatest increase in world production value (4.5 percent on average, 7 percent in years with peak subsidy levels).

Production responses depend, among other things, on supply price elasticities. The higher the supply elasticity, the greater the production effect in a given country. When supply is highly elastic, production changes can be substantial even in the presence of small price changes. Conversely, when supply is highly inelastic, changes in production can be small despite large changes in prices. Thus, the choice of elasticities is an important one. All simulations reported in this subsection are based on the elasticities reported in Sumner (2003) and summarized in Table 1.4. *Ceteris paribus*, production responses are highest in the EU, US and Brazil (0.6, 0.42 and 0.4, respectively), and lowest in India and China (0.13 and 0.14, respectively). In Australia, Central Asia, Pakistan, Turkey and West Africa, the supply elasticity is 0.3.

Production effects vary significantly across countries and scenarios. While output decreases in countries that undertake reductions in applied subsidy and tariff levels, it increases elsewhere. Figures 1.19 and 1.20 summarize the impact of alternative scenarios on production quantities and values in specific countries and regions.

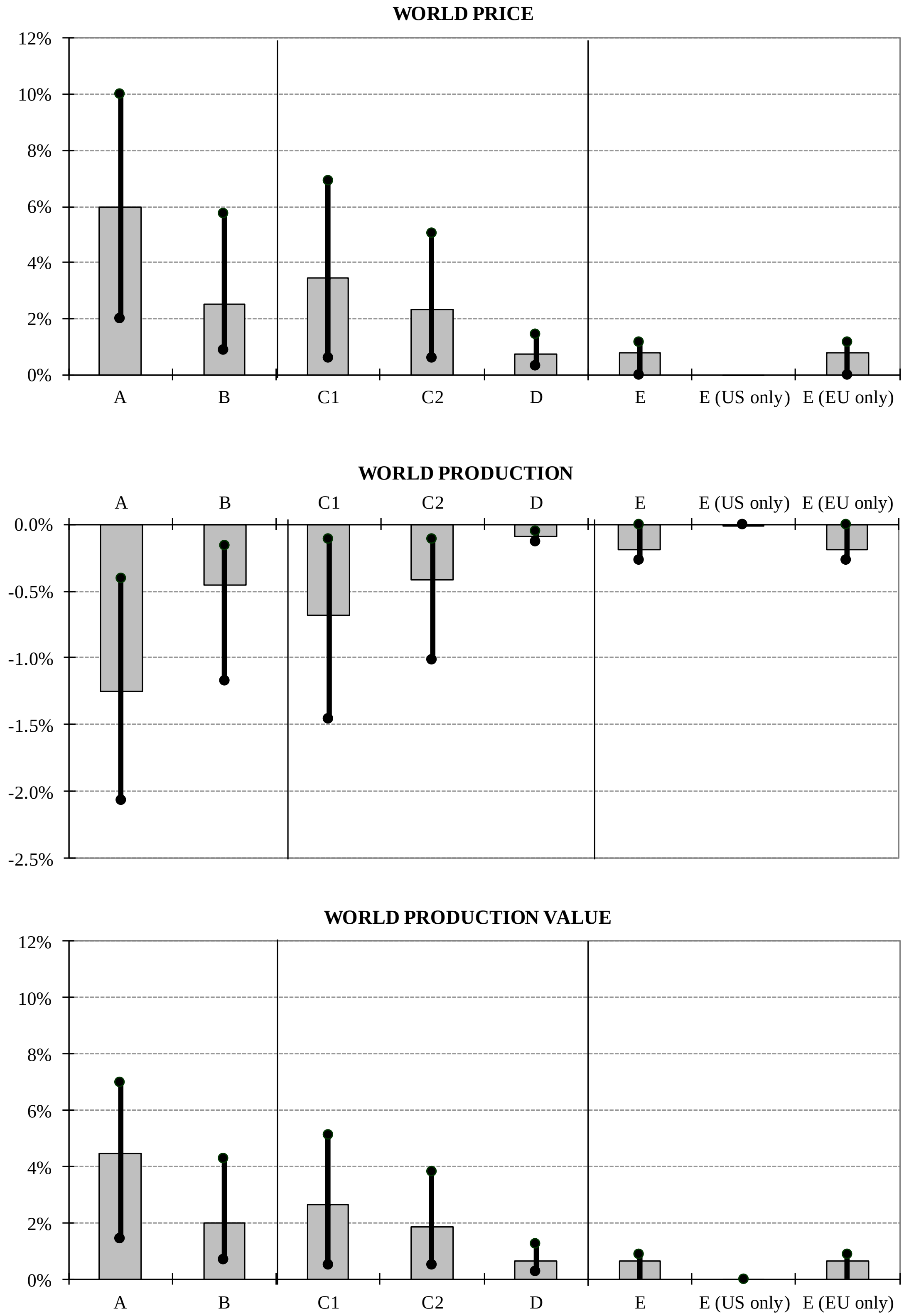


Figure 1.18: Estimated impact of alternative scenarios on cotton world price, production and production value, average and range, 1998-2007

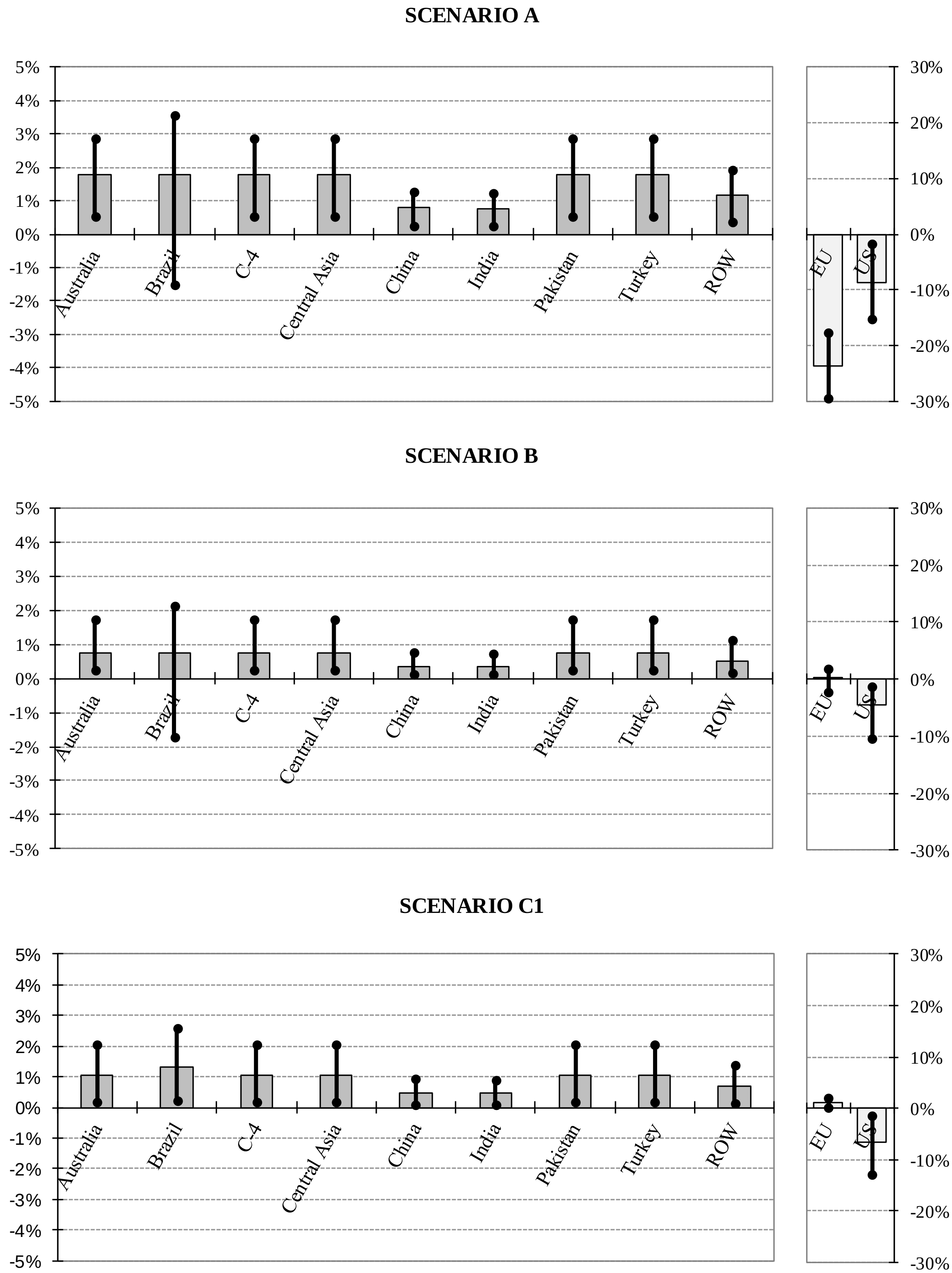
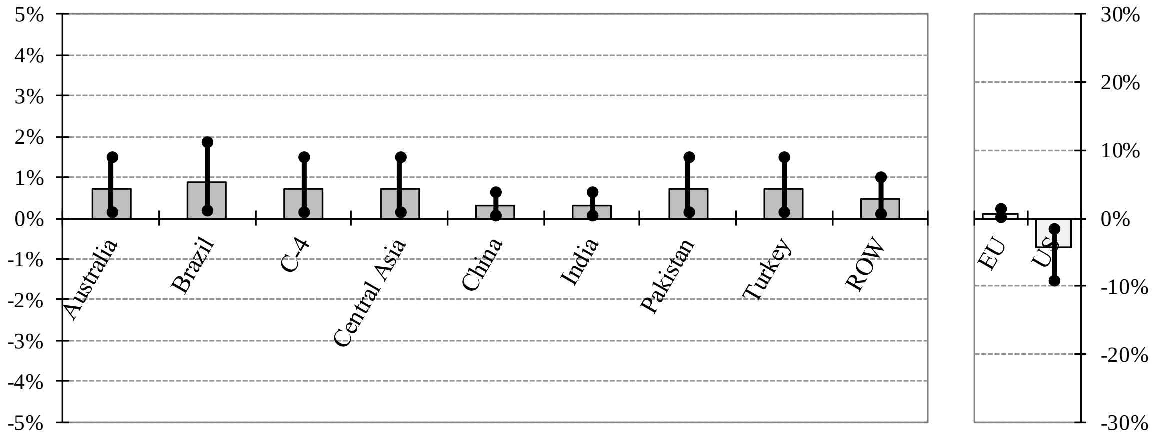
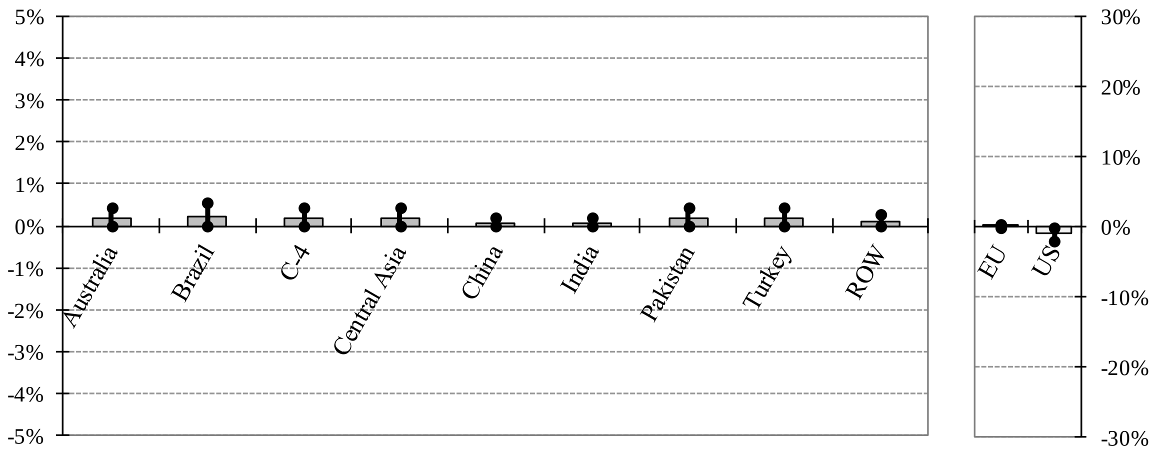


Figure 1.19: Estimated impact of alternative scenarios on cotton production quantities, average and range, 1998-2007

SCENARIO C2



SCENARIO D



SCENARIO E

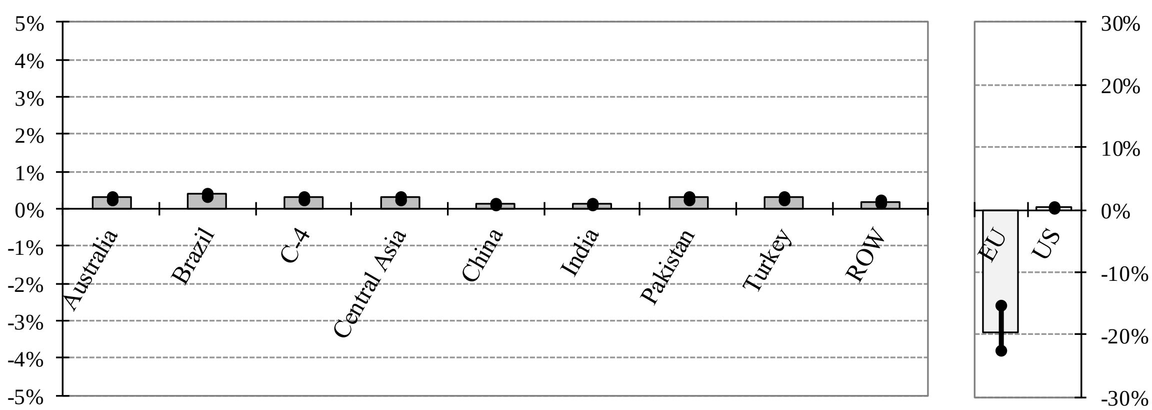


Figure 1.19 (cont.): Estimated impact of alternative scenarios on cotton production quantities, average and range, 1998-2007

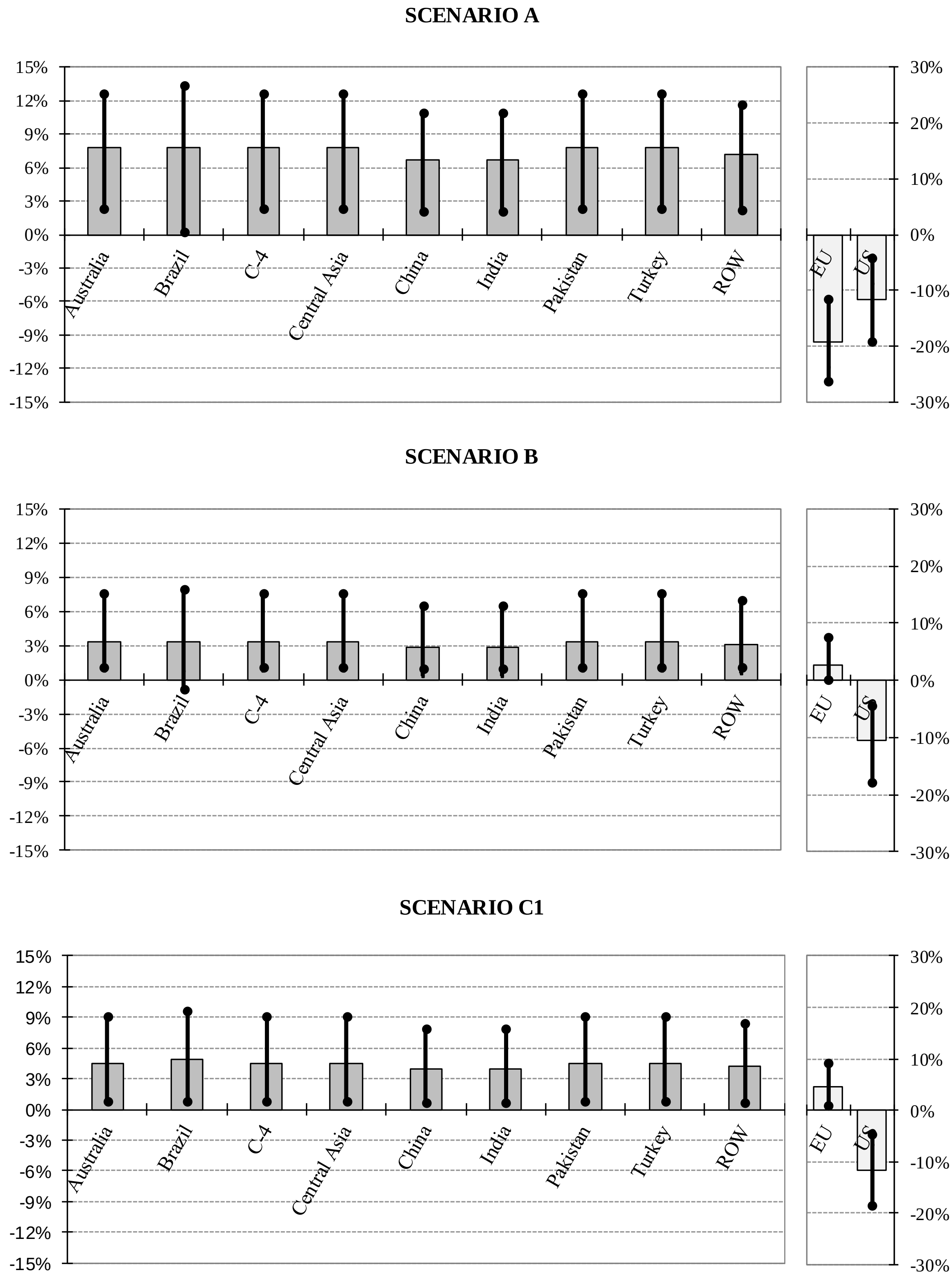
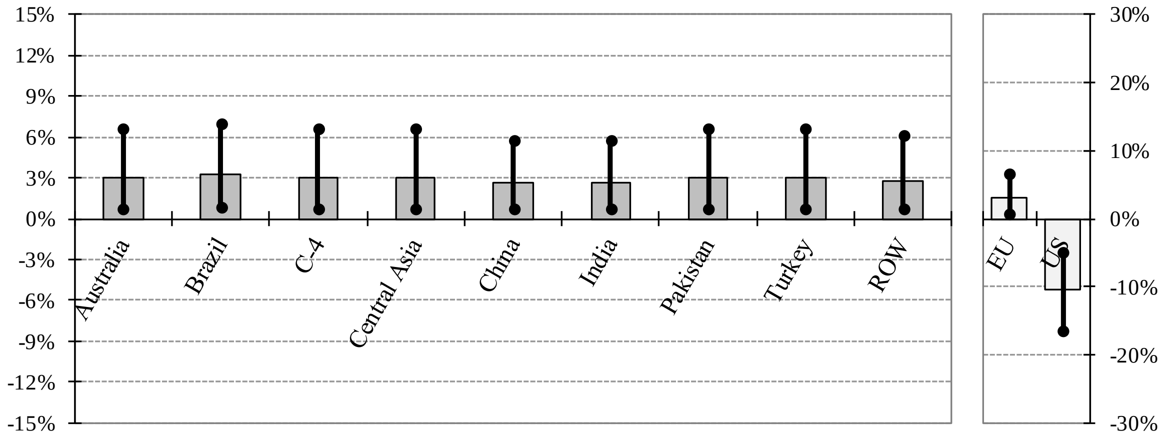
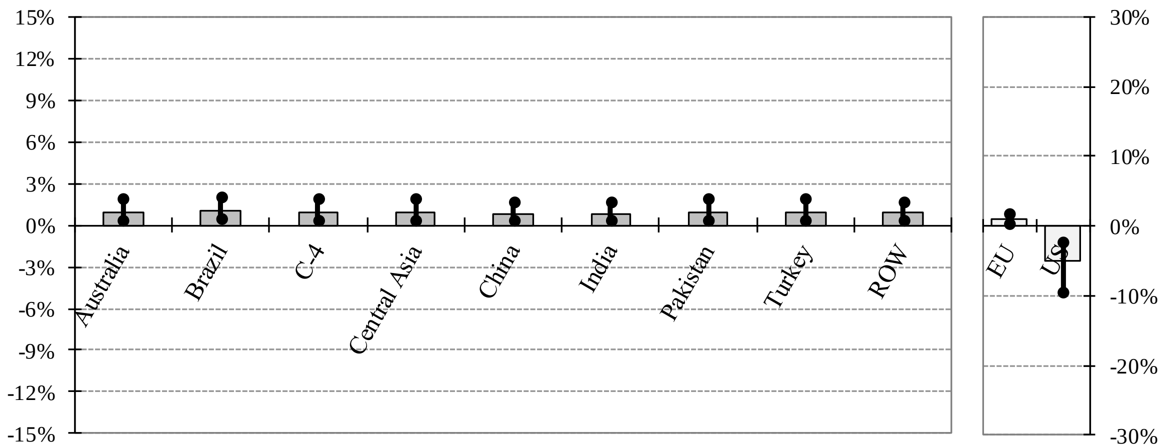


Figure 1.20: Estimated impact of alternative scenarios on cotton production value, average change and range, 1998-2007

SCENARIO C2



SCENARIO D



SCENARIO E

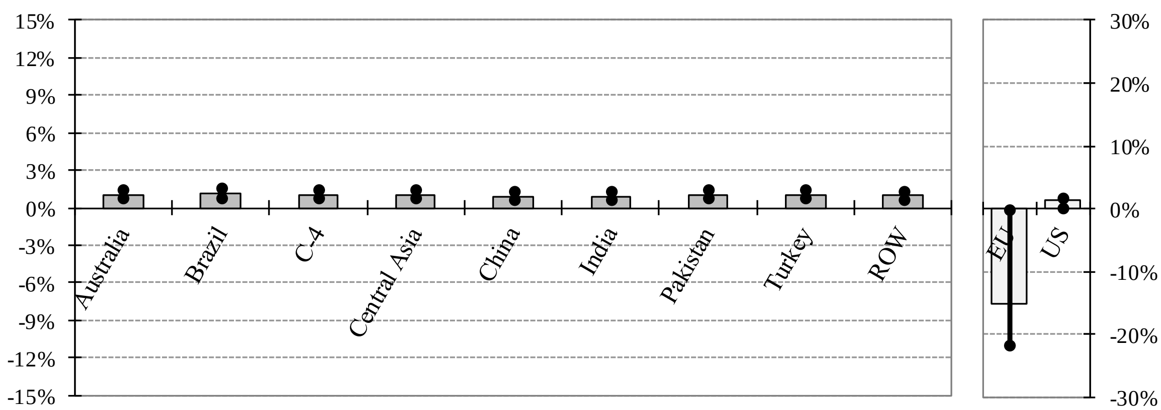


Figure 1.20 (cont.): Estimated impact of alternative scenarios on cotton production value, average and range, 1998-2007

The model adopted in this chapter assumes perfect price transmission from world to domestic markets and the full ability of producers to respond to price changes. In reality, price transmission in some developing countries may be hindered by government-controlled pricing systems, excessive transportation and transaction costs and overvalued exchange rates. Moreover, producers in these countries may be significantly constrained by lack of access to inputs such as credit, labor and water.[19] Under these circumstances, simulation results overestimate potential impacts on production.

In a detailed econometric study of the Indian cotton sector, Mittal and Reimer (2008) show that, despite extensive public regulation, Indian rural market prices of cotton closely follow world prices. They also find that Indian cotton farmers are surprisingly responsive to price changes in the medium to long run. In contrast, Goreux (2003) notes that cotton production in the CFA countries of West Africa is not very correlated to the world price and that transmission to domestic producer prices varies significantly from year to year. He also emphasizes the lack of reliable estimated elasticities of supply response to world prices for African countries.

Doha Round Scenarios

In Scenario A, US and EU cotton production would decline on average by 9 percent and 24 percent, respectively. In years with historically low world prices, the decline in US output would be larger than average (15 percent). In 2001 alone, US production would decline by 680 thousand metric tons, which was more than the combined production volume of the C-4 countries that year. In the EU, output decline would be less pronounced following the implementation of the 2003-2004 CAP reform (18 percent). The fall in US and EU production would be almost fully compensated by

[19] For example, cotton growers have repeatedly boycotted cotton markets in Côte d'Ivoire and Mali over the past decade because of high input prices (Bassett, 2008).

output expansion elsewhere. On average, production would be 2 percent higher in Australia, Brazil,[20] the C-4 countries, Central Asia,[21] Pakistan and Turkey, and 1 percent higher in China and India. In years with historically high subsidy levels, production in these two sets of countries would increase by 3-3.5 percent and 1.3 percent, respectively. More importantly, production value (measured at the world price level in USD) would increase by 7-8 percent on average and 11-14 percent in years of peak subsidy levels.

The impact on production would be significantly smaller in Scenario B. On average, production volumes would decline by 4 percent in the US and remain unchanged in the EU. Average output expansion in the rest of the world would be limited: 0.8 percent in Australia, Brazil, the C-4 countries, Central Asia, Pakistan and Turkey, and 0.3 percent in China and India. Production value in these countries would rise by 3 percent.

US Upland Cotton Dispute

The hypothetical implementation of Scenario C1 in 1998-2007 would cause US production to fall by 7 percent on average, with a range between 1 and 13 percent. In response, production would increase by 1-1.3 percent in Australia, Brazil, the C-4 countries, Central Asia, EU, Pakistan and Turkey, and 0.5 percent in China and India. Production value in these countries would increase by 4-4.5 percent.

Production impacts in Scenario C2 are approximately two-thirds as high as in Scenario C1. Production in the US would decline by 4.3 percent on average, with a range between 1 and 9 percent. Production would increase by 0.7-0.9 percent in Australia, Brazil, the C-4 countries,

[20] In Scenario A, cotton output in Brazil would increase by 1-4 percent in every single year in 1998-2006. However, Brazilian production would decline by 1.5 percent in 2007 since the country would be required to cut its applied level of subsidies. A similar pattern would be observed in Colombia and Mexico.

[21] "Central Asia" refers to Kazakhstan, Turkmenistan and Uzbekistan.

Central Asia, EU, Pakistan and Turkey, and by 0.3 percent in China and India. Production value in these countries would increase by 3 percent.

Scenario D would have negligible effects on production. US output would decline by 1 percent on average and production elsewhere would remain virtually unchanged.

Domestic Reforms in the US and EU

The 2003-2004 reform of the CAP would reduce EU production by on average 20 percent between 1998 and 2005. Production elsewhere would increase by only 0.1-0.3 percent. The 2008 US Farm Bill would have virtually no impact on production in the US and elsewhere. The combined impact of EU and US domestic reforms (Scenario E) coincides with the individual impact of the EU CAP reform.

1.5.3. Impact on Trade

Figures 1.21 and 1.22 summarize the impact of alternative policy reform scenarios on net trade volumes and values. Changes in exports and imports are large in Scenario A, moderate in Scenarios B and C, and small or negligible in Scenarios D and E (except for EU imports in Scenario E). Trade volumes exhibit a large variance in a year-to-year basis, significantly more so than production volumes.

Among net exporters, export volumes generally retract in the main subsidizing country (the US) and increase elsewhere (Australia, Brazil, C-4 countries, Central Asia and India). Countries with larger textiles and apparel sectors (India and Brazil) experience relatively greater expansion in exports due to the contraction in domestic consumption caused by higher world prices. The simultaneous increase in export quantities and world prices leads to an unambiguous rise in the value of exports for all net exporters except the US. For this country, the increase in the world price does not compensate for the retraction of export quantities in scenarios A through D.

Among key net importers (Bangladesh, China, Indonesia, Pakistan and Turkey), import volumes decrease in every scenario analyzed due to increased domestic output and decreased domestic demand. Estimated import costs also fall in countries with large domestic cotton sectors (China, Pakistan and Turkey) since reductions in import quantities dominate world price increases. Nonetheless, import bills increase slightly in countries with small domestic cotton production volumes (Bangladesh and Indonesia). In the EU, import quantities and costs increase substantially in Scenarios A and E (scenarios in which EU subsidies are significantly reduced), decrease slightly in Scenarios B and C, and remain virtually unchanged in Scenario D.

Doha Round Scenarios

Had Scenario A been retroactively applied in 1998-2007, annual US export volumes would have declined by 16 percent on average, with a wide range between 2 percent and 34 percent. This fall in US exports would have been counterbalanced by increased exports from other cotton suppliers. Export volumes would have increased on average by 12-14 percent in Brazil and India and 2-2.5 percent in Uzbekistan, the C-4 countries and Australia. Imports would have declined in the major Asian importing countries, especially in those with large domestic cotton sectors, including Pakistan (14 percent), China (12 percent decrease) and Turkey (8 percent). The decline in import volume would have been less pronounced in countries that rely almost exclusively on imported cotton, such as Bangladesh (1.3 percent) and Indonesia (1.2 percent). In the EU, import volumes would have been on average 30 percent higher than actual observed levels. Nonetheless, European import volumes would have continued on their downward trend year after year.

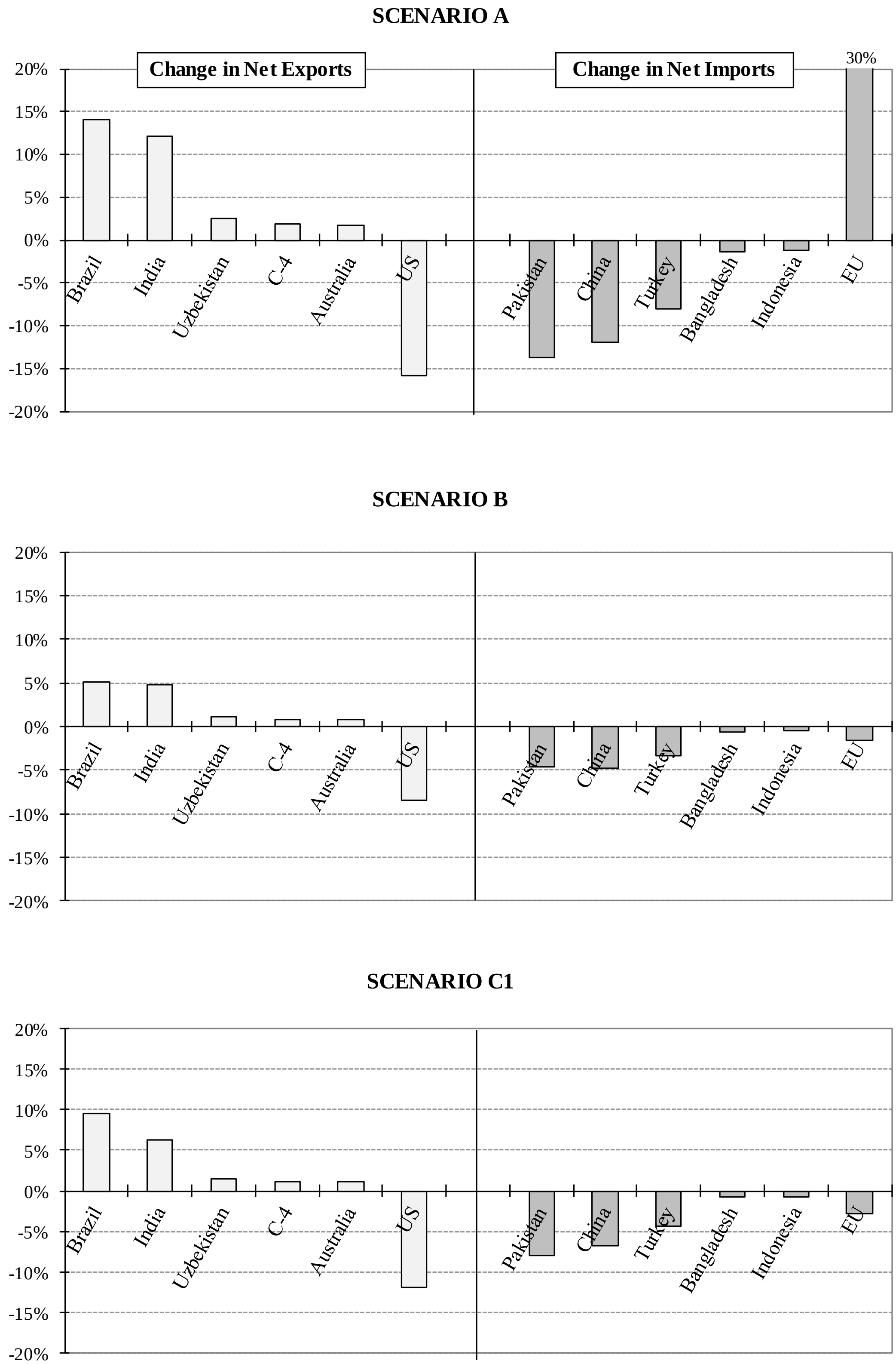


Figure 1.21: Estimated impact of alternative scenarios on cotton net trade volumes, average percentage change, 1998-2007

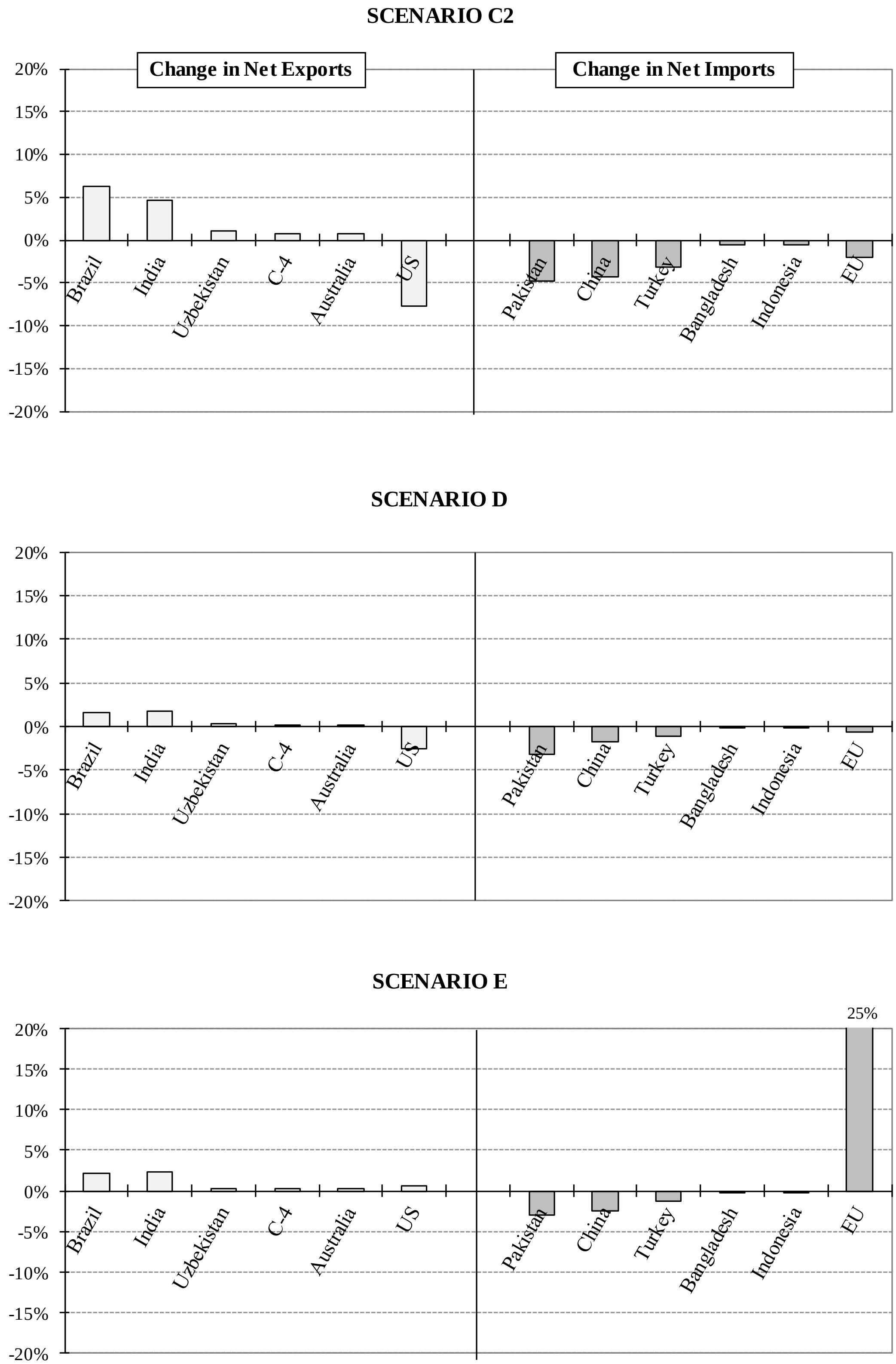
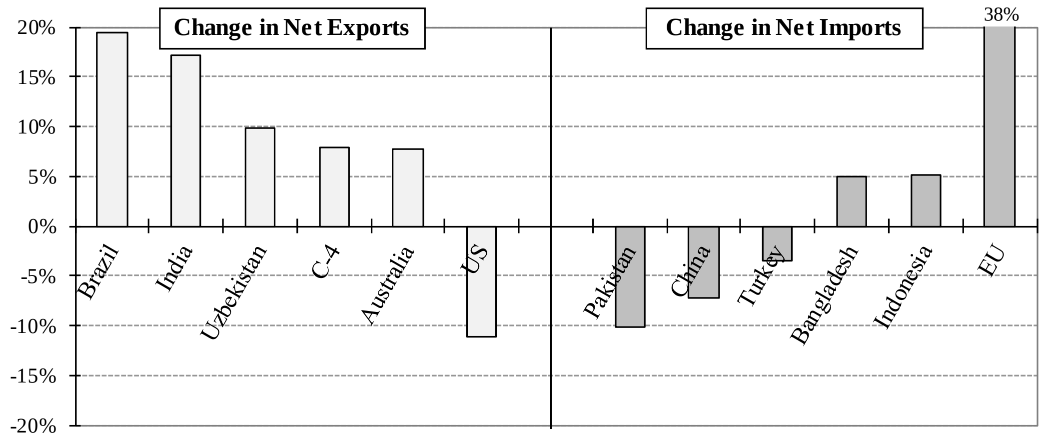
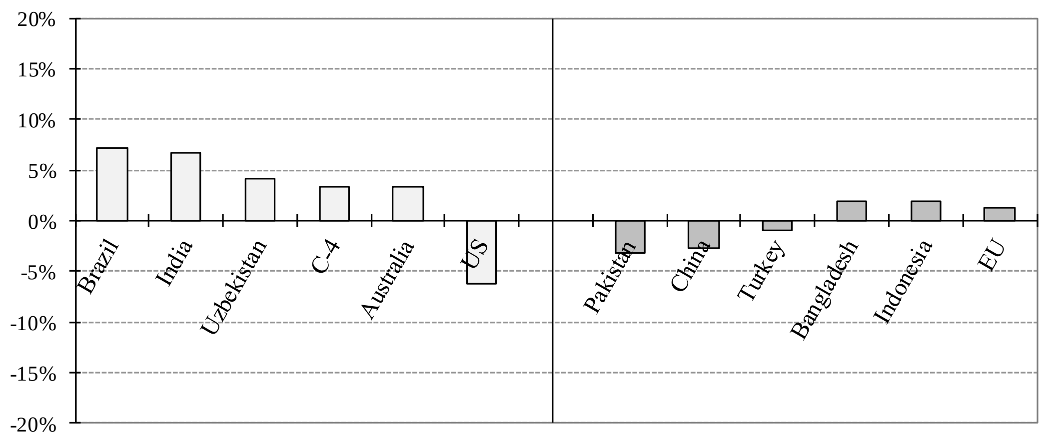


Figure 1.21 (cont.): Estimated impact of alternative scenarios on cotton net trade volumes, average percentage change, 1998-2007

SCENARIO A



SCENARIO B



SCENARIO C1

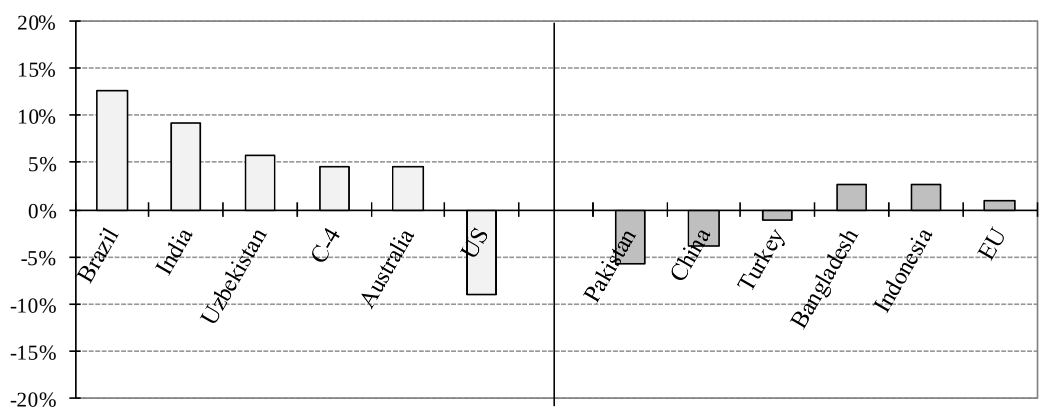


Figure 1.22: Estimated impact of alternative scenarios on cotton net trade values, average percentage change, 1998-2007

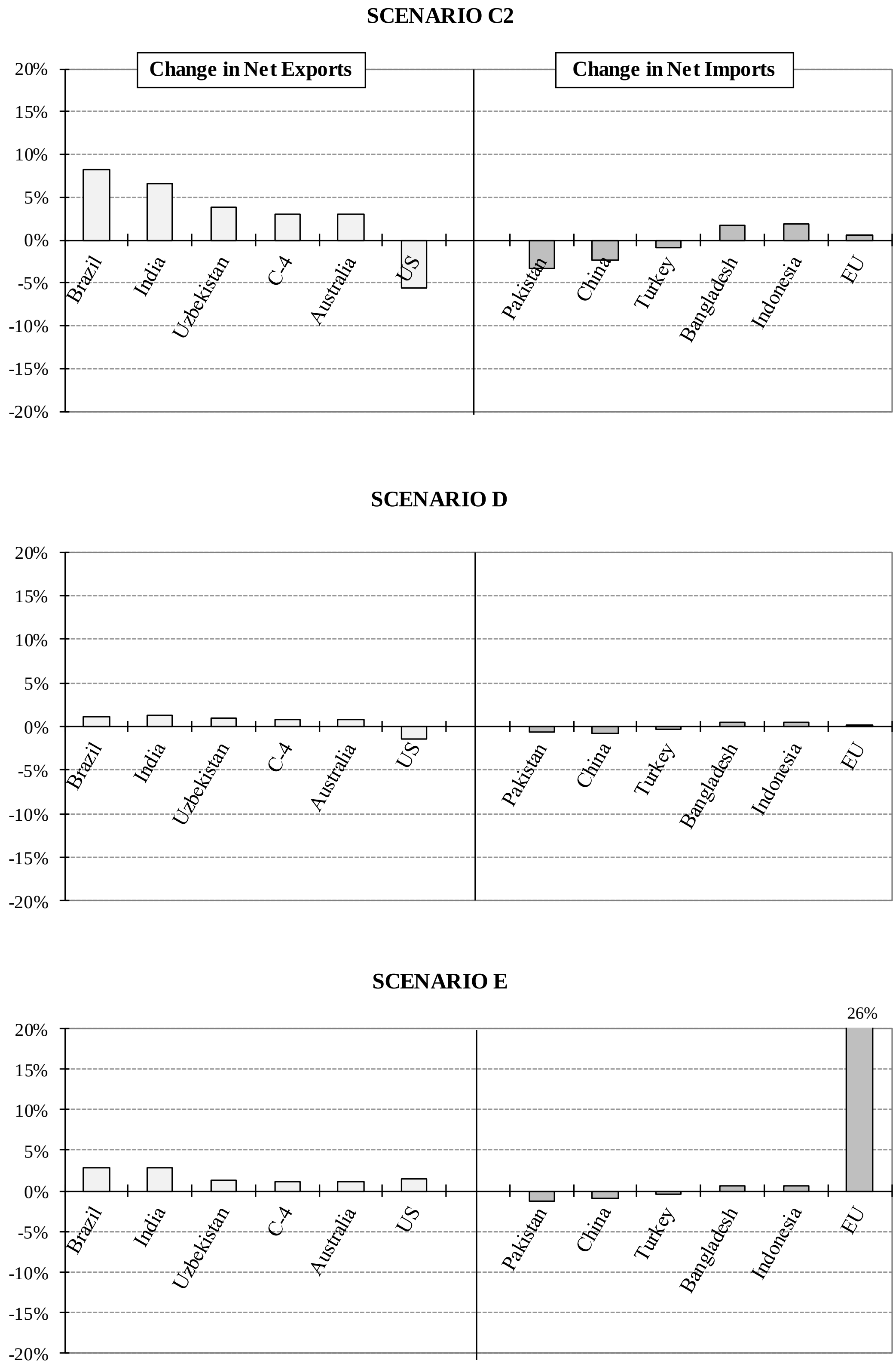


Figure 1.22 (cont.): Estimated impact of alternative scenarios on cotton net trade values, average percentage change, 1998-2007

Trade flow effects in Scenario B would be approximately two-fifths as high as in Scenario A for all countries except the EU. While EU import volumes would increase on average by 30 percent in Scenario A, they would decrease by 1.5 percent in Scenario B. This is because the EU would not be required to significantly alter applied subsidy levels in order to conform to the cotton product-specific caps established in Scenario B.

US Upland Cotton Dispute

The hypothetical full implementation of the DSB recommendations in Scenarios C1 and C2 would lead to trade flow effects that are three-fifths and two-fifths as high as in Scenario A, respectively. As in Scenario B, the only exception would concern EU imports, which would decrease by 2-2.5 percent.

In contrast, if the measures actually taken by the US in response to the DSB recommendations were retroactively applied in the 1998-2005 period (Scenario D), impacts on trade flows would be negligible. Exports would on average decline by 2.5 percent in the US and increase by 1.5 percent in Brazil and India and 0.25 percent in Uzbekistan, the C-4 countries and Australia. Imports would decline by 3 percent in Pakistan, 2 percent in China and 1 percent Turkey, and remain virtually unchanged in the EU, Bangladesh and Indonesia.

Domestic Reforms in the US and EU

Scenario E would lead to a large average increase in EU imports (25 percent) and a small increase in US exports (1 percent). For the other key importing and exporting countries, results would be similar to Scenario D. Virtually all changes would be brought about by the 2003-2004 reform of the CAP. When considered alone, the 2008 US Farm Bill would have no impact on trade flows.

1.5.4. Sensitivity Analysis

As reported in Goreux (2003) and Poonyth *et al.* (2004), estimates of price, production and trade impacts from cotton policy reforms are sensitive to the choice of price elasticities of supply and demand. Accordingly, this subsection analyzes the sensitivity of simulation results to changes in elasticity parameters.

Price elasticities of supply and demand are drawn from the existing literature and are assumed to be constant over time. While results presented in Subsections 1.5.1, 1.5.2 and 1.5.3 are based on elasticities reported in Sumner (2003), results discussed below are based on elasticities reported in Poonyth *et al.* (2004), which are also summarized in Table 1.4. The two sets of elasticities differ considerably. Nearly all elasticities in Poonyth *et al.* are larger (in absolute value) than those in Sumner. The simple mean of the demand elasticities reported in the former is 2.5 times larger (in absolute value) than in the latter (–0.67 in Poonyth *et al.* vs. –0.27 in Sumner). For supply elasticities, the difference in simple means is of three to one (0.90 in Poonyth *et al.* vs. 0.30 in Sumner). In addition, the correlation between the two alternative sets of elasticities is low (0.25 for demand elasticities and 0.04 for supply elasticities). Elasticity values for key countries differ significantly between the two sets. For example, supply elasticities for China and India, the world's two largest cotton producers, are 0.14 and 0.13 according to Sumner, but 1.2 according to Poonyth *et al.* While Mexico has the lowest (in absolute terms) demand elasticity of any country according to Sumner (–0.14), it has the highest as per Poonyth *et al.* (–1.30).

In general, when the elasticities reported in Sumner are replaced by the ones reported in Poonyth *et al.*, the impact on world prices becomes weaker and the effect on quantities produced and traded becomes stronger. The sensitivity of price, production and trade impacts to the use of this different set of supply and demand elasticities is analyzed in more detail below.

World Price

Table 1.5 compares world price effects estimated using the two alternative sets of elasticities. In every scenario and year, the estimated impact on the cotton world price is weaker when the elasticities from Poonyth *et al.* are used. While differences are small in absolute terms, they are significant in relative terms.

With the elasticities reported in Poonyth *et al.*, estimated world price increases in Scenario A are approximately one-half of those obtained with the elasticities reported in Sumner. In Scenarios B, C and D, they are roughly three-fifths as large. Finally, in Scenario E, they are only two-fifths as large. Although the magnitudes of the price rises vary with the different sets of elasticities, the year-by-year variation in results remains unchanged: the greatest impact occurs in years with the lowest world prices and the lowest impact occurs in years with the highest world prices. The relative differences between price impacts across scenarios also remain mostly unaffected.

Production

Table 1.6 summarizes average production impacts under the two alternative sets of elasticities. Given that supply elasticities in Poonyth *et al.* are higher than in Sumner, production effects are greater under the former. Differences in estimated production effects are especially pronounced for countries that are required to reduce applied subsidy levels. For example, while US and EU cotton outputs in Scenario A decline by 9 percent and 24 percent under Sumner's elasticities, they retract by 19 percent and 33 percent when Poonyth *et al.*'s elasticities are used. Estimates based on Sumner and Poonyth *et al.* elasticities are within three percentage points in China and India, two percentage points in Pakistan and Turkey, and one percentage point in Australia, Brazil, the

C-4 countries and Central Asia. The greater the difference in supply elasticities for a given country, the larger the disparity in estimated production impacts. Differences are larger for China and India because their supply elasticities in Poonyth *et al.* are substantially greater than in Sumner.

Table 1.5: Estimated impact on cotton world prices according to alternative sets of elasticities, by base year, 1998-2007

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Average	Highest
Scenario A: December 2008 Revised Draft Modalities												
Sumner (2003)	5.5%	9.0%	5.7%	10%	6.3%	3.0%	7.5%	6.2%	4.4%	2.0%	6.0%	10.0%
Poonyth et al. (2004)	2.9%	4.9%	3.0%	5.0%	3.2%	1.5%	3.7%	3.1%	2.2%	0.9%	3.1%	5.0%
Scenario B: Cotton Treated as a Standard Product												
Sumner (2003)	1.8%	5.0%	1.6%	5.7%	1.7%	1.2%	3.7%	2.4%	1.3%	0.9%	2.5%	5.7%
Poonyth et al. (2004)	1.2%	3.0%	1.0%	3.2%	1.0%	0.7%	2.0%	1.2%	0.7%	0.5%	1.4%	3.2%
Scenario C1: Full Implementation of DSB Recommendations (2% Maximum Price Effect)												
Sumner (2003)	2.2%	5.6%	2.6%	6.9%	3.7%	1.1%	4.9%	3.9%	3.1%	0.6%	3.5%	6.9%
Poonyth et al. (2004)	1.3%	3.3%	1.5%	3.8%	2.0%	0.7%	2.6%	2.1%	1.6%	0.3%	1.9%	3.8%
Scenario C2: Full Implementation of DSB Recommendations (4% Maximum Price Effect)												
Sumner (2003)	1.8%	3.9%	1.6%	5.0%	1.8%	1.1%	3.5%	2.4%	1.7%	0.6%	2.3%	5.0%
Poonyth et al. (2004)	1.2%	2.3%	1.0%	2.8%	1.0%	0.7%	1.9%	1.3%	0.9%	0.3%	1.3%	2.8%
Scenario D: Incomplete Implementation of DSB Recommendations												
Sumner (2003)	1.1%	1.5%	0.8%	0.6%	0.6%	0.4%	0.7%	0.3%	0.0%	0.0%	0.7%	1.5%
Poonyth et al. (2004)	0.7%	0.9%	0.5%	0.4%	0.3%	0.2%	0.4%	0.2%	0.0%	0.0%	0.5%	0.9%
Scenario E: Internal Policy Reforms in the US and EU												
Sumner (2003)	1.1%	1.1%	1.1%	0.9%	1.0%	0.9%	0.9%	1.0%	0.0%	0.0%	0.8%	1.1%
Poonyth et al. (2004)	0.4%	0.4%	0.4%	0.3%	0.4%	0.3%	0.3%	0.4%	0.0%	0.0%	0.4%	0.4%

Table 1.6: Estimated impact on cotton production volumes according to alternative sets of elasticities, by country or region, 1998-2007 averages

	Scenario A		Scenario B		Scenario C1		Scenario C2		Scenario D		Scenario E	
	Sumner	**Poonyth *et al.***	**Sumner**	**Poonyth *et al.***	**Sumner**	**Poonyth *et al.***	**Sumner**	**Poonyth *et al.***	**Sumner**	**Poonyth *et al.***	**Sumner**	**Poonyth *et al.***
Australia	1.8%	2.4%	0.8%	1.2%	1.0%	1.5%	0.7%	1.1%	0.2%	0.4%	0.3%	0.3%
Brazil	1.8%	2.2%	0.8%	1.0%	1.3%	2.2%	0.9%	1.5%	0.3%	0.5%	0.4%	0.4%
C-4	1.8%	2.4%	0.8%	1.2%	1.0%	1.5%	0.7%	1.1%	0.2%	0.4%	0.3%	0.3%
Central Asia	1.8%	2.4%	0.8%	1.2%	1.0%	1.5%	0.7%	1.1%	0.2%	0.4%	0.3%	0.3%
China	0.8%	3.5%	0.3%	1.7%	0.5%	2.2%	0.3%	1.5%	0.1%	0.5%	0.1%	0.4%
EU	-23.7%	-32.6%	0.2%	-0.2%	1.0%	0.7%	0.7%	0.5%	0.2%	0.2%	-19.7%	-26.6%
India	0.8%	3.7%	0.3%	1.7%	0.4%	2.3%	0.3%	1.6%	0.1%	0.5%	0.1%	0.4%
Pakistan	1.8%	3.7%	0.8%	1.7%	1.0%	2.3%	0.7%	1.6%	0.2%	0.5%	0.3%	0.4%
Turkey	1.8%	3.7%	0.8%	1.7%	1.0%	2.3%	0.7%	1.6%	0.2%	0.5%	0.3%	0.4%
US	-8.8%	-18.5%	-4.5%	-9.3%	-6.7%	-13.7%	-4.3%	-8.8%	-1.2%	-2.4%	0.3%	0.3%
ROW	1.2%	0.6%	0.5%	0.3%	0.3%	0.4%	0.5%	0.2%	0.1%	0.1%	0.2%	0.1%

The impact on the value of production depends on simultaneous changes in world prices and production quantities. Since in most countries price changes dominate changes in production volumes, estimated changes in production value are generally greater with the elasticities reported in Sumner (Table 1.7). Since changes in production quantity dominate price changes in countries that undertake reductions in applied subsidy levels, changes in production value are higher with the elasticities reported in Poonyth *et al.* For China and India, changes in production values are approximately the same with either set of elasticities.

Trade

Tables 1.8 and 1.9 summarize average trade impacts estimated under the two alternative sets of elasticities. For most countries, changes in net trade volumes are less than one percentage point greater when simulations are run with the elasticities reported in Poonyth *et al*. The main exceptions are India, China and countries that undertake reductions in applied subsidy levels (the US in Scenarios A through D; the EU in Scenarios A and E). In India and China, changes in net trade flows are three times higher when Poonyth *et al.*'s elasticities are used. This wider disparity in results is due in part to the large difference between the supply elasticities reported in Sumner (0.13 for India and 0.14 for China) and Poonyth *et al.* (1.2 for both countries). China and India are the countries in which the difference between Sumner's and Poonyth *et al.*'s elasticities is the greatest.

In exporting countries other than the US, the expansion in net exports is due to the combined effect of increased production and reduced domestic consumption. Since supply and demand elasticities are larger in Poonyth *et al.,* the rise in production and fall in domestic consumption are also larger under this choice of elasticities. In most key importing countries, the

Table 1.7: Estimated impact on cotton production values according to alternative sets of elasticities, by country or region, 1998-2007 averages

	Scenario A		Scenario B		Scenario C1		Scenario C2		Scenario D		Scenario E	
	Sumner	**Poonyth *et al.***	**Sumner**	**Poonyth *et al.***	**Sumner**	**Poonyth *et al.***	**Sumner**	**Poonyth *et al.***	**Sumner**	**Poonyth *et al.***	**Sumner**	**Poonyth *et al.***
Australia	7.8%	5.6%	3.3%	2.6%	4.5%	3.5%	3.1%	2.4%	1.0%	0.6%	1.0%	0.5%
Brazil	7.8%	5.3%	3.3%	2.5%	4.8%	4.3%	3.3%	4.2%	1.0%	0.7%	1.1%	0.6%
C-4	7.8%	5.6%	3.3%	2.6%	4.5%	3.5%	3.1%	2.4%	1.0%	0.6%	1.0%	0.5%
Central Asia	7.8%	5.6%	3.3%	2.6%	4.5%	3.5%	3.1%	2.4%	1.0%	0.6%	1.0%	0.5%
China	6.7%	6.7%	2.9%	3.2%	3.9%	4.2%	2.7%	2.9%	0.8%	0.8%	0.9%	0.6%
EU	-19.2%	-30.6%	2.7%	1.3%	4.5%	2.7%	3.0%	1.9%	0.9%	0.5%	-15.2%	-21.0%
India	6.7%	6.8%	2.9%	3.2%	3.9%	4.3%	2.7%	4.3%	0.8%	0.8%	0.9%	0.7%
Pakistan	7.8%	6.8%	3.3%	3.2%	4.5%	4.3%	3.1%	4.3%	1.0%	0.8%	1.0%	0.7%
Turkey	7.8%	6.8%	3.3%	3.2%	4.5%	4.3%	3.1%	4.3%	1.0%	0.8%	1.0%	0.7%
US	-11.7%	-23.1%	-10.5%	-15.8%	-11.7%	-19.5%	-10.4%	-15.4%	-5.0%	-4.7%	1.3%	0.7%
ROW	7.2%	3.7%	3.1%	1.7%	4.2%	2.3%	2.8%	1.6%	0.9%	0.4%	1.0%	0.4%

Table 1.8: Estimated impact on cotton net trade volumes according to alternative sets of elasticities, by country, 1998-2007 averages

	Scenario A		Scenario B		Scenario C1		Scenario C2		Scenario D		Scenario E	
	Sumner	**Poonyth *et al.***	**Sumner**	**Poonyth *et al.***	**Sumner**	**Poonyth *et al.***	**Sumner**	**Poonyth *et al.***	**Sumner**	**Poonyth *et al.***	**Sumner**	**Poonyth *et al.***
NET EXPORTERS												
Australia	1.8%	2.5%	0.8%	1.2%	1.0%	1.5%	0.7%	1.1%	0.2%	0.4%	0.2%	0.2%
Benin	1.8%	2.5%	0.8%	1.2%	1.1%	1.6%	0.7%	1.1%	0.2%	0.4%	0.2%	0.2%
Brazil	14.0%	15.3%	5.2%	5.5%	9.6%	13.1%	6.2%	8.6%	1.5%	2.2%	2.2%	2.0%
Burkina Faso	1.8%	2.5%	0.8%	1.2%	1.1%	1.6%	0.7%	1.1%	0.2%	0.4%	0.2%	0.2%
Chad	1.9%	2.7%	0.8%	1.3%	1.1%	1.7%	0.8%	1.2%	0.2%	0.4%	0.3%	0.3%
India	12.1%	37.4%	4.7%	16.5%	6.3%	21.6%	4.7%	16.4%	1.7%	6.3%	2.3%	5.1%
Kazakhstan	2.2%	3.0%	0.9%	1.4%	1.2%	1.9%	0.8%	1.3%	0.3%	0.5%	0.3%	0.3%
Mali	1.8%	2.5%	0.8%	1.2%	1.1%	1.6%	0.7%	1.1%	0.2%	0.4%	0.2%	0.2%
Turkmenistan	3.8%	7.3%	1.6%	3.4%	2.2%	4.7%	1.5%	3.2%	0.4%	1.0%	0.5%	0.7%
US	-15.9%	-34.2%	-8.4%	-17.5%	-11.9%	-24.6%	-7.7%	-16.2%	-2.6%	-5.5%	0.7%	0.6%
Uzbekistan	2.6%	3.5%	1.1%	1.7%	1.5%	2.2%	1.0%	1.5%	0.3%	0.5%	0.4%	0.3%
NET IMPORTERS												
Bangladesh	-1.3%	-2.1%	-0.6%	-1.0%	-0.8%	-1.3%	-0.5%	-0.9%	-0.2%	-0.3%	-0.2%	-0.2%
China	-11.9%	-32.6%	-4.7%	-14.5%	-6.8%	-20.0%	-4.3%	-13.3%	-1.8%	-5.7%	-1.7%	-3.4%
Colombia	-6.5%	-5.0%	-3.3%	-4.0%	-4.5%	-5.3%	-3.1%	-3.7%	-1.0%	-1.3%	-1.1%	-0.8%
EU	29.7%	39.6%	-1.6%	-2.4%	-2.8%	-4.1%	-2.0%	-2.9%	-0.6%	-0.9%	24.9%	33.5%
Indonesia	-1.2%	-1.9%	-0.5%	-0.9%	-0.7%	-1.2%	-0.5%	-0.8%	-0.2%	-0.3%	-0.2%	-0.2%
Japan	-1.9%	-1.8%	-0.8%	-0.9%	-1.1%	-1.2%	-0.8%	-0.8%	-0.2%	-0.3%	-0.3%	-0.2%
Mexico	-0.9%	-3.9%	-0.9%	-3.0%	-1.2%	-4.0%	-0.8%	-2.8%	-0.3%	-1.0%	-0.3%	-0.6%
Pakistan	-13.8%	-28.0%	-4.6%	-10.4%	-8.0%	-17.4%	-4.8%	-10.7%	-1.4%	-3.3%	-1.9%	-2.8%
South Korea	-1.8%	-1.8%	-0.8%	-0.9%	-1.1%	-1.1%	-0.7%	-0.8%	-0.2%	-0.3%	-0.2%	-0.2%
Thailand	-1.2%	-1.8%	-0.5%	-0.8%	-0.7%	-1.2%	-0.5%	-0.8%	-0.2%	-0.3%	-0.2%	-0.2%
Turkey	-8.0%	-13.0%	-3.3%	-6.0%	-4.4%	-7.8%	-3.1%	-5.6%	-1.2%	-2.3%	-1.2%	-1.4%

Table 1.9: Estimated impact on cotton net trade values according to alternative sets of elasticities, by country, 1998-2007 averages

	Scenario A		Scenario B		Scenario C1		Scenario C2		Scenario D		Scenario E	
	Sumner	Poonyth *et al.*	Sumner	Poonyth *et al.*	Sumner	Poonyth *et al.*	Sumner	Poonyth *et al.*	Sumner	Poonyth *et al.*	Sumner	Poonyth *et al.*
NET EXPORTERS												
Australia	7.8%	5.6%	3.3%	2.6%	4.6%	3.5%	3.1%	2.4%	0.8%	0.7%	1.0%	0.5%
Benin	7.8%	5.7%	3.3%	2.7%	4.6%	3.6%	3.1%	2.5%	0.8%	0.7%	1.1%	0.5%
Brazil	19.5%	18.1%	7.2%	6.6%	12.7%	14.8%	8.2%	9.7%	1.2%	1.5%	2.8%	2.2%
Burkina Faso	7.8%	5.6%	3.3%	2.6%	4.6%	3.5%	3.1%	2.4%	0.8%	0.7%	1.0%	0.5%
Chad	8.0%	5.8%	3.4%	2.7%	4.6%	3.7%	3.1%	2.5%	0.8%	0.7%	1.1%	0.6%
India	17.2%	40.6%	6.7%	17.7%	9.2%	23.4%	6.7%	17.6%	1.3%	3.9%	2.8%	5.3%
Kazakhstan	8.2%	6.2%	3.5%	2.9%	4.8%	3.9%	3.2%	2.7%	0.8%	0.7%	1.1%	0.6%
Mali	7.9%	5.7%	3.3%	2.7%	4.6%	3.6%	3.1%	2.5%	0.8%	0.7%	1.1%	0.5%
Turkmenistan	9.9%	10.7%	4.2%	4.9%	5.8%	6.7%	3.9%	4.6%	0.9%	1.2%	1.3%	1.0%
US	-11.1%	-32.4%	-6.1%	-16.4%	-8.9%	-23.3%	-5.6%	-15.1%	-1.5%	-4.0%	1.5%	0.9%
Uzbekistan	8.6%	6.7%	3.7%	3.1%	5.0%	4.2%	3.4%	2.9%	0.9%	0.8%	1.2%	0.6%
NET IMPORTERS												
Bangladesh	5.0%	0.9%	1.9%	0.4%	2.6%	0.6%	1.8%	0.4%	0.5%	0.1%	0.6%	0.1%
China	-7.2%	-30.9%	-2.7%	-13.5%	-3.9%	-18.8%	-2.4%	-12.3%	-0.8%	-4.0%	-1.0%	-3.1%
Colombia	-1.0%	-2.2%	-0.9%	-2.7%	-1.3%	-3.5%	-0.9%	-2.5%	-0.2%	-0.7%	-0.3%	-0.5%
EU	38.3%	44.4%	1.3%	-0.7%	0.9%	-2.0%	0.6%	-1.4%	0.2%	-0.4%	26.2%	34.0%
Indonesia	5.1%	1.1%	2.0%	0.5%	2.7%	0.7%	1.8%	0.5%	0.5%	0.1%	0.6%	0.1%
Japan	3.8%	1.2%	1.7%	0.6%	2.3%	0.7%	1.5%	0.5%	0.4%	0.1%	0.5%	0.1%
Mexico	5.0%	-1.0%	1.6%	-1.6%	2.2%	-2.1%	1.5%	-1.5%	0.4%	-0.4%	0.5%	-0.3%
Pakistan	-10.1%	-26.6%	-3.2%	-9.7%	-5.8%	-16.6%	-3.4%	-10.0%	-0.6%	-1.8%	-1.4%	-2.6%
South Korea	4.0%	1.2%	1.7%	0.6%	2.3%	0.8%	1.6%	0.5%	0.4%	0.1%	0.6%	0.1%
Thailand	4.6%	1.2%	2.0%	0.6%	2.7%	0.7%	1.8%	0.5%	0.5%	0.1%	0.6%	0.1%
Turkey	-3.4%	-10.4%	-0.9%	-4.7%	-1.2%	-6.1%	-0.8%	-4.3%	-0.4%	-1.5%	-0.4%	-1.1%

fall in net imports is explained by the combined effect of expanded domestic output and retracted domestic consumption. The rise in production and fall in domestic consumption are greater when elasticities are larger (*i.e.,* in Poonyth *et al.*). In countries with small domestic cotton production (*e.g.,* Bangladesh and Indonesia), the difference between the results obtained with the two sets of elasticities is very small.

1.6. Conclusion

The WTO Doha Round could have a significant positive impact on world cotton prices and contribute to the expansion of cotton production and exports in developing countries. However, the likelihood of such an outcome is highly dependent on the depth of the subsidy reductions adopted by WTO members. The poor record of internal policy reforms in key subsidizing countries and the failure of the US to comply with DSB recommendations in the *US Upland Cotton* dispute highlight the importance of multilateral trade negotiations in addressing the profound distortions that characterize the world cotton market.

This chapter demonstrates that ambitious cotton-specific provisions are imperative in order to achieve meaningful reforms in the Doha Round. It validates the mandate given by the WTO membership in the 2004 Framework for Establishing Modalities in Agriculture and reaffirmed in the 2005 Hong Kong Ministerial Declaration to address cotton "ambitiously, expeditiously, and specifically within the agriculture negotiations."

A partial equilibrium model was utilized to estimate the price, production and trade effects of reforming cotton subsidies and tariffs under alternative policy scenarios. The quantitative estimates derived from the model suggest that effects are substantial under the special cotton provisions of the December 2008 Revised Draft Modalities and would deliver significant gains for developing countries. In contrast, most benefits would be dissipated if cotton were treated under the general provisions applicable to other agricultural products. In the absence of a multilateral trade deal on cotton, the impact of domestic policy reforms in the US and EU would be negligible.

This chapter estimates that the special cotton provisions of the December 2008 modalities draft (Scenario A) would increase the world price of cotton by as much as 10 percent and production volumes in Brazil, Central Asia and West Africa by as much as 3-3.5 percent. As a result, production values in these developing countries and regions would increase by as much as 13 percent when measured at world price levels. Cotton production would decline by as much as 15 percent in the US and 30 percent in the EU due to significant reductions in applied subsidy levels.

Since the counter-cyclical nature of cotton subsidies generates significant variance in simulation results in a year-by-year basis, it is also informative to look at average effects. Had Scenario A been retroactively applied in the 1998-2007 period, the cotton world price would have increased by 6 percent on average. Production quantities in Brazil, Central Asia and West Africa would have increased by 2 percent and production value by 8 percent. Had cotton been treated as a standard product (Scenarios B), the world price would have increased on average by only 2.5 percent, production in the same group of developing countries would have increased by 0.8 percent and production value by 3 percent.

If the measures taken by Washington in response to the *US Upland Cotton* dispute were applied retroactively to 1998-2007 (Scenario D), the world price would have increased on average by less than one percent and production would have remained virtually unchanged across the globe. A similar pattern would have been observed had the 2003-2004 EU CAP reform and the 2008 US Farm Bill applied to 1998-2007 (Scenario E), except that EU production would have declined. The 2008 US Farm Bill alone would have had no impact on prices or quantities.

Four main factors distance Scenario A from the full liberalization of cotton markets. First, the elimination of tariffs and subsidies in this scenario applies only to WTO member countries. Policies in non-WTO members are assumed to remain unchanged. Non-WTO members are significant players in international cotton markets. They accounted for 20 percent of world cotton exports in 2004-2008. Some of the world's top cotton exporters are not members of the WTO, including Uzbekistan (world's second largest exporter), Turkmenistan (eight), Kazakhstan (ninth), Tajikistan (tenth) and Syria (twelfth). The current literature has not clarified whether the cotton sectors in some of these countries are actually taxed or subsidized (Rudenko *et al.*, 2009; Rudenko and Lamers, 2006; EJF, 2005; Guadagni *et al.*, 2005).

Second, Scenario A does not contemplate reductions in payments that are claimed to be decoupled from production, such as Direct Payments in the US and Single Farm Payments (SFP) in the EU. Third, it allows WTO members to continue to provide some degree of trade distorting subsidies, namely the amounts implied by *de minimis* levels and AMS and blue box product-specific caps.

Finally, Scenario A is concerned with the degree of reform that could be achieved through multilateral trade negotiations. Therefore, only subsidies that are officially notified[22] by WTO members are taken into account. The Doha Round *per se* is assumed to have no impact on cotton subsidies that are currently not reported by member countries. Whether or not these subsidies will be notified in the future will depend on WTO member countries filing complaints within the scope of the WTO Dispute Settlement Mechanism or the extended monitoring and surveillance structure

[22] Although the US did not notify market loss assistance payments (MLA) and counter-cyclical payments (CCP) as blue box payments, they are taken into consideration in the analysis since payments of this type are highly likely to be included in the new blue box in the Doha Round. Furthermore, AMS estimates are used for recent years for which domestic support notifications are not yet available, including Brazil (2005-2007), China (2005-2007), EU (2007), Israel (2007), Mexico (2005-2007) and South Africa (2007).

of the Committee on Agriculture that may emerge from a trade deal in the Doha Round.

The International Cotton Advisory Council (ICAC) and other sources report governmental subsidies to the cotton sector that are significantly higher than the values that are officially notified by WTO members.[23] For example, while the Turkish government declares that no domestic support was provided to its cotton sector between 1998 and 2001, the ICAC reports that Turkish cotton subsidies were in the order of USD 220 million in 1998-1999, USD 287 million in 1999-2000 and USD 106 million in 2000-2001 (ICAC, 2002). While Turkey has not submitted any domestic support notifications since 2001, the ICAC reports that the country has continued to subsidize domestic cotton production. A multilateral trade deal in the context of the Doha Round will not by itself force Turkey to notify alleged cotton subsidies. Therefore, for purposes of calculating the potential impacts of the Doha Round, un-notified subsidies are not taken into account.

The magnitude of estimated policy reform effects is fairly sensitive to the choice of supply and demand elasticities. Impacts on the cotton world price are higher when the elasticities reported in Sumner (2003) are selected. On the other hand, impacts on quantities produced and traded are greater with the significantly higher elasticities reported in Poonyth *et al.* (2004). One feature that is common across all scenarios and does not depend on the choice of elasticities is that estimated impacts are almost exclusively explained by reductions in subsidies.

There are two reasons why market access has a marginal role at best. First, the cotton sector already enjoys exceptionally low levels of applied tariffs.[24] Second, only two WTO members (the

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[23] A number of WTO members that have not notified domestic support for cotton have allegedly subsidised domestic production, including Benin, Côte d'Ivoire, Egypt, India, Mali, Pakistan and Turkey (ICAC, 2008; Pan *et al.,* 2009a). ICAC subsidy estimates for the three largest cotton subsidizers – the US, China and the EU – are also substantially higher than officially notified figures.

[24] Of the 153 members of the WTO, 84 currently apply duty-free access to cotton imports, 62 apply tariffs between 0 and 10 percent, and only seven apply tariffs between 10 percent and 33 percent. Of the seven countries with tariffs above 10 percent, only Nigeria has a significantly large domestic market. The other countries are Djibouti, Gambia, Haiti, Maldives, Solomon Islands and Tonga.

US and Oman) will have to reduce current applied tariffs as a result of the negotiations. All other countries either: (i) already provide duty-free access to imports at an MFN basis, (ii) enjoy significant tariff overhang, or (iii) qualify for tariff-cut exemptions due to their status as LDCs, very recently-acceded members or small low-income recently-acceded members.

The extension by developed countries of duty-free access for cotton exports from LDCs will have little if any impact on market access opportunities for LDCs. First, all developed countries apart from the US already provide duty-free access to cotton imports at an MFN basis. Second, as US cotton consumption has plummeted in recent years, the country's share of world cotton imports has collapsed to only 0.05 percent. Moreover, US cotton quotas are consistently under-filled despite the low level of in-quota tariffs (between zero and 3 percent).

In contrast, developing countries account for nearly 95 percent of world cotton imports. Of the top fifteen developing country importers, all but China currently provide duty-free MFN access to cotton. The Doha Round will not significantly alter market access conditions in China since Beijing is likely to exempt cotton from tariff reduction and quota expansion by selecting it as a Special Product. Even if China were not to select cotton as a Special Product, the large tariff overhang would be enough to prevent any effective cut in the applied tariff.

When it comes to cotton, subsidies should be the heart and soul of the negotiations. There is an urgent need to rebalance existing trade rules that permit developed countries to highly subsidize domestic production, depress world prices, push farmers elsewhere out of production and impair prospects for economic advancement in the developing world. The adoption of ambitious domestic support reforms for cotton in the Doha Round would be a significant step towards the establishment of a fair and market-oriented trading system.

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CHAPTER 2

INTERNATIONAL EXPERIENCE WITH AGRICULTURAL EXPORT TAXES

2.1. Introduction

The surge in world commodity prices in 2007-2008 heightened the interest in agricultural export taxes as a source of government revenue and protective shield against rising food prices and inflation. While export taxes may help achieve these and other policy objectives in the short run, theoretical and empirical evidence has shown that such measures are self-defeating in the long term and usually cause more harm than good. This paper reviews current and past export taxes in over 60 countries and provides a detailed analysis of their application and economic impacts in three selected countries (Argentina, Indonesia and Thailand).

Broadly speaking, the taxation of agricultural exports can occur through the application of various direct policy instruments, including explicit export taxes, export quotas, export bans, export licensing requirements and commodity marketing boards. Indirect measures that affect the prevailing exchange rate and the level of protection afforded to non-agriculture may further tax agricultural exports (Krueger, Schiff and Valdés, 1991).

Despite the indisputable importance of each of the aforementioned policy instruments, the current paper is concerned primarily with *explicit* export taxes on agricultural products. Therefore, except as otherwise indicated, the term "export tax" will be used in reference to explicit export taxes. Nonetheless, to the extent that some implicit export taxes are related to explicit export taxes and have similar effects, the analysis may be extended to such measures.

Agricultural products covered in this paper mostly follow the product coverage of the Uruguay Round Agreement on Agriculture, as specified in its Annex 1. Therefore, the analysis comprises export taxes on both primary and agro-industrial products, but does not include experiences with the taxation of fishery and forestry products. Whereas several countries apply export taxes to fishery and forestry products, the taxation of such natural resource products require an analysis distinct from those of agricultural products and more in line with the treatment of taxes on mineral products (Tanzi, 1990; Devarajan *et al.*, 1996; Gaffney, 1967; Corden and Neary, 1982; Goode, 1984; Neary, 1986).

The chapter is organized in four sections in addition to this introduction. Section 2.2 examines the global experience with agricultural export taxes. It investigates the objectives, product coverage, structure and level of agricultural export taxes applied by over 60 countries, as well as the allocation of funds collected from export taxes and the incentives for smuggling. The effectiveness of export taxes in meeting policy goals and their economic effects are discussed for some illustrative countries.

Sections 2.3, 2.4 and 2.5 analyze in more detail the experiences of Argentina, Indonesia and Thailand – three countries that have had very distinctive trajectories in terms agricultural export taxation. Each of the three sections (i) analyzes the evolution and objectives of agricultural export taxes in the particular country, (ii) describes the their coverage, structure and level, (iii) provides an overview of the theoretical and empirical evidence on their short-run and long-run impacts, and (iv) evaluates their effectiveness in meeting policy goals.

Section 2.3 examines Argentina, a country that makes intensive and widespread use of export taxes. The country taxes exports of all agricultural and non-agricultural products, applies some of the highest export tax rates in the world, and is among the most dependent on export tax revenues. Policy objectives have been numerous and not always clearly defined. Agricultural export taxation has a long history and continues to be a divisive issue in Argentinean society. Section 2.4 analyzes Indonesia's agricultural export taxes. In contrast with Argentina, Indonesia taxes exports of only two agricultural product categories and derives a miniscule share of total government revenue from such taxes. Section 2.5 examines Thailand's experience with agricultural export taxes. Thailand provides an interesting example of a country that heavily taxed agricultural exports in its early development stage and later reduced the level of taxation as it achieved successful industrialization. Finally, Section 2.6 summarizes the main findings and discusses their implications.

2.2. Global Experience with Agricultural Export Taxes

2.2.1. Objectives

Countries have used agricultural export taxes to achieve a number of different objectives: to generate public sector revenue; to curb domestic prices and inflation; to promote higher value-added activities; to improve the terms of trade; to distribute income; to stabilize commodity prices; among others. More recently, export taxes have also been used to combat smuggling. This section examines the incidence and relative importance of the aforementioned goals. Two preemptive remarks are necessary. First, a country may use export taxes to attain various goals simultaneously. Second, the declared policy objectives of an export tax may not genuinely reflect a government's underlying goals.

Revenue Generation

The need for revenue rather than any policy of state was historically the prime reason for imposing export taxes (Condliffe, 1950). Such taxes have at times accounted for a significant share of public sector revenue in some developing countries, though their relative importance has fallen since the 1990s. The advantage associated with the ease of administration of export taxes is possibly the main reason for their use by developing countries with low efficiency of tax administration (Gómez-Sabaini, 1990). While land taxes or taxes on the net income of the agricultural sector are in theory more efficient and equitable than export taxes, they are also more difficult and costly to administer.

As late as the 1930s, export taxes did not occupy an important place in the fiscal structure of most countries, the main exceptions being in Latin America, where they accounted for 16-19 percent of total tax receipts of the central governments of Guatemala, Haiti and Mexico in 1939 (Reubens, 1956). The use of export taxes intensified during the Second World War and the materials boom that accompanied the Korean War, reaching peaks of 30-50 percent of total tax revenue in a few countries in parts of Africa, Asia and Latin America. The relative importance of export taxes declined in the period following the Korean War, but reached new peaks of 40-70 percent in the mid-1970s and the mid-1980s.

Table 2.1 lists the highest share that export taxes attained in central government revenue between 1972 and 2006 for 91 developing and transition economies. In twenty of these countries, export duties accounted for more than 20 percent of total central government revenue in at least one year between 1972 and 2006. In addition, export taxes represented between 10 and 20 percent of central government revenue in twenty-six countries; between 5 and 10 percent in fifteen countries; and between 1 and 5 percent in thirty countries in at least one year in the same period. More strikingly, export taxes accounted for 46 percent of Guyana's central government revenue in 1975, 48 percent of Ghana's in 1979, and 67 percent of Uganda's in 1986. In many countries, export taxes have been collected primarily or exclusively on agricultural products. The Democratic Republic of the Congo and Russia, where forestry products and minerals account for the bulk of export tax revenue, are key exceptions.

Table 2.1: Share of export taxes in central government revenue, highest annual value attained, select periods between 1972 and 2006

More than 20%		**Between 10% and 20%**		**Between 5% and 10%**		**Between 1% and 5%**	
Uganda	67%	Costa Rica	19%	Suriname	9%	Tunisia	4%
Ghana	48%	Argentina	19%	Philippines	9%	Malawi	4%
Guyana	46%	Mauritius	18%	Gabon	8%	Benin	4%
Congo, D.R.	40%	Sierra Leone	18%	Cambodia	8%	Syria	4%
El Salvador	39%	Ecuador	17%	Mexico	8%	Kazakhstan	4%
Sri Lanka	39%	Zimbabwe	17%	Maldives	7%	Bangladesh	4%
Guinea	39%	Grenada	17%	Indonesia	7%	Egypt	4%
Rwanda	36%	Vanuatu	16%	Barbados	7%	Somalia	4%
Burundi	35%	Azerbaijan	16%	Togo	6%	Belize	3%
Comoros	34%	Peru	16%	Senegal	6%	Kenya	3%
Swaziland	34%	Tanzania	16%	Sudan	6%	Panama	3%
Solomon Islands	31%	Pakistan	15%	Nepal	5%	Lesotho	3%
Guinea-Bissau	28%	Nicaragua	14%	Bolivia	5%	St. Lucia	3%
Guatemala	26%	Haiti	14%	Burkina Faso	5%	Bahamas	3%
Russia	24%	Gambia	14%	Niger	5%	Namibia	3%
Ethiopia	24%	Zambia	14%			Morocco	3%
Dominican R.	22%	Cameroon	14%			Romania	3%
Côte d'Ivoire	21%	Thailand	12%			Brazil	3%
Honduras	20%	Mali	12%			Congo, R.	3%
Malaysia	20%	Belarus	12%			Fiji	2%
		Tajikistan	11%			Poland	2%
		Colombia	11%			St. Vincent & Gren.	2%
		Madagascar	10%			St. Kitts & Nevis	2%
		Central African R.	10%			India	2%
		Papua New Guinea	10%			Paraguay	2%
		Uruguay	10%			Dominica	2%
						Mongolia	2%
						Jamaica	%
						Botswana	1%
						Bhutan	1%

Note: Periods vary by country according to data availability.
Source: Author. Based on data from IMF.

The average share of export taxes on government revenue in 1972-1978 was 6.4 percent for least developed countries, 3.6 percent for middle-income countries, and 0.2 percent for developed countries (Kostecki and Seck, 1982). The 1986 World Development Report (World Bank, 1986) still identified revenue generation as the single most important reason for taxing exports. Nonetheless, the relative importance of export duties as a source of government revenue declined significantly ever since. Their average share in central government revenue for a sample of 63 developing countries for which data are available fell from 4 percent in 1980-1989 to 1.4 percent in 1990-1999 and 0.7 percent in 2000-2006. Figure 2.1 plots annual shares of export taxes in central government revenue for a subgroup of 30 developing countries where export taxes accounted for more than 2 percent of central government revenue in at least one year in 1972-2006. Until the 1980s, shares ranged from zero to almost 40 percent, with the majority being between 0 and 20 percent. After 1990, the shares of almost every country in the sample were consistently below 5 percent. The only outliers were Côte d'Ivoire, which had shares between 10 and 20 percent; Argentina, which had shares close to zero in 1991-2001 and between 10 and 20 percent in 2002-2006; and Burundi and Papua New Guinea, which had shares mostly between 0 and 10 percent.

Figure 2.2 illustrates the decline in the relative importance of export taxes in countries where they used to account for a substantial share of central government revenue, as well as in countries where their contribution to public finances has been traditionally more modest. In the Dominican Republic, Costa Rica and Mauritius, the share of export taxes in central government revenue declined from peaks of 15-20 percent in the 1970s and 1980s to virtually 0 percent since the late 1990s. In Thailand, Indonesia and India the decline was from peaks of 12 percent, 7 percent and 2 percent, respectively, to nearly zero in 2000-2006.

The loss of revenue from a reduction in export taxes has been a concern for trade policy reform in many developing countries. For example, the removal or reduction of explicit export taxes has proved problematic in Tanzania in 1981-1983, Uruguay in 1984-1986 and Argentina in 1987-1988. In Argentina, the failure to implement a new land tax measure, which was expected to compensate for the decline in revenue, was followed by the re-imposition of export duties (Thomas and Nash, 1991). Tax reform strategies that reduce trade taxes without adversely affecting either government revenue or consumer welfare have been proposed by Dasgupta and Stiglitz (1974), Heady and Mitra (1987), Diewert *et al.* (1989), Michael *et al.* (1993), Chambers (1994), Falvey (1994), Hatzipanayotou *et al.* (1994), Abe (1995), Anderson (1996) and Emran (2005), among others. The prevailing consensus among policy advisors favors a reduction in export taxes and import tariffs with revenue-neutral or revenue-increasing reform of consumption taxes.

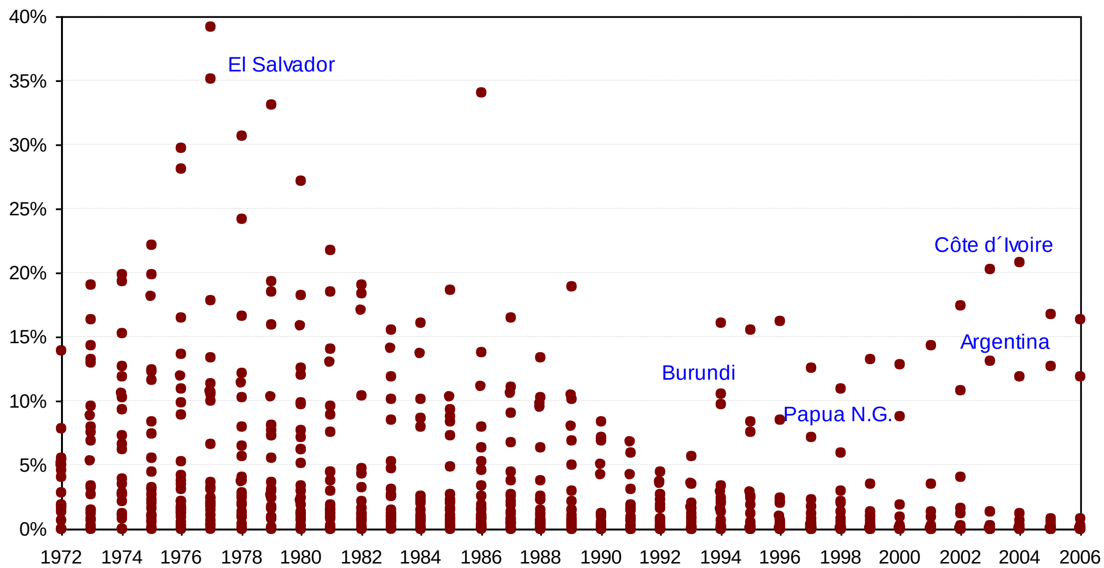

Figure 2.1.: Share of export taxes in central government revenue, 30 selected countries, 1972-2006

Notes: Countries were selected based on two criteria: (i) data availability and (ii) export tax revenue represented over 2 percent of central government revenue in at least one year in 1972-2006. Thirty countries were selected, including twelve in Latin America (Argentina, Bolivia, Brazil, Colombia, Costa Rica, Dominican Republic, El Salvador, Mexico, Nicaragua, Panama, Peru and Uruguay), seven in Asia-Pacific (India, Indonesia, Malaysia, Maldives, Nepal, Papua New Guinea and Thailand), seven in Sub-Saharan Africa (Burundi, Cameroon, Côte d'Ivoire, Lesotho, Madagascar, Mauritius and Zambia) and four in Northern Africa and the Middle East (Egypt, Morocco, Syria and Tunisia).
Source: Author's calculations. Based on data from IMF.

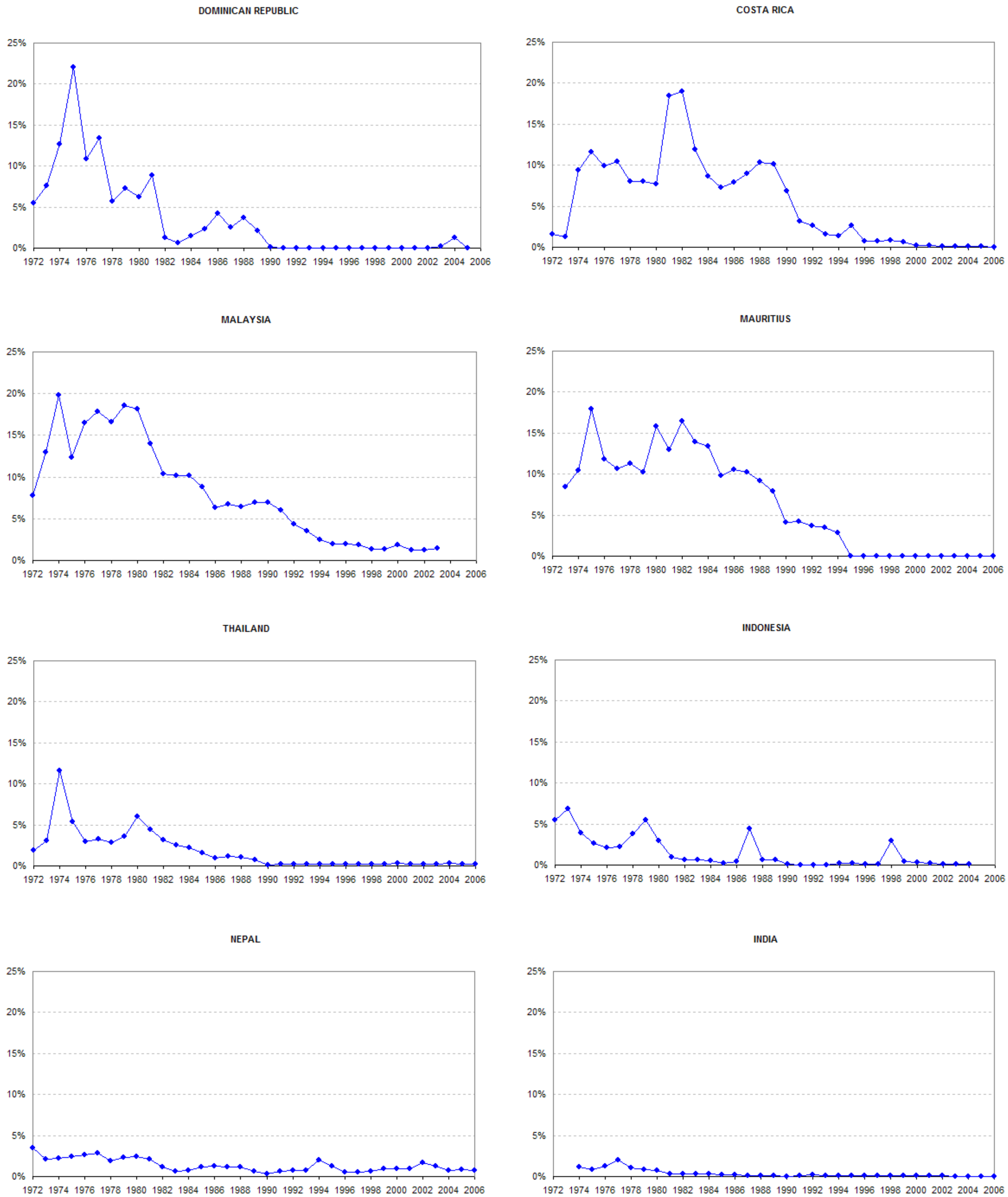

Figure 2.2: Share of export taxes in central government revenue, 6 selected countries, 1972-2006

Source: Author's calculations. Based on data from IMF.

Despite the trend of overall decline in the relative importance of export taxes as a source of government revenue in the developing world, political and economic crises have led some countries to reinstate or raise export taxes for revenue purposes. In Côte d'Ivoire the 1999 coup d'état and continuing civil conflict have hampered the economy and divided the country, with the northern provinces still held by rebel troops as of 2007. According to Abbott (2007), the increased need for tax revenue has resulted in the resumption of export taxes on cocoa and coffee, crops that are grown primarily in the south. Among countries for which data are available, Côte d'Ivoire is currently the most dependent on agricultural export tax revenues. Not less than 18 percent of central government revenue in 2004-2006 came from export duties.

In Argentina, export duties were reintroduced during the 2002 financial crisis to counter the sharp fall in tax revenue and control domestic prices. Since then, export taxes have become a key source of public revenue. "Between 2002 and 2005, revenue collected from these duties averaged nearly 2.2 percent of GDP, the highest level recorded in the historical series that began in 1932. During that period, income from export duties represented 9.2 percent of exports and 9.9 percent of total public revenue. In 2005, it accounted for 62 percent of the primary surplus" (WTO Secretariat, 2007a). Revenue from agricultural export taxes, in particular, accounted for 1.3 percent of GDP in 2002-2005. Section 2.3 analyzes agricultural export taxation in Argentina in more detail.

Domestic Price Control

The upsurge in international food prices in 2007-2008 has put in evidence the use of export taxes as a tool to control domestic prices. At least nine countries, including large producers such as Argentina, China, Indonesia, Russia and Vietnam, have recently imposed or raised taxes on agricultural exports to address concerns over inflation fueled by rising food prices. In addition, not less than twenty-one countries, including Bangladesh, Egypt, India, Kazakhstan and Pakistan, have imposed outright bans on exports of certain, several or all agricultural products. Tables 2.2 and 2.3 summarize countries and agricultural commodities affected by recent export taxes and bans imposed on grounds of domestic price stabilization. As of August 2008, declining prices had led Cambodia, Russia and Vietnam to eliminate their measures.

Table 2.2: Export taxes imposed/increased with the goal of curbing prices, 2007-2008

Country	Products Affected	Export Tax Rate
Argentina	Soybeans; sunflower seeds; wheat; corn	Sliding-scale taxes could exceed 50%; processed products had lower taxes (*)
Belarus	Wheat and meslin	40%
	Wheat flour and products; rye flour	25%
China	Wheat; rye; barley; oats; buckwheat	20%
	Rice flour; corn flour; soybean flour	10%
	Rice; corn; sorghum; millet; soybeans	5%
Croatia	Wheat; corn	n.a.
India	Basmati rice	8,000 INR per t
	Crude palm oil	10% to 25%
Indonesia	Palm oil derivatives	9% to 13%
	Biodiesel	8% to 11%
Kyrgyzstan	Wheat; wheat flour; vegetable oils	n.a.
Russia	Wheat and meslin	40% (**)
	Barley	30% (**)
Vietnam	Rice	0.6 to 2.9 million VND per t (***)

Notes: (*) Replaced by flat tax rates in July 2008.
(**) Lifted in July 2008.
(***) Lifted in August 2008.
Source: Author.

Table 2.3: Export bans imposed with the goal of curbing prices, 2007-2008

Country	Products Affected
Argentina	Beef (*); wheat (*)
Bangladesh	Rice
Bolivia	Wheat; wheat flour; corn; rice; sugar; oilseeds; vegetable oils; meats
Cambodia	Rice (*)
Ecuador	Rice
Egypt	Rice
Guinea	All agricultural products
India	Non-basmati rice; wheat; corn
Kazakhstan	Wheat
Kenya	Sugar
Liberia	All agricultural products
Madagascar	Rice
Malawi	Corn; corn products
Nepal	Rice; wheat; corn
Pakistan	Wheat
Serbia	Wheat; corn
Syria	Wheat; wheat flour; pasta
Tanzania	Corn
Uzbekistan	All agricultural products
Venezuela	Cereal flour; vegetable oils; dairy products; meats
Vietnam	Rice (*)

Note: (*) Export ban lifted in or prior to July 2008.
Source: Author.

The imposition of export restrictions as a reaction to rising inflation or perceived shortages of certain commodities is not a new phenomenon. It has occurred in different intensities at several occasions. For example, with the objective of curbing domestic prices, some countries resorted to export taxes and bans on a considerable scale in the early 1970s. Nonetheless, such action led to competitive beggar-thy-neighbor behavior whereby different exporters applied similar policies to other commodities in short supply. As a result, expected benefits failed to materialize (GATT Secretariat, 1989).

Indonesia introduced taxes on palm oil exports in 1978 in order to ensure the domestic availability of cooking oil – an essential household item – at affordable prices. Export taxes were reintroduced on the same grounds in 1994 and in 1998 (following an export ban in 1997). Violent social unrest during the 1997 Asian financial crisis demonstrated the high political sensitivity of prices of essential goods in Indonesia. In 2007-2008, export tax rates have again risen in response to the surge in international food prices. Section 2.4 analyzes Indonesia's experience with export taxes in more detail.

Argentina reinstated export taxes in 2002 to both raise government revenue and cushion the effect of exchange rate devaluation on domestic prices of household necessities (WTO, 2007). In 2007-2008, Argentina raised export tax rates in an attempt to shield the internal market from rising world prices. While export taxes have ensured the existence of a wedge between domestic and world prices, they have not prevented significant and recurrent domestic price increases. Despite the extensive use of both export taxes and export bans, the inflation rate in Argentina has been higher than in neighboring countries that have not adopted such policies.

China's Premier Wen Jiabao has reiterated repeatedly that the primary task for the country in 2008 is to curb inflation and maintain food prices at a reasonable level (Xu, 2008). With a view to achieving these goals, China removed the value-added tax (VAT) rebate on exports of 84 agricultural tariff lines – including wheat, rice, corn, other cereals, soybeans, and their derived flour byproducts – in December 2007 (WTO, 2008a). In June 2008, the elimination of the VAT rebate on exports was extended to some vegetable oils. Government concerns that the development of export oriented ethanol plants could lead to domestic grain shortages had previously led to the elimination of the VAT rebate on ethanol exports in January 2007. Prior to the elimination of the VAT, most of the aforementioned products were entitled to a 13 percent rebate upon export. To further discourage exports, the government introduced interim export taxes on grains and flour products in January 2008. These provisional export taxes range from 5 percent to 25 percent and are effective January 1 through December 31, 2008. The elimination of the VAT rebate and the interim export taxes impose a combined burden of between 18 and 38 percent on exports of grains and flours.

Despite these restrictions on exports, China's consumer price index (CPI) for the first quarter of 2008 grew 8 percent, compared with 2.7 percent in the first quarter of 2007, and well above the government's target of 4.8 percent. Food prices, which account for about one-third of China's CPI, rose 21 percent in the first quarter of 2008 compared to a year ago. In February 2008, China's inflation rose to 8.7 percent, its biggest jump in 12 years (Foreign Agricultural Service, 2008). Such price increases are attributed not only to inflationary pressures resulting from global commodity price rises, but also to domestic factors such as rising incomes and consumption, urbanization of prime arable land and supply shortfalls due to animal diseases and winter snowstorms.

Russia's annual inflation rate of 12 percent in 2007 far exceeded the official target of 8 percent, fueled in great part by the growth in commodity prices. In September 2007, food prices increased by as much as 30 percent for nine out of every ten food products (Svec, Maksimenko and Vassilieva, 2007). In response to rising global grain prices and inflationary pressures, the Russian government introduced export tariffs of 30 percent (but not less than 70 Euros per metric ton) on barley and 10 percent (but not less than 22 Euros per metric ton) on wheat and meslin in November 2007. In January 2008, the export tariff on wheat and meslin was raised to 40 percent ad valorem (but not less than 105 Euros per metric ton), a prohibitive level designed to shut off wheat exports (Vassilieva and Mustard, 2007; Vassilieva, 2007). Grain prices began to fall in mid April 2008 (Vassilieva, 2008). Given increased stocks, falling prices and the good crop outlooks, export taxes on wheat and barley exports were removed in July 2008.

Russia's wheat and barley export duties were designed to cover exports from the territories of Russia, Belarus and Kazakhstan, all of which signed an agreement in October 2007 to form a customs union by 2011. The implementation of such taxes required export policy coordination among these countries, which proved problematic. By shipping wheat to Belarus or Kazakhstan, which could be done duty-free under terms of the common customs union, traders could conceivably circumvent the export tariff and then re-export the wheat to an onward destination. To preclude circumvention of the export tax, Russia imposed a ban on exports of wheat and meslin to Belarus and Kazakhstan in March 2008 (Mustard, 2008). The need for such ban was short-lived, as Russia's neighbors ultimately imposed their own restrictions on wheat exports. Due to rising inflation and grain shortages resulting from higher than usual exports, Kazakhstan banned wheat exports in April 2008. In June 2008, Belarus adopted an export tax of 40 percent on wheat and meslin. Two other former Soviet republics have also restricted agricultural exports: Uzbekistan banned exports of all agricultural products and Kyrgyzstan imposed export taxes on wheat, wheat flour and vegetable oils in June 2008.

It is worth noting that export restrictions may actually contribute to inflationary pressures. When used continuously or improperly, export taxes, quotas or bans can have disincentive effects on production, thus increasing the price of goods as the supply declines. Argentina's bans, quotas and taxes on exports of beef in 2006-2008 provide a good example of measures that, though designed to curtail domestic prices, promote the opposite in the long term. With the objective of containing the transmission of high international prices to the domestic market, a beef export ban was introduced in March 2006 and replaced by export quotas in May 2006. In addition, the government has applied a tax of 15 percent on exports of beef and beef preparations. While these measures resulted in the immediate fall of domestic beef prices, they have also restrained investment, led to the slaughtering of young animals and breeding cows at unprecedented high rates, and encouraged market exit (Heft, 2006; Lojo, 2008). Falling local beef prices and high international grain prices have already caused many Argentine landowners to convert their cattle pastures into soybean fields. The measures were not as effective in reducing domestic prices because export beef represents less than a third of output and because the beef cuts consumed domestically are different from the cuts that are exported (Castro and Díaz Frers, 2008). Meanwhile, continuous wage rises have increased domestic demand, precipitated shortages and led to the development of a parallel market for beef, where prices are substantially higher than the official prices controlled by the government (Nogués *et al.*, 2007).

Protection of Domestic Processing Industries

One of the key reasons for the imposition of export taxes on agricultural products is the promotion of domestic downstream processing industries (OECD, 2005). Since such taxes tend to lower the domestic prices of primary products that are used as inputs by the agro-industry and manufacturing sectors, they encourage local processing and raise the value-added content of exports. Some countries have raised this argument for export taxes in conjunction with infant industry or broader import-substitution industrialization policies. Others have justified the adoption of export taxes in order to counter the existence of tariff escalation among importing countries.

Agricultural export taxes that have been imposed on grounds of promoting domestic value-added activities have typically focused on three classes of commodities: (i) tropical products, such as cocoa, coffee and cashew nuts; (ii) oil-bearing crops, such as soybeans, sunflower seeds and palm; and (iii) and animal products, such as hides, skins and wool. While the protection of local processing industries is in some cases the sole or primary reason for the imposition of export taxes; in other cases, it is only one of several declared goals and as such may be overshadowed by more pressing needs.

Table 2.4 presents a non-exhaustive list of countries and sectors in which agricultural export taxes are imposed with the official declared goal of promoting domestic processing. This objective is particularly prevalent for raw hides and skins, as not less than eighteen countries across Africa, Asia and Latin America tax such exports primarily or exclusively to promote domestic processing. For oil-bearing crops and tropical products, other reasons for taxing exports – such as revenue generation and food price stabilization – are also important.

Some of the world's largest producers of oil-bearing crops – such as Argentina, Indonesia and Malaysia – apply higher export taxes to unprocessed raw materials in order to promote domestic vegetable oils and associated industries. Argentina has been particularly successful in attracting investment to its soybean processing industry in part due to the competitive advantage derived from differential export taxes, which decrease the domestic price of soybeans and increase the profitability of local processors. As a result, the country has become the world's number one exporter of soybean oil and meal.

Table 2.4: Export taxes imposed with the goal of promoting domestic processing

Tropical Products	Oil-bearing Crops	Animal Products
Cocoa	**Soybeans**	**Raw hides and skins**
Côte d'Ivoire	Argentina	Argentina
Ghana	Paraguay	Brazil
Nigeria		Egypt
		India
		Indonesia
		Kenya
		Mongolia
		Pakistan
		Paraguay
		Saudi Arabia
		Sri Lanka
		Tanzania
		Thailand
		Turkey
		Uganda
		Ukraine
		Uruguay
		Vietnam
Cashew nuts	**Sunflower seed**	**Raw cashmere**
Mozambique	Argentina	Mongolia
Sri Lanka	Russia	
Tanzania	Ukraine	
Vietnam		
Coffee	**Palm kernel**	**Raw wool**
Argentina	Indonesia	Argentina
Côte d'Ivoire	Malaysia	Mongolia

Notes: This is an illustrative list, not an exhaustive list. It reflects declared policy goals.
Source: Author. Based on WTO Trade Policy Review reports (various countries, various years).

Côte d'Ivoire, Ghana and Nigeria also tax exports of cocoa beans to encourage the local cocoa butter and paste industries. However, unlike Argentina, they have failed to significantly develop local processing industries and remain exporters of predominantly unprocessed cocoa beans. Figure 2.3 depicts the average shares of processed and unprocessed exports in the total value of soy and cocoa exports by key exporting countries in 2001-2005. While soybean oil and meal accounted for over three-quarters of total Argentinean soy exports in this period, processed cocoa products represented only 19 percent of cocoa exports in Côte d'Ivoire and less than 10 percent in Ghana and Nigeria.

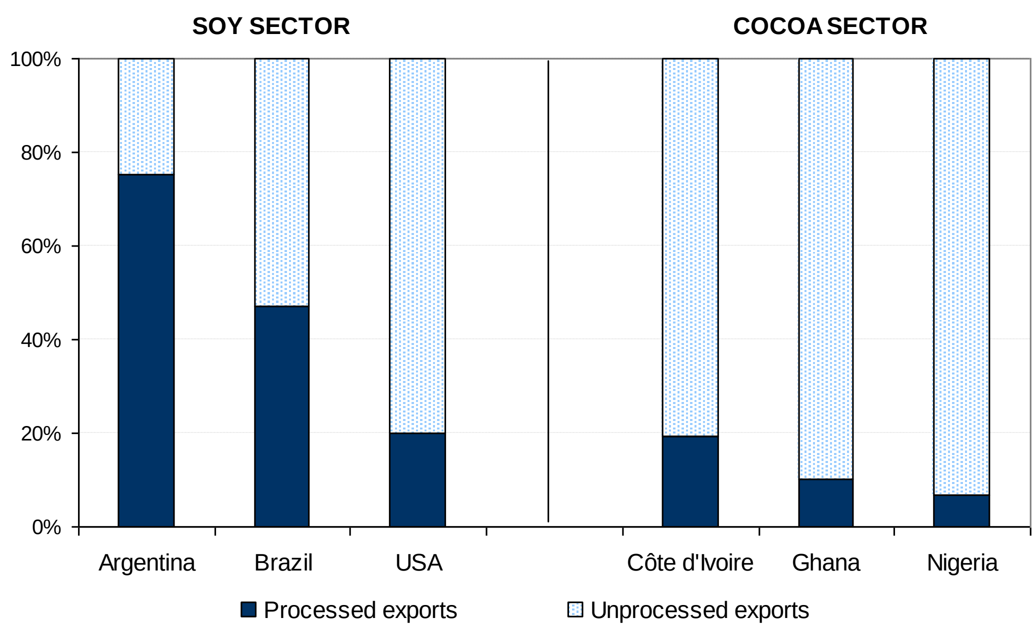

Figure 2.3: Shares of processed and unprocessed exports in the total value of soy and cocoa exports, by main exporters, 2001-2005

Source: Author. Based on FAO (2010).

Golub and Finger (1979) use a fixed-coefficient, partial-equilibrium model to analyze the economic effects of developing countries' differential export taxes and developed countries' tariff escalation. They find that the elimination of export taxes alone would retard developing countries' processing of seven out of eight commodities examined. Repeal of export taxes has the expected result of increasing developing country raw material production and lowering developed country raw material production, but in most cases it also leads to a fall in developing country foreign exchange receipts. On the other hand, if both developing country export taxes *and* developed country import tariffs were simultaneously eliminated, developing country processing of six out of eight commodities would increase, while developed country processing of five out of eight commodities would decline. "Processing in the developing countries would increase by more than 8 percent – a substantially larger percentage increase than the less than 1 percent decline in the developed countries. More important, liberalization increases total world final consumption and, hence, the size of the processing pie" (Golub and Finger, 1979).

The criticism often raised against the infant industry argument for protection also apply to export taxes that are designed to promote domestic processing industries, as they may ultimately promote the development of inefficient industries that remain perpetually dependent on government support (Baldwin, 1969; Krueger, 1984). Mongolia's experience in the cashmere sector illustrates how protective measures can be counterproductive. With the goal of building a domestic cashmere processing industry, the government imposed a ban on exports of raw cashmere in 1994 and then replaced it by an export tax in 1997. These measures encouraged widespread smuggling, reduced the availability of raw cashmere for processing, and did not increase value added. While the tax encouraged foreign processors to locate processing facilities in Mongolia, few of them produced quality products. Most established primary processing facilities in Mongolia only to partially dehair cashmere and circumvent export restrictions. This added little value to the product, as it had to be dehaired again by purchasers abroad. "The final goods manufacturing industry did not grow over time with the export ban or tax. The tax did not fulfill government expectations of increasing the production of high value added products in the sector. The value added component from raw greasy cashmere to dehaired cashmere is marginal" (Songwe, 2003). Exports of raw cashmere dropped, exports of semi-processed goods increased, and exports of garments increased only slightly. "In 2001 exports of garments accounted for 17 percent of cashmere exports, only marginally above 15.2 percent in 1993. Overall the tax has depressed cashmere exports, as increases in garment industry exports could not offset decrease in raw and dehaired material exports" (Songwe, 2003).

Terms of Trade Improvement

The possession of market power by an exporting country with competitive producers provides a strong analytical case for an export tax (Devarajan *et al.*, 1996). By levying an optimal export tax on a product for which the demand abroad is inelastic, a country with market power can improve its terms of trade and raise total national welfare (Corden, 1974). Thus, market power in a given commodity is a necessary condition that must be met by a country that wishes to accrue terms of trade improvements from the application of export taxes. This is a position enjoyed by only certain developing countries in a limited number of agricultural commodities.

Countries that individually do not possess market power have signed international commodity agreements – such as International Coffee Agreement and the International Cocoa Agreement – with the intention of coordinating their policies and jointly achieving the desired market power. These groups of country have adopted export taxes and export quotas to limit supply and achieve higher prices. However, controls of this nature have rarely been operative in the long term. "Either new producers have emerged which have not participated in the policies designed to maximize prices through restrictions on sales, or substitutes for the product have been developed in such a way as to reduce the inelasticity of demand for it (GATT Secretariat, 1989).

In the nineteenth century, Ceylon (present-day Sri Lanka) used export taxes to take advantage of its monopolist position in world cinnamon and quinine trade (Reubens, 1956). After the Second World War, several developing countries that had, or thought they had, monopoly positions in their major export commodities adopted export taxes and related supply-limiting and price-increasing devices to improve their gains from trade. As a result, a number of countries that had acquired leading positions in international markets prior to the adoption of export taxes saw their market positions dwindle, including Uganda in the cotton market and Pakistan in the jute market (Lewis, 1967). In order to determine the true degree of market power, the ability of consumers and existing and potential suppliers to respond to price changes must be carefully considered. When the elasticity of excess-demand facing individual producing countries is large, market shares overestimate true market power.

A number of developing countries that have taxed exports with the goal of improving their terms of trade saw their market shares usurped by other countries with more favorable policies towards producers (World Bank, 1986). Ghana, which accounted for 40 percent of world cocoa exports in 1961-1963, had its market share drop to 18 percent after 20 years of heavy export taxation. Meanwhile, Côte d'Ivoire, which was more producer-friendly at the time, expanded its market share from 9 percent to 29 percent. Ghanaian producer prices dropped significantly below those of competing West African countries in this period. While prices in Ghana, Côte d'Ivoire and Togo were at almost the same level in 1965, by 1980 the ratio of the Ghana price to the Côte d'Ivoire price had reached 0.18, and the ratio of the Ghana price to the Togo price was 0.23 (Table 2.5).

Sri Lanka also lost a substantial part of its market share to other countries that have applied lower taxes to tea export. Average tax rates on Sri Lankan tea exports exceed 50 percent in 1970s and 35 percent in the 1980s. Meanwhile, tax rates were more moderate in Kenya (Table 2.6). While Sri Lanka's share of the world tea market dropped from 33 percent in 1961-1963 to 19 percent in 1980-1982, that of Kenya increased from 2.6 percent to over 9 percent. Other countries that taxed agricultural exports between the 1960s and 1980s to take advantage of a perceived monopoly power include Egypt (cotton), Nigeria (cocoa and palm oil) and Zaire, currently known as the Democratic Republic of Congo (palm oil). All three lost significant portions of their export market shares (World Bank, 1986).

Table 2.5: Relative price incentives for cocoa farmers in Ghana, Côte d'Ivoire and Togo, 1965-1982

Year	Ratio of Ghana price to Côte d'Ivoire price	Ratio of Ghana price to Togo price
1965	0.97	0.97
1970	0.60	0.56
1975	0.48	0.74
1980	0.18	0.23
1981	0.26	0.36
1982	0.30	0.40

Source: World Bank (1986).

Table 2.6: Export tax rates on tea, Kenya and Sri Lanka, 1985

FOB price (US$ per kg)	Kenya		Sri Lanka	
	Average tax rate	Marginal tax rate	Average tax rate	Marginal tax rate
1.20	0.0%	0%	22.4%	0%
1.80	2.8%	10%	14.9%	0%
2.40	2.6%	15%	27.7%	50%
3.00	8.2%	20%	32.2%	50%
3.60	10.7%	25%	35.2%	50%
4.20	13.1%	30%	37.3%	50%
4.80	14.9%	25%	38.9%	50%

Source: World Bank (1986).

While export taxes on commodities in which a country enjoys market power may be justified on efficiency grounds, the benefits derived from improved terms of trade and higher national welfare could be outweighed by negative distributional effects. Such concerns have led Thailand to refrain from reintroducing an export tax on rice, despite its privileged market power position as the world's leading exporter with a current market share of over a quarter of all rice traded globally. Section 2.5 examines Thailand's experience with export taxes in more detail.

Income Distribution

Governments may use agricultural export taxes to redistribute wealth, whether or not income distribution is a declared policy objective. Although export taxes necessarily reduce aggregate national welfare in countries that do not enjoy sufficient market power, they do affect the distribution of wealth among different groups in a country. As a result of agricultural export taxes, income is generally transferred from producers to consumers, from rural areas to urban areas, and from land and low-skilled labor to capital and high-skilled labor. While such taxes may in principle address income inequality, experience shows that more often than not they have led to transfers from the most vulnerable social groups to the more sophisticated ones. Preexisting social and economic conditions significantly affect the distributional outcome of agricultural export taxes in different countries.

In Thailand, the rice export taxes that were in place until 1986 hurt the lowest income quintile groups the most, both in rural and urban areas. Since even the poorest Thai farmers derive a substantial proportion of their income from land ownership, they were affected by the negative impact of export taxes on the returns to land. Both the rural and the urban poor also suffered from the negative impact of agricultural export taxes on the returns to unskilled labor. On the other hand, the urban rich gained from the rise in the returns to skilled labor and mobile forms of capital and from the curbing of income taxation that was made possible by increased revenue collection from the rice export tax (see Section 2.5).

More recently, the Argentine government has justified high export tax rates on agricultural products in part as a measure to redistribute income from rural producers to urban consumers. Nonetheless, it has been shown that the majority of the income transfers derived from agricultural export taxes in Argentina favor rich urban consumers and processors of raw materials. In addition, studies have concluded that the elimination of agricultural export taxes would have virtually no impact on the Gini coefficients for household per capita income and labor income (see Section 2.3).

Combat Smuggling

Although export taxes typically *encourage* smuggling (see Subsection 2.2.4), more recently they have been applied to *combat* smuggling. The leading examples are Brazil's and Canada's export taxes on cigarettes.

Brazilian cigarette exports increased 8000-fold between 1988 and 1998, from 11 metric tons to 87,000 metric tons. In 1998, over half of Brazil's total domestic production was exported, the principal destination being Paraguay, a neighboring country of only four million inhabitants. In the same period, per capita consumption of cigarettes decreased 63 percent in Brazil (from 1,913 to 714 cigarettes per person) and increased 16-fold in Paraguay (from 678 to 10,929 cigarettes per person).[25] These trends coincided with local evidence that large volumes of cigarettes manufactured in Brazil for export to Paraguay were smuggled back and consumed tax-free in

[25] In comparison, estimated per capita cigarette consumption in 1998 was 1,748 cigarettes per person in the United Kingdom, 2,255 in the United States, and 2,403 in Japan.

Brazil. Similar trends, but in a smaller scale, were also observed in Brazil's cigarette trade with Bolivia and Uruguay. Brazil's Federal Tax Bureau estimated that annual consumption of contraband cigarettes in Brazil reached a peak of 58 billion and captured 37 percent of the domestic cigarette market in 1998 (Shaffey *et al.*, 2002).

To combat widespread cigarette smuggling into Brazil, a tax of 150 percent on exports of cigarettes to countries in South and Central America was introduced by the Brazilian government in 1999. After the passage of the export tax, Brazil's official cigarette exports fell 89 percent and estimated per capita consumption in Brazil and Paraguay returned to 1990 levels. In 2006, 21 billion cigarettes were smuggled into Brazil, which represented 20 percent of domestic consumption. Although the export tax has helped to halve the level of smuggling by making it harder for Brazilian-made cigarettes to be channeled into neighboring countries, it has not prevented smugglers from finding alternative ways to bring contraband cigarettes into the country.

Canada experienced similar cigarette smuggling problems along its border with the United States. In the 1990s, contraband tobacco seizures reached epidemic proportions, primarily because legitimate industry was exporting its products to the United States, which were then being smuggled back into Canada and sold on the black market. Total cigarette exports to the United States increased from 1.2 billion cigarettes in 1989 to 18.6 billion in 1993, despite the absence of any added American demand for Canadian brands. Given that more than 90 percent of the contraband consisted of products originally manufactured in Canada, export taxes were introduced in a few occasions in the 1990s and then repealed due to pressures from the tobacco industry. In 2008, exports of tobacco products over 1.5 percent of a manufacturer's production were subject to taxes totaling C$22 per carton of cigarettes, C$16 per 200 tobacco sticks and C$12 per 200 grams of fine-cut tobacco.

Other Objectives

Export taxes have been applied to achieve a myriad of other policy objectives, including price or income stabilization, quality control, environmental protection, and the provision of services to agricultural producers or exporters.

Developing countries have used export taxes with the objective of reducing price and income fluctuations for agricultural producers. In low-income rural areas where the capital market is highly imperfect and the management of consumption risk is costly, the short-run variability in the price of export commodities can be a threat to income and food security. While domestic prices of agricultural products were more stable than border prices in a number of developing countries that taxed exports between the 1960s and the 1980s (Schiff and Valdés, 1992), in other countries government intervention instead accentuated the transmission of world price fluctuations to domestic producers. Bautista (1996) shows that taxes on exports of coconut products in the Philippines led not only to a lower average producer price level for copra in 1960-1982 (13 percent lower than the border price), but also to higher price instability (9 percent higher than for the border price). The negative impact of export taxes on producer income was even more notable: the income level of copra producers was 16 percent lower and 33 percent more unstable than without the export taxes.

Export taxes have also been employed to provide incentives for improvements in the quality of products exported (Reubens, 1956). For many years, Colombia imposed an additional tax on coffee exports that was equivalent to 6 percent of the export volume and had to be paid in kind, in low quality coffee beans (Junguito and Pizano, 1997). The fact that the payment was made in low quality beans effectively reduced the amount of such beans that was eventually exported. The tax contributed to the strengthening of the international reputation of Colombian coffee, as it created additional disincentives for the export of low quality coffee beans. More generally, the choice by some countries of specific tax rates over ad valorem rates has also been justified on grounds of promotion of exports of higher quality products.

Countries have also imposed export taxes to promote environmental protection. Some of these taxes are applied to agricultural products. Angola's taxes on exports of furs and skins (20 percent *ad valorem*) and unworked ivory (10 percent *ad valorem*) are applied for purposes of protection of the local fauna. Iceland applies a specific export tax of 500 Icelandic Crowns per unit of horse exported with the goal of protecting the species.

Export taxes that are applied in order to obtain funds to finance the provision of services to producers or exporters are addressed in Subsection 2.2.3.

2.2.2. Structure, Coverage and Level

At least 60 countries apply taxes to agricultural exports.[26] The product coverage of such taxes varies from country to country, ranging from a single product to all agricultural products. Examples of countries that tax a single agricultural product include Botswana (beef), Ghana (cocoa) and Mali (cotton). Only a few countries impose export taxes on all agricultural products, including Argentina, Niger and Togo. Gambia applies export taxes to all products except groundnuts, its most important agricultural export commodity. Most other countries apply export taxes to only a handful of agricultural product categories.

The importance of covered products varies significantly across countries. In one extreme are countries such as Argentina (all products), Côte d'Ivoire (cocoa and coffee) and Ghana (cocoa), where covered products account for a large share of agricultural GDP and exports. In the other

[26] In addition, at least 57 other countries claim not to apply export taxes on agricultural products.

extreme are Brazil (cigarettes and hides and skins) and Thailand (hides and skins), where covered products account for a miniscule portion of total agricultural exports.

Some agricultural products stand out for the fact that they are subject to export taxation in a large number of countries, most notably raw hides and skins, coffee, vegetable oils, cocoa and livestock. Exports of raw hides and skins are taxed by at least 23 countries across Africa, Asia and Latin America. As seen in Subsection 2.2.1, such products are taxed primarily to protect domestic downstream processors. Coffee exports are taxed by at least 14 countries in Africa and Latin America.[27] A number of other countries – including Brazil, Burundi, the Dominican Republic, El Salvador, Haiti, Honduras, India, Kenya and Tanzania – also used to tax coffee exports. Vegetable oil exports are taxed by at least 12 countries, and cocoa and livestock exports by at least 11 countries each. Table 2.7 provides illustrative lists of countries that tax exports of the aforementioned products. Other agricultural products whose exports are taxed by at least five countries include: wheat (Argentina, Belarus, Burundi, China, Croatia, Kyrgyzstan, Russia); sugar (Argentina, Fiji, Gambia, Guyana, Mozambique, Pakistan, Togo); cashew nuts (Gambia, Mozambique, Sri Lanka, Tanzania, Togo, Vietnam); and rice (Argentina, China, Guyana, India, Vietnam).

Until the 1960s, most export taxes were specific in form, a fact that reflected preferences for a simple, definite tax and minimum paperwork and investigation. However, due to the dangers of over- or under-taxation associated with specific rates and export price fluctuations, *ad valorem* taxes have gained significant ground and are now the most common form of export tax. Belize, Cameroon, Canada, the Central African Republic, Chad, Costa Rica, Côte d'Ivoire, Guinea, Guyana, Iceland, Mongolia, Morocco, Niger, Nigeria, Saint Kitts and Nevis, Sri Lanka, Suriname,

[27] Some of these countries use the terms "cess," "fee" or "financial tax" to describe taxes on exports.

Turkey and Vietnam use specific taxes or a combination of specific and *ad valorem* taxes. Most other countries use ad valorem taxes only. The successful use of *ad valorem* duties depends on the capacity of customs administrations to value exports correctly. To address export price underreporting, governments have established official values or tax reference prices, sometimes without a formal link to prevailing world market prices. "Such a practice is generally undesirable, however, because failure to adjust the official prices, or their manipulation, introduces an arbitrary element into the determination of effective duty rates" (Goode, 1984). Both Argentina and Indonesia currently apply official reference prices to exports subject to taxation.

Table 2.7: Countries that tax exports of select agricultural products, 1998-2008

Raw hides & skins	Coffee	Vegetable oils	Cocoa	Livestock
Argentina	Argentina	Argentina	Argentina	Argentina
Brazil	Cameroon	China	Benin	Belize
Burundi	Colombia	Gambia	Cameroon	Burkina Faso
Chad	Costa Rica	Indonesia	Côte d'Ivoire	Cambodia
Egypt	Côte d'Ivoire	Malaysia	Gambia	Central African R.
Gambia	Ecuador	Nepal	Ghana	Chad
India	Gambia	Niger	Niger	Gambia
Indonesia	Guatemala	Russia	Nigeria	Malaysia
Kenya	Guinea	Solomon Islands	Sierra Leone	Niger
Mongolia	Niger	Sri Lanka	Solomon Islands	St. Kitts & Nevis
Niger	Rwanda	Togo	Togo	Togo
Pakistan	Sierra Leone	Ukraine		
Paraguay	Togo			
Saudi Arabia	Uganda			
Sri Lanka				
Tanzania				
Thailand				
Togo				
Turkey				
Uganda				
Ukraine				
Uruguay				
Vietnam				

Note: This is not an exhaustive list.
Source: Author.

Although most countries apply flat-rate export taxes (either ad valorem or specific), some apply graduated or sliding-scale taxes that depend on prevailing world prices. Such taxes were first popularized after the Korean War. In simple graduated tax structures, the duty might be fixed at a bottom rate of *x* cents per kilogram plus *y* percent of the amount by which the price exceeds *z* cents per kilogram. More elaborate bracket or slab rates may be applied, by which successive price tiers are subject to increasing levels of taxation. Early examples of graduated duties included India's tax on tea exports, Costa Rica's tax on coffee exports, and Sri Lanka's tax on exports of coconuts and derived products. Sliding-scale export taxes are currently applied by Indonesia and Malaysia, and were applied until recently by Argentina and Vietnam.

In Malaysia, export duties are based on the cost-plus concept: duties are only imposed on the excess over a threshold price that reflects the cost of production. As prevailing prices increase, so do the tax rates. Vietnam's recently abolished export tax on rice also varied with prevailing prices: VND500,000 (US$30) per ton when prices were between US$600-$700 per ton; VND600,000 (US$35.89) per ton when prices were between US$700-$800 per ton, and as much as VND2.9 million (US$173) when prices were above US$1,300 per ton. Argentina's sliding-scale export taxes for soybeans, sunflower seeds, wheat and maize were applied from April to June 2008, when they reverted to the preexisting flat rate export taxes. Argentina's and Indonesia's sliding-scale taxes are analyzed in Sections 2.3 and 2.4, respectively.

Export tax levels not only vary significantly across countries and products, but also tend to be volatile over time. Taxation levels have higher during periods of high commodity prices (such as the Korean War commodity boom and the 2007-2008 world food price crisis) and following significant exchange rate devaluations (such as the ones experienced by Argentina in 1955, 1967 and 2002). Currently, some of the highest ad valorem export tax rates include Ukraine's tax on livestock (50 percent), Belarus' tax on wheat (40 percent), Kenya's tax on raw hides and skins (40 percent), and Argentina's taxes on soybeans (35 percent), sunflower seeds (32 percent), wheat (28 percent) and maize (25 percent). Some of the lowest current ad valorem rates are levied on coffee exports, including those applied by Guatemala (1 percent), Costa Rica (1.5 percent), Ecuador (2 percent) and Sierra Leone (2.5 percent).

2.2.3. Use of Export Tax Revenue

The revenue collected from the taxation of agricultural exports finds different uses across countries and commodities. It can be allocated to the general government budget or earmarked for specific ends that may or not be circumscribed to the taxed sectors.

In some countries, export tax revenue has been channeled to commodity institutes or marketing boards. This has included institutions in the following sectors and countries: cocoa in Ghana; cocoa and coffee in Cameroon and Côte d'Ivoire; coffee in Colombia, Costa Rica and Ecuador; meat and wool in Uruguay; rice in Guyana and Suriname; and coconuts in Sri Lanka. While some of these institutions have used export taxes to offer valuable services to producers, others have become bureaucratic cash-cows characterized by patronage and inefficiency. Colombia's National Federation of Coffee Growers, well known for its successful Juan Valdez branding campaign, has been among the most effective. This non-profit business association has used export tax revenue from the National Coffee Fund to finance agricultural extension services, research and development, promotion and advertising, and guaranteed purchasing of the producer's crop. On the other end of the spectrum are the African commodity boards, most of which are "weak institutions, almost invariably inefficient in their operations, usually politicized, and frequently ineffectual in achieving their objectives" (Rimmer, 1986). One example of a highly politicized institution with a bloated labor force is Ghana's Cocoa Marketing Board, which in the early 1980s had about 100,000 employees (Devarajan *et al.*, 1996).

In some countries and sectors, export tax revenues have been allocated to specific uses within the taxed sector, including the replanting of rubber trees in Malaysia and the financing of healthcare for tea workers in Sri Lanka. In other countries, revenues have been directed outside the taxed sectors. In Paraguay, the resources generated by the tax on soybeans exports from the 2003-2004 harvest were earmarked "for rural poverty eradication projects and the enhancement of family farm productivity, as well as for the financing of other social, environmental, health or education projects" (WTO, 2005a). In Benin, the proceeds from the tax of 0.85 percent on all exports are applied towards a general road works fund. In Argentina, the government announced in the midst of the 2008 general rural strikes that the additional revenue from increased export tax rates on cereals and soybeans were to be used to fund social programs, including increases in seniors' pensions and financial assistance to the poor. Nevertheless, substantial parts of the tax collections were ultimately used to cover subsidies to food and energy consumption.

Another application of export tax revenues is the payment of dues to international commodity organizations. Part of the revenues collected from Guinea's export tax on coffee are used to pay the country's contributions to the Inter-African Coffee Organization (IACO). Similarly, part of the revenues collected from Cameroon's export taxes on cocoa and coffee are used to pay dues to international organizations monitoring international agreements on cocoa and coffee, the International Coffee Organization (ICO) and International Cocoa Organization (ICCO). Finally, Chad applies a Community Preferential Tax (TPC) of 0.5 percent ad valorem on all exports on behalf the Central African Economic and Monetary Community (CAEMC).

2.2.4. *Smuggling*

Excessive taxation of exports creates incentives for smuggling when prevailing prices in neighboring countries are significantly higher than distorted domestic prices. This is especially true when: (i) the commodity has a high unit value; (ii) countries share long unpatrolled borders; (iii) customs administrations are inefficient or corrupt; and (iv) transportation and other logistics-related costs are low.

The Ghana-Côte d'Ivoire border has been particularly porous to contraband. According to the African Development Bank (2006), high export taxes in Côte d'Ivoire explain the smuggling of a large part of Ivorian production to neighboring Ghana, which gives planters higher prices. Smuggled Ivorian cocoa has been flowing into Ghana since at least 2003, when Ghanaian prices were roughly double those paid in Côte d'Ivoire. In 2004, widespread smuggling was estimated to be in the region of 100,000-120,000 tons. An additional 10,000-20,000 tons were also reported to have been smuggled out of Côte d'Ivoire into Liberia and Guinea. Total cocoa smuggling out of Côte d'Ivoire in 2004 was estimated at 9-10 percent of the domestic output. In 2008, cocoa and coffee contraband also intensified along Côte d'Ivoire's rebel-controlled northern borders. Exporters estimate that around 70,000-80,000 tons of cocoa were smuggled into Burkina Faso and Togo during the October-March main crop season (Aboa, 2008).

Contraband cocoa along the Ghana-Côte d'Ivoire border has not always flowed eastwards, from Côte d'Ivoire into Ghana. In 2001-2002, the low prices that the Ghana Cocoa Board (Cocobod) paid growers led to an increase in smuggling, with many farmers selling their beans to traders in Côte d'Ivoire, where prices were higher. Total cocoa smuggling out of Ghana in 2002 was estimated at 65,000 tons, or approximately 14 percent of total domestic output. To stem the tide of smuggling to Côte d'Ivoire, Ghana raised its farm gate price for cocoa bean in March 2002.

In response to better producer prices and a national pesticide spraying campaign, Ghanaian cocoa output increased from 340,000 tons in 2002 to 497,000 tons in 2003 and 737,000 tons in 2004. The increase price created incentives to production and led to outstanding output growth rates of 48 percent in 2003 and 46 percent in 2004. In 2008, cocoa smuggling was reported to occur from Ghana to Togo, where prices were 50 percent higher.

Export taxes have also created incentives for the smuggling of beans out of Chad (USITC, 2003), coffee out of the Central African Republic (George and Lizon, 2007) and Honduras (Luxner, 2001), rubber out of Cambodia (Far East and Australasia, 2002), and raw cashmere out of Mongolia (Songwe, 2003). Rubber contraband between Cambodia and Vietnam in the 1990s led Cambodia to drop is 10 percent export tax in 1997. In Mongolia, it has been estimated that about 560 tons of raw cashmere – 20 percent of domestic production – were smuggled across the Chinese border in 2001 as a result of the export tax and poor customs administration (Songwe, 2003). The share of smuggled raw cashmere in total production is estimated to have reached a high of 42 percent in 1998 and a low of 10 percent in 2000.

Finally, higher export taxes in Argentina in 2007-2008 have led to the development of small-scale smuggling along Argentina's borders with Bolivia, Paraguay and Uruguay. Bolivia's bans on exports of flours, vegetable oils and other food products have also bolstered small-scale smuggling along its border's with Chile and Peru.

2.3. Argentina

Export taxes on agricultural products were at the very center of the four-month conflict between the federal government and the farming sector in Argentina in 2008. President Cristina Fernández de Kirchner's March 2008 decision to replace the existing flat rate taxes on oilseed and cereal exports with a system of progressive levies met fierce resistance from agricultural organizations in the form of nationwide protests, lockouts, roadblocks and interruption of exports. The new sliding taxes immediately raised levies on exports of soybeans, the country's foremost crop, from 35 percent to over 44 percent, with higher taxation levels reached subsequently due to rising world prices. After much social unrest and political turmoil, the government abolished the progressive tax system on July 18 and reinstated the preexisting flat rate taxes on exports. In the meantime, the industrial and transportation sectors incurred losses estimated at US$4.2 billion and the president's approval rate dropped from 58 percent to 23 percent.

Despite their pivotal role in the 2008 nationwide protests, export taxes are far from being a novelty in Argentina. The country has a long history of taxing agricultural exports, either directly or through unfavorable foreign exchange regulations. This section analyzes Argentina's past and current experiences with agricultural export taxation. It provides an overview of the evolution of such taxes and examines their impact on the performance of the sector and the economy at large.

2.3.1. Evolution of Agricultural Export Taxation

Explicit taxes have been applied to Argentina's agricultural exports in roughly three main periods of its modern history: (i) from the mid-nineteenth century to 1905; (ii) from 1955 to 1991; and (iii) from 2002 to the present. In addition, implicit export taxes in the form of sector-specific discriminatory foreign exchange regulations and overvalued exchange rates were also a general rule from the 1930s onwards.

Export taxes were a key component of Argentina's fiscal and trade regimes in the second half of the nineteenth century. In contrast with the constitution of the United States of America, which expressly prohibited the taxation of exports, the 1853 Argentine constitution provided that central government expenditures were to be financed in part by export taxes. While the first constitutional reform of 1860 established that export taxes would be eliminated in 1866, the eruption of the Triple Alliance War (1864-1870) against Paraguay led the second constitutional reform of 1866 to indefinitely extend the central government's prerogative to tax exports. This language survives in the current version of the constitution, last reformed in 1994.

Export taxes were applied almost uninterruptedly between 1862 and 1905, with a single incidental interlude between 1888 and 1890. At the time, agriculture accounted for the vast majority of exports. Wool alone represented over 50 percent of national exports in 1880, followed by hides and skins, dry meats, and fats and tallow (Alemann, 1989). Export taxes were applied primarily for fiscal reasons. They were second only to import tariffs as a source of funds to the national treasury. Nonetheless, their share in total government revenue gradually declined from 29 percent in 1865 to 2.8 percent in 1887 (see Figure 2.4). Export taxes regained importance after Argentina's first great debt crisis in 1890, but were ultimately discarded in 1905.

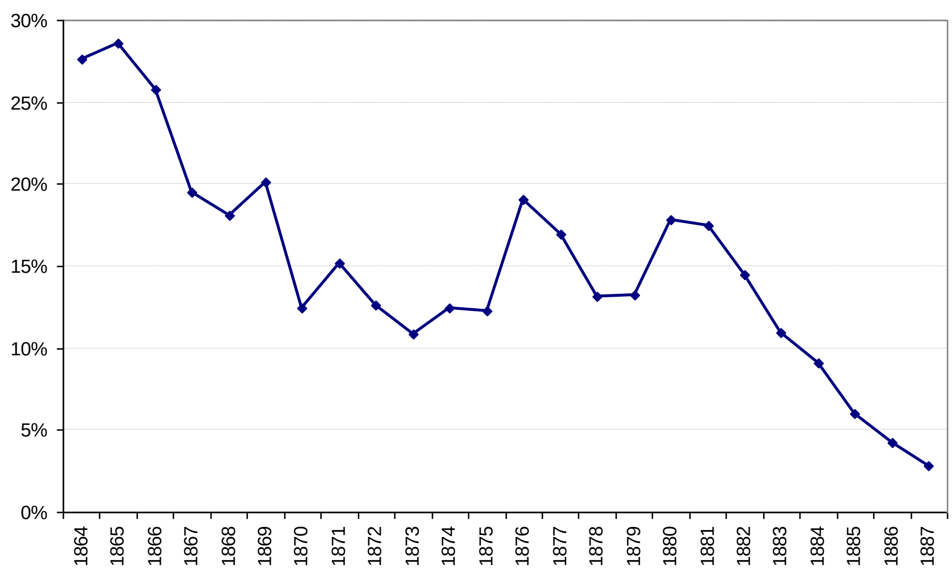

Figure 2.4: Export taxes as a share of central government revenue, Argentina, 1864-1887

Source: Cortés Conde (1989).

The apogee of Argentinean agricultural crops in the first decades of the twentieth century coincided with a break in export taxes, except for the period between 1918 and 1923. Despite the incidence of export taxes during significant parts of the nineteenth and early twentieth centuries, Argentina was tightly integrated into the world economy. The country exploited its competitive advantage in agriculture and commanded significant shares of world trade and finance. The period between 1860 and 1929 was characterized by rapid growth in agricultural production and exports, stimulated in part by the expansion of cultivated land, reductions in transportation costs for agricultural products, and large increases in international demand for the country's main commodities.

The Great Depression of the 1930s induced a substantial rupture with the agro-exporter model that had until then prevailed. Starting in 1929, the economy turned inward and became less and less integrated with world markets. The worsening of agriculture's external terms of trade and the increase in import tariffs on manufactured goods, along with a multiple exchange rate system that discriminated against exports, reduced the rural sector's internal advantage and improved the conditions for the growth of industrial production. While explicit exports taxes were not applied between 1930 and 1955, unfavorable exchange rate regimes constituted an implicit tax on agricultural exports

The average difference between the commercial and financial exchange rates was 15 percent in 1930-1945 and 55 percent in 1946-1960 (Figure 2.5). In addition, commercial exchange rates were at times further differentiated between export and import rates. Multiple exchange rate regimes were a *de facto* agricultural export tax since agriculture accounted for over 90 percent of total exports well into the 1960s (Figure 2.6).

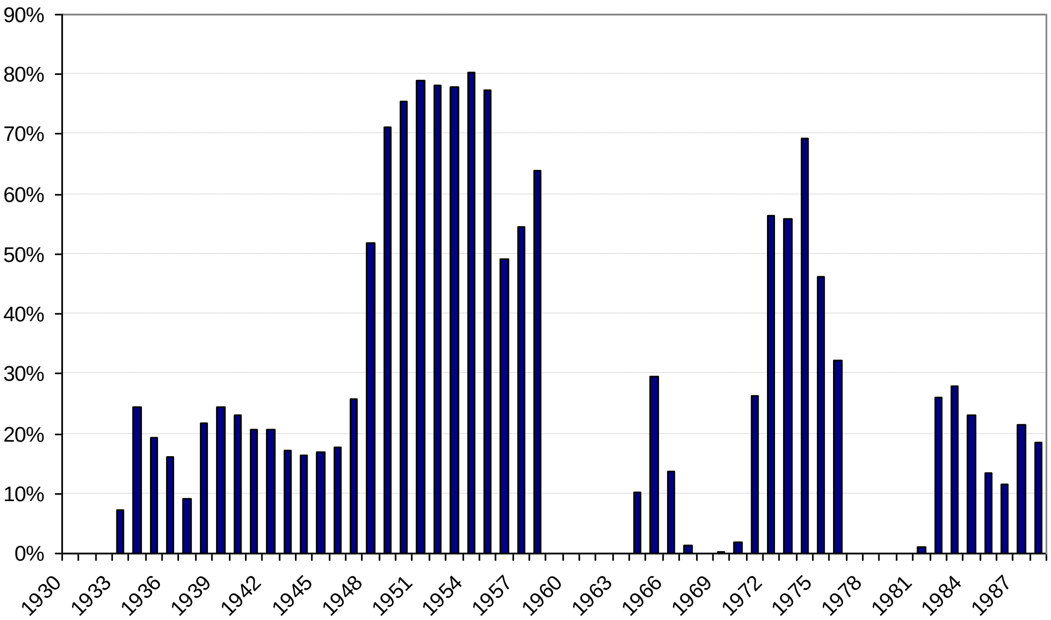

Figure 2.5: Difference between commercial and financial exchange rates, Argentina, 1930-1988

Note: A unified official exchange market has prevailed since 1990.
Source: Author. Based on Fundación Norte y Sur (2005).

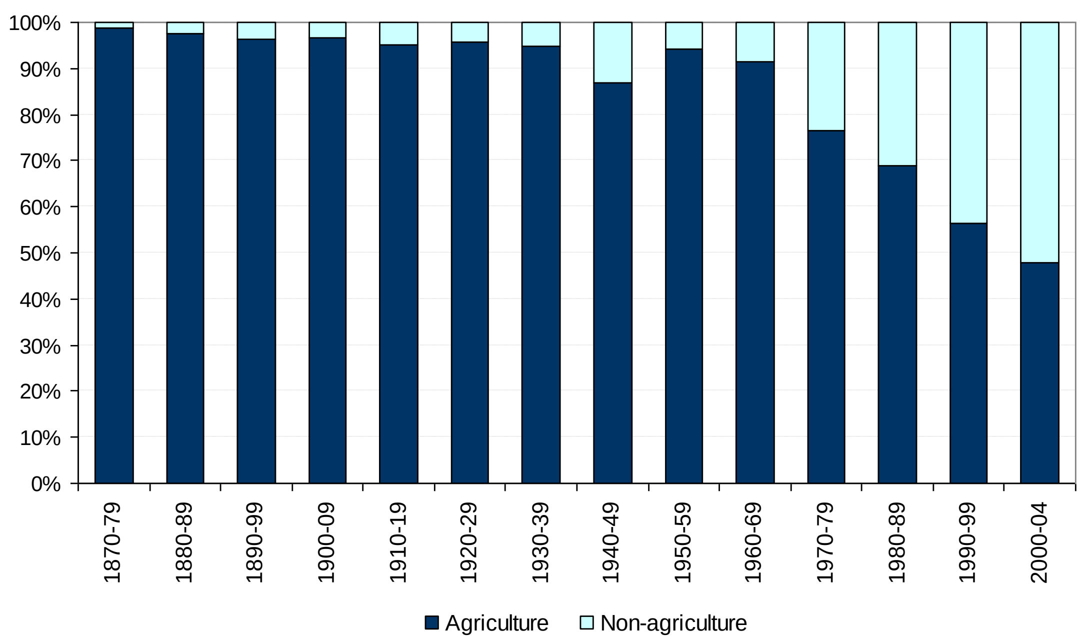

Figure 2.6: Sectoral composition of exports, ten-year averages, Argentina, 1871-2004

Source: Author. Based on Fundación Norte y Sur (2005) and World Bank Development Indicators.

Since the end of the Second World War, government interventions have led to substantial price discrimination against the country's main agricultural products (Sturzenegger, 1991). During the first (1946-1952) and second (1952-1955) administrations of Juan Domingo Perón, taxation of agricultural exports occurred implicitly via foreign exchange manipulations by the Argentine Institute for the Promotion of Exchanges (IAPI). As part of the import-substitution industrialization strategy, the IAPI absorbed a substantial portion of agricultural export revenues, which were redistributed by the state in the form of massive public works and subsidized credit to the industrial sector. While the IAPI at first benefited from the escalation in international grain demand and high prices in the aftermath of the war, it ultimately stifled production and exports and attracted stern opposition from the agricultural sector (Cufré, 2007).

The military *junta* that overthrew Perón abolished the IAPI and reinstituted explicit export taxes after a major devaluation of the peso in 1955. The taxes were designed to improve the government's fiscal position and to curtail spiraling domestic food prices. The same justification would later be given for the reintroduction of export taxes in other instances of devaluation, most notably in 1967 and 2002. After the 1955 *junta*, several military and civilian governments made recurrent use of export taxes. Export taxation was renewed or incremented in 1958, 1959, 1965, 1967, 1971, 1972, 1974 and 1975 (Rapoport, 2008; Economic Research Service, 1986). Several types of export taxes, including flat rate and progressive levies, were imposed at differing levels to an ever-increasing list of commodities. Following a strong improvement in international agricultural terms of trade in 1973 and 1974, taxation levels on agricultural exports were raised significantly during the third administration of Perón (1973-1974) and that of his wife Isabel Perón (1974-1976). From an *ad valorem* rate of 10 percent in 1965, export taxes on wheat and corn rose intermittently to 50 percent in 1975. Export taxes on soybeans were first instituted 1974 at 46 percent and reached 53 percent in 1975 (Economic Research Service, 1986). Multiple exchange rate regimes and official agricultural prices were also adopted. Furthermore, high import tariffs and quantitative restrictions pushed up the relative prices of importable products and caused a real appreciation of the currency, which resulted in additional discrimination against traditional agricultural exports (Sturzenegger, 1991).

Export taxes were virtually cut to zero in 1977 by Argentina's last military government, only to be revived in 1981 and boosted in 1982 during the Falklands/Malvinas War. Taxation of agricultural exports survived the transition to civilian rule in 1983 and was bolstered by President Raúl Alfonsín after devaluations in 1984 and 1985. Export taxes were mostly eliminated in 1991, as part of President Carlos Menem's neoliberal reforms.[28] The period between 1991 and 2001 constituted a rare exception in recent Argentine history to the general rule of discrimination against agricultural exports.

Export taxes were most recently reintroduced in April 2002, in the context of the greatest economic crisis in Argentina's history. The measure, which was supported by the International Monetary Fund (IMF), was aimed at financing the budget deficit and a new subsidies program for the unemployed. Almost all agricultural and non-agricultural products were subject to the new export tax. Nonetheless, tax rates on the main agricultural commodities were significantly higher than those for most nonagricultural products (see Subsection 2.3.2).

Export tax rates for certain agricultural products were increased in July 2005, November 2005, and November 2007. In addition, reimbursement of domestic taxes on agricultural exports was eliminated for most products in November 2005. Moreover, export bans for beef and wheat

[28] Export taxes remained for a limited number of products, including raw hides and skins and unprocessed oilseeds (soybeans, flaxseed, rapeseed, cottonseed and peanuts). The export tax on unprocessed oilseeds corresponded to 3.5 percent of the f.o.b. price. In 1998, the tax on raw hides and skins was 5 percent for intra-Mercosur exports and 10 percent for extra-Mercosur exports.

were also applied in 2006. With the goal of controlling inflation, the government also signed agreements with the dairy, beef, leather, poultry and vegetable oil sectors designed at reducing or stabilizing prices at the consumer level, for periods of generally 90 days.

In March 2008, the government instituted a new progressive export tax on oilseeds and grains. The level of taxation changed according to the prevailing world price. As a result, taxation levels for soybeans increased significantly. Due to the substantial social unrest and political turmoil, the government finally removed the progressive taxes and reinstituted the preexisting flat rate taxes on exports in July 2008.

2.3.2. Coverage, Structure and Level

Export taxes have been traditionally targeted at the most competitive agricultural products of the Pampas region, the fertile lowland plains that cover the provinces of Buenos Aires, Córdoba, Entre Ríos, La Pampa, Santa Fe and the southeast of San Luis. Until the 1970s, the key Pampean products were cereals (wheat, corn and sorghum) and livestock. In the 1970s, oilseeds (soybeans and sunflower seed) were added to the list of key commodities. Special products from other regions (tobacco and sugarcane from the Northwest; tea and mate from the Northeast; fruit from the Cuyo region) were generally spared from heavy export taxation. Between 1991 and 2001, taxes were applied only to exports of unprocessed oilseeds and raw hides and skins. In 2002, export taxes were reinstated for all products, agricultural or otherwise, albeit at different levels

In terms of their structure, export taxes in Argentina have been applied in general through flat duty rates on freight on board (FOB) export values. Nonetheless, at times the government has imposed progressive tax systems, in which export tax rates increased with the prevailing world price. This occurred, for example, in 1972, when floating export taxes were limited by a ceiling of 15 percent of the export value, and between March and July 2008, when progressive export taxes could reach over 50 percent of external reference prices.

Export tax levels can be quantified either explicitly or implicitly. The explicit export tax level corresponds to the official export duty rate. It may be obtained directly from laws or regulations, or can be calculated as the ratio of fiscal revenue from exports over the value of exports. The Nominal Protection Rate (NPR) is often used as an implicit measure of the export taxation level. It corresponds to the ratio of the prevailing domestic price relative to the appropriate adjusted border price in the absence of intervention. A negative NPR signals that exports are being taxed; a positive NPR, that they are being subsidized. While export taxes have generally explained most of the observed price wedge in Argentina, domestic market structures may also influence the results. Therefore, since not all of the price wedge observed is necessarily due to export taxes, the NPR may overestimate the actual level of export taxation.

Export tax levels in Argentina have varied significantly across products and over time. Mundlak, Cavallo and Domenech (1989) find that the aggregate explicit export tax was either null or corresponded to less than 2.5 percent of the value of total exports between 1915 and 1955 (Figure 2.7). Taxation was higher and more volatile in 1955-1984, ranging from 2.5 to 15 percent of the value of total exports. Explicit export taxes on individual Pampean products were generally much higher, at times upwards of 50 percent.

Sturzenegger, Otrera and Mosquera (1990) find that the aggregate explicit export tax on agriculture and agro-industry fluctuated between an average of 8 percent in 1976-1980 and an average of 18 percent in 1971-1975 (Table 2.8). The highest annual aggregate export tax level on agriculture occurred in 1973: 23 percent of the aggregate export value (Sturzenegger, 1991). They also found that agriculture and agro-industry were further taxed through high import tariffs on the manufacturing sector unrelated to agriculture. As a result, the anti-export bias (ATB) in Argentina reached approximately 55 percent in 1961-1980 and 45 percent in 1981-1985.

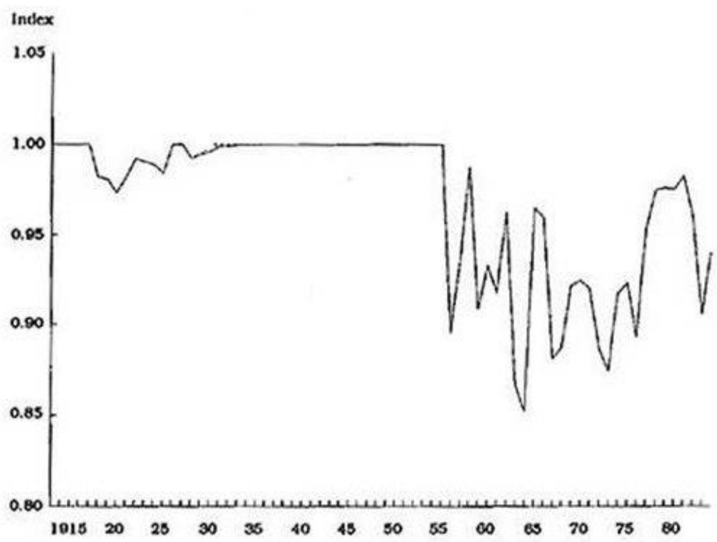

Figure 2.7: Aggregate explicit export taxation levels, Argentina, 1913-1984

Note: Line represents $(1 - t_x)$, where t_x is the proportion of taxes collected on exports over the value of exports.
Source: Mundlak, Cavallo and Domenech (1989).

Table 2.8: Aggregate explicit export tax on agriculture, implicit import tariff on manufactures and anti-trade bias, Argentina, 1961-1985

Period	t_X	t_M	Anti-trade bias
1961-1965	12%	60%	56%
1966-1970	13%	61%	55%
1971-1975	18%	51%	55%
1976-1980	8%	64%	56%
1981-1985	13%	95%	45%

Notes: t_X: export tax on agriculture; t_M: import tariff on non-agriculture.
Source: Sturzenegger, Otrera and Mosquera (1990).

Taxation levels are substantially higher for key agricultural commodities. Sturzenegger *et al.* (1990) estimate NPRs for six key exportables (wheat, corn, sorghum, soybeans, sunflower seeds and beef) in 1960-1985. These products were discriminated against through both export taxes and an overvalued exchange rate. Tables 2.9 and 2.10 summarize direct nominal protection rates (NPR_D) and total nominal protection rates (NPR_T), respectively. While the NPR_D reflects the impact of direct interventions in the form of taxes on agricultural exports, the NPR_T also incorporates indirect effects through exchange rate overvaluation and artificially high nonagricultural prices.

Table 2.9: Direct nominal protection rates (NPR_D), Argentina, 1961-1985 (percent)

Period	Wheat	Corn	Sorghum	Soybeans*	Sunflower seeds*	Beef
1961-1965	-15.8	-4.3	-12.6	-	-	-31.8
1966-1970	-15.2	-12.1	-19.3	-	-	-24.4
1971-1975	-45.8	-28.8	-29.5	-	-	-23.9
1976-1980	-19.0	-18.9	-14.4	-12.5	-25.6	-2.7
1981-1985	-20.2	-21.5	-25.4	-22.3	-24.5	-22.5

* The year of 1976 is not included in the 1976-1980 averages for soybeans and sunflower seeds.
Source: Sturzenegger *et al.* (1990).

Table 2.10: Total nominal protection rates (NPR_T), Argentina, 1961-1985 (percent)

Period	Wheat	Corn	Sorghum	Soybeans*	Sunflower seeds*	Beef
1961-1965	-35.0	-26.3	-33.5	-	-	-46.7
1966-1970	-35.7	-36.5	-41.7	-	-	-44.3
1971-1975	-51.7	-35.7	-36.5	-	-	-31.8
1976-1980	-39.4	-42.3	-39.6	-39.1	-47.6	-25.5
1981-1985	-47.7	-48.4	-51.4	-48.0	-49.7	-47.1

* The year of 1976 is not included in the 1976-1980 averages for soybeans and sunflower seeds.
Source: Sturzenegger *et al.* (1990).

Direct nominal (dis)protection on the six key commodities was generally higher than the average explicit export tax on agriculture and agro-industry. While the latter was 18 percent in 1971-1975, direct taxes on wheat, sorghum, corn and beef were respectively 46 percent, 30 percent, 29 percent and 24 percent in the same period. By and large, agricultural export taxes were high when the prevailing real rate of exchange or the international prices of the six products were high. Therefore, variations in direct nominal protection tended to compensate for variations in the real exchange rate or international prices. Short-run (annual) variations in export taxes in 1960-1985 are given by the coefficients of variation of 0.31 for wheat, 0.25 for corn, and 0.20 for both sorghum and beef. Significant negative long-run trends are observed for corn (-1.8 percent per annum), wheat (-1.4 percent per annum), and sorghum (-1.2 percent per annum), while no particular trend is identified for beef (Sturzenegger, 1991).

When indirect effects are considered, taxation of agricultural exports increases significantly to about 40 to 50 percent on average in 1960-1985. These results coincide with Cavallo's (1985) estimate of an average annual rate of export taxation of approximately 44 percent in 1960-1983. While export taxes substantially reduced producer prices for each of the six commodities, industrial protection policies and the overvaluation of the real exchange rate taxed agriculture even more than direct interventions. Due to the negative correlation between direct and indirect protection, the NPR_T exhibits less volatility than the NPR_D. Nonetheless, a general pattern of increased taxation is observed for grains and a decreasing pattern for beef (until 1976-1980). By 1981-1985, total nominal taxation for each of the six agricultural commodities was either close to or above 50 percent.

Valdés and Schaeffer (1995) computed NPRs for the 1986-1993 period. They find that implicit export taxation reaches a peak in 1989-1990 (66 percent for soybeans, 56 percent for sunflower seeds), declines substantially in 1991-1992, and becomes negative for some products in 1993 (Table 2.11). Since the computed NPRs are almost identical to the explicit export taxes (Table 2.12), Valdés and Schaeffer conclude that other factors, such as market structure, do not contribute significantly to the wedge between domestic and border prices.

Table 2.11: Nominal protection rate (NPR), key agricultural products, Argentina, 1986-1993 (percent)

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Beef	-4.6	-7.5	-7.5	-6.3	-21.7	-18.7	-4.5	-1.5	3.5
Cotton	-6.9	-2.8	0.0	0.0	-20.6	-19.0	-4.0	0.0	0.0
Corn	-35.0	-31.0	-23.1	-2.2	-30.3	-30.2	-6.5	-2.1	3.5
Sorghum	-37.4	-33.5	-25.7	-2.8	-31.0	-24.1	-8.6	-2.5	4.5
Soybeans	-36.3	-32.6	-18.6	-17.6	-38.3	-36.1	-12.4	-8.6	-3.8
Sunflower seed	-37.3	-30.6	-19.6	-14.0	-38.6	-38.5	-13.3	-9.4	-4.3
Wheat	-24.2	-20.9	-8.0	-1.8	-26.0	-30.0	-6.3	-1.9	3.2
Weighted average	-19.5	-15.3	-10.5	-8.2	-25.0	-25.3	-7.2	-3.4	1.4

Source: Valdés and Schaeffer (1995).

Table 2.12: Nominal protection rate (NPR) and explicit export taxes/subsidies, key agricultural products, Argentina, 1992 and 1993 (percent)

Product	1992		1993	
	NPR	Export Tax	NPR	Export Tax
Beef	-1.5	1.5	3.5	-3.5
Cotton	0.0	0.0	0.0	0.0
Corn	-2.1	1.5	3.5	-2.5
Sorghum	-2.5	1.5	4.5	-2.5
Soybeans	-8.6	7.5	-3.8	3.5
Sunflower seed	-9.4	7.5	-4.3	3.5
Wheat	-1.9	1.5	3.2	-2.5

Source: Valdés and Schaeffer (1995).

Sturzenegger and Salazni (2008) compute the Nominal Rate of Assistance (NRA) for farmers in the 1960-2005 period. Since their measure includes an adjustment for direct interventions on inputs, it is closer to effective assistance measures. The authors conclude that the economy's most efficient and competitive tradable sectors were strongly discouraged through direct export taxation. Included in their estimates are " the support provided to grain input use, although it adds very little because the gain from seed input assistance was largely offset by taxation via higher-than-free-market prices for fertilizers and pesticides." The long-run trend shows a reduction in the aggregate (simple average) NRA at the farm level until 2001, followed by a significant increase well into 2005. In the short- or medium-run, the NRAs were more volatile, which was due especially to fluctuations in the real exchange rate. Figure 2.8 depicts the NRA at the farm level and trend using the Hodrick-Prescott filer.

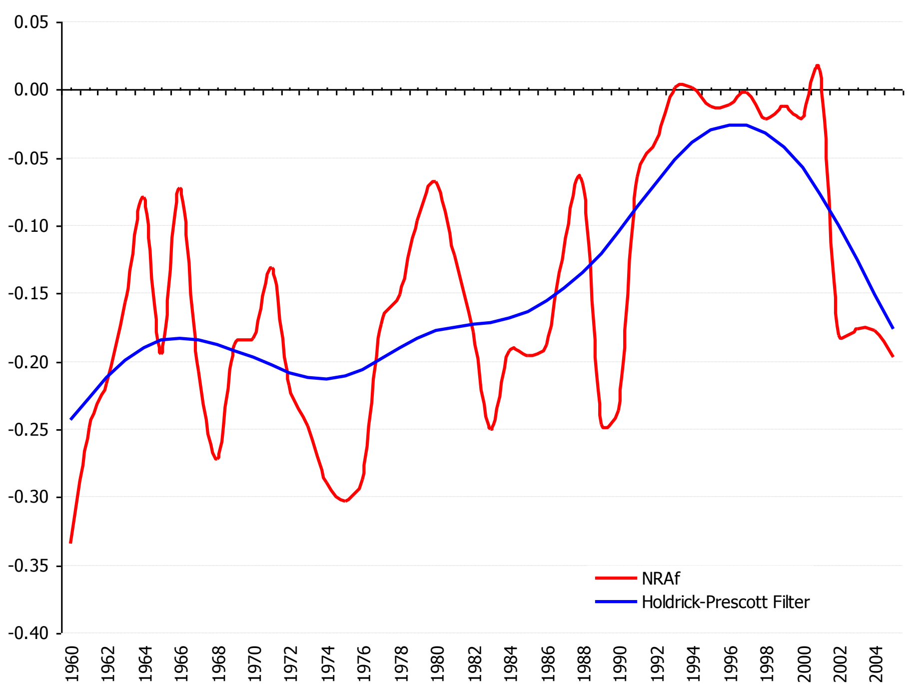

Figure 2.8: NRA at the farm level and trend using the Hodrick-Prescott filter, Argentina, 1960-2005

Source: Sturzenegger and Salazni (2008).

Table 2.13 summarizes explicit export tax rates on both agricultural and non-agricultural products as of August 2008. There were fifteen duty rates, ranging from zero to 45 percent of the

FOB value. The highest rates are for petroleum products and metal waste and scraps, followed by oilseeds and their products, cereals and their products, and beef and raw hides and skins.

Table 2.13: Explicit export tax rates, Argentina, August 2008

RATE	PRODUCTS AFFECTED
0%	Works of art
5%	All other products not specified elsewhere in this table, including: Meat other than beef; Some types of fish; Dairy products; Eggs; Some types of beans; Oranges, mandarins, grapefruit, limes and lemons; Dried grapes; Processed fruit; Roasted Coffee; Tea, mate and spices; Brown and milled rice; Rolled or flaked grains; Safflower; Lac, guns and resins; Peanut, olive, palm, coconut, rapeseed, colza, mustard, castor and sesame oil; Glycerol; Beeswax; Fruit and vegetable preparations; Beverages, spirits and vinegar; Cigars and cigarettes; Some types of wood; Most manufactured products
10%	Live animals; Some types of fish; Honey; Feathers for stuffing; Unworked corals; Live plants, bulbs, roots, cut flowers and ornamental foliage; Some types of beans (lima beans, cowpeas, kidney beans, red beans, pinto beans); Nuts; Most types of fresh fruit (bananas, plantains, dates, figs, pineapples, avocados, guavas, mangoes, mangosteens, grapes, melons, apples, pears, quinces, apricots, cherries, peaches, nectarines, plums, sloes, berries, kiwifruit); Unroasted coffee; Paddy and broken rice; Grain sorghum; Buckwheat, millet, canary seed and wild rice; Malt; Shelled peanuts in packages; Rapeseed; Sunflower seeds in packages; Mustard seed; Palm kernels and nuts; Hop cones; Hay, alfalfa, clover and other fodder; Unmanufactured tobacco; Not humid raw hides and skins; Some types of wood; Silkworm cocoons; Unprocessed wool, cotton, true hemp and jute; Salt; sulfur; earths and stone; plastering materials and cement; Most ores; Natural rubber
13.5%	Cotton seed
15%	Beef; Preparations and preserves of bovine meat; Humid raw hides and skins; Tanned or crust hides and skins
18%	Wheat flour; Mixes and dough for preparations of bakers' wares
20%	Rye; Barley; Oats; Cereal flours other than of wheat; Cereal groats, meal and pellets; Germ of cereals; Potato flour; Meals and flours of oilseeds other than soybeans; Safflower, cotton seed, linseed and corn oil; Margarine; Vegetable waxes; Recovered (waste and scrap) paper and paperboard
23.5%	Unshelled peanuts; Shelled peanuts in bulk; Flaxseed
25%	Corn
28%	Wheat
30%	Sunflower oil; Sunflower oilcake
32%	Sunflower seeds in bulk; Soybean meal, flour and oilcake; Soybean oil; Mixtures containing soybean oil
35%	Soybeans
40% (*)	Ferrous waste and scrap; Remelting scrap ingots of iron or steel; Waste and scrap of tin, tantalum, bismuth, beryllium, chromium, thallium, hafnium, niobium and germanium
45% (*)	Petroleum oils; Petroleum gases and other gaseous hydrocarbons; Petroleum jelly, paraffin wax and other mineral waxes

(*) Minimum export tax rate. Actual rate varies according to external reference price and may reach 100 percent.
Source: Author.

Figure 2.9 provides monthly explicit export tax levels for three products in unprocessed soybeans, soybean meal and soybean oil in the period between January 1987 and August 2008. Export taxes on unprocessed soybeans reached peaks of over 40 percent in both 1989-1990 and 2008, and were at their lowest (3.5 percent) in 1991-2001. Export taxes on soybean meal and oil were consistently lower than the tax on the raw material. This differential export taxes system has the goal of encouraging exports of products with higher value-added. The negative taxes on soybean meal and oil in 1991-2001 imply that exports of these products were in fact subsidized in this period.

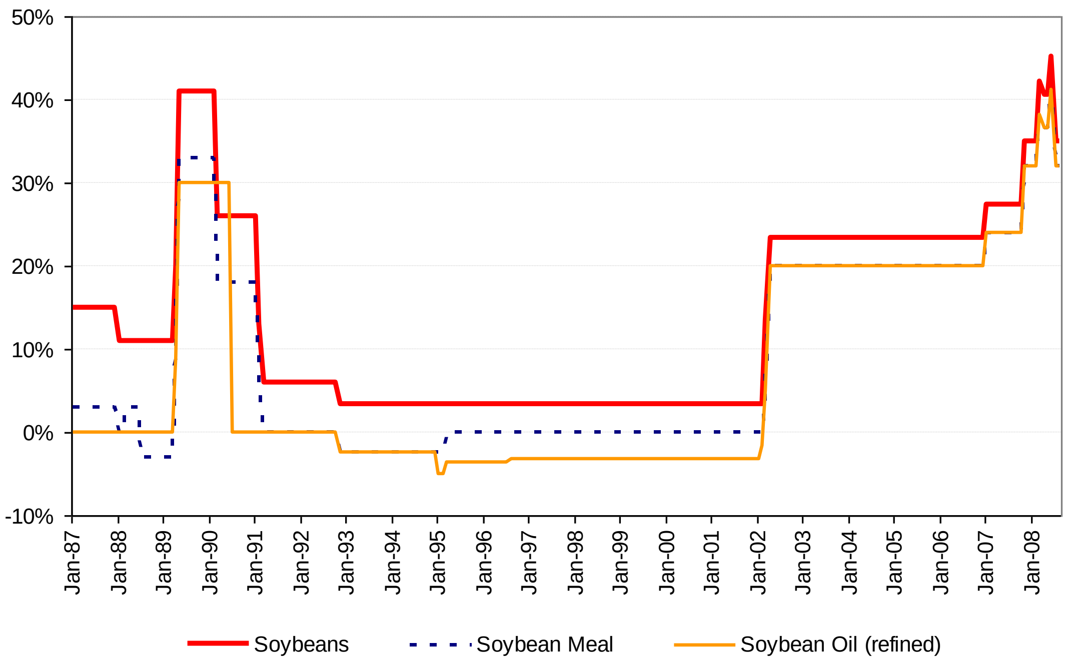

Figure 2.9: Monthly explicit export taxes, soybean complex, Argentina, Jan. 1987 to Aug. 2008

Source: Author. Based on data from the Cámara de la Industria Aceitera de la República Argentina (CIARA).

2.3.3. Economic Impacts

Mundlak *et al.* (1989) argue that Argentina could have attained a growth trajectory in 1930-1985 similar to that of Australia or Canada had it followed policies that allowed producers to fully benefit from the country's comparative advantage in agriculture. Instead, the country heavily taxed agriculture, either directly through export taxes or indirectly through the protection of nonagriculture and the overvaluation of the exchange rate. The outcome is now well known: Argentina's remarkable growth in the late nineteenth century and early twentieth century was followed by dismal economic performance between 1930 and 1990. This section analyzes the influence of export taxes on the performance of the agricultural sector and the economy at large.

In the 1950s and 1960s, Argentine policymakers believed that agricultural output did not respond significantly to price changes. They argued that taxing agriculture to promote import-substitution industrialization would not result in big losses in farm output (World Bank, 1986). Nevertheless, they were ultimately proved wrong, as several studies have shown that agricultural supply response is strong in Argentina (Reca, 1974; Gluck, 1979; Ferrer, 1980; Cavallo, 1985; Sturzenegger *et al.*, 1990; Herrou 2001).

Sturzenegger *et al.* (1990) report that Argentina's agricultural output was adversely affected by export taxes in 1960-1985. They use comparative-dynamics analysis to simulate what would have happened to agricultural output in the absence of export taxes. They find moderate short-run effects and substantial cumulative effects. Once long-run effects are taken into account, the removal of export taxes increases output on average by 49 percent for sunflower seeds, 31 percent for wheat, 26 percent for beef, 24.5 percent for sorghum, 13 percent for corn, and 9.5 percent for soybeans.

In a study of supply response in Argentina between 1916 and 1984, Mundlak *et al.* (1989) find that it takes time for agriculture to respond in full to price changes. In three years, output increases by 30 percent of the price change; in 15 years, by 70 percent; and in 20 years, by 99 percent. The response results mainly from capital accumulation and from an increase in productivity. The same study finds that sectoral prices affect productivity of resources: "[t]he scope of producers' decisions is not limited to properly locating themselves on a given production function, but it is much broader in scope in that it also requires a decision on what production functions or techniques producers should employ." The study indicates that because of a lack of incentives, Argentine farmers failed to implement new technology, which caused it to fall behind countries such as the United States.

Figure 2.10 compares crop yields in Argentina and the United States between 1913 and 1984. Until the 1930s, crop yields in the two countries were at similar levels, and usually higher in Argentina. Nevertheless, yields in Argentina were consistently and increasingly below U.S. levels after the 1930s. While Argentina's Divisia yield index for 14 crops was one-third higher than that of the United States in 1935, it was 15 percent lower by 1945. The difference between the Argentine and the U.S. indices increased to 40 percent in 1945 and 60 percent in 1980. While several factors may explain this relative loss of productivity, agricultural export taxes can be listed as one of them.

A detailed depiction of annual yields for six key agricultural products in Argentina and the United States in 1961-2007 is provided in Figure 2.11. Argentina's cereal yields were significantly below those of the United States in 1961-1991: maize, sorghum and wheat yields corresponded on average to 47 percent, 70 percent and 76 percent of the respective yields in the United States. Substantial relative improvements occurred since the 1990s, such that maize, sorghum and wheat yields in 2000-2007 corresponded on average to 70 percent, 130 percent and 90 percent of the respective yields in the United States. For soybeans and sunflower seeds, Argentine yields have been close to or higher than United States yields since the 1980s. Such improvements in Argentina's crop yields seem to reflect movements in relative incentives for agriculture since the 1960s. Anderson and Valdés (2008) identify a steady improvement in the relative rate of assistance (RRA) to agriculture from -49 percent in 1965-1969 to -13 percent in 1995-1999, followed by a decline to -20 percent in 2000-2004. Table 2.14 shows a strong positive correlation between crop yields and the aggregate RRA to agriculture between 1961 and 2007. This relationship exists for yields measured in absolute terms (column A1), as well as for yields as a share of prevailing yields in the United States (column B1). Nonetheless, the correlation between improved yields and reduced disprotection is substantially weaker when product-specific nominal rates of assistance (NRA) are considered (columns A2 and B2).

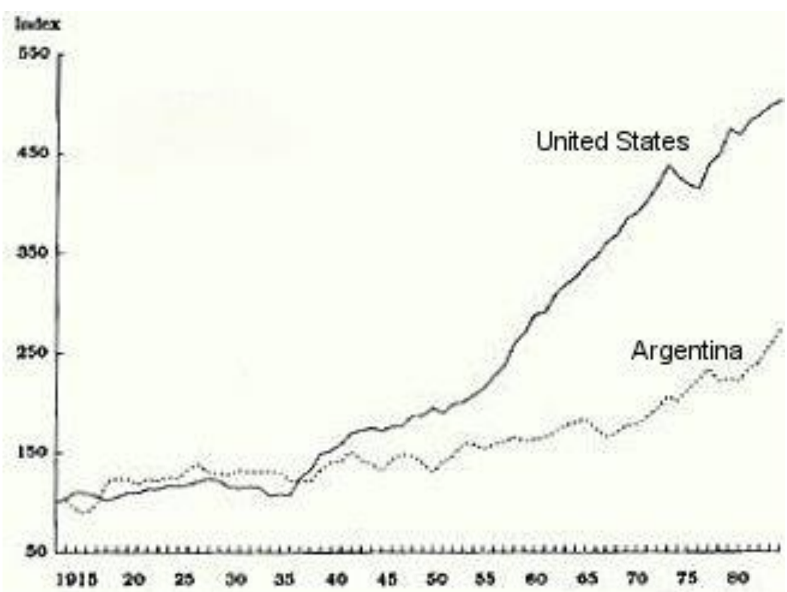

Figure 2.10: Crop yields, Argentina and the United States, 1913-1984

Note:This figure is based on a Divisia index of yields for 14 crops in Argentina and the United States (1913 = 100).
Source:Mundlak, Cavallo and Domenech (1989).

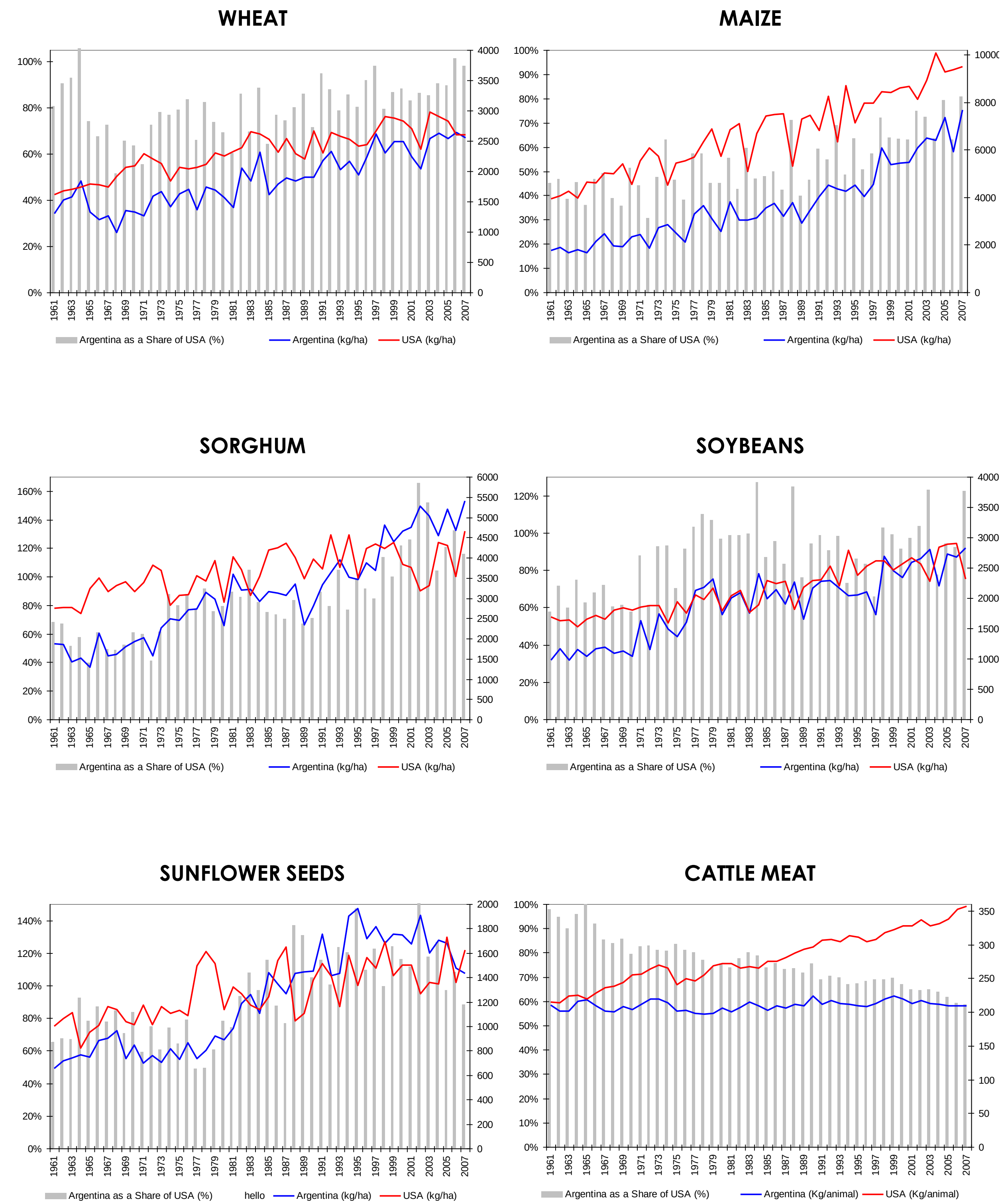

Figure 2.11: Annual yields for six key agricultural products, Argentina and the US, 1961-2007

Note: Right axes indicate yield in kg per hectare, except for cattle meat, which is in kg per animal.
Source: Author. Based on FAO (2010).

Table 2.14: Coefficient of correlation between yields and rates of assistance, Argentina, 1961-2004

Product	Correlation with yields		Correlation with share of US yields	
	(A1) Aggregate RRA	(A2) Product-specific NRA	(B1) Aggregate RRA	(B2) Product-specific NRA
Wheat	0.96	0.85	0.97	0.88
Maize	0.87	0.34	0.86	0.31
Sorghum	0.88	n.a.	0.74	n.a.
Soybeans	0.75	-0.01	0.59	-0.39
Sunflower seed	0.93	0.23	0.82	0.18
Cattle meat	0.49	0.58	-0.94	-0.95

Notes: RRA: Aggregate relative rate of assistance to agriculture.
NRA: Product-specific nominal rate of assistance.
Source: Author. Based on Anderson and Valdés (2008) and Sturzenegger and Salazni (2008).

Argentina's lack of investment in the agricultural sector is reflected in its poor performance in agricultural input use. The country's agricultural tractor fleet expanded at a very slow pace between 1961 and 2003. The number of tractors in use remained nearly unchanged during the 1970s, which implies that investment in new tractors was not beyond the depreciation rate. After a short-lived expansion in 1981, the number of tractors in use declined for five consecutive years. Following moderate growth in 1986-1988, Argentina's tractor fleet increased at an annual average rate of less than 1 percent in 1989-2003.

The rate of adoption of agricultural tractors in Argentina in the second half of the twentieth century was particularly slow when compared to the rest of Latin America. Although it had by far the largest the region in the early 1960s, it fell behind its regional counterparts in the following three decades. In 1961, the Argentinean tractor fleet was 70 percent larger than the Brazilian fleet and 120 percent larger than the Mexican fleet. At the time, the three countries had comparable amounts of arable land (22-26 million hectares in 1960-1964). By 1991, the number of tractors in use in Argentina was 62 percent smaller than in Brazil and 13 percent smaller than in Mexico (Figure 2.12). While Argentina's loss of regional leadership partly reflects the rapid expansion of arable land in Brazil, it is largely explained by Brazil's and Mexico's higher density of tractors per hectare of arable land since the 1980s.

In terms of tractors per hectare of arable land, Argentina lags behind its competitors in both North and South America (Figure 2.13). In 2001-2003, Chile, Uruguay and the United States each had approximately 2.5 times more tractors per hectare of arable land than Argentina. Brazil, Mexico and Ecuador, all of which had only a fraction of Argentina's number of tractors per hectare of arable land in 1961-1963, experienced significant expansion in the subsequent decades. By 2001-2003, Brazil and Mexico had, respectively, 30 percent and 20 percent more tractors per hectare of arable land than Argentina. Ecuador, a country with a substantially lower level of socio-economic development, had the same number of tractors per hectare of arable land as Argentina in 2001-2003.

While agricultural export taxes may have contributed to Argentina's slow rate of adoption of tractors in 1961-1991, the elimination of such taxes in the 1990s did not coincide with a rapid expansion in the tractor fleet. Between 1991 and 2001, the number of tractors in use per 1,000 hectares in Argentina increased only slightly from 104 to 107. Moreover, the share of obsolete tractors (*i.e.*, machines in use for more than 15 years) increased from 55 percent in 1988 to 73 percent in 2002 (Dolcet and Leone, 2005).

In the three decades that preceded the elimination of Argentina's agricultural export taxes in 1991, the country had the lowest grain output growth rate among all countries in South America. While Argentina's average grain output increased by 45 percent between 1961-1965 and 1987-1991, Chile's and Peru's expanded by 90 percent, and Brazil's and Colombia's by over 150 percent

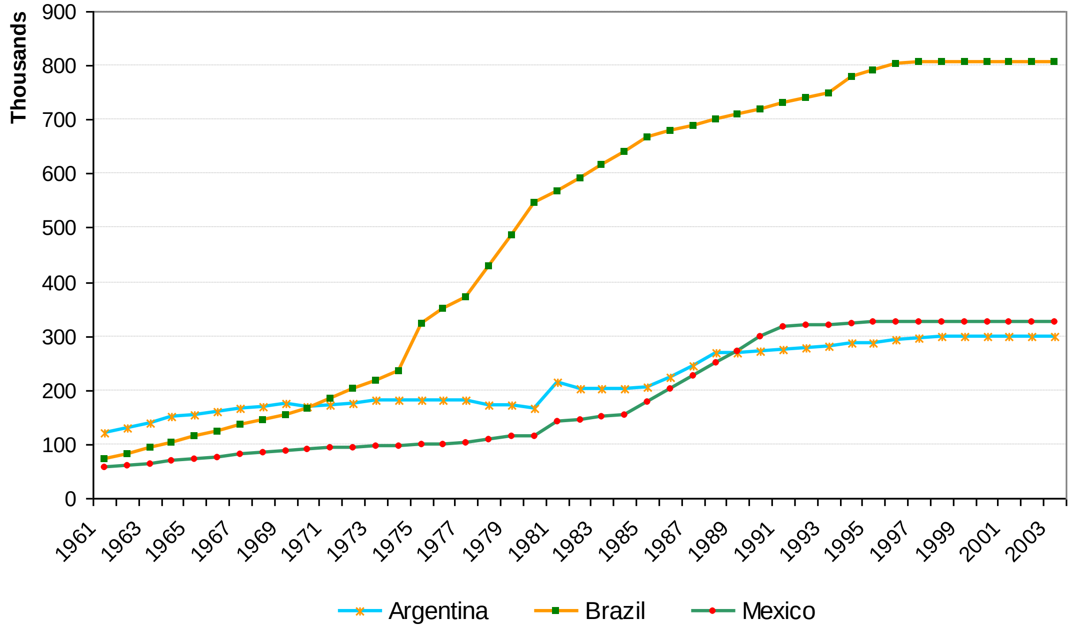

Figure 2.12: Number of agricultural tractors in use, Argentina, Brazil and Mexico, 1961-2003

Source: Author. Based on data from the World Bank's World Development Indicators.

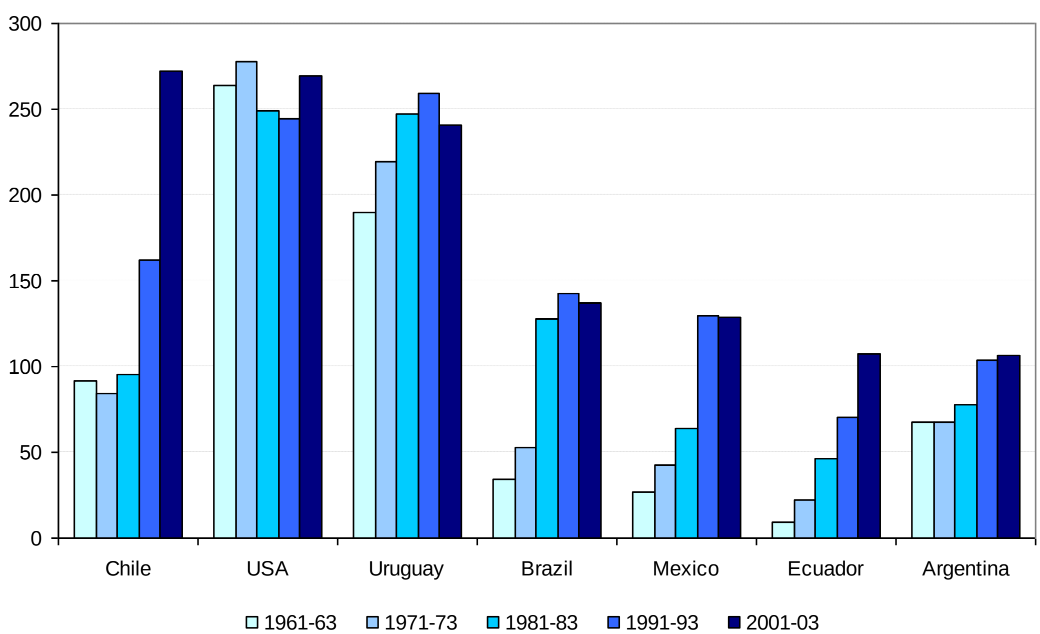

Figure 2.13: Number of tractors per 1000 hectares of arable land, select countries, 1961-1963 to 2001-2003

Source: Author. Based on data from the World Bank's World Development Indicators.

(Figure 2.14). Argentina's growth record in this period was also inferior to that of other key grain producers, including Australia, Canada, China, India, Mexico, South Africa and the United States. Argentina's grain output also grew at a slower rate than that of Sub-Saharan Africa.

Argentina also recorded the second lowest growth rate in cattle meat production among all South American countries in 1961-1991. While Argentina's average cattle meat output increased by 22 percent from 1961-1965 to 1987-1991, Chile's expanded by 45 percent, Peru's by 60 percent, Colombia's by 80 percent and Brazil's by almost 200 percent. As in the case of grains, Argentina's output growth in the cattle meat sector was inferior to that of key producers in other regions of the world, as well as to that of Sub-Saharan Africa (Figure 2.15).

Argentina's poor performance in terms of grain and cattle meat output growth coincides with high levels of taxation of agriculture in 1961-1991. While other South American countries also taxed agriculture, taxation levels were generally lower than in Argentina. Schiff and Valdés (1992) report the following NPR_D for agriculture in 1960-1984: 10.1 percent in Brazil, -1.2 percent in Chile, -4.8 percent in Colombia and -17.8 in Argentina. Valdés (1995) reports the following NPR for agriculture in 1985-1990: 22.1 in Chile, 8.9 in Colombia, 1.7 in Brazil, -5.4 in Uruguay, -13.5 in Paraguay, -17.2 in Ecuador and -17.3 in Argentina.

In the longer period between 1961-1965 and 2003-2007, Argentina comes in second to last among South American countries in terms of grain output growth and last in terms of cattle meat output growth (Figures 2.16 and 2.17).Argentina is also outperformed by other developing countries and regions, including China, Mexico, India and Sub-Saharan Africa. When compared to the developed world, Argentina's growth pattern in grains is superior to that of Western Europe, the United States and Canada, but inferior to that of Australia. In cattle meat, Argentina is outperformed by every developed country or region in the sample except Western Europe.

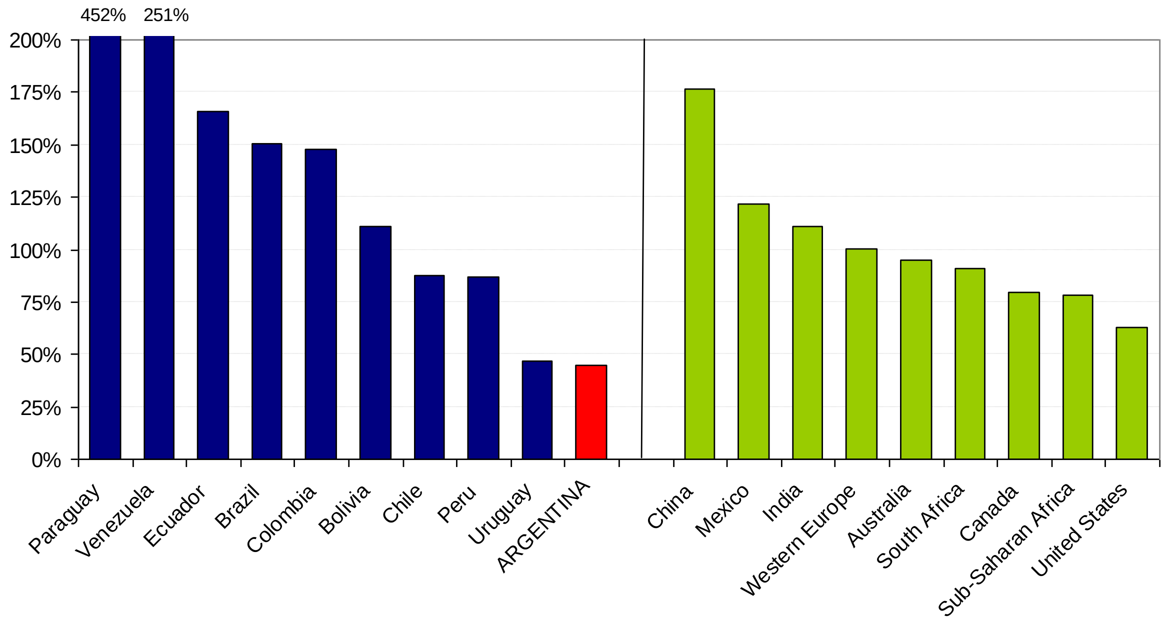

Figure 2.14: Growth in grain output in South America and select reference countries and regions, 1961-1965 to 1987-1991

Source: Author. Based on FAO (2010).

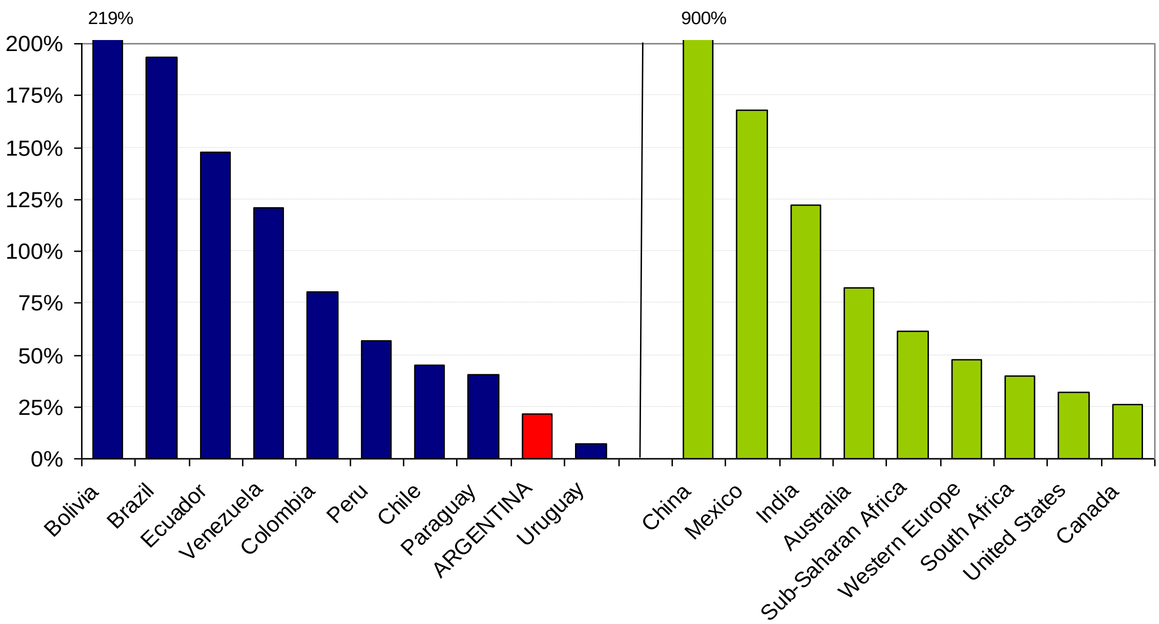

Figure 2.15: Growth in cattle meat output in South America and select reference countries and regions, 1961-1965 to 1987-1991

Source: Author. Based on FAO (2010).

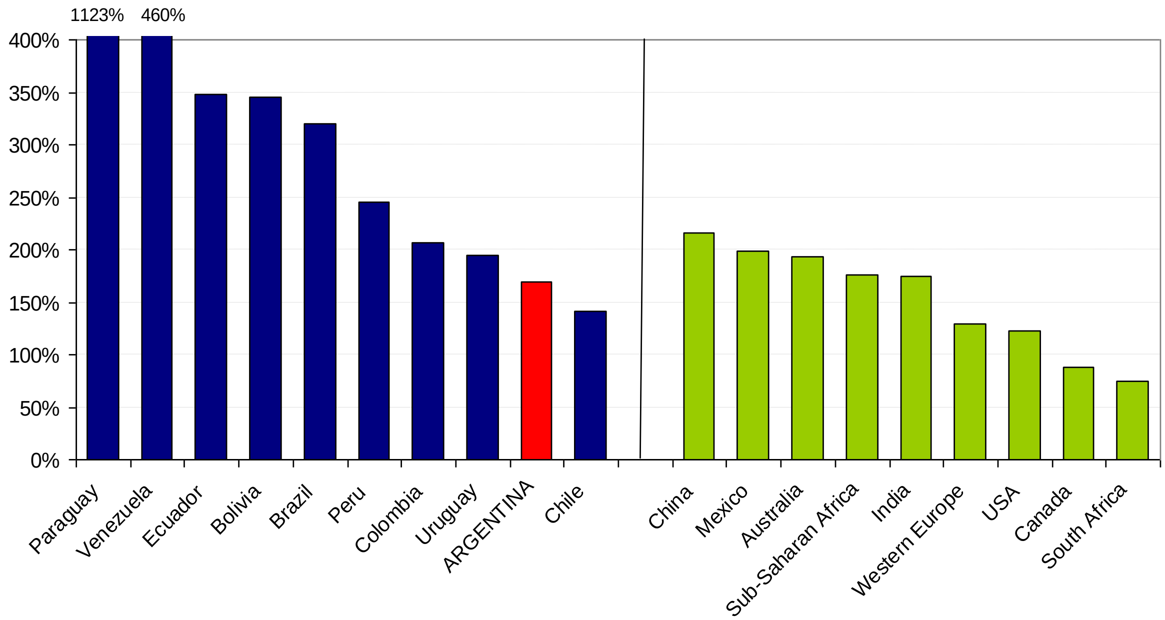

Figure 2.16: Growth in grain output in South America and select reference countries and regions, 1961-1965 to 2003-2007

Source: Author. Based on FAO (2010).

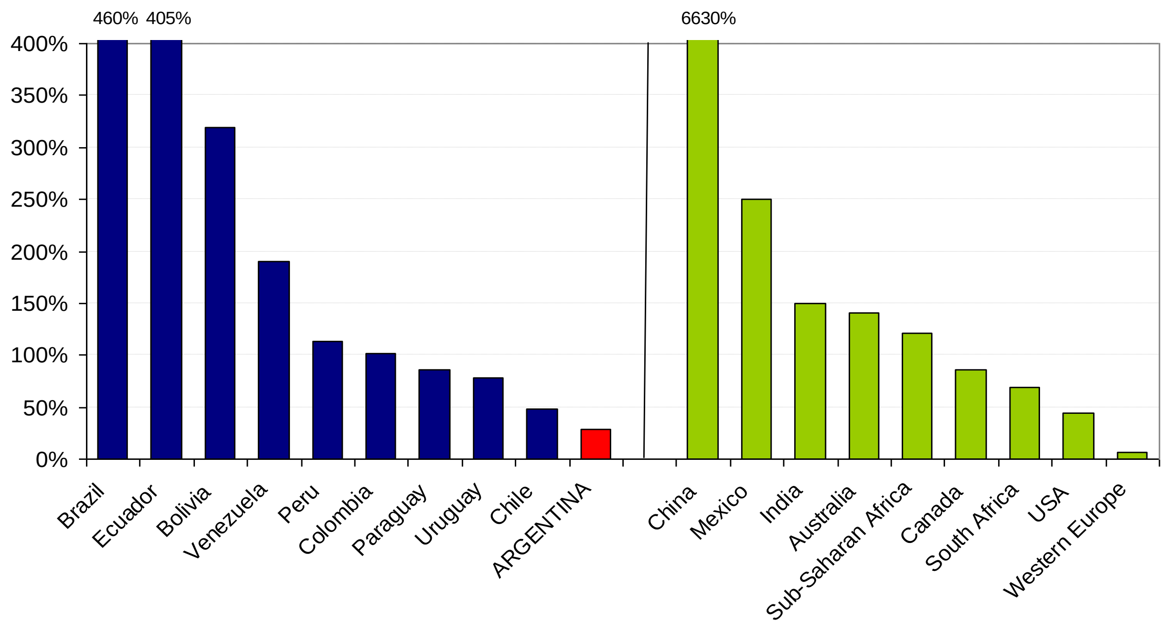

Figure 2.17: Growth in cattle meat output in South America and select reference countries and regions, 1961-1965 to 2003-2007

Source: Author. Based on FAO (2010).

Despite the imposition of taxes on agricultural exports in 2002-2008, Argentina's agricultural sector experienced remarkable growth in this period. This was a substantial departure from the several decades of relative slow growth prior to the 1990s. Nonetheless, most of this growth was linked to very favorable prices in the international market for some of Argentina's key commodities, soybeans in special. The margin for soybeans was so attractive, that soybeans remained profitable despite the incidence of export taxes. Since soybean margins were on average superior to that of other key grains (corn, wheat, sunflower seeds), soybean planted area and production increased substantially. In contrast, sectors like livestock and dairy became less profitable. Government intervention in the form of export bans and quotas on beef exacerbated problems in the sector and provided ranchers with additional reasons to switch into grains (see Subsection 2.2.1).

Increased investment and intensification of input use characterized the period between 2004 and 2006. Fertilizer use increased significantly, from 1.72 million tons in 1999-2000 to 2.57 million tons in 2004-2005. Nonetheless, the nutrient balance continued to be negative. The rate of reposition of nutrients extracted from the soil was below 25 percent, while the average application level per hectare was still below that of other countries. In 2005-2006, Cargill inaugurated a superphosphates plant in Puerto General San Martín, which was to generate investments of US$100 until 2010. Profertil, Bunge and Petrobras also announced significant investments in fertilizer plants.

Investment in agricultural machinery also increased. Sales reached US$940 million in 2004, compared to US$497 in 2000 and US$340 in 2002. In the case of harvesters, a growing trend in favor of equipment of larger size and more advanced technology was observed in 2004-2005. This was expected to result in greater efficiency and fewer losses during harvests. Other signs of increased agricultural input use included high growth rates in sales of herbicides, fungicides and insecticides, as well as of precision tools, especially yield monitors and satellite equipment.

Nevertheless, successive increases in export tax rates and the imposition of export bans, export quotas and price caps have led to the flight of capital away from Argentina's agricultural sector. A comparative study of Argentina and Uruguay found that government involvement represents a significant risk to FDI in beef systems in Argentina, but that this is much less of a problem in neighboring Uruguay, where government policy is designed to promote beef exports (Thor *et al.*, 2007). In 2008, tiny Uruguay was expected to export 50 percent more beef than Argentina (Wasilevsky, 2008).

In the soybean sector, Argentina became an important *source* of FDI. Increases in soybean export taxes in Argentina made Uruguay, Paraguay and Brazil more attractive to Argentine investment. Small and large Argentine agricultural groups have invested in the three neighboring countries, including Grobocapatel, MNU, Cresud and El Tejar. Uruguay's soybean planted area was estimated to expand by 25 percent in 2008-2009 due among other things to increased interest of Argentine producers in expanding production in the neighboring country (Wilder, 2008a). Whereas the domestic price producers receive for their product in Argentina is substantially below the world price, Uruguayan prices reflect international prices. Taxation of the soybean sector in Uruguay is 2.5 times lower than in Argentina. This differential spurred investment in Uruguay, with foreign investment in Uruguayan land multiplying 16-fold in 2001-2008. In 2008, more than half of Uruguay's soybean production was carried out by Argentines. Increasing interest in biofuels may lead to increased demand for soybean oil and cause Argentina to source soybeans from Uruguay to fulfill their crushing demands. In Paraguay, soybean planted area was expected to rise by more than 5 percent to 2.75 million hectares in 2008, due to high international prices and increased investment from abroad, particularly Argentina (Wilder, 2008b).

Despite other shortcomings, Argentina's differential export taxes in the soybean sector have succeeded in promoting a strong downstream processing industry. Such objective was so central for Argentinean policymakers that the export taxes on soybeans were one of a handful of export taxes that were not eliminated in the early 1990s. The country has become the world's number one exporter of soybean oil and oilcake, in part due to a wave of investments in the processing industry of over US$8 billion, directed at increasing processing capacity and improving port logistics. Investors have included Bunge (US$300 million), Cargill (US$160 million), AGD (US$139 million), Molinos Río de la Plata (US$80 million), Dreyfus (US$65 million), Vincentín (US$40 million), Noble (US$25 million), ACA (US$9 million) and AFA (US$8 million).

Two recent studies have estimated the socioeconomic effects of Argentina's post-2002 export taxes and have arrived at largely different results. Both Nogués *et al.* (2007)[29] and Cicowiez *et al.* (2008)[30] use a combination of general equilibrium models and micro-simulations to estimate the impact of the elimination of export taxes on GDP, employment, poverty, extreme poverty, inequality and government revenue. Results are compared below:

(i) <u>GDP</u>: Nogués *et al.* find that GDP *grows* by between 2.8 and 6 percent due to increased agricultural production and exports. In contrast, Cicowiez *et al.* find that GDP *falls* by between 0.9 and 1.7 percent due to the expansion of primary sectors that are less labor intensive and more outward oriented than other sectors, a fact that negatively affects domestic downstream industries.

[29] Nogués *et al.* (2007) use the World Bank's GTAP-Agr model and follow Anderson and Valenzuela (2007).
[30] Cicowiez *et al.* (2008) use a global economy-wide CGE model and a national CGE model. The CGE model follows Lofgren *et al.* (2002), McDonald (2005) and Lofgren and Díaz-Bonilla (2007).

(ii) Unemployment: Nogués *et al.* present data only for the primary and agro-industrial sectors, where skilled labor expends by 7.1 percent and unskilled labor and 6.5 percent. Cicowiez *et al.* finds that unemployment *increases* (from 12.3 percent to 13.4 - 14.7 percent) given that expanding sectors (cereals and oilseeds) are less labor intensive, even when compared to other agricultural sectors from which they would be capturing land (livestock, dairy and agro-industrial products).

(iii) Poverty Headcount: Nogués *et al.* find that the poverty headcount *increases* in the short run (from 24.6 percent to 27.2 percent), but *falls* in the medium run (to between 22.5 and 23.7 percent, depending on the wage-price elasticity). This is due to the interaction of two forces: a negative effect through the higher cost of the consumption basket, and a positive effect through higher wages. In the long run, the wage effect dominates the consumption basket effect. In contrast, Cicowiez *et al.* find that the poverty headcount necessarily *increases* from 34.21 percent to 36.12 – 36.96 percent. The authors do not use the same baseline.

(iv) Extreme Poverty Headcount: Nogués *et al.* find that the extreme poverty headcount *increases* in the short (from 7.3 percent to 9.1 percent), and either *remains unchanged* in the long run (when wage-price elasticity is unitary) or *increases* (to 7.8 percent, when wage-price elasticity is 0.7). Cicowiez *et al.* find that the extreme poverty headcount necessarily *increases* from 12.65 percent to 13.56 – 14.39 percent. The authors do not use the same baseline.

(v) Inequality: Cicowiez *et al.* find that the Gini coefficient *increases* slightly for household per capita income (from 0.499 to 0.500) and *remains unchanged* for labor income (0.472).

(vi) Government Revenue: Nogués *et al.* find that total government revenue falls by 2.2 billion pesos. The fall of 8.6 billion pesos in export tax revenue is mostly compensated by increases in revenue from taxes on profits, rural land taxes, and the elimination of consumption subsidies on exportable goods. The impact would be different across different levels of the government: the central government would lose almost 5 billion and the provinces would gain about 2.8 billion pesos in revenue.

2.3.4. Effectiveness in Meeting Policy Objectives

The Argentine government has sought to achieve four main objectives through the taxation of agricultural export: (i) collection of government revenue; (ii) income distribution; (iii) domestic price control; and (iv) protection of domestic industries. At different points in time, each of these objectives has had a greater or lesser weight.

The primary goal of export taxes in the nineteenth century and early decades of the twentieth century was to raise government revenue. Export and import taxes financed the bulk of government expenditures until more sophisticated forms of taxation were developed. During recurring instances of economic crisis, such as in 1981 and 2002, the collection of much needed government revenue was one of the main objectives for the reintroduction of export taxes. This objective has generally been met with success in the short run, especially during periods of high international commodity prices. Nonetheless, lower economic growth rates in the long run imply lower tax revenues. Moreover, due to fluctuations in export volumes and values, governments at times have had to raise the level of taxation significantly in order to collect the necessary revenue. This can be particularly strenuous when tax proceeds are used to finance recurring budget expenditures. Public spending has continued to climb, funneling cash out for subsidies, infrastructure projects and a 27 percent hike in the minimum wage. At the same time, government revenue was expected to fall due to the slowing economy and a decline in commodity prices. The cut in electricity subsidies in July 2008 was an initial attempt to curb public spending.

At the outset of major devaluations in 1955, 1967 and 2002, export taxes were seen as a tool to fight inflation. Their effectiveness in meeting this objective has been mixed. While export taxes have kept domestic prices at levels significantly below world prices, they have not prevented price increases and inflationary pressures. Argentina's galloping annual inflation, which was officially reported at 9.1 percent in July 2008, was widely estimated by independent sources to be closer to 25 percent. Export taxes promote the goal of income distribution through their effect on lower domestic food prices for the poor. Nonetheless, they also generate results that contradict this goal. First, since lower food prices generate benefits to all consumers, both rich and poor, it has been argued that most benefits have accrued to upper and middle class consumers. Second, while lower food prices generally benefit urban consumers, it can have a negative impact on the rural poor, who may derive their income from agriculture or related activities. Since income levels are lower in rural areas, export taxes may further debilitate the situation of the poorest. There are certainly more efficient ways to help the poor and promote income distribution.

Finally, agricultural export taxes have been used to support the domestic industry. While export taxes have generated enormous income transfers from agriculture and into industry, and have helped establish and consolidate certain industrial sectors, this has been done at a very high cost. Long-run growth was significantly penalized by short-run gains of the industrial sector. Mundlak, Cavallo and Domenech (1989) show that the elimination of agricultural export taxes and other price interventions would have had a positive impact on non-agriculture in the long run (Figure 2.18).

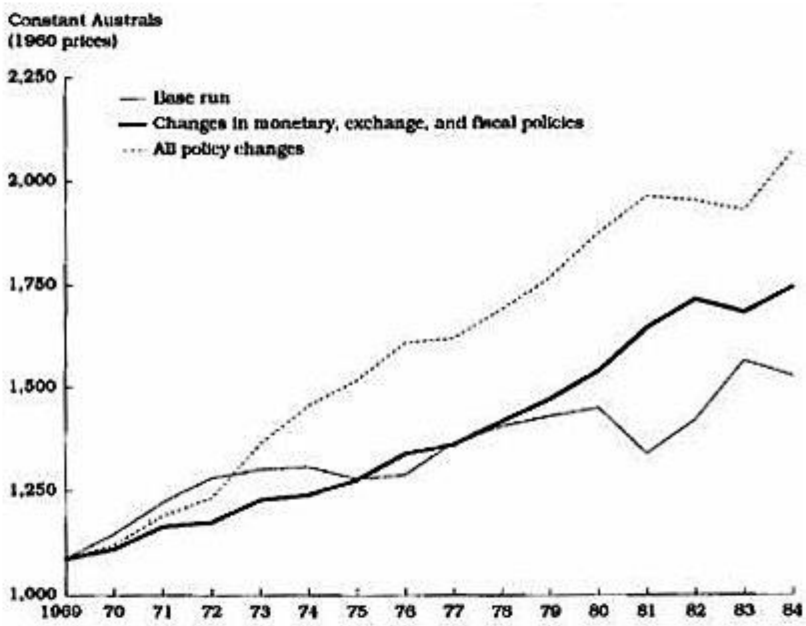

Figure 2.18: Response of nonagricultural output (excluding government) to changes in trade and macroeconomic policies, Argentina, 1969-1984

Simulation scenario: Open economy, no export taxes, uniform and constant tariff on imports of 10 percent, no quantitative restrictions and exchange controls. In addition, monetary policy is designed so that the growth of money supply in excess of nominal devaluation, foreign inflation, and real growth is stabilized at the average level actually observed during the period 1934-1984; sharp increases in public expenditure that are not sustainable in the longer run are avoided; fiscal deficit financed by borrowing is adjusted accordingly.
Source: Mundlak, Cavallo and Domenech (1989).

2.4. Indonesia

2.4.1. Evolution of Agricultural Export Taxation

Palm oil is both an important export commodity and a primary source for domestic cooking oil in Indonesia. Since the availability of essential food items at affordable prices is a key element in the government's policy of maintaining economic and political stability, the palm oil industry is subject to heavy intervention. The government intervenes through both production investment policies and a variety of policy measures to guarantee an adequate domestic supply, including export taxes, export restrictions and a domestic allocation price.

Prior to 1978, there was no tax or other restriction on the export of palm oil. During this period, palm oil exports were extremely large, ranging from 73 percent to 94 percent of production. In 1978, the government imposed export taxes and domestic allocation prices in order to ensure the availability of cooking oil at affordable prices. As a result, palm oil exports dropped significantly from 82 percent of production in 1978 to 55 percent in 1979 (Figure 2.19). Indonesia's share of world palm oil exports dropped from an average of 20 percent in 1961-1978 to 12 percent in 1978 and an all-time low of 5.7 percent in 1984 (Figure 2.20).

In June 1991, the government lifted all palm oil trade restrictions. As a result, the domestic price of cooking oil and Indonesia's share of world palm oil exports increased considerably. Concerned with the increase in the price of cooking oil, the government imposed export taxes on palm oil products in September 1994. As price pressures eased, the government reduced and simplified these taxes in June 1997. Nonetheless, a monetary crisis and the drastic depreciation of the rupiah in late 1997 led the government to impose increasingly strict export restraints, culminating in the indefinite ban of crude palm oil (CPO), olein, stearin, and crude palm kernel oil (CPKO) exports in early 1998. In a letter of intent signed to the IMF in 1998, the government committed itself to phase out export taxes and remove all other types of export restrictions. In March 1998, it replaced the ban on exports of palm oil products by *ad valorem* export taxes.

In 2001, the export tax on CPO was cut from 10 percent to 3 percent, and the tax rates on CPO by-products (including olein) were cut from 6-8 percent to 1 percent (WTO, 2005b). The lower export tax rates coincided with a significant growth in international demand for palm oil. Indonesian palm oil output and exports significantly expanded after the 1998 ban. As of 2005, approximately 75 percent of total production was exported and Indonesia's share of world palm oil exports had reached 40 percent.

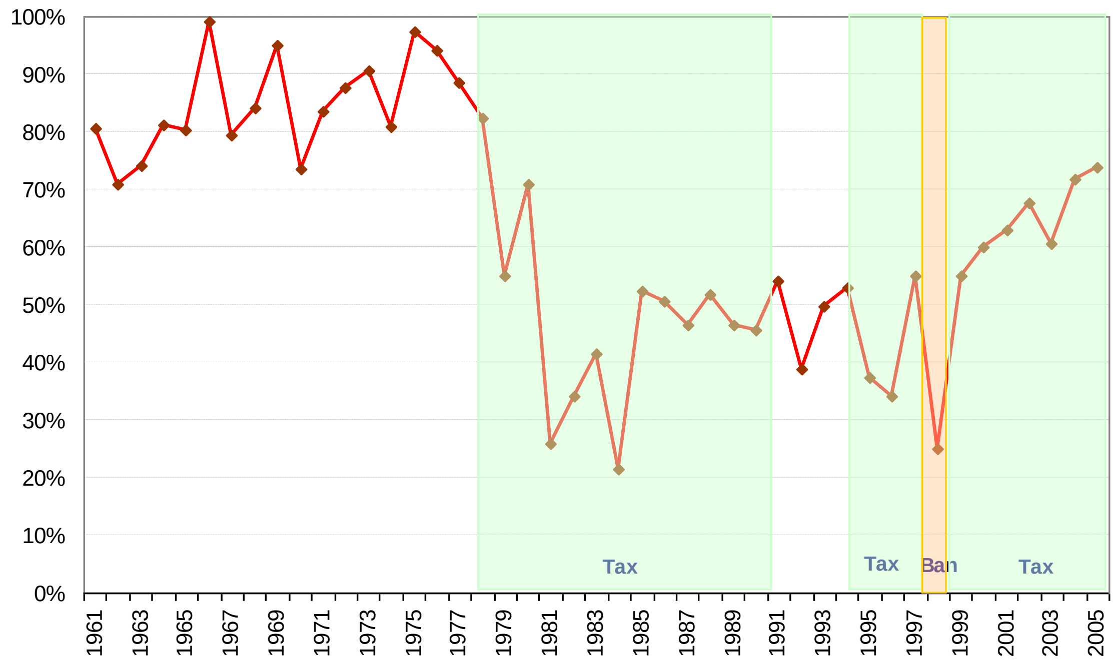

Figure 2.19: Exports as a share of total palm oil production, Indonesia, 1961-2005

Source: Author. Based on FAO (2010).

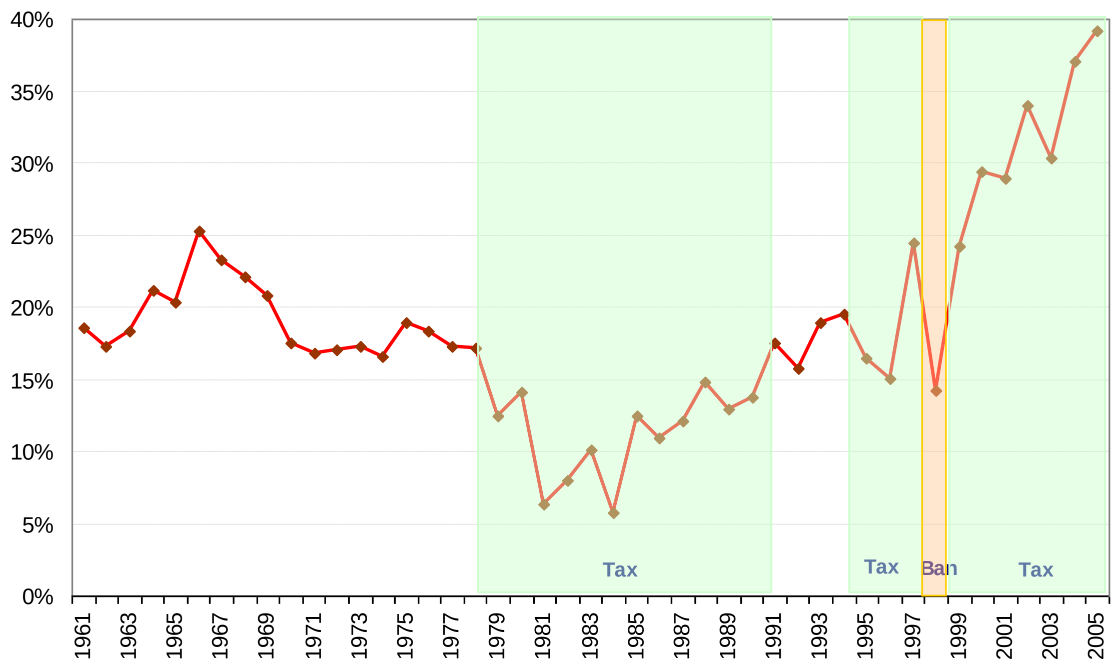

Figure 2.20: Indonesia’s share in world exports of palm oil, 1961-2005

Source: Author. Based on FAO (2010).

More recently, the escalation in international food prices and a renewed concern that domestic shortages of cooking oil may fuel inflation have led to increases in the export tax of CPO and its derivatives. In February 2008, the government introduced a new progressive tax regulation that was still in force as of July 2008.

2.4.2. Coverage, Structure and Level

Palm oil products are not the only commodities affected by export taxes in Indonesia. Prior to the 1997-1998 crisis, about 80 tariff lines – most of which forestry, mining and metal products – were also subject to export taxation. By April 1998, the list was reduced to 51 tariff lines, 10 of which were agricultural tariff lines and covered only two product categories: palm oil and coconuts (and their derived products). Between 1999 and February 2001, the coverage of export taxes was further reduced to four product categories (palm oil, rattan, wood, minerals, and sand), of which only palm oil is an agricultural product.

The export tax on palm oil and derived products, as applied between 1994 and 1997, was modeled after a Malaysian policy intended to tax windfall profits during boom periods. "A domestic target price was specified in dollars per metric ton, and was treated as a base price for the purpose of the export tax calculations. Only if the FOB price of the product rose above the base price was a tax collected in a given month. The tax rate was then determined by a schedule of tax rates that depended on the realized FOB price" (Marks, Larson and Pomeroy, 1998). There were separate domestic target prices and tax schedules for (i) CPO, (ii) refined, bleached and deodorized palm oil RBD PO), (iii) crude olein (CRD olein), and (iv) refined, bleached and deodorized olein (RBD olein).

The first two columns in Table 2.15 show the average *ad valorem* equivalent of the export tax for each of the four product categories in two different periods, September 1994-December 1995 and January 1996-June 1997. Average taxation levels in the second period were approximately half of those in the first period. Since international prices declined significantly after January 1996, so did the level of taxation, which was dependent on prevailing international prices. The average tax on crude palm oil in the first period was lower than the average tax on refined products, which is not the case when the goal of the export tax is to creative incentives for further domestic processing.

Table 2.15: Average *ad valorem* equivalent of export taxes on palm oil products, Indonesia, September 1994-December 1995, January 1996-June 1997 and July 1997

Product	September 1994-December 1995	January 1996-June 1997	July 1997
Crude palm oil	11.4%	6.4%	5%
RBD palm oil	12.1%	6.3%	4%
Crude olein	15.1%	7.7%	4%
RBD olein	14.5%	6.7%	2%

Source: Marks, Larson and Pomeroy (1998).

In July 1997, reduced price pressures in the world market led the government to simplify and reduce export taxes. New *ad valorem* rates were set at 5 percent for CPO, 4 percent for RBD palm oil and crude olein, and 2 percent for RBD olein, as indicated in the third column of Table 2.15. The new tax structured clearly favored additional domestic processing. Nonetheless, the new *ad valorem* rates had a short life span. With the arrival of the Asian crisis in late 1997, palm oil exports were first subject to quotas in November and December 1997 and then banned in late December 1997.

In April 1998, the export ban was replaced by *ad valorem* export taxes on ten products (Table 2.16). "Concerns about smuggling of olein disguised as stearine, palm kernel oil, and even crude and refined coconut oil led to the imposition of sizable export taxes on these products as well. The taxes on coconut oil effectively caused major commercial production of crude and refined coconut oil to shut down, as it became more profitable to export copra and desiccated coconuts than to produce oil" (Marks, Larson and Pomeroy, 1998).

Table 2.16: Export taxes on palm oil and coconut oil products, Indonesia, April 1998

HS Code	Product Description	Tax Rate
1511.10	Crude palm oil (CPO)	40%
1511.90	Refined bleached deodorized palm oil (RBD PO)	35%
1513.11	Crude coconut oil (CCO)	20%
1513.19	Refined bleached deodorized coconut oil (RBD CO)	15%
1513.21	Crude palm kernel oil (CPKO)	35%
1513.29	Refined bleached deodorized palm kernel oil (RBD PKO)	30%
3823.11	Crude stearin (CRD stearin)	35%
3823.11	Refined bleached deodorized stearin (RBD stearin)	30%
3823.12	Crude olein (CRD olein)	40%
3823.12	Refined bleached deodorized oelin (RBD olein)	35%

Source: WTO (1998).

Export taxes on palm oil have gone through significant changes since April 1998. By 2001, they had dropped to 3 percent for CPO and 1 percent for RBD olein. With the most recent escalation in world food prices, CPO export taxes have once again been raised. In September 2007, the tax rate was raised from 6.5 percent to 7.5 percent. In November 2007, the tax was again raised to 10 percent. In February 2008, a new progressive rate system was introduced for CPO and its derivative products (Table 2.17). As a result, CPO exports have been taxed at the following rates in 2008: 10 percent in January, February and March; 20 percent in April; 15 percent in May and June; 20 percent in July, and 15 percent in August (Bloomberg, 2008; Reuters, 2008).

Table 2.17: Export taxes on palm oil and coconut oil products, Indonesia, April 1998

Product	Rotterdam Reference Price	Tax Rate
CPO	Below US$1,100 per ton	10%
	Between US$1,100 and US$1,200 per ton	15%
	Between US$1,200 and US$1,300 per ton	20%
	Above US$1,300 per ton	25%
Derivative Products	Below US$1,100 per ton	9%
	Above US$1,100 per ton	13%
Biofuels	Below US$1,100 per ton	8%
	Above US$1,100 per ton	11%

Source: Author.

2.4.3. Economic Impacts

Hasan, Reed and Marchant (2001) use times series analysis to evaluate the dynamic effects of export taxes on the performance of the Indonesia palm oil industry. The vector autoregressive results show that exports fell dramatically with the imposition of the tax. The study also shows that the imposition of an export tax has long-lasting, negative effects on the competitiveness of the Indonesian palm oil industry. The variance decomposition reveals that more than 83 percent of the variation in the forecast error of the net export shares is explained by its own shock, and 8.6 percent and 8.4 percent are explained by the export tax and relative export prices, respectively.

Marks, Larson and Pomeroy (1998) estimate the economic effects of the palm oil export tax applied between 1994 and 1997. They find that Indonesian export taxes:

(i) Reduced the domestic price of palm cooking oil relative to the levels it otherwise would have attained, so that there were some consumer benefits;

(ii) Lowered the profits earned by CPO producers, although by all accounts the sector remained highly profitable;

(iii) Lowered the prices of the primary product for CPO refiners, but these lower prices were not passed along to consumers or users of cooking oil and the products into which CPO is refined. However, CPO refiners suffered losses due to the export tax on RBD olein. Overall, export taxes slightly lowered the profits earned by CPO refiners;

(iv) Lowered government net revenues, through their effects on state-owned oil palm estates;

(v) Harmed the coconut cooking oil industry within Indonesia, since increased competition from low-priced palm cooking oil put downward pressure on coconut oil prices;

(vi) Transferred income from Sumatra and Kalimantan (where most oil palm plantations are located) to Java (where most consumers are located);

(vii) Achieved only modest price stabilization, especially considering the cost of reduced economic efficiency. While consumers did not benefit from the tax on CPO, they did benefit from the tax on RBD olein.

Table 2.18 summarizes the estimated effects of export taxes on different sectors of society for calendar year 1995, as reported by Marks *et al.* (1998). The authors also examine the efficiency effects and aspects of the export taxation.

Table 2.18: Impact of palm oil export taxes on different sectors of society, Indonesia, 1995

	Impact *(US$ million)*
Non-state-owned oil palm estates	-195.2
Loss to smallholder oil palm estates due to lower CPO prices	-68.2
Loss to private oil palm estates due to lower CPO prices	-127.0
Government	-18.1
Tax revenues from palm oil and olein export taxes	91.8
Crude and RBD palm oil	75.9
Crude and RBD olein	15.9
Loss to state-owned oil palm estates due to lower CPO prices	-109.9
Palm oil refiners	-2.5
Gain to palm oil refiners due to lower CPO prices	238.3
Loss to palm oil refiners due to lower RBD olein prices	-240.8
Palm oil and olein importers	-4.6
Loss to CPO importers	0.0
Loss to RBD olein importers	-4.6
Palm cooking oil consumers and distributors	220.5
Gain to distributors	102.0
Gain to final consumers	118.5

Source: Marks, Larson and Pomeroy (1998).

2.4.4. *Effectiveness in Achieving Policy Objectives*

The key objectives of Indonesia's export taxes on palm oil products were to stabilize domestic prices of cooking oil and control inflation. The price of palm cooking oil in Indonesia increased significantly after the elimination of foreign trade restrictions in 1991. Between August 1993 and August 1994, the retail price increased 47.5 percent, compared with an inflation rate of 8.5 percent in the same period. This motivated the government to reinstitute export taxes in 1994. Figure 2.21 shows that prices eased from 1995 through mid-1997, which seems to suggest that export taxes delivered on the goal of stabilizing prices. However, Marks, Larson and Pomeroy (1998) argue that ex-factory prices came down in 1995-1996 largely due of lower world prices. Thus, export taxes can take only part of the credit for the stabilization of palm oil prices in Indonesia.

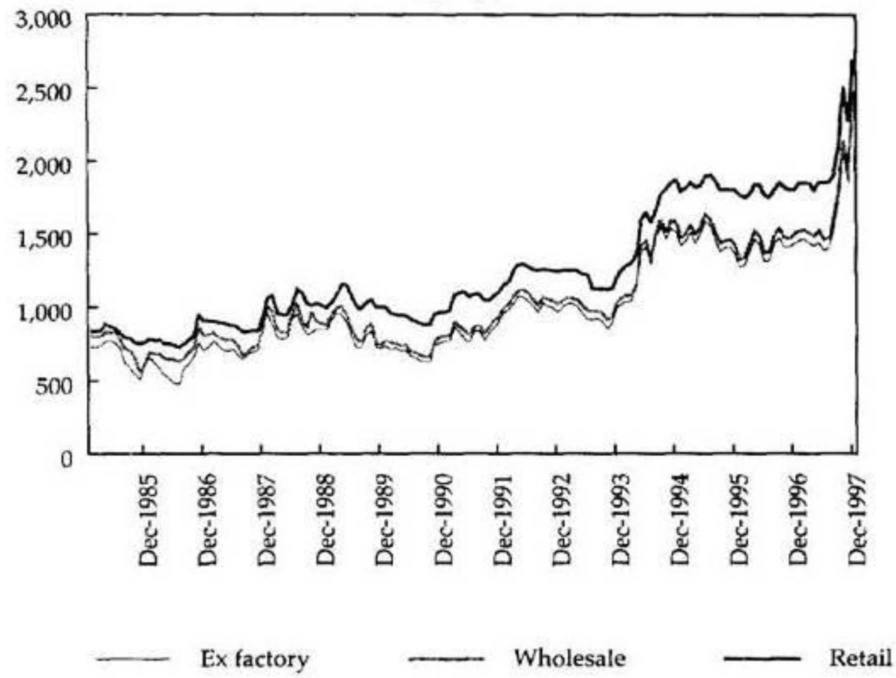

Figure 2.21: Prices of palm cooking oil in the Jakarta area, Rupiah per kg, 1985-1997

Source: Marks, Larson and Pomeroy (1998).

Cooking oil constitutes only 1.4 percent of the basket of goods in the Indonesian consumer price index (CPI). About 77 percent of the local cooking oil market is supplied by palm cooking oil, 17 percent by coconut oil, and 6 percent by palm kernel oil, soybean oil, peanut oil and small amounts of other imported vegetable oils. For the 20 percent poorest rural households, cooking oil represents 4 percent of total expenditures. Therefore, palm oil has a weight of only 1.1 percent on the Indonesian CPI, and of 3.1 percent on the expenditures of Indonesia’s poorest social stratum. Thus, the stabilization of palm oil prices can have at best a moderate impact on controlling inflation. Nonetheless, the government considers cooking oil as one of nine essential commodities. Popular riots in early 1998 in response to increases in prices and shortages of cooking oil and other commodities reflected its political sensitivity.

2.5. Thailand

Thailand constitutes an interesting example of a country that heavily taxed agricultural exports in its early development stage and later reduced the level of taxation as it achieved successful industrialization (Choeun *et al.,* 2006). While agricultural export taxes were a central element in Thailand's trade, fiscal and development policies in 1950-1985, they are nearly non-existent today. Agricultural export taxes affected 60 percent of total merchandise exports in 1951; 15 percent in 1980; and less than 0.1 percent in 2006. In addition, they accounted for close to 20 percent of central government revenue in the 1950s; 6 percent in 1980; and less than 0.1 percent in 2006. This section focuses on Thailand's experience with the taxation of exports of rice, the country's staple food and most important crop, as well as its principal export item until the 1980s.

2.5.1. Evolution of Agricultural Export Taxation

In its modern form, the taxation of rice exports began in period immediately after World War II. In response to an Allied demand that Thailand pay its war indemnity in rice, the Thai government instituted a rice export monopoly (Siamwalla and Setboonsarng, 1991). After the original reason for its establishment no longer applied, the government monopoly over rice exports was retained primarily for the convenience in revenue collection. The Ministry of Commerce "bought" milled rice from the mills at a price substantially below the international market price and then "sold" it to shippers at higher rates. "All this was merely a paper transaction, since the shippers got their rice directly from the mills and were often themselves the millers" (Ayal, 1965). Between 1947 and 1954, the government also administered a multiple exchange rate system under which all foreign-exchange proceeds from rice exports had to be surrendered to the Bank of Thailand at some two-thirds of the market rate.

In 1954, the government eliminated the multiple exchange rate system and replaced the rice export monopoly by a system of private exports subject to taxes, a reserve requirement and occasional quotas. Rice exporters had to pay both a fixed ad valorem export duty and a variable specific export tax – the rice premium. The government's primary consideration in changing the premium level was to ensure an adequate supply of rice for the domestic market at reasonable prices, in addition to its permanent feature as a source of revenue. The important place of rice in household budgets implied that the taxation of rice exports had a significant impact on the cost of living (Roy, 1981). In addition to the two explicit export taxes, an implicit export tax operated through a compulsory rice reserve scheme. Exporters were required to sell to the government a proportion of their rice (fixed in relation to the amount of rice exported) at below market prices. The government later sold this rice to urban consumers at subsidized prices. This policy further depressed farmgate prices for paddy and was similar to an ad valorem export tax (Warr and Nidhiprabha, 1996). In addition, the government periodically assigned export quotas to individual rice exporters.

A perceived lack of promising alternatives to foreign trade taxes reinforced the government's reliance on rice export taxes as a revenue source in the 1950s and 1960s. "Widely dispersed distribution and production units, lack of honest administration, and a general unwillingness on the part of the population toward voluntary compliance to tax law made direct taxation on income, output, sales, or business profits extremely difficult" (Bertrand 1969). The taxation of rice exports was a more a politically expedient way for governments to exercise effective taxation authority. This was especially true of the rice premium, since its tax burden on the rural community was hidden.

A remarkable change in the direction of rice pricing policy occurred in the 1970s. The increasing rural-urban income disparity that resulted from successful industrialization and the mounting dissatisfaction with the military regime induced popular riots that brought down the authoritarian government in 1973. "The increase in farmers' education level under improved communication and transportation infrastructure made them more sensitive to their relative income with urban dwellers. Correspondingly, the number of protests and demonstrations by farmers began to rise in this period" (Choeun, 2006). To appease agricultural producers, the new representative government placed all revenues from the rice premium in a fund to support farmers and instituted a rice price support program. Nonetheless, such measures proved insufficient to counteract the heavy burden of export taxation.

As Thailand's per capita income rose further, farmers' welfare gained greater political weight in the government decisions. Meanwhile, the importance of rice in urban household expenditure declined and the reliance of the government budget on rice export tax revenue waned owing to large increases in tax revenue form commerce and industry. Under the pressure of the continued downfall of world rice prices in the 1980s, the government suspended the rice premium in 1986 (Choeun *et al.*, 2006). This policy reform took place with little reaction from employers or consumers. "For the rice tax – which for decades was a highly contentious issue – to have been removed with such apparent ease suggests that its role had become an insignificant one for those with political influence or for those who were in a position to protest" (Dixon, 1999).

In the early l990s and prior to the 1997 economic crisis, proposals were made for the subsidization of rice exports as an instrument of income redistribution toward poor rice farmers, but the possible adverse effects on Thailand's terms of trade remained controversial (Warr, 2001). Pressures for the reintroduction of an export tax reemerged in the context of the 1997 economic crisis. Large exchange rate depreciation and severe fiscal problems provoked an urgent search for new sources of government revenue and for ways of shielding vulnerable social groups from potential large consumer price increases for rice. After vigorous debates in which distributional issues dominated, the proposed tax was shelved (Warr, 2001). More recently, Thailand has been the only major Asian rice exporter not to tax or restrict exports due to the substantial rise in international commodity prices in 2007-2008.

2.5.2. Coverage, Structure and Level

The taxation of rice exports has been the single most important government intervention in Thailand's agricultural sector since World War II. Nonetheless, other agricultural products have at times been subject to export taxation, including important crops such as maize and rubber.[31]

The taxation of rice exports was accomplished through the application of four separate instruments: (i) the rice premium; (ii) the *ad valorem* export duty; (iii) the rice reserve requirement; and (iv) export quotas. Their combined taxation burden was equivalent to an average ad valorem tax of 40 percent of the export price in 1959-1972, 56 percent in 1973-1974, and 22 percent in 1975-1985 (Figure 2.22).[32] If only the two explicit export taxes (the premium and the *ad valorem* export duty) are considered, the taxation burden was equivalent to an average *ad valorem* tax of 35 percent in 1959-1972, 31 percent in 1973-1974, and 13 percent in 1975-1985.

[31] The export tax on maize was instituted with the goal of raising revenue for the central government. Export quotas were also occasionally applied to maize. However, Thailand's loss of export market share to new low-cost producers such as China and Vietnam led the government to abolish the corn export tax in 1982 (Dixon, 1999). Exports of rubber were subject to an export tax for general revenue purposes and a lower rubber cess that was to finance new rubber seedlings and rubber replanting. The rubber export duty was suspended in 1987 (Aziz, 1990); the rubber cess was still applied in 2008.

[32] Choeun *et al.* (2006) report similar average rice export taxation rates: 45 percent for 1950-1970 and 24 percent for 1971-1985. Warr and Nidhiprabha (1996) cite figures reported by Pinthong (1984), which are lower for the earlier period and higher for the mid and later periods: 31 percent in 1970, 67 percent in 1973-1974, and 13 percent in 1984.

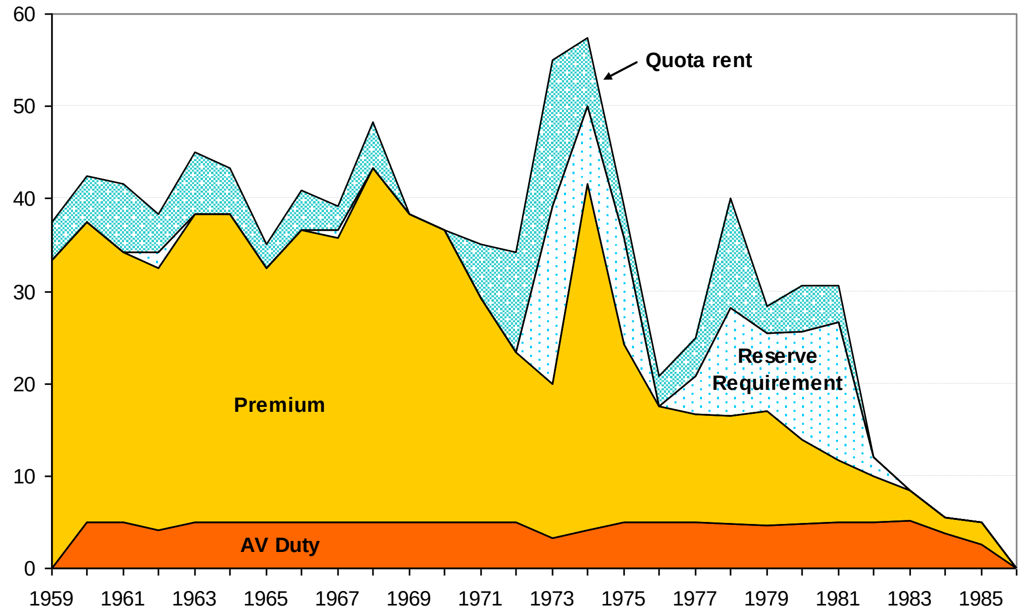

Figure 2.22: *Ad valorem* equivalent of four government measures on rice exports, Thailand, 1959-1986

Source: Marks, Larson and Pomeroy (1998).

The premium accounted for the bulk of the export taxation of rice, especially before 1973. It accounted on average for 80 percent of total export taxation in 1959-1972 and 40 percent in 1973-1985. The rate of the rice premium depended on the world price. When the price was high, the premium was raised to discourage exports and ensure domestic supply and reasonable prices. The Thai government raised the premium rates for rice in the period from 1973 to 1974, when world rice prices rose rapidly due to widespread food shortages (Yukawa, 1988). As the world price declined steadily after 1981, the premium rate was gradually reduced and finally eliminated in 1986 (Aziz, 1990).

The rate of the ad valorem export duty was fixed at 5 percent of the FOB value. Changes in the official rate were difficult to come across because they had to be approved by Parliament. However, by manipulating the standard price used in the calculation of the tax, the Customs

Department was able to vary this tax rate slightly with the world price. The tax rate was lowered to 2.5 percent in 1985. The objective of the fixed export duty was to generate government revenue. Hence, its proceeds accrued to the Ministry of Finance.

Although the rice reserve requirement system was established in 1962, it only became widely used after 1972. It accounted on average for 0.6 percent of total export taxation in 1962-1972 and 27 percent in 1973-1982. In addition to depressing domestic rice prices, the reserve requirement allowed the Ministry of Commerce to use the rice obtained at below-market prices to launch a cheap rice program. Amid falling world food prices, the compulsory rise reserve scheme was ended in 1982 (Warr and Nidhiprabha, 1996).

Export quotas were used throughout most of the 1959-1985 period, but were relatively more important in 1972-1974 and 1978. The primary objective behind the imposition of quantitative controls "appears to have been the Commerce Ministry's wish to limit competition among exporters as a strategy for cartelizing the trade and thus for extracting additional monopoly profits from foreign buyers – profits that would accrue mostly to exporters" (Siamwalla and Setboonsarng, 1991).

The rice premium was the intervention of choice in the early years because the Ministry of Commerce had exclusive control over its rates and proceeds. Starting in 1974, changes in the premium had to be approved by the cabinet and all revenue from the premium was to accrue to the farmers' fund under the control of the Ministry of Agriculture. As a result, the Ministry of Commerce began to prefer the rice reserve requirement over the premium as an instrument of intervention" (Siamwalla and Setboonsarng, 1991).

The adverse impact of export taxation on rice producers was reinforced by overall trade policies that protected the industrial sector and macroeconomic policies that resulted in the overvaluation of the domestic currency. Siamwalla and Setboonsarng (1991) computed average *direct* nominal protection rates (NPR_D) of -0.19 to -0.40 in 1962-84 and *total* nominal protection rates (NPR_T) of -0.27 to -0.47 in the same period (Table 2.19). The NPR values computed by Choeun *et al.* (2006) for the period 1950-2002 show that after direct disincentives were phased out in the mid-1980s, indirect disincentives – primarily through import protection in manufacturing – have continued to disfavor rice production, albeit at a much lower rate of approximately 10 percent in 1990-2002 (Figure 2.23).

Table 2.19: Direct Nominal Protection Rate (NPR_D) and Total Nominal Protection Rate (NPR_T), Rice, Thailand, 1962-1984

Period	NPR_D	NPR_T (S)	NPR_T (U)
1962-1972	-0.29	-0.37	-0.39
1973-1975	-0.40	-0.45	-0.47
1976-1984	-0.19	-0.27	-0.33

Notes: (S): Assumes current account deficit is sustainable. (U): Assumes current account deficit is unsustainable.
Source: Siamwalla and Setboonsarng (1991).

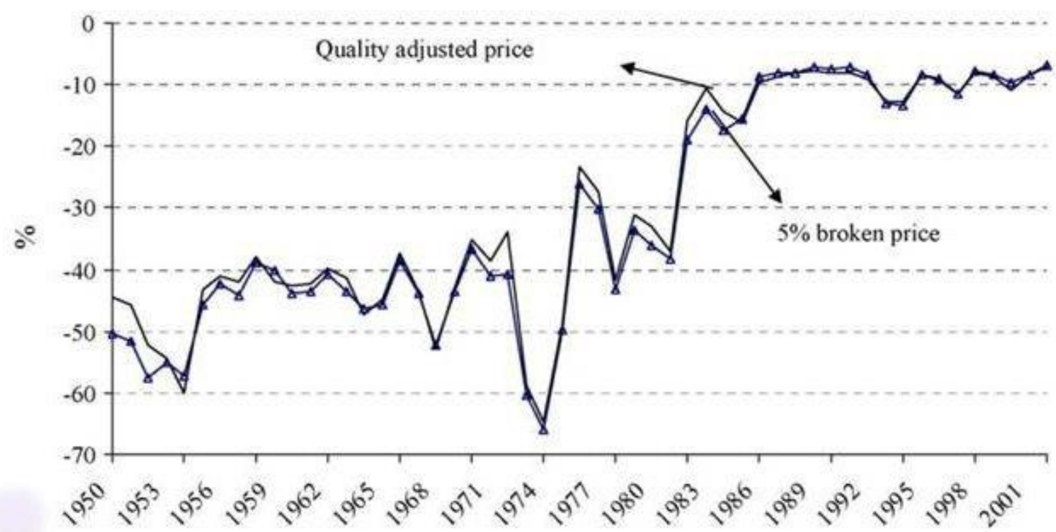

Figure 2.23: Nominal Protection Rate (NPR), Rice, Thailand, 1950-2002

Source: Choeun *et al.* (2006).

As of 2007, Thailand applied export taxes to only one agricultural product – cattle hides – and one non-agricultural product category – wood, sawn wood and articles made of wood. Export taxes accounted for 0.3 percent of central government revenue in 2005-2006 (WTO, 2008b), almost all of which was collected from the exportation of wood and wood products. Thailand exports only small amounts of cattle hides and is in fact a net importer of this product. Over 60 percent of the raw hides consumed by the domestic tanning industry are currently imported (Thai Tanning Industry Association, 2008). As a result, agricultural export taxes have virtually no impact on government revenue.

In addition to cattle hides and wood and wood articles, three agricultural products – rice, rubber and silk – and two non-agricultural products – certain fish and metal scrap – continue to be subject to statutory export taxes (Table 2.20). Although applied rates for these products are currently set at zero, in principle they could be raised up to statutory levels without legislative approval. This generates uncertainty in Thailand's trade regime, as relatively high export taxes on key export commodities, such as rice, may be imposed at any moment (WTO, 2008b).

Table 2.20: Statutory and applied export tax rates, Thailand, 2007

Sector	Commodity	Statutory Rate	Applied Rate
Agriculture	Raw hides	Baht 5 per kg	Baht 5 per kg
	Parings, waste and dust	Baht 4 per kg	Baht 0.4 per kg
	Rice	10%	0%
	Rubber	40%	0%
	Raw silk and silk yarn	Baht 100 per kg	0%
Non-Agriculture	Wood and sawn wood	40%	0% to 40%
	Articles of wood	10% to 20%	10% to 20%
	Certain fish	75%	0%
	Metal scrap	50%	0%

Source: Author. Based on WTO (2008b).

2.5.3. Economic Impacts

Warr (2001) uses an empirically based, applied general equilibrium model to analyze the economic effects of a rice export tax in Thailand. He draws upon available statistical estimates of the elasticity of international demand for Thailand's rice exports and approximates the solution to nonlinear problems using linearized general equilibrium models. The disaggregated approach of the study makes it possible to: (i) conduct the welfare analysis of a particular intervention in the explicit "second-best" context in which market distortions elsewhere in the economy remain in place; and (ii) examine in detail its income distributional implications.

Warr simulates the welfare outcomes from a rice export tax or subsidy at different export demand elasticity for rice, where welfare is measured by aggregate real consumption. When the export demand elasticity for rice is -2.5, the optimal tax rate is 42 percent and generates a moderate welfare gain of 0.63 percent. This implies that aggregate real consumption, computed on the assumption that a Baht in the hands of each household has equal social value, would rise slightly. However, to have a more complete understanding of the economic effects of an export tax, it is important to look at its distributional implications.

An export tax affects the distribution of income across households through three mechanisms: (i) effects on household gross incomes operating through factor returns; (ii) effects on household budgets operating through consumer good prices; and (iii) effects on household disposable incomes operating through changes in taxes. Warr finds that the slight gain in aggregate welfare created by the export tax rate of 42 percent is concentrated in the urban areas, especially among the richest households, and occurs at the expense of the rural and urban poor, particularly the former. Simulated macroeconomic and distributional effects are summarized in column I of Table 2.21.

Table 2.21: Simulated economic and distributional effects of an export tax on rice, percentage changes, Thailand

Simulation	I	II	III	IV	V	VI	VII	VIII
Macroeconomic Results								
Gross domestic product								
Nominal (local currency)	-0.62	-2.07	-0.30	-1.17	-1.25	-0.28	-0.59	-4.78
Real	-0.09	0.06	-0.02	-0.37	-0.54	0.11	0.04	-1.88
Consumer price index	-1.47	-2.30	-1.34	-1.75	-1.66	-1.24	-1.30	-3.43
GDP deflator	-0.54	-2.12	-0.28	-0.79	-0.72	-0.39	-0.63	-2.42
Wage (nominal)								
Skilled	3.83	5.27	6.59	4.47	4.47	3.38	-1.79	5.47
Unskilled	-9.37	-8.06	-7.14	-11.07	-11.38	-9.14	-1.86	-17.11
Returns to variable captial (nominal)								
Nonagriculture	0.14	1.51	2.73	0.04	-0.07	-0.72	-0.23	-0.95
Agriculture	-10.11	-10.18	-9.68	-11.72	-11.83	-0.72	-9.45	-16.79
Aggregate Real Consumption	0.63	0.28	0.33	0.87	0.70	0.74	0.95	-2.39
Distributional Effects								
Household welfare effects								
Rural RQ1 (poorest quintile)	-3.82	-2.55	-2.40	-4.56	-4.54	-2.57	-1.15	-6.45
Rural RQ2	-4.10	-2.66	-2.59	-4.82	-4.50	-2.99	-1.78	-6.81
Rural RQ3	-3.49	-1.95	-1.83	-4.11	-3.99	-2.27	-1.49	-5.83
Rural RQ4	-1.81	-0.89	-0.86	-2.37	-2.26	-0.97	-0.73	-4.25
Rural RQ5 (richest quintile)	0.40	0.74	0.58	-0.04	0.07	0.80	-0.06	-2.56
Urban UQ1 (poorest quintile)	-0.95	0.60	0.97	-1.28	-1.52	-1.08	0.72	-2.28
Urban UQ2	0.94	2.17	2.44	0.79	0.51	0.60	1.20	-0.06
Urban UQ3	2.58	3.23	3.44	2.51	2.11	2.16	1.88	1.45
Urban UQ4	4.23	3.76	3.94	4.08	3.41	3.73	3.05	2.02
Urban UQ5 (richest quintile)	7.00	3.95	4.01	6.47	5.26	6.47	5.51	1.69

Simulation I: Export demand elasticity is -2.5; export tax of 42 percent; tax adjustment mechanism operates through income taxes; factor demand elasticities based on econometric estimation; immobility of sector mobile capital between agricultural and nonagricultural sectors; elasticities of substitution between skilled and unskilled labor based on empirical estimates using industrial data.

Simulation II: As in Simulation I, except that the tax adjustment mechanism operates through import tariffs.

Simulation III: As in Simulation I, except that the tax adjustment mechanism operates through value-added taxes.

Simulation IV: As in Simulation I, except that factor demand in rice sector is CES with elasticity of substitution of 0.5.

Simulation V: As in Simulation I, except that factor demand in rice sector is CES with elasticity of substitution of 1.0.

Simulation VI: As in Simulation I, except that sector mobile capital is mobile economy-wide.

Simulation VII: As in Simulation I, except that skilled and unskilled labor are close substitutes in production.

Simulation VIII: As in Simulation I, except that export demand elasticity is -5.

Source: Warr (2001).

The return to factors intensively employed in rice production – land and unskilled labor – decline as the price of rice falls. In rural Thailand, even the poorest income quintile group derives a significant proportion of its total income from the ownership of land. This partly explains the result that rural households of all income quintiles are more negatively affected by a rice export tax than urban households. Both the rural and urban poor suffer from the reduction in the return to unskilled labor, while the urban rich gain from the rise in the returns to other mobile factors, including skilled labor and mobile forms of capital. Changes in good prices reduce the decline in real incomes for all rural households and for the poorest urban quintile while still leaving them net losers. Finally, increased revenue collection from a rice export tax allows for reduced income tax rates, which benefit primarily the richest households and reinforce the regressive distributional effect of the export tax on rice. This reflects the assumption that as a government revenues rise, personal income tax rates adjust downward to balance the government's budget.

Warr's results concur with Ayal's (1965) findings more than thirty years earlier: "At first blush one would expect that the lower rice prices, by improving the urban sector's term of trade, would bring about higher real wages to urban employees. However, although true in principle, this aspect has been of little significance in practice. […] [S]alary earners, especially in the lower echelons, have been even worse off, because the rise in pay has lagged behind the rise in prices. The net result is that although, *ceteris paribus*, the employees would be better off with cheap rice, in fact their salaries are neither completely independent of rice prices nor have they risen with other prices. […] Non-rice businessmen gain from the tax both as consumers and as employers. […] The tax decreased their labor costs and increased their investible surplus."

Warr examines the sensitivity of the distributional results to: (i) fiscal adjustments; (ii) factor demand elasticities; (iii) factor mobility assumptions; and (iv) factor aggregation assumptions. He finds that while these assumptions do influence the results, the distributional effects of a rice export tax itself are powerful enough to dominate the distributional effects of alternative assumptions. These results are summarized in columns II through VII in Table 2.21. By and large, the qualitative pattern of the distributional results remains unchanged.

Warr also explores the implications of errors in estimating the optimal tax rate. Given uncertainty about the true value of the export demand elasticity, errors are necessarily be made in any attempt to set an optimal tax. The relationship between the tax rate and its welfare consequence is strongly asymmetric: as the optimal tax rate is exceeded, the welfare gain quickly turns into a large loss. Warr assumes an export demand elasticity for rice of -2.5 for his base simulations, seemingly the largest absolute value broadly consistent with the limited econometric evidence available. He also examines what would happen if the true elasticity was -5, but the export tax rate was set at 42 percent on the erroneous assumption that the elasticity was -2.5. His findings are summarized in column VIII in Table 2.21. There would be a large aggregate welfare loss 2.39 percent. The distributional effects would be even more severe, with greater losses for the entire rural population as well as the urban poor, and little gains for the urban rich. Because the cost of setting the rate too high greatly outweighs the loss from setting correspondingly too low, Warr concludes that there is a strong case for setting the rate of any export tax conservatively.

Siamwalla and Setboonsarng (1991) estimate the effects of direct and total government intervention on rice output in 1961-1984. Direct intervention includes the four key trade policy instruments discussed in Subsection 2.5.2 (rice premium, *ad valorem* export duty, rice reserve requirement and export quotas); total intervention includes direct intervention as well as macroeconomic policies and general trade policies – primarily the protection of the manufacturing sector. Short-run and cumulative effects are summarized in Table 2.22. Average short-run and cumulative output effects of direct intervention in 1961-1972 were -11.5 percent and -19 percent, respectively; for 1973-1984, they were -7 percent and -13 percent, respectively.

Table 2.22: Effect of price intervention on rice output, Thailand, 1961-1984

Year	Short-run Effect		Cumulative Effect	
	Direct	Total	Direct	Total
1961	-14.5%	n.a.	n.a.	n.a.
1962	-14.4%	n.a.	n.a.	n.a.
1963	-11.7%	-15.5%	n.a.	n.a.
1964	-12.9%	-17.0%	n.a.	n.a.
1965	-15.0%	-17.5%	-23.4%	n.a.
1966	-14.1%	-16.8%	-24.0%	n.a.
1967	-9.6%	-13.1%	-18.4%	-23.2%
1968	-10.4%	-13.4%	-20.1%	-25.4%
1969	-12.8%	-17.1%	-20.6%	-26.4%
1970	-8.6%	-14.1%	-17.0%	-23.9%
1971	-6.4%	-12.3%	-14.1%	-21.4%
1972	-8.0%	-13.4%	-14.1%	-22.3%
1973	-8.1%	-11.5%	-15.2%	-23.2%
1974	-12.6%	-14.9%	-17.7%	-23.7%
1975	-14.9%	-15.9%	-22.3%	-26.1%
1976	-8.8%	-12.5%	-18.2%	-22.3%
1977	-3.9%	-7.4%	-13.0%	-17.5%
1978	-5.3%	-10.3%	-12.0%	-17.6%
1979	-7.7%	-11.9%	-11.9%	-17.1%
1980	-5.3%	-10.2%	-11.1%	-17.0%
1981	-6.1%	-9.9%	-10.6%	-16.5%
1982	-6.0%	-10.2%	-10.8%	-17.1%
1983	-2.5%	-5.8%	-8.1%	-14.2%
1984	-1.7%	-6.9%	-5.1%	-11.9%
1961-1972	-11.5%	-15.0%	-18.9%	-23.8%
1973-1984	-6.9%	-10.6%	-13.0%	-18.7%

Notes: Simple distributed-lag form is assumed for the long run. Elasticities and distributed-lag coefficients obtained from econometric estimates in the literature. Rice output elasticity assumed to decline linearly between 1960 and 1980 to reflect the exhaustion of surplus land.

Source: Siamwalla and Setboonsarng (1991).

Bertrand (1969) argues that the two main effects of the rice export tax in the agricultural sector were: (i) the obstruction of the modernization of a large part of Thai agriculture, and (ii) the distortion of the rate of return on production of rice relative to other agricultural products. He sees Thailand's poor performance in fertilizer use as one of the best indicators of how export taxation obstructed the modernization of the sector: in 1962-1963, per capita fertilizer use in the Southeast Asian country corresponded to only 6 percent and 7 percent of the comparable levels in Taiwan and South Korea. Bond *et al.* (1966) showed that the application of fertilizer was uneconomical under the price structure prevailing in Thailand in the 1960s. Behrman (1968) found that the benefits/costs factors were often against the application of improved inputs in Thailand, and that most of the chemical inputs applied in the country were not for the rice crop, but mainly for vegetable and tobacco crops and mulberry bushes. According to Lam (1977), the cost of fertilizers relative to the farm price of paddy was higher in Thailand than in all other Asian countries except Burma (present-day Myanmar). Consequently, usage of major chemical fertilizers such as nitrogen, phosphates and potash per unit area in Thailand in the 1970s was the lowest in Asia, except again for Burma.

In a study of agricultural productivity growth in eighteen countries across South and East Asia, Suhariyanto (2001) found that Thailand had the second worst performance in terms of total factor productivity (TFP) between 1965 and 1996. TFP declined at an annual rate of 1 percent in Thailand during this period, while it increased at annual rates of 3.55 percent in Malaysia, 1.57 percent in the Philippines and 0.17 percent in Indonesia (Table 2.23). Thailand was the only middle-income country in Asia to experience negative growth in agricultural TFP in 1965-1996. The country also had the region's second worst performance in terms of technical efficiency change (TEC) and the third worst in terms of technical change (TC). Technical efficiency in

Thailand's agricultural sector fell at the remarkable rate of 1.33 percent per year for more than three decades. This was coupled with very low growth in technical progress. Innovation in Thailand's agricultural sector grew at a rate that was approximately one-half of Indonesia's, one-fourth of the Philippines' and one-tenth of Malaysia's. Myanmar and Nepal were the only two countries in South and East Asia to experience lower rates of technological progress in the agricultural sector than Thailand between 1965 and 1996. Since Suhariyanto's analysis covers a time period that spans beyond the 1986 elimination of Thailand's rice export taxes, his figures must be interpreted with caution.

Table 2.23: Percentage annual growth rates of agricultural productivity, South and East Asia, 1965-1996

Country	Technical Efficiency Change (TEC)	Technical Change (TC)	Total Factor Productivity (TFP)
Malaysia	0.00	3.55	3.55
South Korea	0.00	3.30	3.30
Japan	0.00	2.70	2.70
Laos	-0.26	2.02	1.76
Philippines	0.07	1.26	1.33
Sri Lanka	-0.62	1.29	0.67
Mongolia	-0.31	0.82	0.51
China	-0.41	0.88	0.47
North Korea	-0.70	0.40	0.30
Indonesia	-0.45	0.63	0.18
Myanmar	-0.09	0.07	-0.02
Vietnam	-0.71	0.54	-0.17
Bangladesh	-0.77	0.35	-0.42
Pakistan	-1.29	0.82	-0.47
India	-1.05	0.55	-0.50
Nepal	-0.89	0.20	-0.69
Thailand	**-1.33**	**0.33**	**-1.00**
Cambodia	-3.02	1.19	-1.83

Source: Suhariyanto (2001).

2.5.4. Effectiveness in Achieving Policy Objectives

The two key declared policy objectives of Thailand's rice export taxes in the second half of the twentieth century were the collection of government revenue and the control of domestic prices. In addition, two undeclared policy goals also guided Thai government interventions in the rice export market in this period. First, Thailand attempted to impose optimal export taxes to take advantage of its assumed monopoly power in the world rice market, with the goal of improving its terms of trade and maximizing aggregate welfare gains at the cost of foreign consumers and domestic rice farmers (Choeun *et al.*, 2006; World Bank, 1986). Second, export taxes were used to "modernize" the economy by encouraging capital, labor and entrepreneurs to move away from rice production and into manufacturing and other economic activities (Ayal, 1965, Bertrand, 1969).

The collection of government revenue was the dominant policy objective in the period immediately following the Second World War. The rice export monopoly that was established to pay Thailand's war indemnities and the successive taxes on exports proved to be a convenient source of government revenue. Given the seeming absence of alternative forms of taxation at the time, rice export taxes were a rather successful measure. In the 1950s, they accounted for over 20 percent of central government revenue. However, as Thailand achieved progressively higher levels of development, other effective revenue sources became available and the government turned less dependent on rice export taxes. Concurrently, the suppression of domestic prices became the central goal of export taxes. In the 1960s, rice was Thailand's key staple food constituting about 36 percent of total food expenditure. As the Shultzian food problem was dominant, the Thai government redistributed income from rice producers to consumers. As seen in Subsection 2.5.3, rice export taxes and the resulting low domestic rice prices were an inefficient way to support poor urban consumers. Ultimately, the taxes had an adverse effect on the welfare of the most vulnerable urban groups, as their wages were linked to the price of rice.

On the other hand, the taxes did contribute to the development of the manufacturing sector. Since rice was a wage good, low prices meant that industrialists benefited from the low wages paid to their employees. Furthermore, low rice prices encouraged the abandonment of rice cultivation and the migration to urban areas, ensuring an ever-increasing supply of labor to the incipient manufacturing sector. Together with other, largely independent, developments, Thailand's rice export tax caused a reduction in the number of middlemen and discouraged new investments in the rice sector: "It freed people with business acumen – notably Sino-Thai middlemen – for other economic activities. It also freed capital, which potentially could be invested in the rice sector, for other purposes. Both could be viewed as favorable for development in that they encourage the expansion of the non-rice urban sector" (Ayal, 1965). Whether or not this was an appropriate goal is outside the scope of the current study, but Thailand did succeed in developing a diverse industrial sector and increasing per capita income levels. The share of manufacturing in total GDP rose from 17.7 percent in 1951 to 41.5 percent in 1995, and per capita income expanded from US$355 to US$2,000 in the same period (measured in 1998 US$).

Finally, while several studies have estimated that Thailand's rice export taxes did increase the world price of rice, it is unclear whether the country actually maximized aggregate national welfare. Given the uncertainty about the true level of the elasticity of demand for Thai rice exports, it is more likely that the government did not set the export tax rate at the optimal level. This is especially true considering the changing levels of taxation. Assuming an elasticity of -4, as in Choeun *et al.* (2006), the average applied export tax was well above the corresponding optimum level (25 percent) in 1950-1970, but converged to it in 1971-1985. Assuming an elasticity of -2.5, as in Warr (2001), conflicting results are reached: applied export tax rates were closer to the corresponding optimal level (40 percent) in 1950-1970, and substantially below it in 1971-1985. Since welfare losses from incorrectly estimating the optimal tax rate are significant, it is reasonable to conclude that Thailand's rice export taxes failed to maximize national aggregate welfare.

2.6. Conclusion

The assessment of the global experience with agricultural export taxes provides insightful lessons on both the factors that motivate the adoption of such measures and their impacts on the agricultural sector and the economy at large. This is especially relevant in the context of the recent surge in world commodity prices, which has led a myriad of countries to adopt or raise export taxes on agricultural products. As this study shows, export taxes have generally been ineffective in delivering their intended policy goals and have adversely affected economic incentives, output, income distribution and growth prospects. The main findings are summarized below.

Export taxes are only one of a number of government measures that effectively burden agricultural exports. Other instruments of agricultural export taxation include export quotas, export bans, export licensing requirements and commodity marketing boards. Export taxes are generally preferred to quotas or bans on both analytical and practical grounds (Devarajan *et al.*, 1996). Moreover, multilateral trade rules are permissive regarding export taxes and restrictive regarding export bans and quotas.[33]

[33] According to article XI of the GATT, "no prohibitions or restrictions other than duties, taxes or other charges […] shall be instituted or maintained by any contracting party on […] the exportation or sale for export of any product destined for the territory of any other contracting party." Exceptions to this general rule apply to limited cases, including export restrictions (i) that are applied to relieve critical shortages of foodstuffs or other essential products, (ii) that are necessary protect human, animal or plant life or health; (iii) that are necessary to ensure essential quantities of materials to a domestic processing industry during periods when domestic price of such materials is held below the world price as part of a governmental stabilization plan; or (iv) undertaken in pursuance of obligations under certain intergovernmental commodity agreements.

In addition to export taxes and other direct restrictions exports, agriculture is indirectly taxed by exchange rate overvaluation and tariff protection of non-agriculture. At times, the negative economic impact of indirect taxation has been substantially greater than that of explicit export taxes, as was the case for grains and beef in Argentina in 1961-1985 (Sturzenegger, 1991), wheat and beef in Chile in 1960-1974 (Valdés *et al.*, 1991), rice and cotton in Egypt in 1960-1972 (Dethier, 1991), copra in the Philippines in 1960-1982 (Bautista, 1996), tea, rubber and coconut in Sri Lanka in 1953-1985 (Bhalla, 1991), and wheat, barley tobacco, cotton and hazelnuts in Turkey in 1961-1983 (Olgun, 1991). Furthermore, in some countries, explicit export taxes have tended to compensate for variations in the real exchange rate: they are higher when the prevailing real rate of exchange or the international prices high. This was the case of Argentina in 1960-1991, 2002 and 2007-2008.

As of 2008, at least sixty countries impose explicit export taxes on agricultural products. With the exception of Canada and Iceland, they are all developing countries.[34] Product coverage ranges from a single product (such as cocoa in Ghana) to all agricultural products (as in Argentina). The relative importance of covered products also varies significantly across countries. In one extreme are countries where covered products represent a large share of total export value (such as Argentina and Ghana); in the other, countries where the taxed commodities account for a miniscule portion of total exports (such as Brazil and Thailand).

The agricultural products that are subject to export taxation in the greatest number of countries are raw hides and skins, coffee, vegetable oils, cocoa, and livestock. The objectives and outcomes of export taxation are often dependent on the characteristics of the product to be exported: whether it is a staple food or an industrial raw material; whether or not it is also

[34] Canada taxes exports of cigarettes and other tobacco products; Iceland taxes exports of live horses.

consumed locally; the institutional structure and cultural makeup of the sector producing it; the availability of substitutes both on the demand and the supply sides; and the degree of market power enjoyed by the exporter (Ayal, 1965).

Countries have used agricultural export taxes to achieve a number of different objectives: to generate public sector revenue; to curb domestic prices and inflation; to promote higher value-added activities; to improve the terms of trade; to distribute income; to stabilize commodity prices; among others. The relative importance of agricultural export taxes as a source of public revenue has declined significantly in recent decades. The average share of export duties in central government revenue for a sample of 63 developing countries fell from 4 percent in 1980-1989 to 1.4 percent in 1990-1999 and 0.7 percent in 2000-2006. While at least 25 countries derived over 10 percent of central government revenue from export taxes in the 1970s and 1980s, only a handful did so in 1996-2006. Currently, the two main outliers are Côte d'Ivoire and Argentina, both of which derive between 10 and 20 percent of public revenue from export taxation.

Export taxes are ineffective at controlling prices and curbing inflation in the medium and long run. While they may seem successful in the short run, their continuous application has disincentives effects on production that ultimately lead to increased domestic prices. In addition, export taxes may encourage smuggling and the development of a domestic black market, which ultimately increase domestic upward price pressures.

While export taxes on primary agricultural products may provide sufficient incentives to the promotion of downstream processing industries, they can also be counterproductive. Argentina's differential export taxes and remarkable comparative advantage in soybean production have attracted substantial investments to the domestic crushing industry and turned the country into the world's number one exporter of soybean oil and meal. On the other hand, Ghana's export tax on cocoa and Mongolia's export tax on raw cashmere have failed to promote the development of their processing industries. The two countries remain exporters of predominantly unprocessed and low value-added products and have suffered from widespread smuggling.

Although export taxes in theory allow countries with sufficient market power to improve their terms of trade and maximize aggregate domestic welfare, in practice uncertainty about the true elasticity of export demand may lead to significant efficiency losses. This was the case with Thailand's rice export taxes between 1950 and 1986. In addition, the emergence of new producers and existence of product substitutes may reduce the inelasticity of demand. Several developing countries that were believed to have enough monopoly power and taxed exports of key agricultural commodities lost significant market share to competitors. This group includes Ghana (cocoa), Pakistan (jute), Sri Lanka (tea) and Uganda (cotton).

While export taxes can be used to transfer wealth between different domestic groups, the direction of such transfers has often been *from* the poorest and most vulnerable groups and *to* the most sophisticated and influential sectors. This was the case with the export taxes on rice in Thailand and raw cashmere in Mongolia. In Argentina, recent studies show that most benefits from agricultural export taxation accrue to rich urban consumers and that the elimination of such taxes would leave the Gini coefficients for household per capita income and labor income largely unchanged.

Excessive export taxation creates incentives for smuggling, especially when the commodity has a high unit value, countries share long unpatrolled borders, customs administrations are inefficient, and transportation and logistics costs are low. Examples of agricultural products that have been subject to widespread smuggling due to export taxes include cocoa along the Côte d'Ivoire-Ghana border, raw cashmere along the Mongolia-China border, and rubber along the Cambodia-Vietnam border. While export taxes have typically encouraged smuggling, more recently they have also been applied to combat it. The leading examples are Brazil's and Canada's export taxes on cigarettes.

Export taxes adversely affect economic incentives. Artificially depressed rates of return for agricultural commodities discourage investment and promote market exit. As early as the 1960s, Ayal (1965) warned that "[h]ardly any investments have been made in Thailand in facilities for the rice business for a number of years now, not even in upcountry mills. […] In parts of Bangkok where land values are very high [rice] mills have been torn down." Thailand's poor performance in fertilizer use in 1950-1986 indicates how export taxation obstructed the modernization of the rice sector. Fertilizer application was uneconomical under the prevailing price structure at the time, when Thailand had the second highest relative cost of fertilizers in Asia. In Argentina, the number of tractors per hectare of arable land remained largely unchanged during most of the 1970s and 1980s. More recently, Argentina's taxes and quotas on beef exports have diverted foreign direct investment into the Uruguayan meat industry. Furthermore, high export taxes on soybeans have encouraged Argentine farmers to invest in Uruguay, Paraguay and Brazil. As of 2008, more than half of Uruguay's soybean production was carried out by Argentines.

Export taxes also affect output and income distribution. The long-run effect of Thailand's export taxes was to reduce annual rice output by approximately 19 percent in 1961-1972 and 13 percent in 1973-1984. Argentina's annual production of wheat and beef would have been on average 31 percent and 26 percent higher, respectively, in the absence of export taxes in 1960-1985. In contrast, Argentina's agricultural sector has experienced remarkable growth in 2002-2008. The margin for grains, especially soybeans, has been so attractive that planting has remained profitable despite the imposition of export taxes. However, the situation may change as international agricultural prices start to decline and domestic energy subsidies are reduced.

Significant income transfers occurred from rural producers to urban consumers, middlemen and downstream processors of agricultural raw materials. In Indonesia, export taxes on palm oil negatively affected both smallholder farmers and large private estates, while net gains were almost equally split between cooking oil consumers and distributors. In Thailand, both the rural and the urban poor suffered from export taxes because the lower domestic price of rice led to decreased factor returns to unskilled labor. The benefits accrued to rich urban consumers and to industrialists that employed unskilled labor.

In summary, the empirical evidence summarized above indicates that agricultural export taxes are ultimately self-defeating. While in the short run they may generate much-needed government revenue and curb domestic prices, in the long run they shift economic incentives, discourage the adoption of improved inputs, and adversely affect yield and output. In addition, export taxes have often benefited sophisticated economic groups and hurt the most vulnerable sectors of society. Due in part to its excessive taxation of the agricultural sector, Argentina has come to epitomize a country that has turned a blind eye on comparative advantage and eluded significant development opportunities. In the other hand, Thailand provides an interesting example of a country that heavily taxed agricultural exports at earlier stages of development and later reduced the level of taxation as it achieved industrialization. Higher per capita income levels and alternative sources of revenue allowed the Thai government to eventually suspend export taxes. Thailand's transition away from high agricultural export taxation levels shows an alternative to the current overburden of agriculture in Argentina and other developing countries.

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CHAPTER 3

MEASUREMENT OF ETHANOL SUBSIDIES AND ASSOCIATED ECONOMIC DISTORTIONS: AN ANALYSIS OF BRAZILIAN AND UNITED STATES POLICIES

3.1. Introduction

Governments across the globe subsidize biofuel production through a complex set of policy instruments that include blending mandates, tax exemptions and rebates, production subsidies, input subsidies, and market price support, among others. Justified with reference to goals as diverse as curbing global warming, increasing energy security and promoting rural development, these support mechanisms have spurred unprecedented demand for biofuels and stimulated massive investments in production. Global biofuel output more than quintuplicated in the last decade, rising from 20 billion liters in 2001 to over 110 billion liters in 2011 (EIA, 2014). As the sector expands and domestic biofuel policies become more multifaceted, governments have increasingly exchanged accusations of unfair practices that distort production and trade.[35] In the meantime, significant debate has emerged regarding the adequacy of existing World Trade Organization (WTO) rules to deal with biofuels (Howse *et al.*, 2006; Kojima *et al.*, 2007; Harmer, 2009; Weiss, 2011). This chapter contributes to the ongoing discussion on biofuels by proposing a methodology to measure the subsidy component of biofuel policies, quantifying their associated effects on prices, supply, demand and trade, and determining whether they violate multilateral

[35] In December 2007, at the request of Canada and Brazil, the Dispute Settlement Body (DSB) of the World Trade Organization (WTO) established a panel to investigate US agricultural subsidies, including to corn, the main feedstock for ethanol production in this country. In June 2008, the European Commission (EC) initiated investigations that culminated in the establishment of anti-subsidy and anti-dumping duties against biodiesel imports from the US. In November 2011 and August 2012, the EC initiated similar investigations against, respectively, ethanol imports originating in the US and biodiesel imports originating in Argentina and Indonesia. These investigations culminated in the termination of anti-subsidy proceedings, but in the imposition of definite anti-dumping duties. In August 2012, Argentina requested the establishment of a WTO panel against the EU due to a Spanish law that required that only EU fuel could meet quotas for biofuels used in transport. In addition, Brazil protested for over two decades against a US ethanol import charge that denied foreign producers the benefit of the domestic ethanol tax credit. The US suspended this additional charge unilaterally in 2012.

trade rules. The analysis focuses on ethanol, the single most widely used type of biofuel, and on the United States and Brazil, the world's largest producers and consumers of biofuels.

Ethanol, also known as ethyl alcohol, is a renewable, high-octane, clean-burning, motor fuel, generally obtained from sugarcane or corn. It is by far the world's most important type of biofuel, accounting on average for 85 percent of world biofuel production in 2002-2012 (Table 3.1). Although ethanol's share in total biofuel production declined during this period, output at the end of the decade was still 3.5 times larger than that of biodiesel, the second most common type of biofuel. Other types of biofuels, such as biomethanol and green diesel, are seldom produced at a commercial scale and, therefore, account for a negligible share of global biofuel production.[36]

Table 3.1: World biofuel production, by type of biofuel, 2002-2012

Year	**Production** (Billion liters)			**Share of Biofuel Production**	
	Ethanol	**Biodiesel**	**Total Biofuel**	**Ethanol**	**Biodiesel**
2002	21.9	1.5	23.4	94%	6%
2003	27.0	2.0	29.0	93%	7%
2004	29.7	2.5	32.3	92%	8%
2005	33.9	4.1	38.1	89%	11%
2006	41.5	7.2	48.8	85%	15%
2007	53.6	10.4	64.0	84%	16%
2008	70.7	15.2	85.9	82%	18%
2009	77.0	17.9	94.9	81%	19%
2010	88.6	19.6	108.2	82%	18%
2011	86.8	23.4	110.2	79%	21%
2012	85.9	25.0	110.9	77%	23%
2002-2012 average	56.1	11.7	67.8	85%	15%

Sources: ANP (2014), EIA (2014a), LMC International (2013) and OECD-FAO (2013).

[36] As of 2012, there were only three biomethanol plants in operation in the world, with startup dates in 2010-2011 and a combined capacity of 204.5 kt per year (IEA-ETSAP and IRENA, 2013). In addition, only four green diesel production facilities were identified worldwide in 2013, with a combined capacity to process 2.1 million tons of vegetable oils per year (Vonortas and Papayannakos, 2014).

Brazil and the United States are the world's leading players in the ethanol sector. Together, the two countries accounted for 89 percent of world production and 88 percent of world consumption in 2002-2012 (Tables 3.2 and 3.3). Their leadership position in the ethanol market has been facilitated by the convergence of market forces (i.e. high world prices for foreign petroleum and readily available domestic feedstock) and significant government support. While Brazil's large-scale adoption of ethanol as a substitute to fossil fuels dates back to the National Alcohol Program (Proálcool) that ensued the 1970s oil crises, the United States' drastic shift towards ethanol use occurred in the early twenty-first century, following statewide bans on the use of methyl tertiary butyl ether (MTBE) as an oxygenate additive in gasoline and federal legislation establishing annual targets for the volume of renewable fuel that must be blended in transportation fuel.[37] Although strong incentives have given rise to fledgling ethanol industries elsewhere, ethanol production in these countries is still small compared to ethanol production in the United States and Brazil.[38]

This chapter is divided into three sections, in addition to this introduction. Section 3.2 reviews policy instruments that support ethanol in the United States and Brazil and presents a methodology to estimate their subsidy equivalent value. The proposed metric is based on the concepts of support used by the Organization for Economic Cooperation and Development (OECD) to monitor and evaluate developments in agricultural policy, most notably the producer support estimate (PSE) and the consumer support estimate (CSE). The analysis focuses on the 11-year period following the deregulation of the Brazilian sugarcane industry (2002-2012).

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[37] The Energy Policy Act of 2005 established a volume target of 28.4 billion liters of renewable fuel use by 2012. The Energy Independence and Security Act of 2007 extended the target to 136.3 billion liters by 2022.

[38] The European Union (EU), China and Canada are the world's three main producers and consumers of ethanol after the United States and Brazil. They accounted for respectively 4.8 percent, 2.6 percent and 2 percent of world ethanol output in 2011. All other countries in the world combined accounted for only 3.5 percent of production in the same year, most of which was concentrated in Thailand, Australia, Colombia and India (EIA, 2014).

Table 3.2: World ethanol production, by main producers, 2002-2012

Year	**Production** (Billion liters)						Share of US & Brazil in World Production
	US	Brazil	EU	China	ROW	World	
2002	8.1	12.6	0.3	0.3	0.7	21.9	94%
2003	10.6	14.5	0.4	0.8	0.7	27.0	93%
2004	12.9	14.6	0.4	1.0	0.7	29.7	93%
2005	14.8	16.0	0.8	1.2	1.1	33.9	91%
2006	18.5	17.8	1.5	1.6	2.1	41.5	87%
2007	24.7	22.6	1.8	1.7	3.0	53.6	88%
2008	35.2	27.1	2.7	2.0	3.6	70.7	88%
2009	41.4	26.1	3.4	2.1	3.9	77.0	88%
2010	50.3	28.2	4.1	2.1	3.8	88.6	89%
2011	52.7	22.9	4.2	2.3	4.8	86.8	87%
2012	50.0	23.5	4.3	2.3	5.7	85.9	86%
2002-2012 average	29.0	20.5	2.2	1.6	2.7	56.1	89%

Note: ROW: rest of the world.
Sources: ANP (2014), EIA (2014a), and LMC International (2013).

Table 3.3: World ethanol consumption, by main consumers, 2002-2012

Year	**Consumption** (Billion liters)						Share of US & Brazil in World Consumption
	US	Brazil	EU	China	ROW	World	
2002	7.8	9.3	0.3	0.3	0.5	18.3	94%
2003	10.7	8.3	0.5	0.8	0.6	20.8	91%
2004	13.4	10.3	0.6	1.0	0.6	25.9	92%
2005	15.4	10.6	1.1	1.2	0.8	29.0	89%
2006	20.7	11.3	1.8	1.6	1.1	36.5	88%
2007	26.1	15.2	2.3	1.7	2.1	47.4	87%
2008	36.7	19.6	3.5	2.0	2.6	64.4	87%
2009	41.8	22.8	4.5	2.1	3.1	74.3	87%
2010	48.7	22.2	5.7	2.1	3.7	82.4	86%
2011	48.8	19.3	6.0	2.2	5.2	81.6	83%
2012	48.8	17.8	5.7	2.3	5.3	79.9	83%
2002-2012 average	29.0	15.2	2.9	1.6	2.4	51.0	88%

Note: ROW: rest of the world.
Sources: ANP (2014), EIA (2014a) and LMC International (2013).

Section 3.3 assesses the magnitude of market distortions caused by U.S. and Brazilian ethanol support policies. It constructs a partial equilibrium model of the ethanol sector to evaluate the impact of support mechanisms on prices, supply, demand and trade. Finally, Section 3.4 draws conclusions and discusses policy implications in light of recent market developments and changes in ethanol support instruments in the United States and Brazil. A special focus is given to multilateral trade rules and existing jurisprudence to determine whether grounds exist or existed for the initiation of trade litigation in the WTO Dispute Settlement Body (DSB) against U.S. or Brazilian ethanol policy instruments. In light of the subsidy equivalent values and economic distortions estimated in Sections 3.2 and 3.3, it draws from the General Agreement on Tariffs and Trade (GATT) and the Agreement on Subsidies and Countervailing Measures (ASCM) to determine whether the United States and Brazil failed to live up to multilateral obligations.

3.2. Subsidy Equivalent Value of Ethanol Policies

Measuring subsidies to biofuels is motivated by the interest of governments and society in understanding the effects of biofuels policies on areas as diverse as trade, the environment, energy security, food security, and development. While a subsidy indicator alone does not contain information on these effects, it is a crucial input in economic models aimed at estimating them. As a comprehensive and consistent method for quantifying subsidies permits comparisons of support levels both across time and between countries, it facilitates the examination of policy progress domestically and serves as a common base for the establishment of international policy dialogue. This section investigates US and Brazilian public policy instruments that support ethanol and present a methodology to assess their subsidy equivalent values. Results obtained in this section are used as inputs in Section 3.3 to estimate the impacts of ethanol subsidies on prices, production, consumption and trade.

There exists no set of internationally agreed standards for estimating the subsidy value of programs, and for preparing and using aggregates and derived indicators (Jones and Steenblik, 2010). Numerous methodologies for estimating subsidy values have been developed for particular products and sectors by inter-governmental organizations (FAO, IEA, OECD, World Bank and WTO), non-governmental organizations (Earth Track, the Environmental Working Group and the International Institute for Sustainable Development) and national government agencies.[39] These methodologies may vary significantly due to their distinct definitions of subsidy and different valuation methods.

Notable among such methodologies is the one underlying the family of support indicators developed by the OECD: the producer support estimate (PSE), general services support estimate (GSSE), consumer support estimate (CSE), and total support estimate (TSE). Used extensively since 1987 to measure support for agricultural commodities, these indicators serve as a useful tool for policy dialogue not only amongst OECD countries, but also with non-OECD countries, international organizations, the private sector, non-governmental organizations and academia. More recently, the OECD has outlined a comprehensive scheme for discussing support to the energy sector in line with the PSE framework (OECD, 2010a).

In this section, the PSE and its associated indicators are taken as the primary building blocks in the construction of subsidy equivalent values for the US and Brazilian ethanol sectors. Distinguished according to the recipient of the support, the OECD support indicators estimate the annual monetary value of gross transfers arising from policy measures that support a given

[39] Jones and Steenblik (2010) compiled a manual of different methodologies used by these organizations to calculate subsidy values.

commodity, regardless of their nature, objectives or impacts on production or income (OECD, 2010b). These transfers may arise from either taxpayers, consumers or producers, and include not only budgetary expenditures, but also market price support and concessions that do not require actual monetary disbursements. In order for a policy instrument to qualify for inclusion in one of the indicators of support, it must generate an explicit or implicit transfer that supports either producers (PSE), general services provided to producers (GSSE) or consumers (CSE) in a given sector. General policy measures available throughout the entire economy are not considered in the estimation of any of these indicators. A detailed description of the principles applied in estimating the OECD support indicators of support, along with more practical underpinnings of the methodology, are found in OECD (2010b).

3.2.1. United States

Government support has long played a vital role in the expansion of the ethanol industry in the United States. Since the first major federal subsidy to ethanol – a full exemption from the motor fuel excise tax – was introduced in the Energy Tax Act of 1978, hundreds of programs have been put in place to subsidize nearly every stage of the ethanol production chain (Koplow, 2006). This subsection quantifies the subsidy equivalent value of key US policy instruments used to support the ethanol sector in 2002-2012, including tax exemptions and credits, tariffs and other import charges, mandatory blending requirements, input subsidies, and producer payments.

Policy instruments are grouped into four broad categories, according to the method used to quantify the transfers they provide to the ethanol sector:

(i) Measures that involve revenue foregone;

(ii) Measures that provide market price support;

(iii) Measures that lower input costs; and

(iv) Measures that entail budgetary transfers.

The following subsections examine policies in each of these categories and estimate the total subsidy equivalent value for the ethanol sector in the United States.

3.2.1.1 Revenue Foregone

Support may be provided to a particular sector in ways that do not imply actual budgetary transfers, but at the cost of revenue foregone by the government (OECD, 2010b). In much the same way as would happen with a program involving explicit budgetary expenditures, these implicit transfers entail that some revenue is foregone and economic incentives are provided to producers or consumers in a given sector. Fiscal incentives in the form of tax exemptions and tax credits were the single most important type of transfers based on revenue foregone provided to the US ethanol sector in 2002-2012.[40]

Consumption Tax Concessions

The federal motor fuel excise tax exemption for ethanol was first established by the Energy Tax of Act of 1978. Although the Crude Oil Windfall Profits Tax of Act of 1980 introduced an income tax credit for ethanol blenders as an alternative support mechanism for the fledgling biofuel sector, the tax exemption was generally favored as it offered more benefits than the tax credit.[41] The two

[40] Preferential lending is another type of implicit transfer that supports the US ethanol sector. For example, the Energy Policy Act of 2005 instituted loan guarantee programs for ethanol produced from sugar and cellulosic or municipal solid waste sources. In addition, a number of states provide subsidized loans to ethanol producers and authorize tax-exempt financing for ethanol projects (Koplow, 2006).

[41] There are several reasons why the ethanol tax exemption was preferred over the tax credit. First, while the tax exemption was available upfront, the benefit of the tax credit had to await either the filing of the income tax return or the payment of estimated taxes. Second, the ethanol tax credit was itself taxable as gross income, which reduced the value of the credit. Third, the ethanol tax credit was a component of the general business tax credit and was subject

policy instruments were extended and modified by successive pieces of legislation, including the Transportation Equity Act for the 21st Century of 1998, which established exemption and credit rates of 53 cents per gallon of ethanol in 2001-2002, 52 cents per gallon in 2003-2004, and 51 cents per gallon in 2005-2007. The American Jobs Creation Act of 2004 replaced the two historical tax subsidies with a Volumetric Ethanol Excise Tax Credit (VEETC) of 51 cents per gallon, which was reduced to 45 cents per gallon in the Food, Conservation and Energy Act of 2008, and ultimately suspended in December 2011.

According to the PSE methodology, tax concessions should be included in estimated support when they are sector-specific or when agents in a specific sector are their principal beneficiaries. If a tax concession grants a fiscal advantage to a particular sector or group, then there must necessarily exist another sector or group that does not benefit from such concession in the same manner. Therefore, the implicit support provided to the former can be measured in comparison to the treatment provided to the latter. In the case of tax exemptions and credits provided to the US ethanol sector, the counterfactual is the prevailing tax rate on gasoline.

The VEETC and its preceding tax exemption made blenders more willing to blend ethanol into gasoline. They shifted the demand curve for ethanol to the right and raised the domestic price, but left the supply curve unchanged. Transfers arising from federal consumption tax concessions (FCTC) are estimated by multiplying the tax concession rate by the amount of ethanol that was blended in the United States, more formally expressed as follows:

$$G_{FCTC}^{US} = t_{FCTC}^{US}\left(Q_P^{US} + Q_M^{US}\right) \tag{3.1}$$

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to the carryforward and carryback rules. Finally, since the tax credit was not refundable, it could be used only against a positive tax liability (Lazzarini, 1999).

where G_{FCTC}^{US}: Transfers arising from federal consumption tax concessions

t_{FCTC}^{US}: Tax rate differential of federal consumption tax concessions

Q_{P}^{US}: US fuel ethanol production

Q_{M}^{US}: US fuel ethanol imports

Estimated transfers from federal consumption tax concessions are summarized in Table 3.4, along with estimates for transfers from other federal and state tax concessions to the ethanol sector in the United States between 2002 and 2012. The VEETC and its preceding federal ethanol excise tax exemption accounted for an average annual subsidy of US$3.2 billion in 2002-2012, or US$3.5 billion if the year of 2012 is excluded from the average. This support reached its peak in 2011, when a total of US$6.3 billion in federal tax revenue were foregone.

Table 3.4: Government revenue foregone in favor of ethanol, United States, 2002-2012 *(US$ million)*

Year	Consumption Tax Concessions			Production Tax Concessions			Total Revenue Foregone
	Federal	State	Total	Federal	State	Total	
2002	1,141	78	1,219	18	4	22	1,240
2003	1,465	94	1,559	20	6	26	1,585
2004	1,843	116	1,959	21	15	36	1,995
2005	2,060	125	2,186	23	16	39	2,225
2006	2,864	140	3,004	98	22	120	3,124
2007	3,550	188	3,738	108	35	143	3,880
2008	5,004	286	5,290	105	47	152	5,443
2009	5,011	207	5,218	105	47	152	5,370
2010	5,991	178	6,169	108	49	157	6,326
2011	6,345	221	6,567	109	38	147	6,713
2012	0	226	226	0	10	10	235
2002-2012 average	3,207	169	3,376	65	26	91	3,467

Sources: Author's calculations. Based on EIA (2014b), USDA (2014a) and state statutes.

In addition to the federal tax exemptions and credits, ten states provided tax concessions associated with the consumption of fuel mixtures of 10 percent ethanol and 90 percent gasoline (E10) between 2002 and 2012.[42] The share of these states in US ethanol fuel consumption declined from 21 percent in 2002 to 6 percent in 2012. While two states – Iowa and Oklahoma – provided tax credits for motor fuel retail dealers, nine states – Alaska, Connecticut, Hawaii, Idaho, Illinois, Iowa, Maine, Montana and South Dakota – granted exemptions or rate reductions on motor fuel taxes and other taxes connected with motor fuel consumption.

Iowa originally granted a tax credit of 2.5 cents per gallon of blended fuel sold in excess of 60 percent of total fuel sales between 2002 and 2008. A variable tax credit, contingent on both the volume of total motor fuels sales and the share of biofuel sales on total gasoline sales, was implemented in tax years 2009 through 2012, with rates ranging from 2.5 to 8 cents per gallon of pure ethanol sold (Harris, 2009). In Oklahoma, retail dealers were eligible for a tax credit of 1.6 cents per gallon of ethanol blended into gasoline between 2006 and 2012, as long as they provided an identical price reduction to the purchaser of the blended fuel.

Idaho fully exempted ethanol from the motor fuel tax of 25 cents per gallon between 2002 and 2009. Iowa and South Dakota provided average tax rate reductions of 17 cents and 18 cents per gallon of blended ethanol between 2002 and 2012. In Connecticut and Maine, reductions were more limited both in size (10 cents per gallon of blended ethanol) and in duration (2002-2005 in the former, and 2008-2009 in the latter). In Montana, a 15 percent reduction on the tax rate of blended fuel applied between 2005 and 2009. In Alaska, a reduction of 6 cents per gallon of blended fuel applied in areas and during the months in which ethanol blended fuel was sold in an

[42] A larger number of states provided tax concessions for fuel mixtures of at least 85 percent ethanol (E85). Since E85 represented less than 1 percent of total fuel ethanol consumption in the United States in 2002-2012, these concessions are not addressed in this section.

effort to attain federal and state air quality standards for carbon monoxide. Finally, Hawaii and Illinois granted rate reductions not on the motor fuel tax itself, but on other taxes associated with fuel consumption. Hawaii exempted E10 and higher blends from the general excise tax between 2002 and 2009, and Illinois reduced the sales tax on E10 by 30 percent from 2002 to mid-2003 and 20 percent from mid-2003 to 2012.

Total transfers to the ethanol sector arising from state consumption tax concessions (SCTC) correspond to the sum of transfers provided by tax concessions across all states. Transfers from individual tax concessions are estimated by multiplying the applicable tax rate differential by the qualifying volume of fuel ethanol consumed in the respective state. More formally:

$$G_{SCTC}^{US} = \sum_{s} G_c^s = \sum_{s} t_c^s \, \omega_c^s \, Q_c^s + \sum_{s} \left(t_g^s - t_e^s\right) Q_c^s \qquad (3.2)$$

where

where	G_{SCTC}^{US}:	Transfers arising from state consumption tax concessions
	G_c^s:	Transfer arising from consumption tax concessions in state *s*
	t_c^s:	Consumption tax credit rate in state *s*
	ω_c^s:	Share of state *s* consumption that qualifies for tax credit
	Q_c^s:	Ethanol consumption in state *s*
	t_g^s:	Tax rate on gasoline in state *s*
	t_e^s:	Tax rate on blended ethanol in state *s*

Unlike in equation 3.1, where production and import levels are used to estimate transfers from federal consumption tax concessions, consumption levels are used in equation 3.2 because state tax concessions are contingent on the consumption of ethanol within the borders of a given state. While the federal tax credit applied to all ethanol blended with gasoline in the United States, irrespective of whether it was consumed domestically, state tax credits and tax rate reductions applied only to sales that took place in a particular state. The parameter ω_k^s, which modifies state consumption levels in the first part of equation 3.2, is equal to one for all states, with the exception of Iowa. Since only blended fuel sales in excess of 60 percent of total fuel sales are eligible for Iowa's retail tax credit, ω_c^{Iowa} may only vary between 0 and 0.4. In the calculations carried out in this subsection, ω_c^{Iowa} is assumed to equal 0.2.

Total transfers arising from state consumption tax concessions were on average US$169 million per year between 2002 and 2012 (Table 3.5). While this figure is small compared to the US$3.2 billion in average transfers from federal consumption tax concessions in the same period, state consumption tax concessions had a significant impact at the local level in some parts so of the country, raising the per liter level of subsidization by approximately 50 percent. This was the case in Idaho, Iowa and South Dakota, where local consumption subsidies of 25, 21 and 20 cents per gallon corresponded to 56 percent, 47 percent and 44 percent, respectively, of the federal tax credit of 45 cents per gallon in 2009.

Table 3.5: State consumption tax concessions for ethanol, United States, 2002-2012
(US$ million)

Year	AK	CT	HI	IA	ID	IL	ME	MT	OK	SD	Total
2002	2	0.4	0	13	0	57	-	-	-	5	78
2003	2	2	0	14	0	72	-	-	-	5	94
2004	3	15	0	19	0	73	-	-	-	5	116
2005	-	4	13	12	4	83	-	4	-	6	125
2006	-	-	17	12	3	96	-	5	1	5	140
2007	-	-	22	20	6	122	-	9	1	7	188
2008	-	-	51	28	7	176	2	11	3	8	286
2009	-	-	43	28	3	113	3	6	2	8	207
2010	-	-	-	29	-	141	-	-	2	6	178
2011	-	-	-	29	-	184	-	-	3	6	221
2012	-	-	-	27	-	191	-	-	2	5	226
2002-12 average	1	2	13	21	2	119	1	3	1	6	169

Note: A dash indicates that consumption tax concessions were not provided in a given year.
Sources: Author's calculations. Based on state statutes and EIA (2014b).

Production Tax Concessions

The main production tax concession provided by the federal government to the ethanol sector between 2002 and 2012 was the Small Ethanol Producer Tax Credit (SEPTC). Established by the Omnibus Budget Reconciliation Act of 1990, it provided a supplemental tax credit of 10 cents per gallon for producers that had, at all time during the tax year, not more than 30 million gallons of productive capacity of any type of ethanol. The incentive applied only to the first 15 million gallons of ethanol produced in a tax year and was allowed as a credit against the producer's income tax liability. The Energy Policy Act of 2005 expanded the eligibility threshold to producers with an annual production capacity of 60 million gallons. Like the VEETC, the SEPTC expired in 2011.

The Food, Conservation and Energy Act of 2008 introduced a second federal production tax credit for ethanol producers: the Cellulosic Biofuel Producer Tax Credit (CBPTC). Producers of cellulosic ethanol obtained from any lignocellulosic or hemicellulosic matter that is available on a renewable or recurring basis were eligible for a tax credit of 46 cents per gallon of second generation biofuel sold or used in-house between 2009 and 2012, in addition to any other tax credit or benefit generally available to first generation biofuels. However, since the cellulosic biofuel industry took longer than foreseen to achieve commercial viability, the CBPTC was not actively used. The United States Energy Information Administration (EIA) estimates that only 20,000 gallons of fuels using cellulosic biomass from commercial-scale facilities were produced until late 2012 (EIA, 2013). If any payments were made to ethanol producers under the CBPTC, they were likely very modest. Therefore, transfers under this program are assumed to have been nil during the period under analysis. As a result, total transfers arising from federal production tax concessions (FPTC) are defined to be equal to transfers under the SEPTC program.

The estimated transfer arising from the SEPTC for qualifying plants with an annual output below 15 million gallons is equal to the SEPTC tax credit rate multiplied by the plant's annual output. For qualifying plants with an annual output above 15 million gallons, the transfer is equal to the tax rate differential multiplied by 15 million. Aggregate SEPTC transfers are equal to the sum of SEPTC for all qualifying plants, more formally expressed as follows:

$$G_{FPTC}^{US} = t_{SEPTC}^{US} \sum_{j} Q_{SEPTC}^{j} \tag{3.3}$$

where $$Q_{SEPTC}^{j} = \begin{cases} Q_p^j & \text{if } Q_p^j \leq \bar{Q}_{SEPTC} \text{ and plant } j \text{ meets eligibility requirements} \\ \bar{Q}_{SEPTC} & \text{if } Q_p^j > \bar{Q}_{SEPTC} \text{ and plant } j \text{ meets eligibility requirements} \\ 0 & \text{otherwise} \end{cases}$$

G_{FPTC}^{US}: Transfers arising from federal production tax concessions

t_{SEPTC}^{US} SEPTC tax credit rate

Q_{SEPTC}^{j}: Qualifying SEPTC volume for plant *j*

Q_p^j: Ethanol output of plant *j*

$\bar{Q}_{SEPTC}$: Maximum per plant qualifying SEPTC volume

As production data at the plant level are difficult to obtain, nameplate plant capacity is used as a proxy for plant output. For years in which a plant is idle, output is set at zero. Since some plants may operate below nameplate capacity, estimates may slightly overestimate the impact of the tax credit on government revenue. Producers operating above nameplate capacity would have little or no effect on estimated transfers, as the capacity of most plants is above 15 million gallons and payments apply to only the first 15 million gallons of ethanol produced by each plant.

The SEPTC accounted for an average annual subsidy of US$65 million in 2002-2012, or US$72 million if 2012 is excluded from the average (Table 3.4). Estimated transfers were under US$23 million per year in 2002-2005, when only plants with a productive capacity at or below 30 million gallons qualified for the tax credit. After the eligibility threshold was raised to 60 million gallons, transfers soared to US$98 million in 2006 and US$109 million in 2011.

In addition to the SEPTC, five states (Indiana, Kentucky, Nebraska, New York and Wyoming) provided production tax credits directly tied to plant output between 2002 and 2012. Five other states (Hawaii, Maine, Montana, Oklahoma and South Carolina) had production tax credits on the books, but did not produce fuel ethanol on a commercial scale during this period.[43] Credits ranged from US$0.036 per gallon in Maine to US$1.00 per gallon in Kentucky, and were generally subject to caps per producer and per year. Transfers arising from state production tax concession (SPTC) are estimated using a generalized version of equation (3.3). More formally:

$$G_{SPTC}^{US} = \sum_{s}\left(t_p^s \sum_{j} Q_s^j\right) \tag{3.4}$$

where $$Q_s^j = \begin{cases} Q_p^j & \text{if } Q_p^j \leq \bar{Q}_s \text{ and plant } j \text{ meets eligibility requirements} \\ \bar{Q}_s & \text{if } Q_p^j > \bar{Q}_s \text{ and plant } j \text{ meets eligibility requirements} \\ 0 & \text{otherwise} \end{cases}$$

G_{SPTC}^{US}: Transfers arising from state production tax concessions

t_p^s: Production tax credit rate in state *s*

Q_s^j: Qualifying volume for plant *j* in state *s*

Q_p^j: Ethanol output of plant *j*

$\bar{Q}_s$: Maximum per plant qualifying volume in state *s*

Total transfers arising from state production tax credits averaged US$26 million per year between 2002 and 2012 (Table 3.6). This corresponds to 40 percent of the average annual value of federal production tax credits provided in the same period. Transfers under state production tax

[43] Ten other states provided incentive payments linked to ethanol production in 2002-2012. Since these payments were in the form of grants, they are accounted under budgetary outlays in Subsection 3.2.1.4.

credits increased significantly over time, from a low of US$4 million in 2002 to a peak of US$49 million in 2010, due to both an increase in the number of states offering production tax credits and an expansion in the ethanol production capacity of these states. The significant fall in transfers between 2011 and 2012 was due in large part to the discontinuation of producer incentives in Nebraska, the second largest ethanol-producing state in the country.

Table 3.6: State production tax concessions linked to output, United States, 2002-2012 *(US$ million)*

Year	IN	KY	NE	NY	WY	Total
2002	-	-	2	-	2	4
2003	-	-	4	-	2	6
2004	-	-	13	-	2	15
2005	-	-	14	-	2	16
2006	-	-	20	-	2	22
2007	6	5	22	-	2	35
2008	10	5	29	2	2	47
2009	10	5	26	4	1	47
2010	7	5	33	4	-	49
2011	5	5	24	4	-	38
2012	2	5	-	3	-	10
2002-2012 average	4	3	17	1	1	26

Note: A dash indicates that state production tax concessions were not provided in a given year.
Sources: Author's calculations. Based on state statutes and EIA (2014b).

Several states also offered tax credits and tax exemptions on investment in ethanol infrastructure, including production, storage, distribution and delivery facilities and equipment. For example, Florida provided an income tax credit for 75 percent of all capital, operation, maintenance and research and development costs incurred in connection with an investment in the production, storage and distribution of ethanol or other biofuels. Georgia provided an exemption from the sales and use tax to tangible personal property used in or for the construction of a facility dedicated to the production and processing of ethanol between July 2007 and June 2012. Transfers arising from ethanol infrastructure investment tax credits are not estimated in this section due to the difficulty in obtaining investment-specific data.

Total federal government revenue foregone in favor of the US ethanol sector (G_{RF}^{US}), defined as the sum of consumption tax concessions ($G_{CTC}^{US} = G_{FCTC}^{US} + G_{SCTC}^{US}$) and production tax concessions ($G_{PTC}^{US} = G_{FPTC}^{US} + G_{SPTC}^{US}$), averaged US$3.5 billion a year between 2002 and 2012. Transfers varied significantly over time, from a peak of US$6.7 billion in 2011 to a bottom of US$205 million in 2012. The great majority of these transfers were consumption tax concessions, with production tax credits accounting for only 3 percent of total revenue foregone during this period. The federal government provided the overwhelming majority of these subsidies. While states accounted for only 5 percent of total revenue foregone in 2002-2011, they became the only source of consumption and production tax credits once the VEETC and SEPTC were eliminated in December 2011.

3.2.1.2 Market Price Support

Market price support (MPS) measures generate transfers from consumers and taxpayers to producers by creating a gap between the domestic producer price and the border price. Measuring the subsidy equivalent value of MPS measures consists of calculating this market price differential (MPD) and multiplying it by the total quantity produced domestically.

Import barriers are the classic example of MPS measures. In the case of the ethanol sector in the United States, the impact of tariffs on domestic and world prices was affected by environmental regulations and MTBE state bans in 2004-2006 and a renewable fuel blending mandate in 2006-2012. While these measures did not affect the wedge between domestic and world prices, they did create a price premium for ethanol by requiring a minimum consumption volume. As a result, blending mandates generated additional transfers to the ethanol sector in a global level by artificially raising returns to producers in the United States and elsewhere.

Between 2002 and December 2011, US import charges on undenatured ethanol consisted of an *ad valorem* import tariff of 2.5 percent and a specific additional import duty of 14.27 cents per liter (54 cents per gallon).[44] Designed to offset the benefit of the excise tax exemption in the case of imports, the latter was first instituted by the Omnibus Reconciliation Act of 1980 and ultimately allowed to expire once federal tax credits were eliminated in December 2011. Although the additional duty remained in place for 34 years, it was in violation of US multilateral obligations. More specifically, it infringed the dual requirement established in GATT Article VIII that any additional charge or duty on imports must involve a service rendered in connection with the importation of a good and must not represent an indirect protection to domestic products.

Given that annual average border prices for ethanol varied between 27 and 54 cents per liter between 2002 and 2009, the combined burden of the *ad valorem* tariff and the specific additional duty on imports was equivalent to an *ad valorem* tariff of 30 to 55 percent. This substantial tariff peak helped keep imports at bay, despite relatively high domestic prices in the United States. As illustrated in Figure 3.1, the significant expansion in fuel ethanol consumption in the United States in 2002-2012 was not accompanied by an increase in import levels. Except in 2006, when foreign ethanol accounted for 14 percent of domestic consumption, imports responded on average for only 2.6 percent of total US fuel ethanol demand.

[44] Imports of denatured ethanol were subject to an MFN import tariff of 1.9 percent and an MFN additional duty of 14.27 cents per liter (54 cents per gallon).

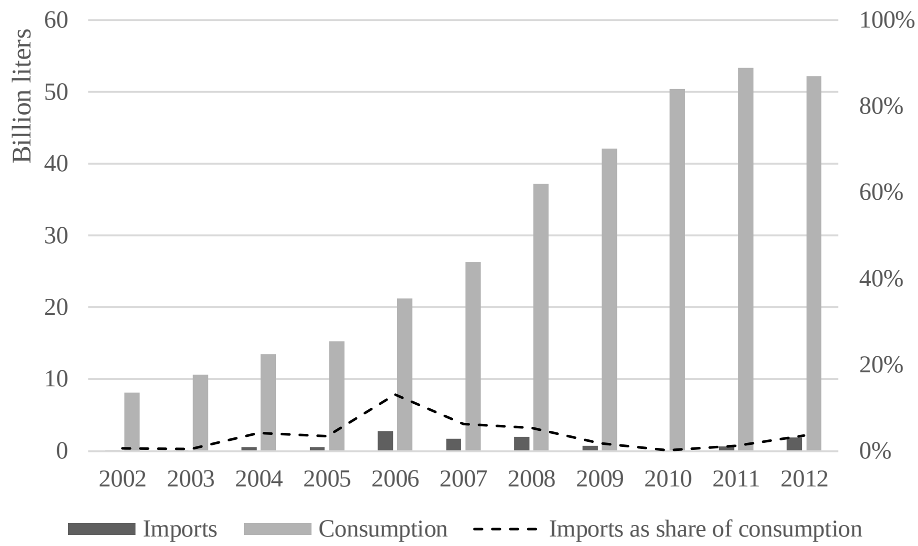


Figure 3.1: United States fuel ethanol consumption and import levels, 2002-2012

Source: Author. Based on USDA (2014a).

Due to the sizeable MFN *ad valorem* equivalent tariff, ethanol imports entered the United States thanks in large part to preferential trade arrangements and a duty drawback mechanism for domestic manufacturers. Between 2002 and 2011, 54 percent of all fuel ethanol imports entered the United States free of duty under the Caribbean Basin Economic Recovery Act (CBERA),[45] the Dominican Republic-Central America-United States Free Trade Area (CAFTA-DR),[46] and the North American Free Trade Area (NAFTA).[47] The great majority of these preferential imports consisted of anhydrous ethanol from CBERA and CAFTA-DR beneficiary countries, which was

[45] Ethanol imports from CBERA beneficiary countries, whether or not produced from agricultural feedstock grown in a CBERA country, were admitted free of duty in 2002-2005. While imports of ethanol produced exclusively from local agricultural feedstock continued to benefit from duty-free access in 2006-2012, duty-free treatment for ethanol dehydrated from non-CBERA and non-CAFTA-DR agricultural feedstock was restricted to a tariff-rate quota (TRQ) of 60 million gallons or 7 percent of the US domestic ethanol market, whichever was greater. An additional 35 million gallons could enter free of duty if it contained at least 30 percent ethanol produced from local feedstock, and an unlimited amount could enter free of duty if it contained at least 50 percent ethanol produced from local feedstock. Imports of fuel ethanol from CBERA and CAFTA-DR countries did not exceed the quota in any year in 2002-2012.

[46] The six countries that signed the CAFTA-DR agreement with the United States were formerly CBERA beneficiaries. Although CAFTA-DR countries ceased to be beneficiary countries under CBERA, they continued to enjoy duty-free access for ethanol in the United States.

[47] The Andean Trade Preference Act and the US-Israel Free Trade Area also contemplated duty-free access to ethanol imports, but no imports of fuel ethanol were made under these preferential trade arrangements in 2002-2012.

obtained through the dehydration of hydrous ethanol originally produced in Brazil. As depicted in Figure 3.2, indirect imports of Brazilian ethanol via CBERA and CAFTA-DR countries were greater than imports coming directly from Brazil in more than half of the years in 2002-2012.

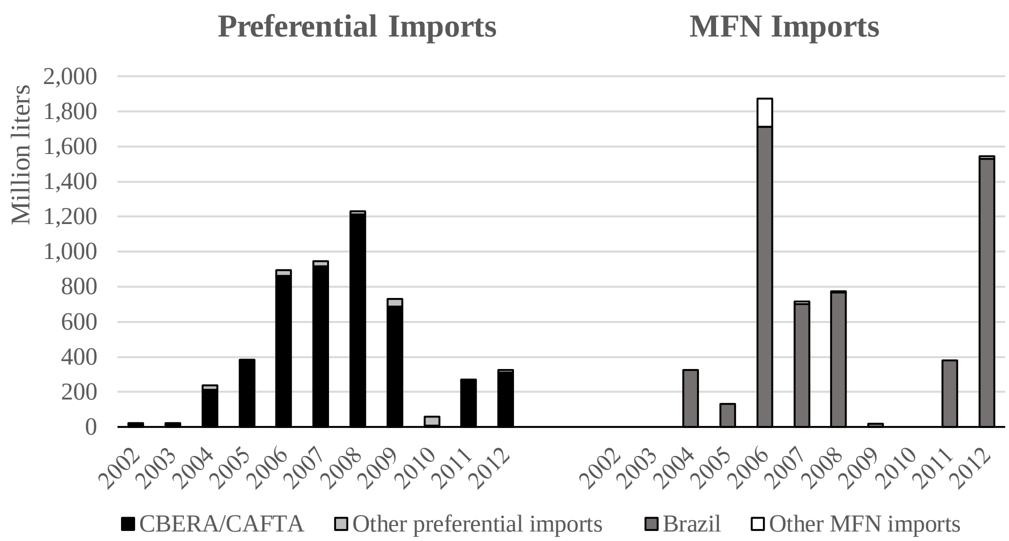


Figure 3.2: Ethanol imports, by import regime and countries of origin, United States, 2002-12

Source: Author. Based on EIA (2014a) and USDA (2014a).

The duty drawback mechanism was used by US importers to circumvent the prohibitive MFN additional duty on ethanol imports. The Tariff Act of 1930, as amended, permitted the refund of duty if the duty-paid good was re-exported or used to make a good that is exported. Special provisions allowed importers to substitute the imported duty-paid product by a like product in the manufacture of the article for exportation. Therefore, a person who manufactured gasoline and imported ethanol could export jet fuel —by selling it to airlines with international flights out of the United States— and still obtain a refund of the duty paid on ethanol, even if the fuel did not contain ethanol (Stubbs, 2010). In order to curtail this loophole, the Food, Conservation, and Energy Act of 2008 established that duty paid on ethanol imports could only be refunded if the exported article upon which a drawback claim was based contained ethanol.

An implicit ethanol blending mandate was introduced in the United States in the early twentieth century when a number of states banned MTBE[48] and Congress decided not to shield MTBE manufacturers from water contamination lawsuits. Ever since the Clean Air Act Amendments of 1990 had required the use of oxygenated and reformulated gasoline in areas with unhealthy levels of air pollution, MTBE and ethanol had been close substitutes in the gasoline oxygenate market. In addition, the two additives had been close substitutes in the octane enhancer market for conventional gasoline sold in all areas of the United States. While refiners were allowed to choose between a number of approved additives, MTBE was the product of choice in most cities outside the Midwest for its lower cost and more favorable blending characteristics.[49] However, the increasing number of state bans and the lack of liability protection forced blenders to drop MTBE and switch over to more expensive ethanol between 2004 and 2006.[50] Figure 3.3 depicts the changing shares of additives in the composition of gasoline weight in the four largest metropolitan areas in the United States.

[48] Iowa was the first state to limit the use of MTBE as fuel additive in the United States. In February 2000, it established that no more than 2 percent of MTBE by volume was allowed in gasoline sold in the state. Effective on July 2000, the cap was lowered to 0.5 percent by volume. In the same month, three other Midwestern states imposed partial MTBE bans: Minnesota (0.33 percent by volume), Nebraska (1 percent) and South Dakota (2 percent). In January 2001, South Dakota lowered its cap to 0.5 percent. These partial bans had limited impact on gasoline additive markets, as these states were not significant consumers of MTBE. Subsequently, six states implemented complete bans on MTBE: Colorado (effective as of May 2002), Michigan (June 2003), California, Connecticut and New York (January 2004), and Minnesota (July 2005). In addition, ten states limited MTBE in motor vehicle fuel to no more than trace amounts: Washington (January 2004), Illinois, Indiana and Kansas (July 2004), Wisconsin (August 2004), Arizona (January 2005), Ohio (July 2005), Missouri and North Dakota (August 2005), and Kentucky (January 2006). This second wave of complete and partial bans had a substantial impact on gasoline additive markets, as it involved states that accounted for a substantial share of total MTBE consumed in the United States. Six other states (Maine, New Hampshire, New Jersey, North Carolina, Rhode Island and Vermont) also passed legislation limiting MTBE in motor fuel to no more than trace amounts, but the May 2006 federal phase out of the oxygenate requirement came into force before state regulations became effective.

[49] Unlike ethanol, MTBE can be shipped through existing pipelines, and its volatility is lower, making it easier to meet emission standards. Moreover, ethanol-blended gasoline cannot be intermingled with other gasolines during the summer months. MTBE was the oxygenate of choice in all metropolitan areas subject to the Reformulated Gasoline Program in the 1990s, except for greater Chicago, Milwaukee-Racine (WI) and Covington (KY), where ethanol was the preferred gasoline additive (EPA, 2014).

[50] MTBE has not been used in significant quantities in oxygenated or reformulated gasoline areas since 2005. A similar decrease in MTBE use has also been observed in conventional gasoline areas (EPA, 2014).

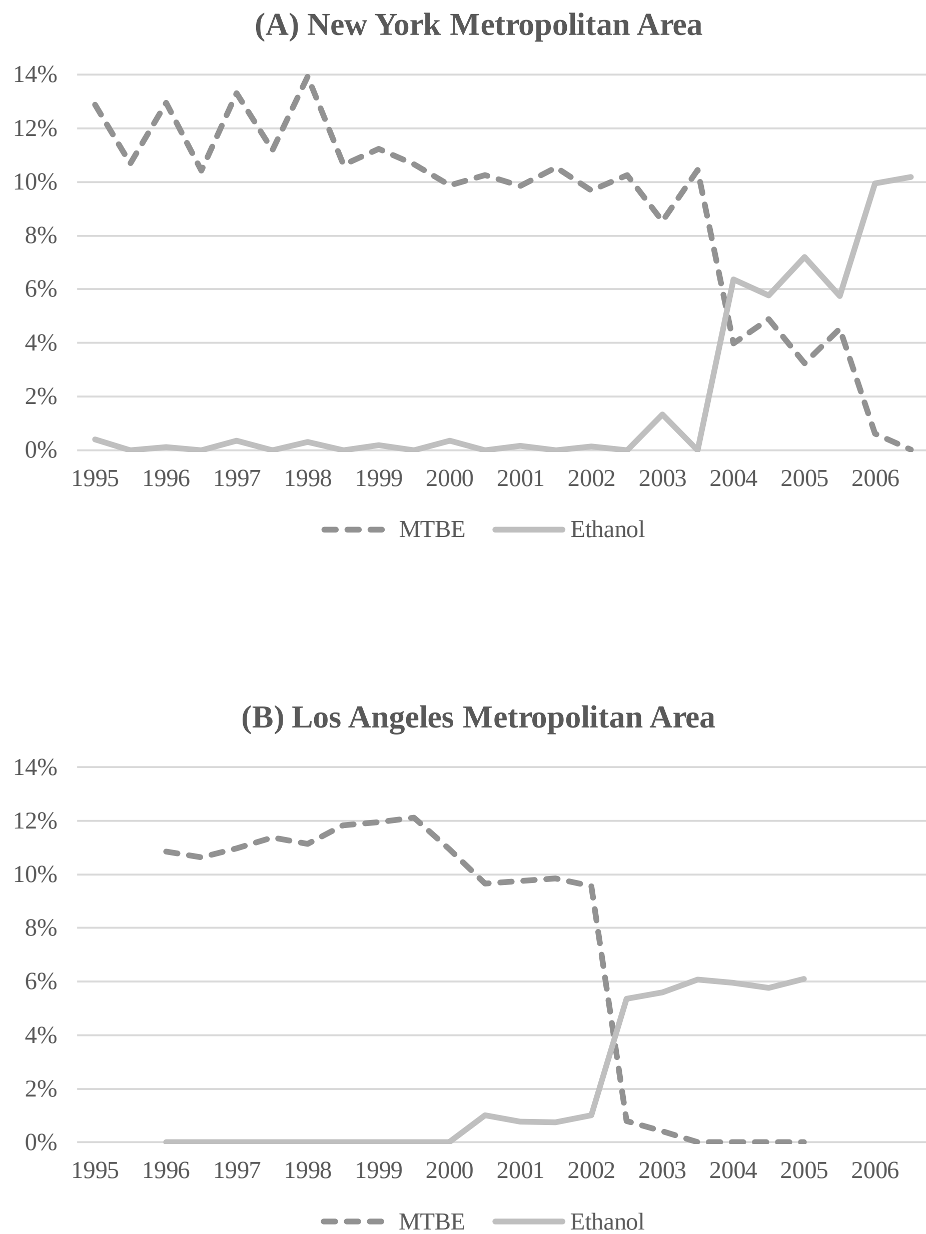
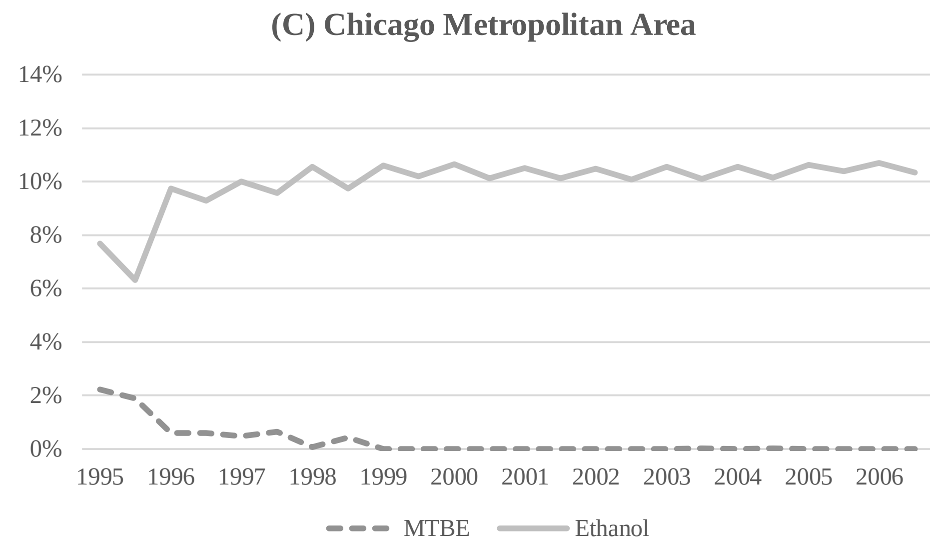


Figure 3.3: Additives as a share of gasoline weight in selected metropolitan areas, United States, 1995-2006

Notes: Short-term fluctuations reflect seasonal (summer vs. winter) differences in gasoline composition. Data for the Los Angeles metropolitan area is only available for 1996-2005.
Source: Author. Based on EPA (2014).



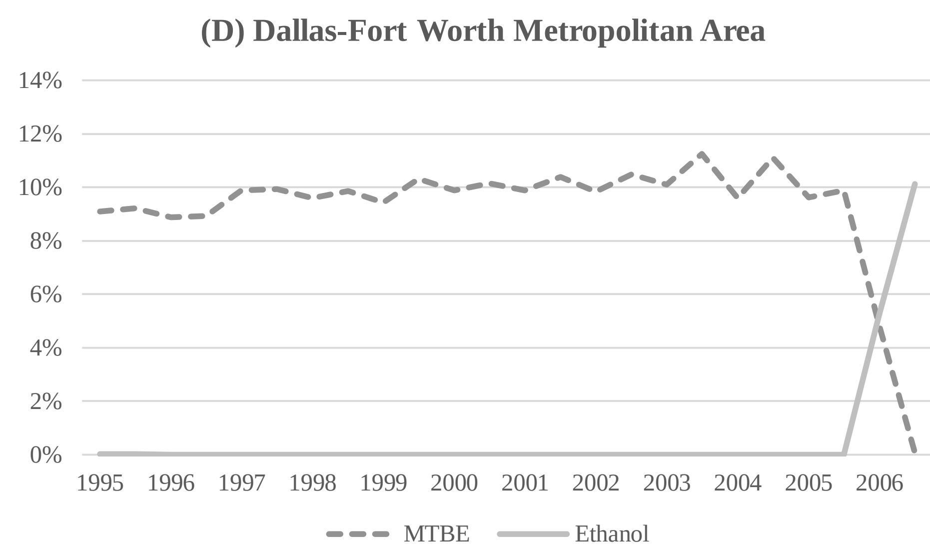


Figure 3.3 (cont.): Additives as a share of gasoline weight in selected metropolitan areas, United States, 1995-2006

Notes: Short-term fluctuations reflect seasonal (summer vs. winter) differences in gasoline composition.
Source: Author. Based on EPA (2014).

In the New York metropolitan area (Panel A), ethanol accounted for close to zero percent of the weight of reformulated gasoline until January 2004, when the state introduced a ban on MTBE. Within two years, ethanol completely substituted MTBE as a gasoline additive. In the Los Angeles metropolitan area (Panel B), ethanol replaced MTBE even before California implemented its ban on MTBE in January 2004. All major refiners in the state switched to ethanol in early 2003 in anticipation of impending regulatory changes (RFA, 2003). By the end of the year, ethanol accounted for more than 90 percent of the additives in gasoline sold in the Los Angeles metropolitan area.

Due to its proximity to the heart of the Corn Belt, the Chicago metropolitan area (Panel C) relied heavily on ethanol as a gasoline additive since the inception of the oxygenate requirements established in the Clean Air Act Amendments of 1990. As of 1999, no traces of MTBE were find in surveys of reformulated gasoline in Chicago (EPA, 2014). The only other reformulated gasoline areas in the United States where ethanol accounted for the majority of gasoline additive use were Covington (KY), Louisville (KY), Milwaukee-Racine (WI) and Saint Louis (MO), all located in the Midwestern region of the country. Chicago became the first city in the United State to ban the manufacture, blending, delivery, sale, distribution or use of MTBE in December 2000.

In the absence of a state ban on MTBE in Texas, gasoline blenders in the Dallas-Fort Worth metropolitan area (Panel D) continued to rely almost exclusively on MTBE as an additive until an explicit federal ethanol blending mandate came into force in 2006. A similar pattern was observed in other US metropolitan areas located in states that did not implement MTBE bans, including Baltimore, Boston, Houston, Manchester, Philadelphia, Providence, Richmond, Virginia Beach, and Washington.

In order to attain the minimum levels of oxygen required by the Winter Oxygenated Fuels Program and the Reformulated Gasoline Program, blenders were compelled to mix gasoline with, respectively, 7.4 percent and 5.8 percent of ethanol by volume (EIA, 2000). Given the levels of oxygenated and reformulated gasoline sales prevailing in the United States in 2004-2006, the phasing out of MTBE established a guaranteed minimum annual demand for 8 billion liters of ethanol as an oxygenate. It also created an additional annual demand for 10.1 billion liters of ethanol as an octane enhancer for conventional gasoline. In total, the substitution away from MTBE effectively established an implicit blending mandate equivalent to 18.1 billion liters of ethanol per year.

Established by the Energy Policy Act of 2005, the Renewable Fuel Standard (RFS) was the first explicit biofuel mandate at the US federal level, requiring 4 billion gallons (15.1 billion liters) of renewable fuel to be blended into gasoline in 2006 and 7.5 billion gallons (28.4 billion liters) by 2012.[51] Given that the implicit mandate for ethanol as a gasoline additive already required 18.1 billion liters of the biofuel per year, the explicit RFS mandate was not binding in its two initial years. The Energy Independence and Security Act of 2007 expanded the RFS program significantly by including diesel, in addition to gasoline, and by extending target volumes to 9 billion gallons (34 billion liters) in 2008 and 36 billion gallons (136.3 billion liters) by 2022, of which 21 billion gallons (79.5 billion liters) for advanced (i.e. non-corn starch) biofuels. The effective cap on corn starch ethanol that may qualify under the RFS program corresponds to the difference between the total renewable fuel mandate and the advanced biofuel mandate, or 15 billion gallons (56.8 billion liters) by 2022.

[51] At the time the federal ethanol mandate was instituted in 2005, Minnesota and Hawaii had already implemented statewide ethanol mandates requiring a 10 percent blend of ethanol in gasoline. In Hawaii, the rule applied to only 85 percent of the gasoline sold in the state. These state mandates were predated by a 1999 county level mandate in Clark County, Nevada, requiring a 10 volume percent ethanol blend for gasoline sold from October through March.

Import tariffs create a gap between domestic and border prices. When tariffs and binding mandates occur at the same time, equilibrium prices are higher, but the gap remains unchanged. The benefit of calculating the value of price support transfers through an MPD is that it isolates the effect of tariffs from that of blending mandates. Additional policies that raise the price received by producers for a commodity without raising consumer prices, like production and consumption subsidies, are accounted for under revenue foregone or budgetary outlays.

Total transfers to ethanol producers arising from MPS in the United States are equal to the MPD multiplied by the appropriate ethanol base quantity, which is either domestic production or consumption, depending on the US net trade status in a given year. More formally:

$$G_{MPS}^{US} = MPD * Q_B^{US} = (P^{US} - P^{ref}) * Q_B^{US} \tag{3.5}$$

where:

	G_{MPS}^{US}:	Transfers to US ethanol arising from MPS measures
	Q_B^{US}:	US ethanol base quantity
	P^{US}:	US ethanol price
	P^{ref}:	Reference ethanol price

Annual average domestic producer prices are obtained from the USDA (2014a). In order to capture the appropriate opportunity cost, the choice of reference price is determined by the country's net trade status in a given year. As the United States was a net importer of ethanol between 2002 and late 2009, the reference price for this sub-period corresponds to an import price based on the Brazilian ex-mill anhydrous ethanol price (CEPEA, 2014), adjusted for insurance and freight costs (USITC, 2014). Since the country was a net exporter between late 2009 and 2012, the reference price in this second sub-period is given by the FOB unit value of US exports (USITC, 2014), discounted for the average cost of transporting ethanol from the Midwestern region of the United States to the port of New York (Reynolds, 2002).

International trade in ethanol is done under two six-digit tariff subheadings of the Harmonized Commodity Description and Coding System (HS): undenatured ethanol (HS 220710) and denatured ethanol (HS 220720). The Harmonized Tariff Schedule of the United States further divides these subheadings into three eight-digit tariff items: undenatured ethanol for beverage purposes (HS 22071030), undenatured ethanol for non-beverage purposes (HS 22071060), and denatured ethanol (HS 22072000). Since HS 22071030 is not a biofuel, the export unit value for ethanol calculated in this subsection corresponds to the weighted average of the export unit values for the other two ethanol tariff items (HS 22071060 and HS 22072000).

MPS estimates for ethanol in the United States in 2002-2012 are summarized in Table 3.7. Price transfers to producers were on average US$1.8 billion per year in the sub-period in which the United States was a net importer of ethanol and US$427 million per year in the sub-period in which the country was a net exporter. Transfers were especially high in 2006-2008, when annual MPS fluctuated between US$2.7 billion and US$ 4 billion per year. At the time, ever expanding and more cost efficient production in Brazil kept the world price significantly below the US domestic price, as reflected in annual MPDs of between US$0.11 per liter and 0.15 US$ per liter.

After the world food price and financial crises in 2008-2009, the situation changed drastically. Ethanol MPS in the United States was zero in two out of three years in 2010-2012. A poor sugarcane harvest in India drove up world sugar prices, contributing to a diversion of sugarcane in Brazil away from ethanol and into sugar production. Lower growth in Brazilian sugarcane yields further reduced feedstock availability. Skyrocket world sugar prices, increased debt, and a substantial appreciation of the Brazilian Real led to rising production costs and spiraling ethanol prices in Brazil. In a context of higher prices and lower Brazilian exports, the United States became a net ethanol exporter in late 2009.

Table 3.7: Market price support for ethanol, United States, 2002-2012

Net Trade Status	Year	Producer Price (US$/liter)	Reference Price (US$/liter)	MPD (US$/liter)	Base Quantity (Million liters)	MPS (Million US$)
Net Importer	2002	0.30	0.27	0.02	8,101	195
	2003	0.36	0.32	0.04	10,616	435
	2004	0.45	0.30	0.15	12,887	1,871
	2005	0.47	0.42	0.05	14,780	793
	2006	0.68	0.53	0.15	18,489	2,863
	2007	0.59	0.48	0.11	24,685	2,716
	2008	0.65	0.54	0.11	35,237	4,018
	Jan-Jul 2009	0.45	0.39	0.06	22,631	1,323
	2002-Jul 2009 annual average					1,802
Net Exporter	Aug-Dec 2009	0.51	0.56	(0.05)	18,691	0
	2010	0.51	0.57	(0.07)	48,673	0
	2011	0.71	0.68	0.03	48,805	1,459
	2012	0.63	0.65	(0.03)	48,763	0
	Aug 2009-2012 annual average					427

Notes: MPD: Market price differential. MPS: Market price support.
Reference price is adjusted CIF import price in 2002-July 2009 and FOB export price in Aug 2009-2012.
Base volume is ethanol production in 2002-July 2009 and ethanol consumption in Aug 2009-2012.
Sources: Author's calculations. Based on CEPEA (2014), EIA (2014a), USDA (2014a) and USITC (2014).

US environmental standards contributed to the negative MPD between domestic and foreign ethanol. At the federal level, the RFS advanced biofuels volume requirements, for which sugarcane ethanol qualifies but corn ethanol does not, established a premium for imported sugarcane ethanol. The California Low Carbon Fuel Standard (LCFS) further contributed to the establishment of a premium for fuels with a lower carbon intensity score. As sugarcane ethanol is significantly less carbon intense than corn ethanol, the LCFS assigned it a greater number of credits that fuel providers may use to offset the high carbon intensity scores of fossil fuels and ensure that annual carbon intensity targets for their overall fuel pool are met.

A positive MPD in 2011 implies that domestic ethanol sales were priced higher than exports. Accordingly, the European Commission found that the United States was engaging in dumping practices in the European market between October 2010 and September 2011 (EU, 2013). Moreover, the imminent expiration of federal tax credits in 2011 encouraged blenders to intensify blending operations in order to get as much of the credit as possible prior to year-end, which promoted higher domestic prices. In the renewed context in which the United States was a net exporter of ethanol, import tariffs became virtually irrelevant, making the elimination of the additional import duty less problematic. Nonetheless, if domestic prices rise and world prices fall in the future, the United States may attempt to reinstate the additional duty on ethanol imports.

3.2.1.3 Lower Input Costs

Given that 70 percent of total costs incurred in ethanol production in the United States are associated with the acquisition of feedstock, corn and grain sorghum subsidies can be an important element in determining profitability in the industry. Subsidies on feedstock decrease the domestic price of grains and have a positive impact on the margin of ethanol plants, which are largely dependent on the availability of cheap local feedstock supplies. While production costs may not have a major impact on pricing decisions, they do affect production volume. Plants typically operate as long as their net plant price exceeds cash production costs. Once sales prices fall to a level that does not allow a gross margin above production costs, they will shut down temporarily.

Total feedstock subsidies for the ethanol industry in the United States (G_{FS}^{US}) are defined as the sum of corn and grain sorghum subsidies prorated by the shares of domestic feedstock that went into the production of ethanol. More formally:

$$G_{FS}^{US} = G_{C}^{US} + G_{GS}^{US} = \theta_{C}^{US}\hat{G}_{C}^{US} + \theta_{GS}^{US}\hat{G}_{GS}^{US} \tag{3.6}$$

where G_C^{US}: Corn feedstock subsidies for US ethanol industry

G_{GS}^{US}: Grain sorghum feedstock subsidies for US ethanol industry

θ_C^{US}: Share of US corn output used by the ethanol industry

$\hat{G}_C^{US}$: Total corn production subsidies in the United States

θ_{GS}^{US}: Share of US grain sorghum output used by the ethanol industry

$\hat{G}_{GS}^{US}$: Total grain sorghum production subsidies in the United States

Total corn and grain sorghum production subsidies in the United States averaged US$5.2 billion a year between 2002 and 2012 (Table 3.8). Since certain subsidy programs were counter-cyclical in nature, payments varied significantly from year to year, ranging from a low of US$3 billion in 2003 to a high of nearly US$11 billion in 2006. A significant portion of these subsidies supported the US ethanol production chain, as distilleries consumed large shares of domestic corn and grain sorghum output. With the expansion in the share of domestic corn destined to ethanol production from 11 percent in 2002 to 43 percent in 2012, the estimate of total feedstock subsidies going to the ethanol industry escalated from US$664 million in 2002 to US$2.2 billion in 2012.

The subsidy figures in Table 3.8 indicate both the colossal magnitude of agricultural domestic support in the United States and the key position of the US ethanol industry as a primary user of subsidized feedstock. However, in order to identify the true impact that agricultural subsidies had on the ethanol sector between 2002 and 2012, it is necessary to determine whether these subsidies translated into lower feedstock input prices for ethanol producers. Based on a partial equilibrium model of the world corn sector, Sumner (2005) concluded that US agricultural subsidies depressed the world price of corn by 9 to 10 percent in 2006. Replicating Sumner's model for the entire 2002-2012 period, we estimate that the effect of subsidies on corn prices was generally modest, ranging between –1 percent and –3 percent for all years, except 2005 (–7.2 percent) and 2006 (–10 percent), when subsidization levels were extraordinarily high.

Table 3.8: Prorated feedstock subsidies for ethanol, United States, 2002-2012

Year	Agricultural Subsidies			Share of Output Used in Ethanol Production		Prorated Feedstock Subsidies		
	Corn *Million US$*	Sorghum *Million US$*	Total *Million US$*	Corn *%*	Sorghum[e] *%*	Corn *Million US$*	Sorghum *Million US$*	Total *Million US$*
2002	5,809	497	6,306	11%	5%	639	25	664
2003	2,712	254	2,966	12%	6%	325	15	341
2004	2,846	264	3,110	11%	9%	313	24	337
2005	8,355	538	8,893	14%	11%	1,170	59	1,229
2006	10,345	534	10,879	20%	13%	2,069	69	2,138
2007	2,985	242	3,227	23%	17%	687	41	728
2008	3,836	284	4,120	31%	12%	1,189	34	1,223
2009	4,200	311	4,511	35%	29%	1,470	90	1,560
2010	4,101	272	4,373	40%	31%	1,640	84	1,725
2011	3,674	265	3,939	40%	32%	1,470	85	1,554
2012	4,838	317	5,155	43%	43%	2,080	136	2,217
2002-2012 average	4,882	343	5,225	25%	19%	1,187	60	1,247

Notes: Agricultural subsidies include direct payments, counter-cyclical payments, loan deficiency payments, marketing loan gains, certificate exchange gains, and crop insurance. [e] Estimate.
Source: Author's calculations. Based on USDA (2014b), USDA (2014c) and USDA (2014d).

Transfers to the ethanol sector arising from lower feedstock costs are estimated by multiplying the total quantity of corn used in the production of ethanol by the annual average price of corn and the percentage price effect of corn subsidies. More formally:

$$G_{LIC}^{US} = -(L_C^{US} P_C^W \mu_C) \tag{3.7}$$

where G_{LIC}^{US}: Transfers to US ethanol arising from lower input costs

L_C^{US}: Quantity of corn used by the ethanol industry in the United States

P_C^W: World price of corn

μ_C: Percentage price effect of US corn subsidies

Total transfers to ethanol producers arising from lower input costs are summarized in Table 3.9. Between 2002 and 2012, the US ethanol sector benefited on average from US$204 million a year in lower feedstock costs as a result of agricultural production subsidies provided by the federal government. This indirect subsidy for ethanol producers varied significantly over time due to the countercyclical nature of certain US agricultural support programs, ranging from US$45 million in 2003 to US$424 million in 2006. The subsidy per unit of corn used was generally between US$1.50 and US$2.50 per ton, but reached record highs in 2005 (US$6 per ton) and 2006 (US$8 per ton), when corn production subsidies were at their highest. Given that feedstock costs accounted for 70 percent of the cost structure of an average ethanol mill in the United States, corn subsidies generated an average reduction of 2 percent in the total costs of the US ethanol industry between 2002 and 2012. In years with higher corn subsidy levels, such as 2005 and 2006, the average reduction in the total cost of the ethanol industry ranged from 5 percent to 7 percent.

Table 3.9: Lower input costs for ethanol due to corn subsidies, United States, 2002-2012

Year	Corn Price	Estimated Price Effects of Corn Subsidies		Corn Used in Ethanol	Lower Input Costs
	(US$/ton)	*(%)*	*(US$/ton)*	*(million tons)*	*(US$ million)*
2002	78.80	-2.9%	-2.26	25	56
2003	92.80	-1.7%	-1.55	29	45
2004	96.80	-2.3%	-2.22	33	73
2005	82.40	-7.2%	-5.97	40	239
2006	80.00	-10.0%	-8.00	53	424
2007	121.60	-1.8%	-2.14	76	163
2008	168.00	-1.3%	-2.12	93	197
2009	162.40	-1.4%	-2.29	115	263
2010	142.00	-1.4%	-2.05	125	258
2011	207.20	-1.0%	-1.99	125	249
2012	248.80	-1.0%	-2.43	116	282
2002-2012 average	134.62	-2.9%	-3.00	76	204

Source: Author's calculations. Based on USDA (2014b), USDA (2014c) and USDA (2014d).

3.2.1.4 Budgetary Outlays

Budgetary transfers are the most transparent category of support. They are also the easiest to measure, as they are observed and do not need to be estimated. Measuring budgetary transfers is an accounting exercise: it depends on data availability and not on estimation methodologies.

The US federal government maintained a number of subsidy programs for ethanol, biofuels and renewable energy between 2002 and 2012, including the Bioenergy Program, the Bioenergy Program for Advanced Biofuels, the Biorefinery Assistance Program, the Rural Energy for America Program, and several research and development initiatives. Federal budgetary outlays to the ethanol sector (G_{FBO}^{US}) between 2002 and 2012 are summarized in Table 3.10, along with state and total budgetary outlays to the ethanol sector (G_{SBO}^{US} and G_{BO}^{US}, respectively) in the same period.

Table 3.10: Budgetary outlays to the ethanol sector, United States, 2002-2012

Year	Federal Budgetary Outlays					State Budgetary Outlays	Total Budgetary Outlays
	Bioenergy Program (Million US$)	Bioenergy Program for Advanced Biofuels (Million US$)	Biorefinery Assistance Program* (Million US$)	Repowering Assistance Program (Million US$)	Total (Million US$)	(Million US$)	(Million US$)
2002	66	-	-	-	66	45	111
2003	131	-	-	-	131	55	186
2004	129	-	-	-	129	49	178
2005	66	-	-	-	66	38	104
2006	14	-	-	-	14	38	52
2007	-	-	-	-	0	41	41
2008	-	-	-	-	0	54	54
2009	-	7	233	0	240	47	287
2010	-	18	43	2	63	46	109
2011	-	18	84	0	103	45	148
2012	-	10	117	5	132	29	161
2002-2012 average	37	5	43	1	86	44	130

Note: Outlays listed under the Biorefinery Assistance Program include additional grants provided by the DOE.
Source: Author's calculations. Based on data from multiple official US federal and state government sources.

Originally established by executive order in 1999 and reauthorized by the Farm Security and Rural Investment Act of 2002, the Bioenergy Program made payments to ethanol and biodiesel producers who augmented their purchases of eligible agricultural commodities and converted those commodities into increased bioenergy production, as compared to the corresponding period in the prior fiscal year. The program lasted from 2002 to June 2006. Annual payments to ethanol producers for eligible purchases of agricultural feedstock under the Bioenergy Program were approximately US$130 million in both 2002 and 2003, and dropped to US$69 million in 2004 and US$14 million in 2005. Most of the support was directed to purchases of corn, which accounted for 96.5 percent of total program outlays to ethanol producers. Grain sorghum and wheat had a limited participation, accounting for respectively 3.2 percent and 0.3 percent of total outlays.

The Food, Conservation and Energy Act of 2008 replaced the Bioenergy Program with the Bioenergy Program for Advanced Biofuels (BPAB), which provided producers of advanced biofuels with payments contingent on base and incremental production volumes, plant size, and feedstock type. Eligible payment recipients must produce biofuels from renewable biomass, other than corn kernel starch. In fiscal year 2009, BPAB payments totaled US$14.7 million, of which US$7.3 went to ethanol producers (US$6.8 million for ethanol produced from grain sorghum and US$500,000 for ethanol obtained from other non-corn kernel sources). BPAB payments for ethanol producers more than doubled in fiscal years 2010 and 2011. For the entire 2009-2012 period, BPAB payments to ethanol producers were on average US$13.5 million per year.

The Food, Conservation and Energy Act of 2008 also introduced three renewable energy subsidy programs for which ethanol was eligible: the Biorefinery Assistance Program (BAP), the Repowering Assistance Program (RAP), and the Rural Energy for America Program (REAP). The BAP provided guaranteed loans for the development and construction of commercial-scale biorefineries or for the retrofitting of existing facilities using eligible technology for the development of advanced biofuels. Obligated USDA amounts for ethanol production facilities under this program totaled US$27 million in 2009, US$84 million in 2010 and US$117 million in 2012. A number of BAP recipients received additional grants from the United States Department of Energy (DOE) in the order of US$206 million in 2009 and US$43 million in 2010. The dollar amounts listed under BPA outlays in Table 3.10 include this supplementary funding.

The RAP provided payments to eligible biorefineries to help offset the costs associated with converting existing fossil fuels systems with renewable biomass fuel systems. RAP payments to ethanol producers totaled US$2 million in 2010 and US$5 million in 2012. Finally, the REAP provided grants and loan guarantees to agricultural producers and small rural business to facilitate access to renewable energy systems, make energy efficiency improvements to non-residential buildings and facilities, use renewable technologies that reduce energy consumption, and participate in energy audits, renewable energy development assistance, and feasibility studies. Since he great majority of REAP funding has been used for renewable energy sources other than ethanol, disbursements under this program are not included in the estimate of total budgetary outlays for the US ethanol sector.

Other US federal programs that provided payments to the ethanol sector between 2002 and 2012 included research and development initiatives under the auspices of the Department of Agriculture and the Department of Energy. As research and development subsidies constitute support to general services and do not provide transfers to specific producers or consumers, they are not included in support estimates for the ethanol sector in this chapter.

In addition to federal payments, ten states provided budgetary transfers to ethanol producers directly linked to ethanol production levels. For example, Missouri's Ethanol Producer

Incentive Fund provided payments of US$0.20 per gallon for the first 12.5 million gallons of ethanol produced by each producer and U$0.05 for the second 12.5 million gallons. Minnesota paid ethanol producers US$0.20 per gallon up to annual limits of US$3 million per plant and US$30 million for all plants in the state. Between 2002 and 2011, Minnesota alone provided producer payments in the order of US$200 million, or an average of US$20 million per year.

Total budgetary outlays for US ethanol producers averaged US$130 million a year between 2002 and 2012, with two-thirds coming from federal funds and the balance from state governments.

3.2.1.5 Subsidy Equivalent Value

Drawing from the OECD methodology for calculating Total Support Estimates (TSE) for agricultural products, transfers to the ethanol sector are classified according to their intended recipient as either production or consumption subsidies.

Measures that affect producers ethanol producers in the United States – production tax concessions (G_{PTC}^{US}), market price support (G_{MPS}^{US}), lower input costs (G_{LIC}^{US}) and budgetary outlays (G_{BO}^{US}) – are included in the Producer Support Estimate (PSE^{US}). Measures that affect consumers – consumption tax concessions (G_{CTC}^{US}) and adjusted market price support $\left(G_{MPS^*}^{US}\right)$ – are included in the Consumer Support Estimate (CSE^{US}). For the CSE^{US}, MPS is adjusted to apply to quantities consumed (as opposed to quantities produced in the PSE^{US}). More formally:

$$PSE^{US} = G_{PTC}^{US} + G_{MPS}^{US} + G_{LIC}^{US} + G_{BO}^{US} \tag{3.8}$$

$$CSE^{US} = G_{CTC}^{US} - G_{MPS^*}^{US} \tag{3.9}$$

Based on these values, it is possible to derive the Subsidy Equivalent Value (SEV) for the US ethanol sector, which corresponds to the sum of all forms of support under the PSE and CSE, adjusted for double-counting given that the transfers associated with MPS policies appear in both the PSE and CSE calculations. Consequently, SEV amounts to the sum of the PSE and consumption tax concessions. More formally:

$$SEV^{US} = PSE^{US} + G^{US}_{CTC} \tag{3.10}$$

The SEV estimated in this chapter differs from the TSE calculated by the OECD in that it does not incorporate transfers provided as general services, such as investments in research, development, training, inspection and promotion. While the OECD classifies these transfers under the General Services Support Estimate (GSSE) category and includes them in the derivation of the TSE, they are excluded from the SEV because they do not cause significant distortions in production, consumption or trade. Therefore, the acronym SEV is used to distinguish between the indicator derived in this chapter and the one originally developed by the OECD.

PSE, CSE and SEV for the ethanol sector in the United States are summarized in Table 3.11. The SEV was on average US$5.2 billion per year between 2002 and 2012, of which US$1.8 billion came in the form of producer support and US$3.4 billion as consumption tax concessions. Support varied significantly over time, from a low of US$674 million in 2012 to a high of US$9.7 billion in 2008. The year of 2012 stands out as it reflects significant policy changes in the United States, such as the elimination of the VEETC, SEPT and additional import duty, as well as the suspension of a number of state consumer and producer tax concessions. The period between late 2009 and 2012 also reflects changes in world market conditions, with production costs rising in Brazil, the United States becoming a net exporter, and environmental standards in the United States creating a premium for imported sugarcane, resulting in the emergence of policy-induced two-way trade between the world's two largest producers of ethanol.

Table 3.11: Subsidy equivalent value for the ethanol sector, United States, 2002-2012

Year	Measures Affecting Producers					Measures Affecting Consumers			Subsidy Equivalent Value (SEV)
	PTC	MPS	LIC	BO	PSE	CTC	MPS*	CSE	
2002	22	195	56	111	383	1,219	189	1,030	1,602
2003	26	435	45	186	693	1,559	439	1,120	2,252
2004	36	1,871	73	178	2,159	1,959	1,947	7	4,117
2005	39	793	239	104	1,175	2,186	824	1,362	3,361
2006	120	2,863	424	52	3,459	3,004	3,213	-209	6,464
2007	143	2,716	163	41	3,063	3,738	2,867	870	6,800
2008	152	4,018	197	54	4,421	5,290	4,168	1,110	9,711
2009	152	1,323	263	287	2,025	5,218	1,338	3,880	7,243
2010	157	0	258	109	523	6,169	0	6,169	6,692
2011	147	1,459	249	148	2,002	6,567	1,459	5,107	8,569
2012	10	0	282	161	453	226	0	226	678
2002-2012 average	91	1,425	204	130	1,850	3,376	1,496	1,879	5,226

Notes: PSE: Producer support estimate; CSE: Consumer support estimate; PTC: Production tax concessions; MPS: Market price support; LIC: Lower input costs; BO: Budgetary outlays; CTC: Consumption tax concessions; MPS*: Adjusted market price support.

Source: Author's calculations.

Nearly two-thirds of the SEV for ethanol in the United States in 2002-2012 came in the form of consumption tax concessions, most notably through the VEETC. Market price support accounted on average for 27 percent of total support. Lower input costs represented 4 percent of total support, and production tax concessions and budgetary outlays each accounted for 2 percent. The make-up of the total subsidy equivalent also fluctuated over time. While the VEETC accounted for the majority of support in every year, transfer due to MPS were as large as transfers under the VEETC in 2004 and 2006, the two years with the greatest differential between domestic and reference prices. Finally, after the elimination of both federal tax credits and the specific import tariff in December 2011, lower input costs due to feedstock subsidies became the most important source of support to the ethanol sector, followed by direct producer payments under budgetary outlays.

Overall subsidization rates per liter of ethanol produced in the United States expanded significantly between 2002 and 2006, but generally followed a downward trend between 2007 and 2012 (Figure 3.4). The ethanol subsidization rate increased from 20 cents per liter in 2002 to a peak of 35 cents per liter in 2006. Subsequently, it declined to 28 cents per liter in 2007-2008, 16 cents per liter on average in 2009-2011, and 1.3 cents per liter after the elimination of the VEETC, SEPTC and the additional import duty in 2012.

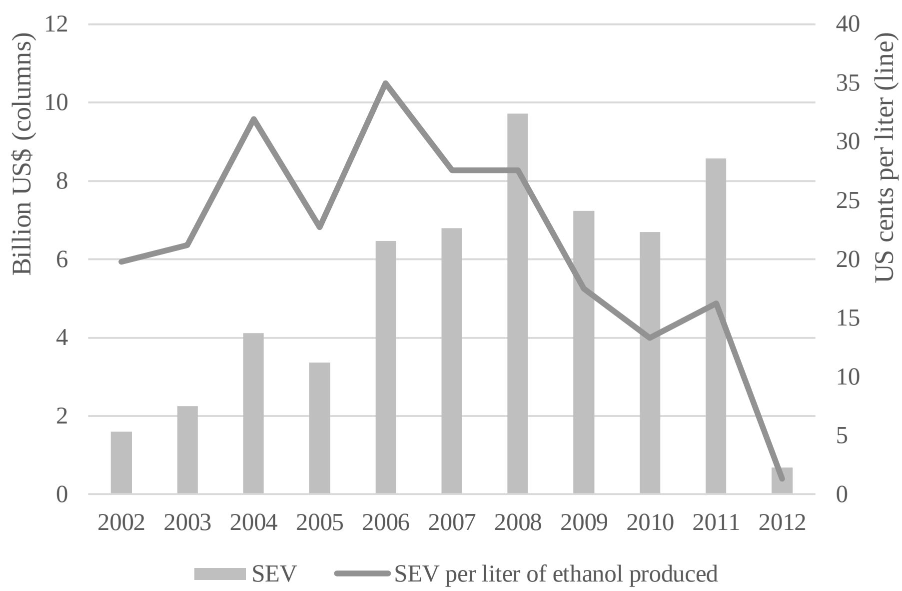


Figure 3.4: Ethanol SEV and SEV per liter produced, United States, 2002-2012

Source: Author's calculations.

3.2.2. Brazil

Support for the ethanol sector in Brazil dates back to the National Alcohol Program (Proálcool) that emerged in the aftermath of the first oil crisis of the 1970s. Strong government intervention in favor of ethanol production and consumption through a number of diverse policy instruments contributed to the development of the world's most advanced biofuel sector. After a hiatus in the

1990s, in which ethanol lost ground to cheap imported gasoline, the sector made a successful come back in the early twenty-first century, now in a deregulated context. Fuel price controls, which had been progressively relaxed since 1996, were finally eliminated in 2002. One year later, the first flexible-fuel vehicles with the ability to run on either ethanol or blended gasoline became available in the Brazilian market — a sign of a new era for the ethanol sector.

There are two types of ethanol used as transportation fuel in Brazil: anhydrous ethanol, which is blended into gasoline, and hydrous ethanol, which is used alone in vehicles with flexible-fuel engines. Brazilian policies and prices vary according to the type of ethanol in question. The competition between hydrous ethanol and gasoline occurs daily at filling stations, as consumers with flexible-fuel vehicles elect their fuel of choice based on relative prices. Since the first commercial flexible-fuel vehicles were launched in early 2003, they have led sales of new automobiles and rapidly transformed the profile of Brazil's automobile fleet. Figure 3.5 illustrates the change in the composition of the Brazilian fleet, by fuel type, between 2006 and 2012.

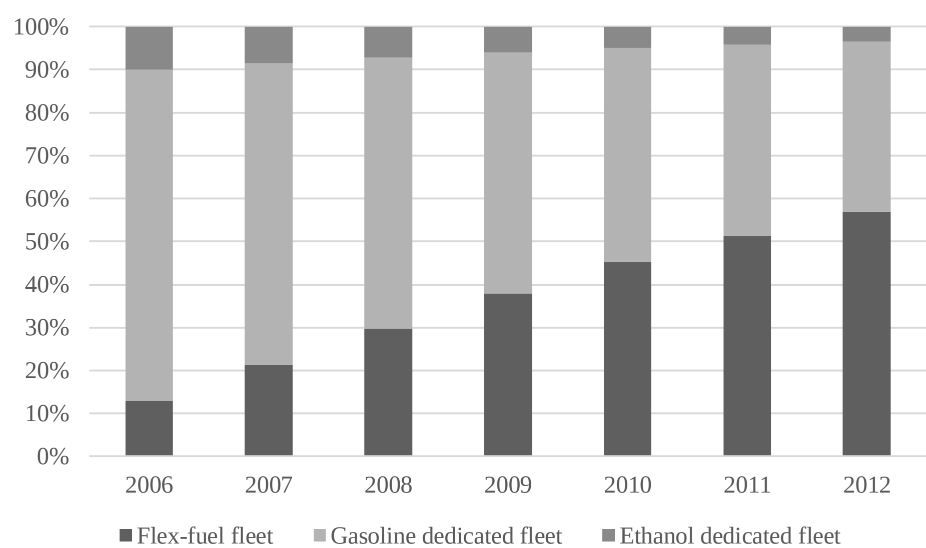


Figure 3.5: Brazilian automobile and light vehicle fleet (Otto cycle), by fuel type, 2006-2012

Source: UNICA (2014).

Although the growth in the flexible-fuel automobile fleet intensified competition between gasoline and hydrous ethanol in Brazil, some competition between the two fuels already existed prior to the advent of the flexible-fuel engine, as they were preceded by engines that ran exclusively on hydrous ethanol. From the 1980s until 2003, Brazilian consumers selected between gasoline and hydrous ethanol when they decided on the type of automobile to buy at the dealer. Since 2003, Brazilians have been able to choose between gasoline and hydrous ethanol every time they fill up at the pump. A key difference between transportation fuel markets in the United States and Brazil is that while ethanol is used only in blended fuels in the former, it may be a direct substitute to gasoline at the point of sale in the latter.

Between 2002 and 2012, the ethanol sector in Brazil was supported by a lower tax burden as compared to gasoline at both the federal and state levels. In addition, minimal amounts of support were provided in the form of production subsidies to sugarcane producers and marketing credit equalization for ethanol distilleries. Despite the existence of a mandatory requirement to blend ethanol into gasoline, domestic ethanol prices were below border prices in 2002-2012. This subsection investigates Brazilian ethanol policies under the same prism used to analyze US ethanol policies, namely by examining whether transfers are provided through revenue foregone, market price support or budgetary outlays.

3.2.2.1. Revenue Foregone

The Brazilian government stimulates the consumption of hydrous ethanol at the expense of C-gasoline (a mixture of 75-80 percent gasoline and 20-25 percent anhydrous ethanol) through the imposition of a lower tax burden on the former as compared to the latter.

Transportation fuels were subject to four key tributes in Brazil in 2002-2012: (i) the Contribution for Intervention in the Economic Domain (CIDE), (ii) the Contribution to the Social Integration Program (PIS), (iii) the Contribution to Finance Social Security (COFINS), and (iv) the Tax on the Circulation of Merchandise and Services (ICMS). While CIDE, PIS and COFINS are federal "contributions" (i.e. taxes destined to finance specific social or economic programs), ICMS is a state tax. Ethanol received preferential tax treatment in Brazil in the form of lower taxation rates in all three of the federal contributions, as well as in lower ICMS rates in some key Brazilian states, most notably in São Paulo.

The CIDE was first instituted in 2002, as a tax on the commercialization and importation of petroleum and derived products, natural gas and derived products, and fuel ethanol. Statutory rates vary according to fuel type, with the highest rate falling on gasoline and the lowest on ethanol. From the outset, a presidential decree exempted ethanol from the tax. Figure 3.6 depicts CIDE rates for gasoline between 2002 and 2012. The rate was fixed at R$0.28 per liter from January 2002 to April 2008, and fluctuated between R$0.091 per liter and R$0.23 per liter from May 2008 to June 2012. Between July 2012 and December 2012, gasoline was exempt from the tax.

PIS and COFINS are social contributions levied on the gross revenues of legal entities to finance unemployment benefits and the social security system,. Since they are similar in structure, they are often lumped together and referred to as PIS/COFINS. Gross revenues derived from the sale of transportation fuels are subject to a special regime of concentrated taxation. In the case of gasoline, PIS/COFINS contributions are calculated by applying a higher concentrated rate on producers and importers, whilst exempting distributors and retailers. In the case of ethanol, producers, importers and distributors are subject to higher concentrated rates, exemptions applying only to retailers. Concentrated PIS/COFINS rates differ across fuel and legal entity types. In

2012, gasoline producers and importers were subject to a combined PIS/COFINS rate of R$0.2616 per liter or 28.5 percent of gross revenues, whichever was lower. By comparison, ethanol producers and importers were taxed at a rate of R$0.0435 per liter or 8.4 percent of gross revenues, and ethanol distributors at a rate of R$0.12029 per liter or 21 percent of gross revenues. Given prevailing fuel prices, legal entities generally favored specific over *ad valorem* rates in 2002-2012.

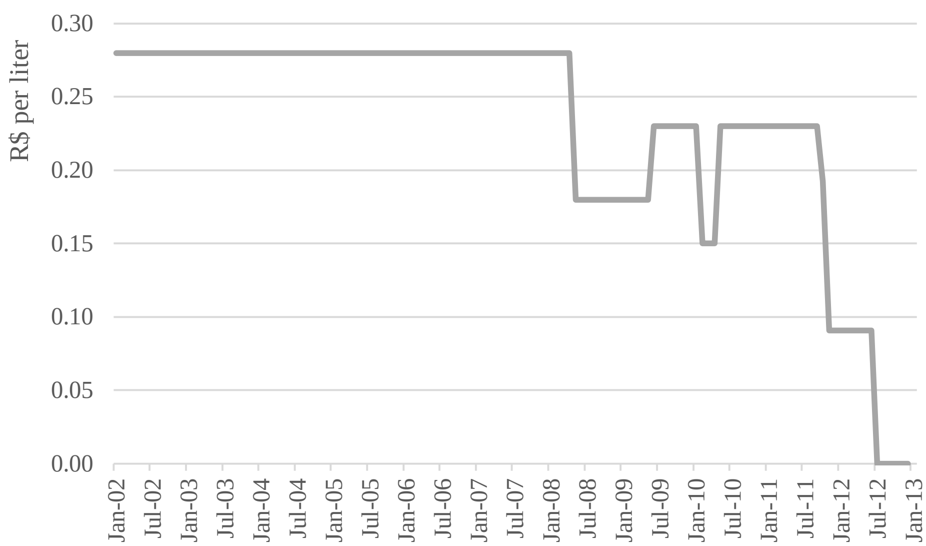


Figure 3.6: CIDE tax rate for gasoline, 2002-2012

Source: Secretariat of the Federal Revenue of Brazil (2014).

ICMS is a value-added tax applied on goods and certain transportation and communication services. ICMS rates for transportation fuels may vary across fuel type, between states, and over time.[52] Average annual ICMS rates on hydrous ethanol in 2002-2012 ranged from 14.3 percent in São Paulo to 29 percent in Pará, with most states having a rate of 25 percent. Variance was less

[52] While several Brazilian states adopt a standard formula by which the ICMS tax is the product of the ICMS rate and the price paid by consumers, some states adopt an alternative approach in which the ICMS tax corresponds to the product of the ICMS rate and an official estimated price. This alternative ICMS tax does not vary with the real price of the purchased product, but with an estimated price that can vary significantly over time and across states. Since it would be very onerous to collect the necessary data to apply this alternative method, ICMS taxes for all Brazilian states are calculated according to the standard methodology.

pronounced in the case of anhydrous ethanol and gasoline, with average annual ICMS rates ranging from a low of 23.5 percent in Roraima to highs of 29 percent in Pará (for anhydrous ethanol) and 30.9 percent in Rio de Janeiro (for gasoline). National average ICMS rates, weighted by the share of each state in national hydrous ethanol sales, were 18.2 percent for hydrous ethanol, 25.4 percent for anhydrous ethanol and 25.7 percent for gasoline.

In 2012, ICMS rates on hydrous ethanol were lower than those for gasoline in twelve out of the twenty-seven states in Brazil.[53] Most importantly, these states accounted for 90 percent of national hydrous ethanol sales. In addition, ICMS rates on anhydrous ethanol were lower than they were on gasoline in seven of these states. Figures 3.7 and 3.8 depict annual average ICMS tax rate differentials between gasoline and hydrous and anhydrous ethanol in 2002-2012. Tax rate differentials ranged from 0.4 percentage points in Rio Grande do Norte to 10.7 percentage points in São Paulo in the case of hydrous ethanol, and between 0.6 percentage points in Pará to 5.3 percentage points in Rio de Janeiro in the case of anhydrous ethanol.

Total consumption tax concessions in favor of ethanol in Brazil (G_{CTC}^{BR}) correspond to the sum of revenue foregone as a result of CIDE, PIS/COFINS and ICMS differential tax rates in favor of ethanol. Implicit transfers to ethanol due to CIDE are estimated by multiplying the CIDE tax rate differential by the volume of ethanol that was domestically produced and consumed in Brazil:

$$G_{CIDE}^{BR} = t_{CIDE}^{BR} * (Q_C^{BR} - Q_M^{BR}) \tag{3.11}$$

where G_{CIDE}^{BR}: Transfers to Brazilian ethanol arising from CIDE

t_{CIDE}^{BR}: CIDE tax rate differential in favor of ethanol

Q_C^{BR}: Brazilian consumption of ethanol

Q_M^{BR}: Brazilian imports of ethanol

[53] Brazil has 26 states and 1 federal district. For simplification purposes, the federal district is counted as a state.

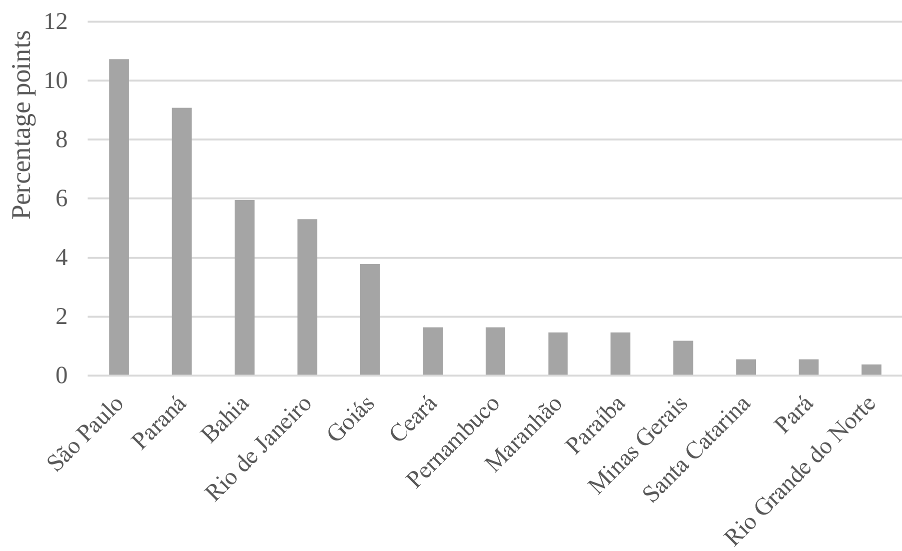


Figure 3.7: ICMS tax rate differentials between gasoline and hydrous ethanol, by state, 2002-2012 average

Source: State secretariats of finance (2014).

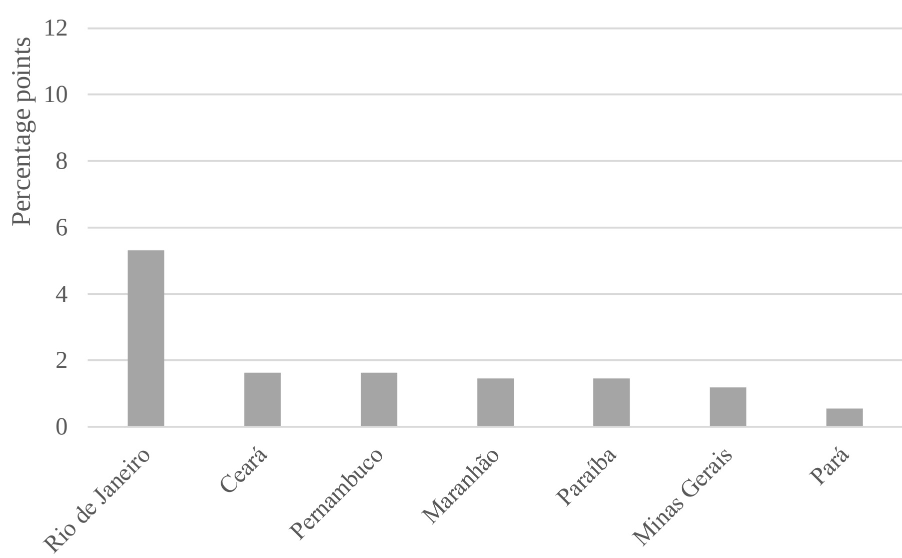


Figure 3.8: ICMS tax rate differentials between gasoline and anhydrous ethanol, by state, 2002-2012 average

Source: State secretariats of finance (2014).

Revenue foregone due to PIS/COFINS is less straightforward to calculate since gasoline and ethanol are subject not only to different tax rates, but also to distinct taxation rules. While gasoline is subject to concentrated taxation at the producer level, hydrous ethanol is levied at both the producer and distributor levels. In addition, hydrous and anhydrous ethanol are subject to different sets of rules. Transfers to ethanol due to PIS/COFINS are given by the difference between what the federal government collected under existing rules and what it would collect if ethanol was treated in the same way as gasoline, more formally expressed as follows:

$$G_{PIS}^{BR} = \left[PIS_G^{prod} * (Q_{PH}^{BR} - Q_{XH}^{BR})\right] - \left\{\left[PIS_E^{prod} * (Q_P^{BR} - Q_X^{BR})\right] + \left[PIS_H^{dist} * (Q_{CH}^{BR} - Q_{MH}^{BR})\right]\right\} \tag{3.12}$$

where G_{PIS}^{BR}: Transfers to Brazilian ethanol arising from PIS/COFINS

PIS_G^{prod}: PIS/COFINS tax rate on gasoline producer

PIS_E^{prod}: PIS/COFINS tax rate on ethanol producer

PIS_H^{dist}: PIS/COFINS tax rate on hydrous ethanol distributor

Q_P^{BR}: Brazilian production of ethanol

Q_X^{BR}: Brazilian exports of ethanol

Q_{PH}^{BR}: Brazilian production of hydrous ethanol

Q_{XH}^{BR}: Brazilian exports of hydrous ethanol

Q_{CH}^{BR}: Brazilian consumption of hydrous ethanol

Q_{MH}^{BR}: Brazilian imports of hydrous ethanol

Transfers to ethanol arising from ICMS are equivalent to the sum of revenue foregone in each state for each type of ethanol. For a given type of ethanol (hydrous vs. anhydrous), revenue foregone is given by the product of the state ICMS differential rate, the state consumer price and the volume of Brazilian ethanol consumed in that particular state:

$$G_{ICMS}^{BR} = \sum_i ICMS_{HE}^i * CP_{HE}^i * \left(C_{HE}^i - I_{HE}^i\right) + \sum_i ICMS_{AE}^i * CP_{AE}^i * \left(C_{AE}^i - I_{AE}^i\right) \quad (3.13)$$

where G_{ICMS}^{BR}: Transfers to Brazilian ethanol arising from ICMS

$ICMS_{HE}^i$: ICMS tax rate differential in favor of hydrous ethanol in state *i*

$ICMS_{AE}^i$: ICMS tax rate differential in favor of anhydrous ethanol in state *i*

CP_{HE}^i: Consumer price of hydrous ethanol in state *i*

CP_{AE}^i: Consumer price of anhydrous ethanol in state *i*

C_{HE}^i: Consumption of hydrous ethanol in state *i*

C_{AE}^i: Consumption of anhydrous ethanol in state *i*

I_{HE}^i: Imports of hydrous ethanol in state *i*

I_{AE}^i: Imports of anhydrous ethanol in state *i*

Consumption levels are used in the estimations of G_{CIDE}^{BR}, G_{PIS}^{BR} and G_{ICMS}^{BR} because exports are not subject to either CIDE, PIS/COFINS or ICMS.[54] This is in contrast with the derivation of revenue foregone due to the VEETC in the United States, which was based on production levels. The choice of the relevant quantity depends on the incidence of each policy instrument. While the VEETC applied to all ethanol blended within the United States, irrespective of where it was produced or consumed, Brazilian tax incentives applied only to domestically consumed ethanol. Moreover, imports are deducted from consumption levels in the estimations of G_{CIDE}^{BR}, G_{PIS}^{BR} and G_{ICMS}^{BR} in order to account only for support that went to domestic producers. Nevertheless, the exclusion of import volumes has little effect on estimates, as imports were insignificant in 2002-2010 and accounted for only 3-6 percent of domestic consumption in 2011-2012.

[54] The Brazilian Federal Constitution exempts exports from PIS/COFINS and CIDE (Article 149, Paragraph 2), as well as from ICMS (Article 155, Paragraph 2, X, a).

Table 3.12 summarizes total consumption tax concessions in favor of ethanol in 2002-2012, as well as separate estimates for transfers arising from CIDE, PIS/COFINS and ICMS in the same period. As there were no production tax concessions for ethanol in Brazil, total consumption tax concessions equal total revenue foregone. Tax concessions provided an average annual subsidy of US$2.7 billion to the Brazilian ethanol sector in 2002-2012, of which US$2.1 billion at the federal level (CIDE and PIS/COFINS) and US$600 million at the state level (ICMS). Until 2011, CIDE was the single most important source of revenue foregone, accounting for 90 percent of all tax concessions in 2002-2003 and 60 percent in 2004-2011. After gasoline was exempted from CIDE in July 2012, ICMS became the main source of revenue foregone in favor of ethanol in Brazil. State governments have adopted an increasingly active role in supporting the ethanol sector through tax concessions. While only two states had an ICMS tax rate differential in favor of hydrous ethanol in 2002, twelve did so in 2012. The share of state tax concessions in total revenue foregone grew from 1.5 percent in 2002 to 25 percent in 2008 and 51 percent in 2012. Most notably, transfers to ethanol arising from ICMS increased from US$15 million in 2002 to over US$1 billion in 2010-2012.

The state of São Paulo plays a key role in subsidizing ethanol consumption in Brazil. It is the country's largest producer and consumer of both sugarcane and ethanol. Between 2002 and 2012, it accounted for 58 percent of domestic ethanol output and 43 percent of domestic demand. Furthermore, the state has the country's largest population, gross domestic product, and automobile fleet. Not surprisingly, São Paulo was the state with the lowest ICMS tax rate on ethanol (12 percent) and the highest tax differential against gasoline (13 percentage points). Given this differential and its large share in domestic consumption, São Paulo independently accounted on average for 63 percent of all state level revenue foregone in the country in 2002-2012.

Table 3.12: Government revenue foregone in favor of ethanol, Brazil, 2002-2012

Year	Transfers arising from CIDE *(Million US$)*	Transfers arising from PIS/COFINS *(Million US$)*	Transfers arising from ICMS *(Million US$)*	Total Revenue Foregone *(Million US$)*
2002	893	64	15	972
2003	760	48	27	836
2004	986	266	187	1,439
2005	1,214	343	258	1,815
2006	1,451	400	456	2,307
2007	2,188	884	604	3,676
2008	2,250	-108	782	2,924
2009	2,403	801	993	4,198
2010	2,678	1,147	1,124	4,948
2011	2,232	726	1,126	4,085
2012	386	604	1,042	2,031
2002-2012 average	1,586	470	601	2,657

Source: Author's calculations.

3.2.2.2. Market Price Support

Unlike in the United States, MPS policies did not have a significant effect on prices in Brazil between 2002 and 2012. Despite the existence of an import tariff for ethanol, domestic prices in Brazil were below reference prices. As a result, estimated MPS for ethanol in Brazil was zero for the entire period under analysis (Table 3.13).

Brazil was a net exporter of ethanol in every year in 2002-2012. Imports were virtually non-existent in 2002-2010, when the country was the world's largest ethanol exporter. Although import volumes increased in 2011-2012, the country remained a net exporter. Brazil's *ad valorem* tariff on ethanol imports, which was set at 20 percent between 2002 and 2009, was reduced to zero in 2010 and remained at that level until December 2012. Moreover, no export subsidies, export taxes or export bans were in place for either ethanol, sugar or sugarcane between 2002 and 2012. As a result, domestic ethanol producers were not shielded from foreign competition.

Table 3.13: Market price support for ethanol, Brazil, 2002-2012

Net Trading Status	Year	Producer Price (US$/liter)	Reference Price (US$/liter)	Market Price Differential (US$/liter)	Base Volume (Million liters)	Market Price Support (Million US$)
Net Exporter	2002	0.20	0.22	(0.02)	9,319	0
	2003	0.21	0.22	(0.00)	8,330	0
	2004	0.20	0.21	(0.01)	10,306	0
	2005	0.30	0.30	(0.00)	10,553	0
	2006	0.41	0.43	(0.02)	11,268	0
	2007	0.36	0.41	(0.05)	15,205	0
	2008	0.40	0.45	(0.06)	19,584	0
	2009	0.39	0.40	(0.01)	22,823	0
	2010	0.52	0.52	(0.00)	22,162	0
	2011	0.71	0.71	(0.00)	19,328	0
	2012	0.57	0.67	(0.10)	17,790	0

Notes: Reference price and base volume correspond to FOB export price and consumption volume, respectively.
Source: Author's calculations. Based on ANP (2014), CEPEA (2014) and EIA (2014a).

3.2.2.3. Lower Input Costs

Production subsidies for sugarcane in Brazil were either zero or very low in every year in the period between 2002 and 2012. As a result, their impact on both the world price of sugarcane and the costs of the ethanol industry were nil.

Feedstock subsidies for the ethanol industry in Brazil (G_{FS}^{BR}) are defined as sugarcane production subsidies prorated by the share of the domestic sugarcane output that went into the production of ethanol. More formally:

$$G_{FS}^{BR} = G_{SC}^{BR} = \theta_{SC}^{BR}\ \hat{G}_{SC}^{BR} \tag{3.14}$$

where G_{SC}^{BR}: Sugarcane feedstock subsidies for ethanol industry in Brazil

θ_{SC}^{BR}: Share of Brazilian sugarcane output used by the ethanol industry

$\hat{G}_{SC}^{BR}$: Total sugarcane production subsidies in Brazil

Crop subsidy levels, prorated feedstock subsidies, and estimated subsidies in the form of lower input costs for the Brazilian ethanol industry are summarized in Table 3.14.

Table 3.14: Feedstock subsidies and lower input costs for ethanol, Brazil, 2002-2012

Year	Sugarcane Production Subsidies *(Million US$)*	Share of Sugarcane Output Used in Ethanol Production *(%)*	Prorated Feedstock Subsidies *(Million US$)*	Lower Input Costs *(Million US$)*
2002	7	50%	4	0
2003	6	51%	3	0
2004	0	52%	0	0
2005	0	53%	0	0
2006	0	50%	0	0
2007	0.2	55%	0.1	0
2008	0.7	60%	0.4	0
2009	32	57%	18	0
2010	30	55%	17	0
2011	45	52%	23	0
2012	0.7	50%	0.4	0
2002-2012 average	11	53%	6	0

Source: Author. Based on MAPA (2014).

Sugarcane subsidies averaged US$11 million per year in Brazil between 2002 and 2012, a very modest figure compared to the average US$4.9 billion per year in corn subsidies provided in the United States in the same period. The magnitude of Brazilian sugarcane and US corn subsidies and their relative shares in the total production value of each crop during the 2002-2012 period are contrasted in Table 3.15.

Table 3.15: Sugarcane subsidies in Brazil and corn subsidies the United States, total values and relative shares in the total value of production of each crop, 2002-2012

Year	Sugarcane in Brazil		Corn in the United States	
	Production Subsidies	Subsidies as a Share of Crop Production Value	Production Subsidies	Subsidies as a Share of Crop Production Value
	(Million US$)	*(%)*	*(Million US$)*	*(%)*
2002	7	0.2%	5,809	31%
2003	6	0.1%	2,712	13%
2004	0	0.0%	2,846	12%
2005	0	0.0%	8,355	34%
2006	0	0.0%	10,345	47%
2007	0.2	0.0%	2,985	9%
2008	0.7	0.0%	3,836	7%
2009	32	0.1%	4,200	9%
2010	30	0.1%	4,101	9%
2011	45	0.2%	3,674	6%
2012	0.7	0.0%	4,838	6%
2002-2012 average	11	0.07%	4,882	17%

Source: Author's calculations. Based on MAPA (2014), USDA (2014b), USDA (2014c) and USDA (2014d).

Given that sugarcane subsidies in Brazil represented on average less than 0.1 percent of the sugarcane production value in 2002-2012, it is assumed that they had no impact on sugarcane prices and input costs for the domestic ethanol industry during this period. By contrast, corn subsidies represented on average 17 percent of the domestic value of production of corn in the United States in the same period. In 2006, the year in which corn subsidization achieved its highest level, US corn subsidies represented 47 percent of the value of production.

3.2.2.4. Budgetary Outlays

Minimal amounts of support were provided to the Brazilian ethanol sector in the form of budgetary outlays in 2002-2012. Table 3.16 summarizes payments this subsidy category. Budgetary transfers to ethanol in Brazil (G_{BO}^{BR}) consisted of credit equalization subsidies under the Ethyl Alcohol Fuel Stock Financing Program. They were on average US$2 million in payments per year between 2002 and 2012. No disbursements were made under this program for seven consecutive years (2004 through 2011). These figures are especially low when compared to the average of US$106 million per year in budgetary support provided to the ethanol sector in the United States in the same period.

Table 3.16: Budgetary outlays to the ethanol sector, Brazil, 2002-2012

Year	Marketing Credit Equalization Subsidies *(Million US$)*	Total Budgetary Outlays *(Million US$)*
2002	3	3
2003	13	13
2004	7	7
2005	0	0
2006	0	0
2007	0	0
2008	0	0
2009	0	0
2010	0	0
2011	0	0
2012	0.4	0.4
2002-2012 average	2	2

Source: MAPA (2014).

3.2.2.5. Subsidy Equivalent Value

As defined in equation (3.10), the SEV is equal to the sum of the PSE and the CSE, adjusted for double counting of MPS policies. Since transfers to ethanol arising from production tax concessions, MPS and lower input costs are equal to zero in Brazil, PSE, CSE and SEV calculations may be simplified as follows:

$$PSE^{BR} = G_{BO}^{BR} \tag{3.15}$$

$$CSE^{BR} = G_{CTC}^{BR} \tag{3.16}$$

$$SEV^{BR} = G_{BO}^{BR} + G_{CTC}^{BR} \tag{3.17}$$

PSE, CSE and SEV for the Brazilian ethanol sector are summarized in Table 3.17. Between 2002 and 2012, the SEV was on average US$2.7 billion a year, or just over half of what support to ethanol was in the United States in the same period. While revenue foregone, market price support and lower input costs all played an important role in subsidizing ethanol in the United States, support in Brazil was concentrated almost exclusively on revenue foregone. Consumption tax concessions accounted for 99.9 percent of all support provided to ethanol between 2002 and 2012, of which approximately four-fifths were at the federal level and the rest at the state level.

Table 3.17: Subsidy equivalent value for the ethanol sector, Brazil, 2002-2012

Year	Measures Affecting Producers					Measures Affecting Consumers			Subsidy Equivalent Value (SEV)
	PTC	MPS	LIC	BO	PSE	CTC	MPS*	CSE	
2002	0	0	0	3	3	972	0	972	975
2003	0	0	0	13	13	836	0	836	849
2004	0	0	0	7	7	1,439	0	1,439	1,446
2005	0	0	0	0	0	1,815	0	1,815	1,815
2006	0	0	0	0	0	2,307	0	2,307	2,307
2007	0	0	0	0	0	3,676	0	3,676	3,676
2008	0	0	0	0	0	2,924	0	2,924	2,924
2009	0	0	0	0	0	4,198	0	4,198	4,198
2010	0	0	0	0	0	4,948	0	4,948	4,948
2011	0	0	0	0	0	4,085	0	4,085	4,085
2012	0	0	0	0.4	0.4	2,031	0	2,031	2,032
2002-2012 average	0	0	0	2	2	2,657	0	2,657	2,660

Notes: PSE: Producer support estimate; CSE: Consumer support estimate; PTC: Production tax concessions; MPS: Market price support; LIC: Lower input costs; BO: Budgetary outlays; CTC: Consumption tax concessions; MPS*: Adjusted market price support.
Source: Author's calculations.

Figure 3.9 summarizes SEV for ethanol in Brazil and United States between 2002 and 2012. Ethanol subsidies in both countries increased significantly between 2002 and 2011, and fell dramatically in 2012 thanks to the elimination of the CIDE tax rate differential in Brazil and the VEETC in the United States. Combined US and Brazilian subsidies reached their peak level in 2008, when ethanol received US$12.6 billion in transfers in the two countries, a sum comparable to the gross domestic product (GDP) of Bolivia, Honduras or Jamaica at the time. By contrast, combined US and Brazilian subsidization of the ethanol sector declined to US$2.7 billion in 2012.

Total ethanol subsidies were higher in the United States than in Brazil in every single year in the period under analysis, except in 2012. The relative difference between ethanol support levels in the two countries was greatest in 2004, 2006 and 2008, when estimated support in the United States was three times higher than in Brazil. In most other years, support to ethanol in the United States was between 1.5 and 2.5 times as high as support in its South American counterpart.

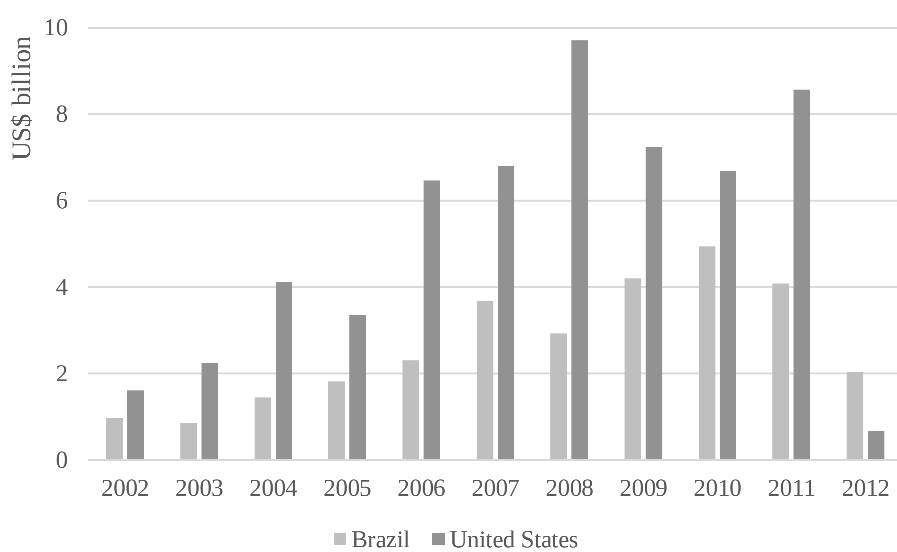


Figure 3.9: Ethanol subsidy equivalent values (SEV) in Brazil and the United States, 2002-2012

Source: Author's calculations.

Figure 3.10 compares subsidization rates per liter of ethanol produced in Brazil and the United States between 2002 and 2012. The ethanol subsidization rate in Brazil increased from 6-8 US cents per liter in 2002-2003 to 16-18 US cents per liter in 2009-2011, and fell to 9 US cents per liter in 2012. By contrast, the rate of subsidization of ethanol in the United States was between three and four times higher than in the Brazil in 2003-2004, and between two and three times as high in 2005-2008. In 2009 and 2011, ethanol subsidization rates in the United States were roughly equivalent to those in Brazil. Subsequently, the subsidy equivalent value per liter of ethanol produced in the United States fell to only 1.3 cents in 2012. Per unit rates of subsidization of ethanol in Brazil and the United States, along with the detailed breakdown of subsidies at the consumer and producer levels provided in Table 3.11 and Table 3.17, are employed in Section 3.3 to estimate the distortions caused by government policies on prices, production, consumption and trade.

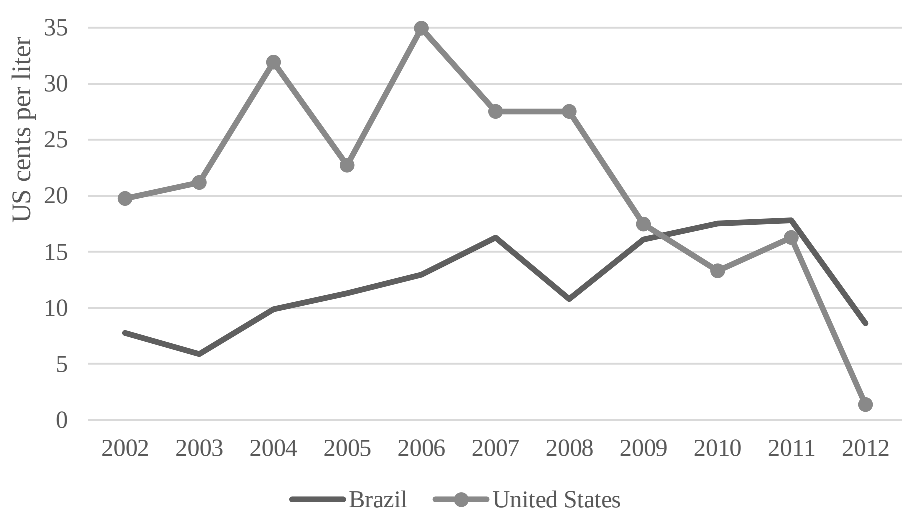


Figure 3.10: Ethanol subsidization rates in Brazil and the United States, 2002-2012

Note: Subsidization rates correspond to ethanol subsidy equivalent values divided by ethanol production.
Source: Author's calculations.

3.3. Economic Impact of Ethanol Support

The objective of this section is to estimate the size of the market distortions caused by US and Brazilian support to the ethanol sector between 2002 and 2012. It is organized in four subsections. Subsections 3.3.1 and 3.3.2 examine the modeling framework and data used to assess the impact of government policies on prices, production, consumption and trade. Subsection 3.3.3 considers model implementation in more detail, paying special attention to how the market effects of consumption tax concessions and import tariffs may differ when applied simultaneously with an ethanol blending mandate. Finally, Subsection 3.3.4 discusses the estimated results under different reform scenarios.

3.3.1. Modeling Framework

A single commodity, multi-country, non-spatial, partial equilibrium model of trade is used to quantify the price, production, consumption and trade effects of reducing ethanol support. The structure of the model is similar to that of other partial equilibrium models used to assess the impact of policies on agricultural trade, such as the ones in Vanzetti and Graham (2002), Tokarick (2003), Poonyth *et al.* (2004), Sumner (2005), Alston *et al.* (2007) and Cabral and Jales (2008). For each scenario, the model simulates the prices and quantities that would have obtained in a base year had the policy reforms implied by the given scenario been retroactively applied to that year.

Fuel ethanol is assumed to be a homogeneous product. This implies that full substitution is presumed between domestic and imported ethanol, as well as among imports from different sources. While the degree of homogeneity of most traded ethanol is such as to warrant the perfect substitution assumption, the introduction of a separate mandate for advanced biofuels in the United States in 2009 created a policy-induced differentiation between products that are essentially undistinguishable based on their physical characteristics. As a result, the model does not capture the intricacies of the two-way trade that emerged between conventional (corn-based) ethanol from the United States and advanced (sugarcane-based) ethanol from abroad, especially from Brazil.

The world ethanol market is divided into five segments: the United States, Brazil, the European Union,[55] China, and the rest of the world (ROW). The four first segments are the world's largest producers and consumers of ethanol, accounting for 96 percent of world output and 88 percent of world demand between 2002 and 2012. Modeling of the world ethanol market is based on the supply and demand functions for each of the five market segments,[56] as described in equations 3.18 and 3.19 below:

$$d \ln S^i = \eta^i d \ln \left(P^W + \widehat{PSE}^i\right) \tag{3.18}$$

$$d \ln D^i = \varepsilon^i d \ln \left(P^W - \widehat{CSE}^i\right) \tag{3.19}$$

where

S^i: Supply in country *i*

η^i: Price elasticity of supply in country *i*

P^W: World price

$\widehat{PSE}^i$: PSE unit value in country *i*, given by $\widehat{PSE}^i = PSE^i/Q_P^i$

D^i: Demand in country *i*

ε^i: Price elasticity of demand in country *i*

$\widehat{CSE}^i$: CSE unit value in country *i*, given by $\widehat{CSE}^i = CSE^i/Q_C^i$

[55] The European Union (EU) went through two enlargement processes between 2002 and 2012. While EU membership comprised fifteen countries in 2002, ten countries joined the union in 2004, and two more in 2007. For the purposes of the model described in this section, the EU is defined – for every year between 2002 and 2012 – to be composed of the 27 countries that were members in December 2012.

[56] Although the European Union and the ROW correspond to collections of countries, hereinafter each of the five market segments in the model may be referred to as "countries" for sake of simplicity.

Supply in country i is related to per unit gross producer returns, including government support, which is given by $\left(P^W + \widehat{PSE}^i\right)$. Demand in country i is dependent on per unit consumer expenditures net of consumer support, which is given by $\left(P^W - \widehat{CSE}^i\right)$.

Equations 3.18 and 3.19 may be expressed as:

$$d\ln S^i = \eta^i \left(\frac{1}{P^W + \widehat{PSE}^i} dP^W + \frac{1}{P^W + \widehat{PSE}^i} d\widehat{PSE}^i\right) \tag{3.20}$$

$$d\ln D^i = \varepsilon^i \left(\frac{1}{P^W - \widehat{CSE}^i} dP^W - \frac{1}{P^W - \widehat{CSE}^i} d\widehat{CSE}^i\right) \tag{3.21}$$

Defining α^i as the share of $\widehat{PSE}^i$ in per unit producer gross receipts in country i, and β^i as the share of $\widehat{CSE}^i$ in per unit consumption expenditures net of consumer support in country i, equations 3.20 and 3.21 may be rewritten as:

$$d\ln S^i = \eta^i \left(\left(1 - \alpha^i\right) d\ln P^W + \alpha^i d\ln \widehat{PSE}^i\right) \tag{3.22}$$

$$d\ln D^i = \varepsilon^i \left(\left(1 - \beta^i\right) d\ln P^W - \beta^i d\ln \widehat{CSE}^i\right) \tag{3.23}$$

where
$$\alpha^i = \widehat{PSE}^i / \left(P^W + \widehat{PSE}^i\right)$$

$$\beta^i = \widehat{CSE}^i / \left(P^W - \widehat{CSE}^i\right)$$

World ethanol supply (S^W) is given by the sum of the supply functions in the five market segments:

$$d\ln S^W = \sum_i \delta^i \eta^i \left(\left(1 - \alpha^i\right) d\ln P^W + \alpha^i d\ln \widehat{PSE}^i\right) \tag{3.24}$$

where δ^i is the share of country i in world ethanol production. Similarly, world demand (D^W) corresponds to the sum of the demand functions in the five market segments:

$$d\ln D^W = \sum_i \varphi^i \varepsilon^i \left(\left(1 - \beta^i\right) d\ln P^W - \beta^i d\ln \widehat{CSE}^i\right) \tag{3.25}$$

where φ^i is the share of country i in world ethanol demand.

Letting world supply equal world demand and singling out $d\ln P^W$ results in:

$$d\ln P^W = \sum_i \left\{\left[\left(\frac{\delta^i \eta^i}{A}\right)\left(\alpha^i d\ln \widehat{PSE^i}\right)\right] + \left[\left(\frac{\varphi^i \varepsilon^i}{A}\right)\left(\beta^i d\ln \widehat{CSE^i}\right)\right]\right\} \tag{3.26}$$

where $$A = \left\{\sum_i \left[\varphi^i \varepsilon^i \left(1-\beta^i\right)\right] - \left[\delta^i \eta^i \left(1-\alpha^i\right)\right]\right\}$$

Since the model examines the impacts of US and Brazilian subsidies only, PSE and CSE values for the European Union, China and the ROW are assumed to remain unchanged. Moreover, as PSE in Brazil is either zero or close to zero in every year between 2002 and 2012, it is. Also assumed to remain unchanged. Accordingly, equation 3.26 may be simplified as follows:

$$\begin{aligned} d\ln P^W = &\left[\left(\frac{\delta^{US} \eta^{US}}{A}\right)\left(\alpha^{US} d\ln \widehat{PSE}^{US}\right)\right] + \left[\left(\frac{\varphi^{US} \varepsilon^{US}}{A}\right)\left(\beta^{US} d\ln \widehat{CSE}^{US}\right)\right] \\ &+ \left[\left(\frac{\varphi^{BR} \varepsilon^{BR}}{A}\right)\left(\beta^{BR} d\ln \widehat{CSE}^{BR}\right)\right] \end{aligned} \tag{3.27}$$

Given the definitions of PSE^{US}, $CSE^{US}$and CSE^{BR} provided in equations 3.8, 3.9 and 3.16, equation 3.27 may be rewritten in its detailed form as:

$$\begin{aligned} d\ln P^W = &\left\{\left(\frac{\delta^{US} \eta^{US}}{A}\right)\left[\left(\alpha^{US}_{PTC} d\ln \hat{G}^{US}_{PTC}\right) + \left(\alpha^{US}_{MPS} d\ln \hat{G}^{US}_{MPS}\right)\right.\right. \\ &\left.\left. + \left(\alpha^{US}_{LIC} d\ln \hat{G}^{US}_{LIC}\right) + \left(\alpha^{US}_{BO} d\ln \hat{G}^{US}_{BO}\right)\right]\right\} \\ &+ \left\{\left(\frac{\varphi^{US} \varepsilon^{US}}{A}\right)\left[\left(\beta^{US}_{CTC} d\ln \hat{G}^{US}_{CTC}\right) - \left(\beta^{US}_{MPS} d\ln \hat{G}^{US}_{MPS}\right)\right]\right\} \\ &+ \left[\left(\frac{\varphi^{BR} \varepsilon^{BR}}{A}\right)\left(\beta^{BR}_{CTC} d\ln \hat{G}^{BR}_{CTC}\right)\right] \end{aligned} \tag{3.28}$$

Equation 3.28 provides a framework for assessing the effect of US and Brazilian subsidies on the market-clearing world price of ethanol. By substituting $d\ln P^W$ back into equations 3.22 and 3.23, it is possible to derive the impacts of ethanol subsidies on supply and demand in each of the five market segments. The effects on net international trade flows are given by the resulting differences between production and consumption in each country. Finally, impacts on world supply and demand are obtained by substituting $d \ln P^W$ back into equations 3.24 and 3.25.

Six different scenarios are investigated in this section. Scenario 1 examines the market effects from hypothetically eliminating US consumption tax concessions in 2002-2012. Scenario 2 does the same for US import tariffs. Scenario 3 considers the joint elimination of US consumption tax concessions and import tariffs. Scenario 4 and Scenario 5 investigate the effects of removing total ethanol SEV in the United States and Brazil, respectively. Finally, Scenario 6 analyzes the simultaneous removal of SEV in the United States and Brazil.

3.3.2. Data

The effects estimated by the model depend on the values of the parameters and variables described in equation 3.28. The components of PSE and CSE for the United States and Brazil are estimated in Section 3.2 and summarized in Table 3.11 and Table 3.17, respectively.[57] Ethanol production and consumption data are from EIA (2014a) for 2002-2011, and from ANP (2014), LMC International (2013) and USDA (2014a) for 2012. Supply and demand price elasticities are from Elobeid and Tokgoz (2008) in the case of the United States (η^{US}= 0.65 and ε^{US} = –0.43), and from Fabiosa *et al.* (2009) in the case of the European Union (η^{EU} = 0.32 and ε^{EU} = –0.18) and China (η^{CH} = 0.17 and ε^{CH} = –0.26). For the ROW, elasticities are assumed to be equivalent to the simple average of European and Chinese elasticities (η^{ROW} = 0.245 and ε^{ROW} = –0.22).

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[57] For purposes of the estimations carried out in Section 3.3, ethanol SEV in the United States is adjusted to reflect only support provided to plants that had reached commercial viability by December 2012. Therefore, budgetary outlays provided to cellulosic ethanol plants under the BAP, as well as supplementary funding provided by the DOE to the same plants in 2009-2012, are excluded from total support provided to the ethanol sector in the United States. Since only US$43 million a year were provided on average to cellulosic ethanol plants in 2002-2012, average ethanol SEV in the United States in this period falls only marginally, from US$5.14 billion to US$5.10 billion.

Changes in the makeup of Brazil's automobile fleet radically transformed the behavior of Brazilian consumers of transportation fuels between 2002 and 2012 (Costa and Guilhoto, 2011). Several studies have demonstrated that the emergence of the flexible-fuel engine strengthened the position of ethanol as both an independent fuel and a substitute for gasoline, considerably altering its demand price elasticity. Table 3.18 lists some of these studies, along with their estimated price elasticities of demand for ethanol in Brazil. Eight studies (Azevedo, 2007; Pontes, 2009; Farina *et al.*, 2010; Serigati *et al.*, 2010; Souza, 2010; Freitas and Kaneko, 2011; Cardoso and Bittencourt, 2013; Santos, 2013) derived elasticities for periods generally beginning in 2001 and ending in 2011, which combine years both before and after the introduction of the flexible-fuel engine in the Brazilian market. Two of these studies (Serigati *et al.*, 2010; Cardoso and Bittencourt, 2013) also provide separate estimates for sub-periods pre- and post-flexible fuel engines.[58] Finally, two additional studies (Iotty *et al.* 2009; Costa *et al.*, 2013a) provide elasticities for periods after the introduction of flexible-fuel automobiles.

In the current model, the price elasticity of demand for Brazil is assumed to vary over the 2002-2012 period. For the beginning year, it is equivalent to the average of the two estimates for the pre-flexible fuel sub-period (ε_{2002}^{BR} = –1.09); for the end year, to the average of the four estimates for the post-flexible fuel sub-period (ε_{2012}^{BR} = –2.76); and for the years between 2003 and 2011, it is assumed to follow a linear trend between ε_{2002}^{BR} and ε_{2012}^{BR}. The supply price elasticity for Brazil (η^{BR} = 1.94) is obtained from Costa *et al*. (2013b) and is assumed to remain unchanged over the 2002-2012 period.

[58] Although the introduction of automobiles with flexible-fuel engines in Brazil occurred in 2003, Cardoso and Bittencourt (2013) define the start date of the post-flexible fuel engine sub-period as August 2006 given that the number of new automobiles was still small compared to the total fleet in 2003-2005. August 2006 is selected as the boundary between the two sub-periods because it was the first month in which flexible fuel automobile sales outperformed gasoline automobile sales. As Serigati *et al.* (2010) do not expressly define when the post-flexible fuel engine sub-period begins, it is assumed to be on January 2004.

Table 3.18: Estimates of the price elasticity of demand for ethanol, Brazil, 2001-2011

	Study	Coverage	Elasticity
A1	Pontes (2009)	2001-2008	-0.93
A2	Azevedo (2007)	2002-2006	-1.25
A3	Farina *et al.* (2010)	2001-2009	-1.23
A4	Souza (2010)	2001-2009	-1.54
A5	Serigati *et al.* (2010)	2001-2009	-1.48
A6	Santos (2013)	2001-2010	-1.25
A7	Freitas and Kaneko (2012)	2003-2010	-1.41
A8	Cardoso and Bittencourt (2013)	2001-2011	-1.48
	Average of A1-A8		-1.32
	Pre-flex fuel engine		
B1	Serigati *et al.* (2010)	2001-2003	-1.15
B2	Cardoso and Bittencourt (2013)	2001-2006	-1.04
	Average of B1-B2		-1.09
	Post-flex fuel engine		
C1	Serigati *et al.* (2010)	2004-2009	-2.12
C2	Cardoso and Bittencourt (2013)	2007-2011	-2.11
C3	Iotty *et al.* (2009)	2005	-3.58
C4	Costa *et al.* (2013a)	2006-2011	-3.25
	Average of C1-C4		-2.76

Source: Compiled by author from existing literature.

3.3.3. Implementation

The standard implementation of the model involves removing one or more types of ethanol support in the United States and Brazil by letting the percentage change in the corresponding PSE or CSE component equal –1 in equation 3.28. However, given that ethanol blending mandates may restrict or impede quantity and price adjustments, specific implementation procedures are needed when these mandates are binding or become binding due to the removal of other support instruments.

Although consumption subsidies generally shift the demand curve to right and result in higher quantities and market prices, when applied simultaneously with an ethanol blending mandate, they may have little or no effect on market equilibrium. In order to appropriately estimate the market effects of removing US consumption tax concessions, one must determine whether either the implicit (MTBE substitution) or explicit (RFS) ethanol mandates would bind in each of the years between 2002 and 2012.

As illustrated by the three panels in Figure 3.11, one of three regimes may emerge when tax credits and blending mandates are applied simultaneously. Let S be the supply curve for ethanol; D_1 and D_2, the pre-mandate demand curves for ethanol with and without the tax credit, respectively; and M_A, M_B and M_C, three different blending mandate levels. For simplicity, and without loss of generality, zero net trade is assumed. In the first regime, depicted in Panel A, the mandate M_A is not binding, irrespective of the tax credit. Market equilibria are given by (Q_1, P_1) prior to the elimination of the tax credit and (Q_2, P_2) after its removal, neither of which are affected by M_A. Under this regime, which occurs when $M_A < Q_2$, the removal of tax credits leads to full quantity and price adjustments.

In the second regime, depicted in Panel B, the mandate M_B is not binding in the presence of the tax credit. Once the tax credit is removed, M_B becomes binding. Market equilibria are given by (Q_1, P_1) prior to the elimination of the tax credit and (M_B, P_B) after the elimination of the tax credit, the latter being determined by the mandate. Under this regime, which occurs whenever $Q_2 < M_B < Q_1$, quantity and price adjustments following the removal of tax credits are restricted by the binding mandate. Finally, in the third regime, depicted in Panel C, the mandate M_C is binding regardless of the tax credit. Market equilibria are given by (M_C, P_C) prior to and after the elimination of the tax credit, both of which are determined by the mandate. Under this regime, which occurs whenever $M_C > Q_1$, the removal of tax credits leads to no change in equilibrium quantity or price.

PANEL A

PANEL B

PANEL C

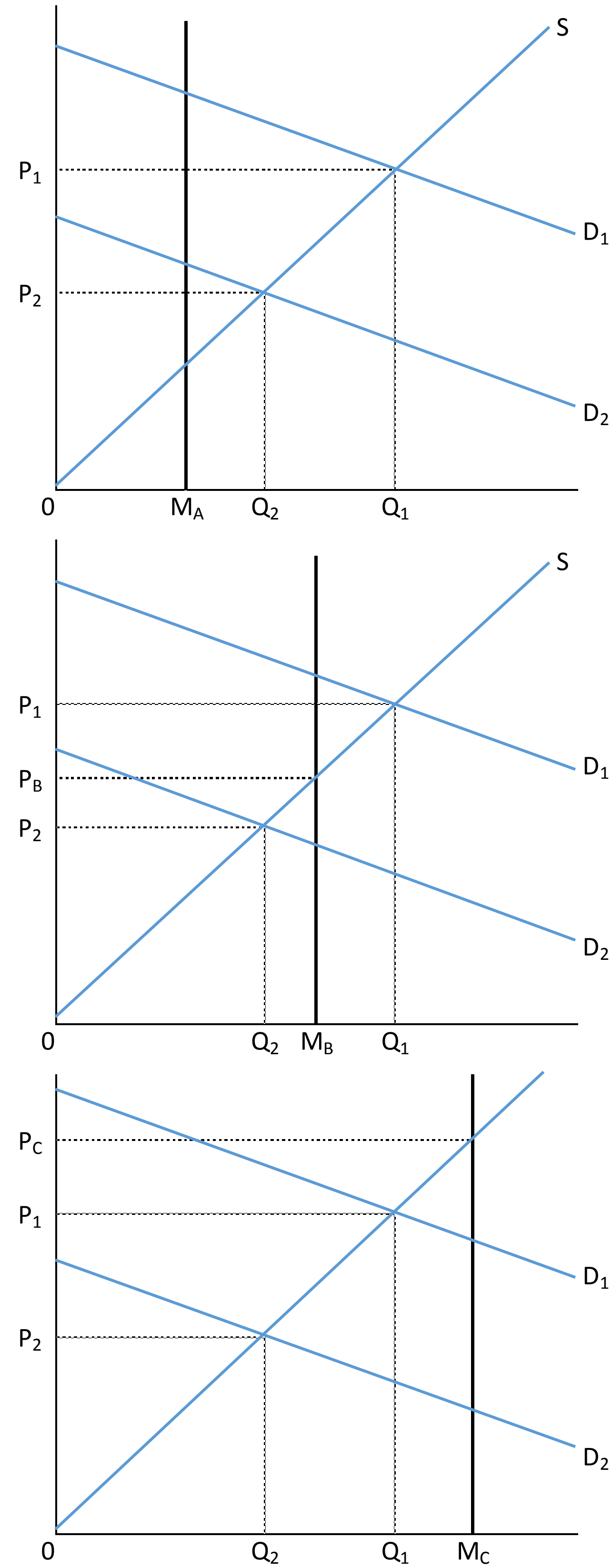

Figure 3.11: Elimination of tax credits in the presence of a blending mandate

The model implementation of the removal of US consumption tax credits (Scenario 1) is conditional on the prevailing mandate regime. When blending mandates are not binding, irrespective of the tax credit, the change in the world price is obtained by letting $d\ln \hat{G}_{CTC}^{US} = -1$ in equation 3.28 and solving for $d\ln P^W$. When blending mandates become binding due to the removal of the tax credit, the change in the world price is obtained by letting $d\ln D^{US}$ equal the percentage difference between the mandate and the observed US consumption level, and subsequently solving equation 3.28 for $d\ln P^W$. Finally, the world price remains unchanged when blending mandates are binding irrespective of the tax credit.

The model implementation of the removal of US import tariffs (Scenario 2) is largely unaffected by blending mandates. This is due to the fact that trade liberalization generally leads to lower domestic prices and higher consumption levels in the liberalizing country. However, if consumption levels prior to the elimination of tariffs were determined by a blending mandate, trade liberalization may not affect quantity demanded. Figure 3.12 illustrates how distinct mandate regimes affect market equilibrium quantities and prices following the elimination of import tariffs. Let T be the import tariff; M_J, M_K and M_L, three different blending mandate levels; S, the supply curve for ethanol; D_J, D_K and D_L, the demand curves for ethanol in the presence of mandates M_J, M_K and M_L, respectively; ES, the excess supply curve, determined by supply and demand conditions in the rest of the world; ED_J, ED_K and ED_L, the excess demand curves, determined by supply and demand conditions in the domestic market.

In Panel J, mandate M_J has no impact on excess demand ED_J and the market equilibrium prior to the elimination of the tariff (P_J, D_J). Once the tariff is removed, market equilibrium converges to the free trade price and quantity combination (P_{ft}, D_{ft}), which is also unaffected by the mandate. This is true whenever M_J is lower than the autarchy equilibrium quantity.

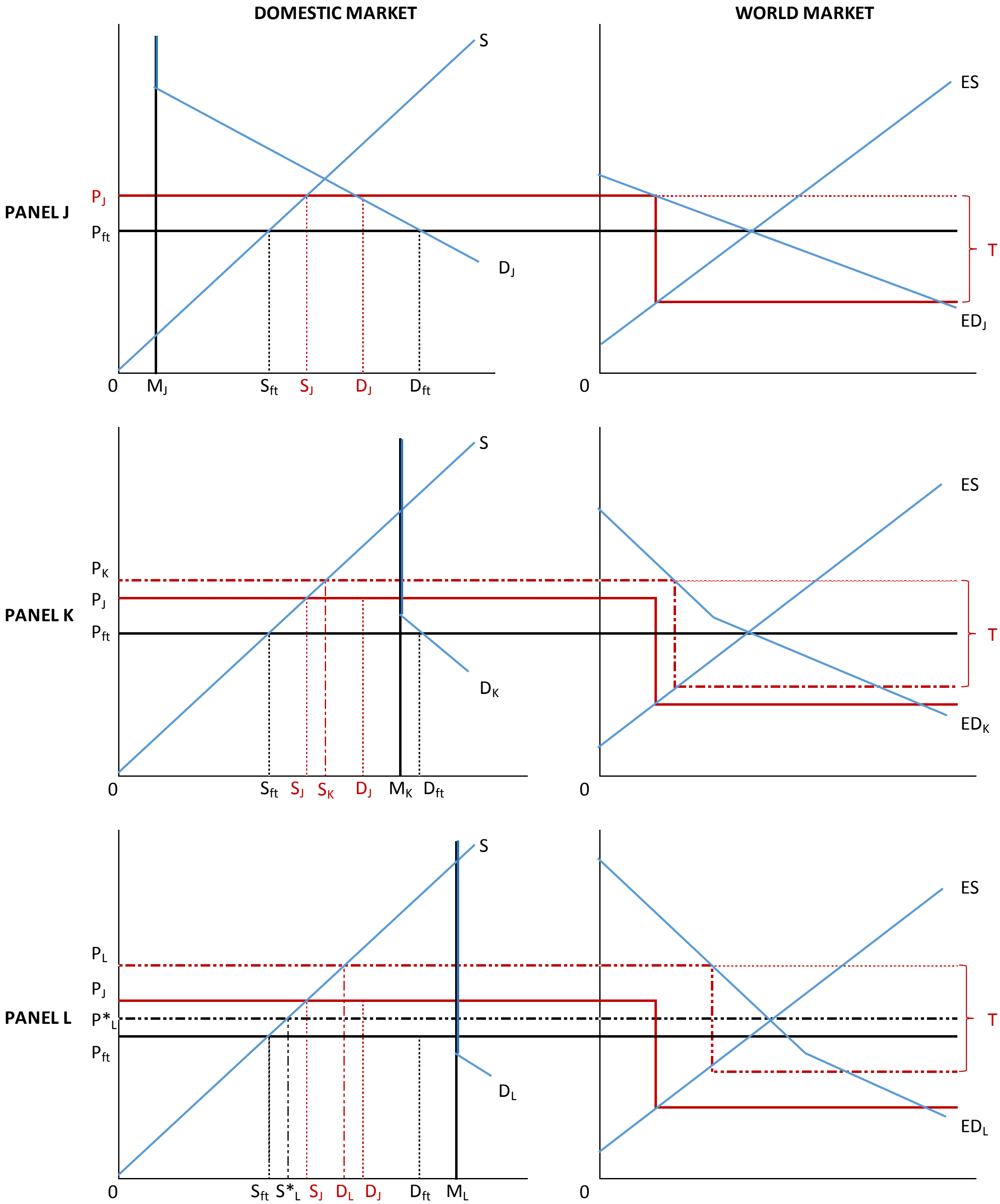

Figure 3.12: Elimination of import tariffs in the presence of a blending mandate

In Panel K, mandate M_K affects excess demand ED_K and the market equilibrium prior to the elimination of the tariff (P_K, M_K). However, once the tariff is removed, market equilibrium converges to the free trade price and quantity (P_{ft}, D_{ft}), which is unaffected by the mandate. This is true whenever M_K is greater than the autarchy equilibrium quantity but lower than the free trade equilibrium quantity. Finally, in Panel L, mandate M_L affects excess demand ED_L and market equilibria both prior to (P_L, M_L) and after the removal of the tariff (P^*_L, M_L). This is true whenever M_L is greater than the free trade equilibrium quantity.

Since observed consumption levels in the United States were above mandated quantities every year in 2002-2012, with the exception of 2006, the standard model implementation is applied as a general rule, i.e. $d\ln\hat{G}_{MPS}^{US}$ is set equal to -1 in equation 3.28. As the implicit ethanol blending mandate was binding in 2006, consumption is assumed to remain unchanged after the removal of the tariff. The change in the world price is obtained by letting $d\ln D^{US} = 0$, $d\ln\hat{G}_{MPS}^{US} = -1$ under the US supply equation, and subsequently solving equation 3.28 for $d\ln P^W$.

The implementation of the joint elimination of consumption tax concessions and import tariffs (Scenario 3) reflects the observations made above for Scenario 1 and Scenario 2. When blending mandates are not binding, irrespective of tax credits and import tariffs, changes in the world price are derived by applying the standard implementation approach, i.e. letting $d\ln\hat{G}_{CTC}^{US} = -1$ and $d\ln\hat{G}_{MPS}^{US} = -1$ in equation 3.28. When mandates become binding due to the joint elimination of tax credits and border protection, world price changes are obtained by letting $d\ln D^{US}$ equal the percentage difference between the mandate and the observed US consumption level, and subsequently solving equation 3.28 for $d\ln P^W$. Finally, market equilibrium remains unchanged when mandates are binding, regardless of tax concessions and tariffs.

3.3.4. Results

The estimated market effects of hypothetically eliminating US and Brazilian ethanol subsidies between 2002 and 2012 are described below for the six distinct reform scenarios. As the most important sources of support to the ethanol sector in both the United States and Brazil were eliminated in 2012, period averages are restricted to the ten years between 2002 and 2011. Since binding mandates and a country's net trade status may cause results within a particular scenario to differ substantially over time, sub-period averages are presented in addition to period averages.

Scenario 1: Elimination of US Consumption Tax Concessions

Estimated world price effects from the removal of US consumption tax concessions are summarized in Table 3.19, along with changes in US and Brazilian production and consumption levels, and corresponding adjustments in world trade flows. Detailed results for the five market segments in each of the six scenarios are presented in the appendix to this chapter. For analysis purposes, the period between 2002 and 2012 is divided into three sub-periods: (i) from 2002 to 2005, when US consumption tax concessions applied in a mandate-free environment; (ii) from 2006 to 2011, when tax concessions interacted with both the implicit blending mandate imposed by state MTBE bans and the explicit mandate introduced by the RFS; and (iii) 2012, when only state tax concessions were in place, as the VEETC was eliminated in December 2011.

The magnitude of the results obtained vary significantly across each of the three sub-periods, being larger in 2002-2005, smaller in 2006-2011, and essentially zero in 2012. The elimination of US consumption tax credits would have resulted in an average world price decline of 6.5 percent in 2002-2005, causing production to fall in the United States (3.5 percent), but especially in Brazil (12 percent), where producers are highly sensitive to relative price fluctuations between ethanol and sugar. Consumption would increase moderately in all market segments (1 to 6.5 percent), except in the United States, where it would fall by 27.5 percent. World trade would expand by 130 percent, as the United States would export its excess supply to the other market segments, including Brazil.

Table 3.19: Estimated Effects of Eliminating US Consumption Tax Concessions, 2002-2012

Year	World Price	Production		Consumption		World Trade
		US	Brazil	US	Brazil	
2002	-9.2%	-5.1%	-17.9%	-45.5%	8.3%	311.5%
2003	-6.0%	-3.3%	-11.7%	-28.0%	6.5%	242.5%
2004	-5.5%	-2.3%	-10.7%	-20.0%	6.2%	-20.2%
2005	-4.4%	-2.4%	-8.6%	-16.9%	5.7%	-16.6%
2006	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2007	-3.7%	-1.9%	-7.2%	-12.5%	5.6%	-43.6%
2008	-3.5%	-1.9%	-6.9%	-11.0%	6.4%	-36.0%
2009	-1.3%	-0.8%	-2.5%	-3.9%	2.4%	-19.7%
2010	-0.8%	-0.5%	-1.5%	-2.3%	1.6%	1.4%
2011	-1.0%	-0.6%	-2.0%	-2.8%	2.3%	4.3%
2012	-0.1%	-0.1%	-0.2%	-0.3%	0.2%	0.2%
2002-2011 average	-3.6%	-1.9%	-6.9%	-14.3%	4.5%	42.4%
2002-2005 average	-6.3%	-3.3%	-12.2%	-27.6%	6.6%	129.3%
2006-2011 average	-1.7%	-0.9%	-3.4%	-5.4%	3.0%	-15.6%

Source: Author's calculations.

Within the pre-mandate sub-period, market effects would be stronger in 2002, when the federal tax exemption of 53 cents per gallon, plus average state tax concessions of 4 cents per gallon at the national level, corresponded to 50 percent of the domestic price of ethanol. As MTBE bans spread to a larger number of states and the price of MTBE substitutes rose, the size of consumption tax concessions relative to the price of fuel ethanol declined to 40 percent in 2003 and 30 percent in 2004-2005. While tax concessions remained important, their relative impact on consumption during this sub-period became less pronounced over time.

State bans effectively worked as state-level ethanol blending mandates in areas that were previously using MTBE to comply with strict oxygenation requirements or to maintain fuel octane levels in the presence of other environmental constraints. However, as one third of US ethanol consumption still occurred in states without MTBE bans in 2005, the combination of these implicit state mandates was not binding at the national level.[59] Despite the large estimated reductions in US ethanol consumption between 2002 and 2005 under Scenario 1, the implicit state-level blending mandates would still have been met during this sub-period. Higher ethanol prices would stimulate MTBE blending into gasoline in states without MTBE bans and divert ethanol that would otherwise be consumed in these states to states with MTBE bans.

In contrast with the pre-mandate sub-period, the elimination of US consumption tax concessions in 2006-2011 would have decreased world prices on average by only 1.7 percent. Lower market prices would cause production to retract on average by just 1 percent in the United States and 3.5 percent in Brazil. Consumption in the United States would decline by 5.5 percent – only one-fifth of the average percentage reduction estimated for 2002-2005. Both consumption and production would remain virtually unchanged in the European Union, China and the ROW. Increased consumption in Brazil (3 percent on average), coupled with reduced domestic

[59] MTBE bans were restricted to four Midwestern states and Colorado in 2002, accounting for only 9.5 percent of total gasoline additive demand in the United States. The progressive adoption of MTBE bans by fourteen other states and the introduction of a statewide ethanol blending mandate in Minnesota increased ethanol's captive share in US gasoline additive demand to 13 percent in 2003, 40 percent in 2004 and 48 percent in 2005. As a result, the share of US fuel ethanol consumption taking place in states with MTBE bans increased from 25 percent in 2002 to 65 percent in 2005.

production, would cut exports in half. Since expanded US excess supply would not make up for the fall in Brazilian exports in most years, world trade would retract by 15 percent on average in 2006-2011.

Smaller market effects from removing US consumption tax concessions in 2006-2011, as opposed to 2002-2005, are largely due to the incidence of binding mandates that significantly restrict quantity and price adjustments. The implicit mandate for ethanol as a replacement for MTBE became binding in 2006, when the lack of liability protection for the ether culminated in a full-fledged switch to ethanol at the national level. The introduction of the RFS explicit blending mandate eventually pushed required minimum consumption levels beyond what was required to serve as a gasoline oxygenate and octane enhancer.

The implicit blending mandate was binding in 2006 irrespective of the VEETC. Therefore, the elimination of consumption tax concessions has no impact on equilibrium prices and quantities in this year. While the RFS explicit blending mandate was not binding between 2009 and 2011, the removal of the VEETC would have caused it to become binding. As a result, estimated price and quantity impacts for these three years are substantially lower than in most other years in Scenario 1.

Finally, the market impacts from hypothetically eliminating residual state consumption tax concessions in 2012 would be essentially nil. Only four states (Illinois, Iowa, Oklahoma and South Dakota) still offered tax credits or reduced taxation rates for E10 in 2012. Since the estimated revenue foregone from these concessions in 2012 (US$226 million) corresponded to less than one percent of the total value of ethanol production in the United States, it is not surprising that the removal of these subsidies would have little impact on domestic and world markets.

Scenario 2: Elimination of US Import Tariffs

The estimated market effects from the hypothetical elimination of US import tariffs are summarized in Table 3.20. Under this scenario, the world price of ethanol is on average 4 percent higher than the levels actually observed between 2002 and 2011. The increase is moderately higher in years when the United States was a net ethanol importer (5 percent in 2002-2009), and significantly lower when it was a net exporter (1 percent in 2010-2011). The positive impact on the world price is most significant in 2004 (11 percent increase), the only year in 2002-2012 when the MPD was equivalent to the full size of the import tariff burden (15.5 cents per liter) and blending mandates were not binding.[60]

Table 3.20: Estimated Effects of Eliminating US Import Tariffs, 2002-2012

Year	World Price	Production		Consumption		World Trade
		US	Brazil	US	Brazil	
2002	2.5%	-3.5%	4.8%	7.3%	-2.2%	109.8%
2003	3.2%	-5.3%	6.3%	8.0%	-3.4%	183.3%
2004	10.9%	-15.6%	21.1%	20.2%	-12.2%	191.9%
2005	3.4%	-5.1%	6.6%	6.2%	-4.4%	64.0%
2006	3.9%	-12.2%	7.6%	0.0%	-5.6%	61.3%
2007	6.0%	-8.7%	11.7%	9.3%	-9.1%	125.3%
2008	6.1%	-8.0%	11.8%	8.3%	-11.0%	110.6%
2009	2.8%	-2.9%	5.4%	3.6%	-5.2%	79.3%
2010	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2011	1.6%	-1.5%	3.1%	1.7%	-3.6%	-1.8%
2012	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2002-2011 average	4.0%	-6.3%	7.8%	6.5%	-5.7%	92.4%
2002-2009 average	4.8%	-7.7%	9.4%	7.9%	-6.6%	115.7%
2010-2011 average	0.8%	-0.7%	1.6%	0.9%	-1.8%	-0.9%

Source: Author's calculations.

[60] Although the MPD was also equivalent to the full size of the import tariff burden in 2006, the implicit blending mandate was binding. As a result, the estimated world price change is more modest this year.

Domestic prices in the United States decline on average by 12 percent in 2002-2009, with larger falls in 2004 (25 percent) and 2006 (20 percent). In the absence of tariffs to shield domestic producers from foreign competition, ethanol output in the United States falls by 8 percent on average (12-15 percent in 2004 and 2006). Blenders react to lower prices by increasing ethanol consumption by 8 percent on average, except in 2006, when consumption remains unchanged as it is determined by the implicit blending mandate. As a result, US imports expand dramatically to an average level of 4.1 billion liters a year, nearly four times the average import level recorded in 2002-2009. The great majority of these imports would come from Brazil, with small amounts coming from China.

The other segments of the world market react to US trade liberalization by expanding production and reducing domestic consumption in 2002-2009. Output increases by 9.5 percent in Brazil, and 1-1.5 percent in the European Union, China and the ROW. Higher world prices imply that consumers in Brazil switch away from hydrous ethanol and into gasoline blended with anhydrous ethanol, causing total ethanol consumption to drop by 6.5 percent. Given that demand is less price elastic in the European Union, China and the ROW, consumption falls by only 1-1.5 percent in these market segments. Despite slightly smaller import levels in these three markets, total world trade more than doubles due to increased imports by the United States.

The removal of import tariffs has only minor effects on production, consumption and trade in the sub-period when the United States was a net ethanol exporter (2010-2012), as MPS per liter of ethanol produced was either zero or significantly lower than in previous years. In 2012, effects are nil as the low *ad valorem* tariff of 2.5 percent was the only import barrier in place after US authorities eliminated the large additional import duty in December 2011.

Scenario 3: Elimination of US Consumption Tax Concessions and Import Tariffs

The estimated market effects of the joint elimination of US consumption tax concessions and import tariffs are summarized in Table 3.21. Results vary substantially over time, depending both on whether the effects of trade liberalization outweigh those from the removal of tax credits, and whether blending mandates become binding. For analysis purposes, the period between 2002 and 2012 is divided into four sub-periods: (i) from 2002 to 2003, when the effects of eliminating tax exemptions prevail over those from trade liberalization; (ii) from 2004 to 2008, when the effects of trade liberalization generally outweigh those from removing consumption tax concessions; (iii) from 2009 to 2011, when the effects from removing the VEETC generally overpower those from trade liberalization, but are restricted by binding mandates; and (iv) 2012, when residual support to ethanol in the United States is too small to significantly impact world prices.

Average effects on world prices and production and consumption levels outside the United States are negligible under Scenario 3 for the 2002-2012 period as a whole. Nonetheless, effects are significant once sub-periods are examined separately. In 2002-2003, the elimination of consumption tax credits prevails over the removal of import tariffs and causes the world price to decrease by 5 percent on average. This is less than the 7.5 percent retraction estimated for the same two years under Scenario 1, as trade liberalization offsets some of the downward price pressure created by the elimination of the blender's tax exemption. As domestic prices in the United States fall by more than in Scenario 1 or Scenario 2, the negative effects on production are more evenly distributed across the five market segments. Whereas production in the United States and Brazil decrease by respectively 4 and 15 percent in 2002-2003 in Scenario 1, average reduction rates for the same period in Scenario 3 are approximately 9 percent for both countries. Consumption retraction in the United States remains large (29 percent on average), but less so than in Scenario 1 for the same two years (37 percent on average), given that blenders are partially compensated for the loss of the tax credit by having access to cheaper imports.

Table 3.21: Estimated Effects of Eliminating US Consumption Tax Concessions and Import Tariffs, 2002-2012

Year	World Price	Production		Consumption		World Trade
		US	Brazil	US	Brazil	
2002	-6.8%	-8.6%	-13.1%	-38.2%	6.0%	199.8%
2003	-2.8%	-8.5%	-5.4%	-20.0%	3.0%	56.2%
2004	5.4%	-17.9%	10.4%	0.3%	-6.0%	94.9%
2005	-1.0%	-7.5%	-2.0%	-10.7%	1.3%	-19.0%
2006	3.9%	-12.2%	7.6%	0.0%	-5.6%	61.3%
2007	2.3%	-10.6%	4.5%	-3.3%	-3.5%	47.9%
2008	2.5%	-9.8%	4.9%	-2.7%	-4.6%	45.9%
2009	0.21%	-4.4%	0.4%	-3.9%	-0.4%	5.9%
2010	-0.79%	-0.5%	-1.5%	-2.3%	1.6%	1.3%
2011	-0.03%	-2.5%	-0.1%	-2.8%	0.1%	0.0%
2012	-0.1%	-0.1%	-0.2%	-0.3%	0.2%	0.2%
2002-2011 average	0.3%	-8.3%	0.6%	-8.4%	-0.8%	49.4%
2002-2003 average	-4.8%	-8.6%	-9.3%	-29.1%	4.5%	128.0%
2004-2008 average	2.6%	-11.6%	5.1%	-3.3%	-3.7%	46.2%
2009-2011 average	-0.2%	-2.5%	-0.4%	-3.0%	0.4%	2.4%

Source: Author's calculations.

Between 2004 and 2008, large MPDs ensure that positive price pressures from trade liberalization outweigh negative pressures from the removal of consumption tax credits, leading to an average increase of 2.5 percent in world prices. Because US domestic prices in 2004-2008 fall even more precipitously than in Scenario 2, domestic production declines are also larger (11.5 percent on average). Domestic consumption retraction is modest (3 percent on average) and significantly lower than in Scenario 1 for the same five years (12 percent on average), as trade liberalization almost fully compensates for the removal of tax credits. In Brazil, production expands by 5 percent and consumption falls by 3.5 percent, leading to a 45 percent increase in exports, virtually all destined to the United States. As production and consumption volumes remain mostly unchanged in the European Union, China and the ROW, the increase in Brazilian exports translates into a similar expansion in world trade.

Finally, as the joint elimination of tax credits and import tariffs activates the mandate in 2010 and 2011, effects on price, production and consumption are small in the third sub-period. Although world prices remain mostly unchanged (0.2 percent average reduction), domestic prices in the United States fall by 4 percent on average, leading to modest retractions in both production (2.5 percent) and consumption (3 percent). Markets outside the United States are virtually unaffected, except that the European Union and the ROW source larger shares of their imports from the United States as opposed to Brazil.

Scenario 4: Elimination of US Subsidy Equivalent Value

The hypothetical elimination of the SEV in favor of ethanol in the United States involves the removal of all consumption tax concessions, market price support, lower input costs and budgetary outlays estimated in Section 3.2, with the exception of payments to cellulosic ethanol plants under the BAP and supplementary DOE funding (see footnote 57). Results are summarized in Table 3.22. Price, production and consumption effects in Scenario 4 are approximately 20 percent lower than in Scenario 3 in 2002-2003, 20 percent higher in 2004-2008, and remain close to zero in 2009-2012. The main exception involves consumption effects in the United States, which are nearly the same in the two scenarios, as production payments and lower input costs do not directly affect demand.

Table 3.22: Estimated Effects of Eliminating US Subsidy Equivalent Value, 2002-2012

Year	World Price	Production		Consumption		World Trade
		US	Brazil	US	Brazil	
2002	-5.8%	-12.8%	-11.3%	-38.1%	5.2%	156.5%
2003	-1.9%	-12.1%	-3.8%	-20.1%	2.1%	6.0%
2004	6.2%	-20.6%	12.0%	0.2%	-6.9%	109.1%
2005	-0.2%	-10.4%	-0.4%	-10.9%	0.3%	-19.6%
2006	4.8%	-14.8%	9.2%	0.0%	-6.8%	74.0%
2007	2.7%	-11.9%	5.3%	-3.3%	-4.1%	56.1%
2008	2.8%	-10.8%	5.5%	-2.8%	-5.1%	51.7%
2009	0.8%	-5.7%	1.5%	-3.9%	-1.4%	21.4%
2010	-0.4%	-1.4%	-0.7%	-2.3%	0.8%	0.6%
2011	0.3%	-3.1%	0.5%	-2.8%	-0.6%	-0.3%
2012	0.1%	-0.6%	0.2%	-0.4%	-0.3%	-0.2%
2002-2011 average	0.9%	-10.4%	1.8%	-8.4%	-1.7%	45.6%
2002-2003 average	-3.9%	-12.5%	-7.5%	-29.1%	3.6%	81.3%
2004-2008 average	3.2%	-13.7%	6.3%	-3.4%	-4.5%	54.3%
2009-2011 average	0.2%	-3.4%	0.4%	-3.0%	-0.4%	7.2%

Source: Author's calculations.

The elimination of ethanol SEV in the United States causes world prices to rise on average by 1 percent between 2002 and 2011. As in Scenario 3, this average conceals significant variation over time. World prices fall on average by 4 percent in 2002-2003 and increase on average by 3 percent in 2004-2008 and 0.2 percent in 2009-2011. Most notably, world prices increase by 6 percent in 2004 and 5 percent in 2006, an indication that US ethanol SEV caused significant price depression in these years.

Following the hypothetical elimination of ethanol SEV in the United States, production in Brazil rises by 12 percent in 2004 and 9 percent in 2006. Output also expands by 1.5-2 percent in the European Union and 1-1.5 percent in China and the ROW in 2004 and 2006. By contrast, production in the United States falls by 21 percent in 2004 and 15 percent in 2006. As consumption in the United States remain essentially unchanged, US imports increase fivefold in 2004 (from 0.6 to 3.3 billion liters) and twofold in 2006 (from 2.8 to 5.5 billion liters). As a result, international trade flows expand by 110 percent in 2004 and 75 percent in 2006.

US ethanol SEV caused world price depression in a total of seven out of eleven years in 2002-2012. Price depression was significant (5-6 percent) in 2004 and 2006, moderate (3 percent) in 2007 and 2008, and low (less than 1 percent) in 2009, 2011 and 2012. As discussed in Section 3.4, significant world price depression – like the ones observed in 2004 and 2006 – may establish grounds for a legal challenge against US ethanol support measures at the WTO.

Scenario 5: Elimination of Brazilian Ethanol Subsidy Equivalent Value

Whereas the effects from eliminating ethanol SEV in the United States differ substantially from year to year due to multiple interactions between distinct types of support measures, in Brazil the results from sector liberalization are consistent over time as virtually all support is provided in the form of tax rate reductions at the pump.

The hypothetical removal of Brazil's preferential tax rates in favor of ethanol leads to an average reduction of 6.5 percent in world prices between 2002 and 2011. Although ethanol production declines across all five market segments, reductions are greater in Brazil (12.5 percent) than elsewhere (3.5 percent in the United States; 1-2 percent in the European Union, China and the ROW). Consumption falls on average by 22 percent in Brazil, especially after 2003, when the introduction of flexible-fuel automobiles made consumers more responsive to relative fuel price changes. Consumption in the other four market segments is only minimally affected (1-2 percent average increase). International trade expands on average by 40 percent, as Brazilian excess supply is exported mainly to the United States, but also to the European Union and the ROW. Estimated price and production effects in 2012 are roughly half as large as in 2002-2011 because the most important source of support for ethanol in Brazil – the CIDE tax differential – was removed by Brazilian authorities in July 2012.

Unlike in the United States, ethanol SEV in Brazil does not lead to word price depression. On the contrary, Brazilian consumption tax concessions have a positive impact on world prices and create incentives for expanded production both domestically and abroad.

Table 3.23: Estimated Effects of Eliminating Brazil's Ethanol Subsidy Equivalent Value, 2002-2012

Year	World Price	Production		Consumption		World Trade
		US	Brazil	US	Brazil	
2002	-5.8%	-3.2%	-11.3%	-0.5%	-14.3%	33.3%
2003	-5.1%	-2.7%	-9.9%	0.3%	-13.2%	50.0%
2004	-7.5%	-3.2%	-14.6%	0.2%	-21.9%	22.3%
2005	-6.8%	-3.7%	-13.2%	1.2%	-22.2%	33.4%
2006	-7.3%	-3.5%	-14.2%	0.0%	-23.4%	21.1%
2007	-8.5%	-4.4%	-16.5%	1.6%	-29.1%	51.2%
2008	-5.0%	-2.6%	-9.7%	1.1%	-19.0%	30.5%
2009	-6.9%	-4.1%	-13.4%	1.6%	-27.1%	81.0%
2010	-6.9%	-4.4%	-13.4%	2.0%	-27.9%	64.3%
2011	-5.3%	-3.3%	-10.3%	1.6%	-23.6%	6.2%
2012	-3.5%	-2.3%	-6.8%	1.5%	-17.7%	34.2%
2002-2011 average	-6.5%	-3.5%	-12.7%	0.9%	-22.2%	39.3%

Source: Author's calculations.

Scenario 6: Elimination of US and Brazilian Ethanol Subsidy Equivalent Values

The hypothetical removal of both US and Brazilian SEV in favor of ethanol leads to an average reduction of 5.8 percent in world prices between 2002 and 2011. As in Scenario 5, production declines across all five market segments. However, this time average reductions are greater in

United States (14 percent), followed by Brazil (11 percent). In the European Union, China and the ROW, production falls by 1-2 percent on average. Brazilian consumption falls on average by 10 percent in 2002-2003 and 27 percent in 2004-2011, reflecting the greater price elasticity of demand after the introduction of flexible fuel automobiles in 2003. In the United States, the reverse occurs: consumption falls are large (29 percent on average) in 2002-2003, but modest (3 percent on average) in 2004-2011. Consumption in the European Union, China and the ROW is only minimally affected (1-1.5 percent average increase). As US excess demand and Brazilian excess supply rise, trade flows expand by 60 percent on average in 2002-2011, the second largest estimated expansion for the period as a whole after Scenario 2.

Table 3.24: Estimated Effects of Eliminating US and Brazilian Ethanol Subsidy Equivalent Values, 2002-2012

Year	World Price	Production		Consumption		World Trade
		US	Brazil	US	Brazil	
2002	-11.6%	-16.0%	-22.6%	-38.6%	-9.1%	128.6%
2003	-7.0%	-14.9%	-13.6%	-19.7%	-11.1%	-37.1%
2004	-1.4%	-23.8%	-2.7%	0.4%	-28.8%	130.0%
2005	-7.0%	-14.2%	-13.6%	-9.6%	-21.9%	-14.7%
2006	-2.6%	-18.3%	-5.0%	0.0%	-30.2%	93.7%
2007	-5.8%	-16.3%	-11.3%	-1.7%	-33.2%	105.5%
2008	-2.2%	-13.4%	-4.2%	-1.7%	-24.2%	81.4%
2009	-6.7%	-10.1%	-13.0%	-3.9%	-27.5%	85.3%
2010	-8.0%	-6.3%	-15.4%	-2.3%	-25.8%	13.1%
2011	-5.6%	-6.7%	-10.9%	-2.8%	-22.9%	6.3%
2012	-3.4%	-2.9%	-6.6%	1.1%	-18.0%	5.6%
2002-2011 average	-5.8%	-14.0%	-11.2%	-8.0%	-23.5%	59.2%
2002-2003 average	-9.3%	-15.4%	-18.1%	-29.2%	-10.1%	45.8%
2004-2008 average	-3.8%	-17.2%	-7.4%	-2.5%	-27.7%	79.2%
2009-2011 average	-6.8%	-7.7%	-13.1%	-3.0%	-25.4%	34.9%

Source: Author's calculations.

3.4. Conclusion

Despite the remarkable growth in the use of ethanol as a transportation fuel in the last decade and the proliferation of government measures to promote the adoption of biofuels across the globe,[61] no international institution monitors and evaluates support to ethanol and other biofuels. Although separate estimates of support have been presented for specific countries and years, there is a need for a consistent method that can be rigorously applied across countries and over time. This chapter bridges this gap by proposing a robust and transparent methodology to systematically measure ethanol support and estimate its effects on domestic and world markets.

Support to the ethanol sector in the United States and Brazil was very significant between 2002 and 2011. The world's two largest biofuel producers and consumers provided their ethanol sectors with US$84 billion worth of transfers during this ten-year period. To put it into perspective, combined expenditures of the agencies in charge of environmental protection in the United States and Brazil – the United States Environmental Protection Agency (EPA) and the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) – reached US$85 billion in the same period. While annual transfers to US and Brazilian ethanol increased almost uninterruptedly from US$2.6 billion in 2002 to US$12.6 billion in 2011, significant policy reforms in the two countries brought the level of support down to US$2.7 billion in 2012.

Ethanol support was disproportionately concentrated in the United States, which accounted for over two-thirds of combined transfers in 2002-2011. The average annual subsidy equivalent value for ethanol in the United States during this period was US$5.7 billion, which accounted for

[61] Global fuel ethanol output almost quadrupled in the last decade, growing from 22 billion liters in 2002 to 87 billion liters in 2011. In addition to the United States and Brazil, various countries have implemented blending mandates, tax concessions or other government support incentives specifically designed to spur the adoption of ethanol as a transportation fuel, including Angola, Argentina, Australia, Canada, China, Colombia, Costa Rica, Ethiopia, India, Indonesia, Jamaica, Malawi, Mozambique, Panama, Paraguay, Peru, the Philippines, South Africa, Sudan, Vietnam and Zimbabwe.

47 percent of the domestic production value and resulted in an average subsidization rate of 23 cents per liter of ethanol produced. By contrast, the average annual subsidy equivalent value in Brazil was US$2.7 billion, accounting for 23.5 percent of the domestic production value and yielding an average subsidization rate of 12.5 cents per liter of ethanol produced. Detailed annual estimates of ethanol subsidy equivalent values and the various PSE and CSE components for the United States and Brazil are summarized in Table 3.11 and Table 3.17, respectively.

This chapter contributes to the literature on the quantification of ethanol subsidies in a number of ways. First, it provides a consistent assessment of transfers to the ethanol sector in the two largest producers of ethanol. Despite the key role played by Brazil as both a biofuel producer and consumer, most studies that measure ethanol subsidies have focused on the United States and other OECD countries (Koplow, 2006, 2007; Kutas *et al.*, 2007; Steenblik, 2007; Quirke *et al.*, 2008; Steenblik *et al.*, 2008; Laan *et al.*, 2009; Jung *et al.*, 2010). One exception is IEA (2010), which quantifies ethanol subsidies for Brazil, China, the European Union and the United States between 2007 and 2009. Nevertheless, the results reported by the IEA not only lack detail, but also significantly underestimate actual subsidization levels in Brazil and the United States. To the best of our knowledge, the current chapter provides the only systematic, detailed and quantified comparison of ethanol support in the United States and Brazil.

Second, while most studies focus on a particular year, this chapter examines subsidies over an eleven-year period (2002-2012), during which significant policy and market developments took place. In the United States, this period encompasses the move away from MTBE as a gasoline additive, the introduction of the RFS ethanol blending mandate, the change in the country's ethanol net trade status, and the elimination of federal tax credits and the additional import charge. In Brazil, the period covers the introduction of flexible-fuel automobiles, the institution of state-level preferential tax treatment for ethanol, the rise in sugar relative prices, and the elimination of the CIDE tax on gasoline. Hence, the estimates provided in this chapter reflect a wide range of policy and market developments, and permit the identification of effects from variations in the magnitude and composition of ethanol support over time.

Third, this chapter provides a thorough assessment of transfers to the ethanol sector at both the federal and state levels. Given that federal support is as a rule substantially larger than state support, much of the research on ethanol is only peripherally related to state government incentives. A thorough investigation of state statutes and data resulted in estimates of state-level ethanol support that correspond to 5 percent of total support to ethanol in the United States in 2002-2011, and 17 percent of total support in Brazil in the same period. While the share of state support in total support in the United States dropped from 8 percent in 2002 to 4 percent in 2011, in Brazil it increased from 2 percent in 2002 to 28 percent in 2011. Most notably, after Washington and Brasília removed key federal support measures in 2012, the relative weight of state-level subsidies in total ethanol support rose to 40 percent in the United States and 50 percent in Brazil.

The analysis of state-level support in the United States and Brazil revealed that other studies often cited as authoritative sources on subsidy quantification are incomplete. For example, the estimates of total ethanol support presented for Brazil in IEA (2010) – US$2.3 billion in 2007, US$2.5 billion in 2008 and US$2.6 billion in 2009 – seem to be based exclusively on the exemption of ethanol from the federal CIDE tax. These IEA figures closely match our own estimates for transfers arising from the CIDE tax (US$2.2 billion in 2007, US$2.3 billion in 2008 and US$2.4 billion in 2009), but are a far cry from our estimates of total support (US$3.7 billion in 2007, US$2.9 billion in 2008 and US$4.2 billion in 2009), which also account for transfers arising from the PIS/COFINS and ICMS taxes. In addition, studies that do quantify ethanol support at the state level lack a rigorous method and are often based on back-of-the-envelope calculations and spurious assumptions rather than on actual data.[62]

Finally, this chapter applies a rigorous and consistent methodology for measuring ethanol subsidies, based on a well-established method developed by the OECD and extensively applied in the agricultural sector since the 1980s. In at least six different ways, its resulting subsidy equivalent values quantify support more accurately than the study most often cited as an authoritative source on US ethanol subsidies. First, market price support is estimated by comparing domestic prices and appropriate reference prices for each year, rather than by assuming a fixed market price differential obtained from an exogenous source.[63] Second, government payments are based on actual expenditures, rather than on budgetary authorizations and appropriations. Third, feedstock subsidies are incorporated by estimating lower input costs, rather than by prorating total agricultural subsidies by the share of feedstock used in ethanol production. Fourth, a greater number of state-level tax concessions and payments are quantified, and more accurate state-level data are used. Fifth, subsidies that are widely available to various sectors of the economy, and thus are not specific to ethanol, such as accelerated depreciation, are not included in the estimate of support. Finally, data collection is carried out for every year and estimations are

[62] Although Koplow (2006) and Koplow (2007) quantify state ethanol support for only a part of the states that actually provided support, the studies substantially overestimates total state production payments and tax concessions. For example, Koplow (2006) estimates that production incentive payments in Wisconsin generated US$15.8 million in state government expenditures in 2006, when official state documents reveal that the correct amount was only US$1.9 million. Koplow (2007) estimates that the exemption of E10 from the 4 percent general excise tax in Hawaii resulted in US$90 million of revenue foregone in 2006. However, since E10 sales in Hawaii totaled US$414 million in 2006, revenue foregone was actually closer to US$17 million, which is less than a fifth of the estimate provided above. Moreover, instead of estimating revenue foregone based on tax rates, fuel prices and sales volumes for each year in the 2006-2008 period, the study assumes that revenue losses grow 5 percent annually in 2007 and 2008.

[63] Koplow (2007) confounds the quantification of support with the quantification of the market effects of support. Instead of measuring US ethanol market price support by examining the gap between domestic and appropriate reference prices, the study assumes a fixed market price differential of 27 cents per liter for each year between 2006 and 2008. This figure is based on results obtained by Elobeid and Tokgoz (2006), which find that the removal of US import barriers would cause an average reduction of 27 cents in projected domestic ethanol prices in 2006-2015.

based on year-specific policies and data, rather than on assumptions about the annual growth rate of support.

The ethanol subsidy equivalent values and associated components allows us to estimate the market distortions caused by ethanol support in the United States and Brazil. The effects of US ethanol support varied remarkably between 2002 and 2012, reflecting significant policy changes and market developments over time. However, as a rule, total support to the ethanol sector in the United States had a depressing effect on world prices, reduced import levels into the country, reduced production and export levels in other countries, and significantly increased the US share of the world market. As these effects were significant in some years, US ethanol support policies were vulnerable to international litigation under the WTO dispute settlement mechanism. Conversely, Brazilian ethanol subsidies were not susceptible to WTO legal action as they did not depress world prices, did not adversely affect production in other countries, and did not lead to an increased Brazilian share of the world market.

As indicated in Subsection 3.2.12, the US additional import duty on ethanol infringed the dual requirement established in GATT Article VIII that any additional charge or duty on imports must involve a service rendered in connection with the importation of a good and must not represent an indirect protection to domestic products. The fact that the United States included the additional charge on its schedule of concessions in the Uruguay Round does not legitimize it. As indicated by DSB findings in *Argentina – Textiles*[64] and *European Communities – Bananas*,[65] schedules of concession must comply with, and give way to, obligations set out in the GATT itself including GATT Article VIII (Guzman and Pauwelyn, 2012). Therefore, what the United States

[64] Panel Report, *Argentina – Measures Affecting Imports of Footwear, Textiles, Apparel and Other Items*, WTO/DS56/R (adopted April 22, 1998).
[65] Appellate Body Report, *European Communities – Regime for the Importation, Sale and Distribution of Bananas,* WT/DS27/AB/R (adopted September 25, 1997).

labelled as an “other duty or charge” on fuel ethanol imports is likely a prohibited measure that does not qualify as either an ordinary customs duty or an additional duty or charge, as described in GATT Articles II and VIII. Despite this apparent breach of multilateral obligations, the US additional charge on ethanol was never officially challenged in its 34 years of existence.

If the DSB were to find the additional duty a violation of GATT Article II and VIII, its removal would eliminate the majority of the adverse effects associated with US support to ethanol. As the estimates presented for Scenario 2 in Subsection 3.3.4 suggest, the additional import duty was the principal source of market price suppression in 2002-2011. However, if the DSB were to find that the US ethanol additional duty did not violate GATT Articles II and VIIII, a complaining country could have recourse to claims of adverse effects under the ASCM.

According to ASCM Article 5(c), no WTO member should cause, through the use of a subsidy, serious prejudice to the interests of another member. Claims of serious prejudice may arise when subsidies: (a) displace or impede imports into the subsidizing country (ASCM Art. 6.3(a)); (b) displace of impede exports from a third country (ASCM Art. 6.3(b)); (c) cause significant price undercutting or significant price depression (ASCM Art. 6.3(c)); and (d) increase the world market share of the subsidizing country (ASCM Art. 6.3(d)). The estimates presented for Scenario 4 in Subsection 3.3.4 suggest that the various US ethanol support measures collectively reduced imports in the US market by 83 percent in 2004 and by 50 to 60 percent between 2006 and 2009 (Figure 3.13), and significantly suppressed world prices by 6.2 percent in 2004 and 4.8 percent in 2006 (Figure 3.14). In addition, the US share of the ethanol world market increased uninterruptedly from 37 percent in 2002 to 61 percent in 2011, and fell for the first in ten years only after federal tax credits and the additional import charge were removed in 2012 (Figure 3.15).

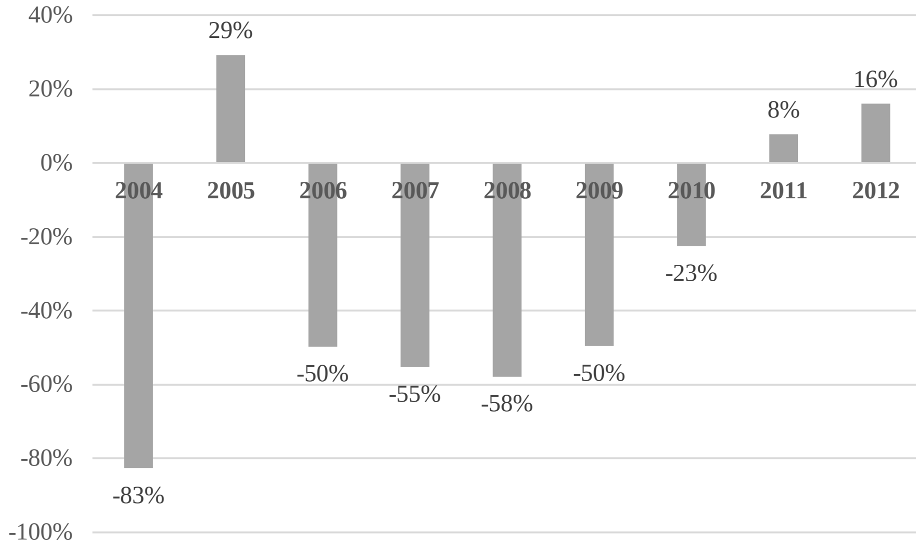

Figure 3.13: Relative impact of US ethanol support on US ethanol net trade, 2002-2012

Note: The United States was a net importer of ethanol in 2004-2009 and a net exporter in 2010-2012.
Source: Author's calculations.

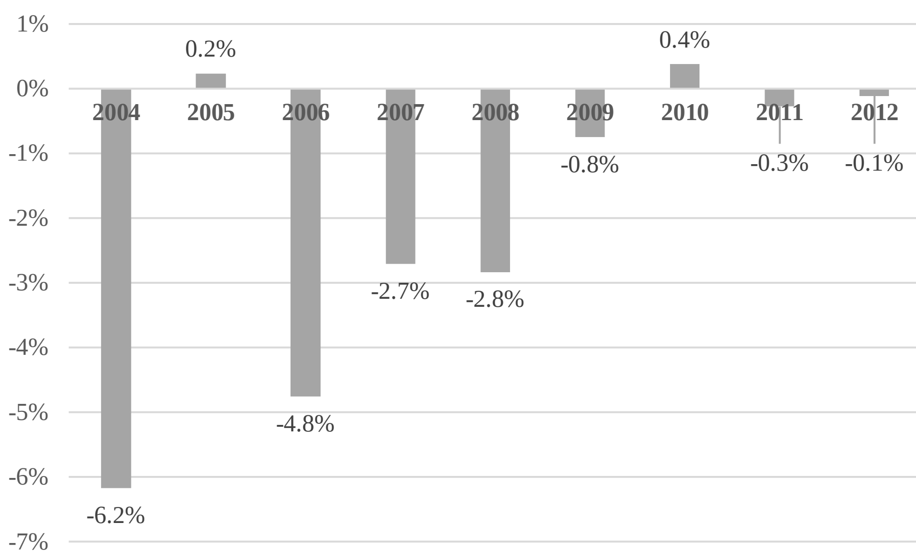

Figure 3.14: Relative impact of US ethanol support on ethanol world prices, 2002-2012

Source: Author's calculations.

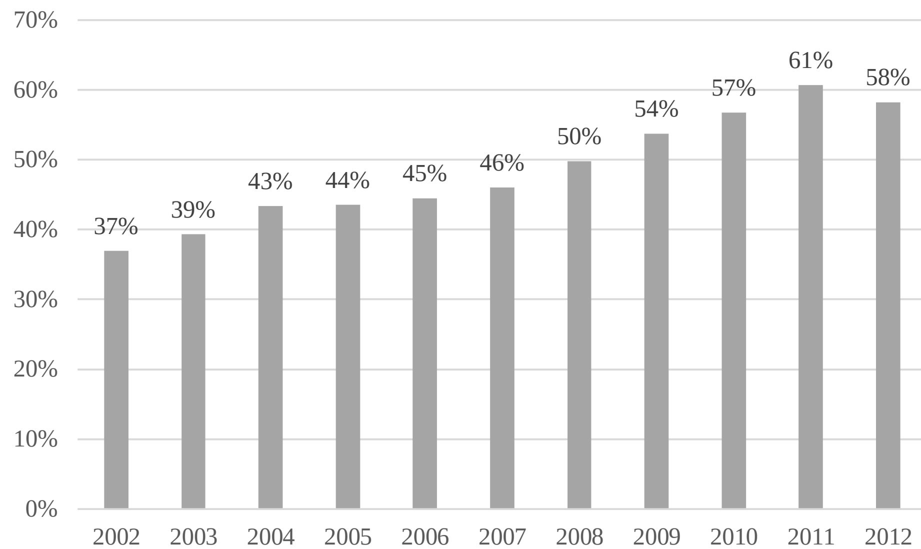

Figure 3.15: US share of the ethanol world market, 2002-2012

Source: Author's calculations. Based on ANP (2014), EIA (2014a) and USDA (2004a).

Based on these findings, four arguments could potentially be construed against US ethanol support as applied between 2002 and 2011: (i) that US ethanol support measures collectively displaced ethanol imports into the United States market in 2004 and 2006-2009; (ii) that US ethanol support measures collectively displaced ethanol exports of other members from third country markets in 2011 and 2012; (iii) that US ethanol support measures collectively caused significant price suppression in the world market in 2004 and 2006; and (iv) that US ethanol support measures collectively resulted in an increase in the world market share of the United States between 2002 and 2011.

Nevertheless, these arguments are contingent on whether the US additional import duty could be considered a subsidy within the meaning of the ASCM. According to ASCM Article 1, a subsidy is deemed to exist if there is a financial contribution by a government, or if there is any form of income or price support in the sense of Article XVI of GATT 1994, and a benefit is thereby conferred. Consumption and production tax concessions, feedstock subsidies and budgetary outlays are clearly subsidies as they involve a financial contribution by a government and confer a benefit. However, the DSB panel would have to determine whether the additional import duty would qualify as a form of price support in the sense of Article XVI of GATT 1994.

As the WTO DSB has never ruled on what constitutes price support in the sense of Article XVI of GATT 1994, there is space for argumentation here. A narrow view of price support would be that it relates exclusively to government programs that establish minimum, fixed, or reference prices for a commodity; a broad view would suggest that price support involves any government scheme designed either to increase prices or to keep prices at a certain level. The negotiating history of the ASCM does not shed any light on the way price support ought to be interpreted. However, as the ASCM makes explicit reference to GATT Article XVI when it speaks of income or price support, the negotiating history of this GATT article may provide some guidance. GATT Article XVI requires countries to notify "any subsidy, including any form of income or price support, which operates directly or indirectly to increase exports of any product from, or to reduce imports of any product into, its territory." Delegates' discussions during the GATT 1947 negotiations convey a broad and unrestricted interpretation of the notion of price support. Given that the obligation under the article was a mere obligation to notify and discuss, the negotiators tolerated a broad wording of the provision (Lambert and Rueffer, 2010).

If the DSB were to find that the additional import tariff constituted a subsidy, the four serious prejudice claims enumerated above would have to be backed with strong legal and economic evidence of a causal link between US ethanol support and the serious prejudice at issue. In addition to the quantitative assessment of the effects of subsidies on market prices and quantities as discussed above and in Subsection 3.3.4, this would require examining the magnitude of subsidies relative to the value of production, the relationship of market revenues and subsidies to costs of production, the influence exerted by the United States on the world market, and the temporal coincidence of serious prejudice and US subsidies, among other factors (Sumner, 2005).

Figure 3.16 depicts US ethanol subsidy equivalent values relative to production values between 2002 and 2012. The larger the share of subsidies in the production value, the greater their presumed distortionary effect. Subsidies accounted on average for 47 percent of the ethanol production value in the United States in 2002-2011. The relative level of support was even higher in the two years on which the claim of significant price suppression is based: 71 percent in 2004 and 51 percent in 2006. This suggests a strong causal link between subsidies and price suppression. To put matters in perspective, the magnitude of ethanol subsidies is comparable to that of the subsidies found to cause significant price suppression in *United States – Upland Cotton* (12 percent to 64 percent in 2004-2006). Moreover, as illustrated in Figure 3.15, the fact that the United States accounted for a large and growing share of world ethanol production in 2002-2011 provides further evidence that US subsidies had a significant impact on world prices.

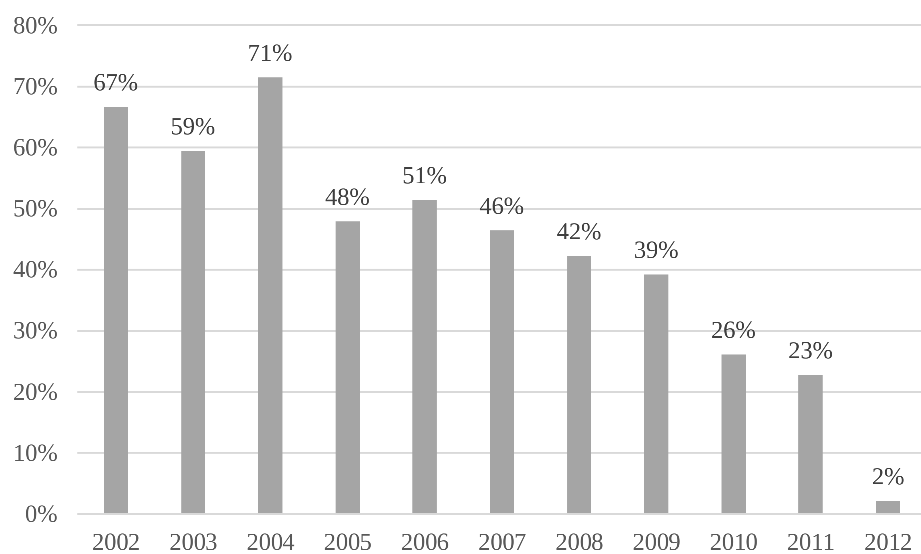

Figure 3.16: US ethanol subsidy equivalent value as a share of production value, 2002-2012

Source: Author’s calculations. Based USDA (2004a).

Nonetheless, if the DSB were to find that the additional import duty does not constitute a subsidy within the meaning of ASCM Article 1, only one of the four serious prejudice claims would stand, i.e. that US ethanol support measures collectively resulted in an increase in the world market share of the United States between 2002 and 2011. The claims based on significant price depression and displaced trade flows would no longer be valid as the additional import duty was the single most important source or price suppression and border protection among the various individual US ethanol support measures in 2002-2011. While production payments and lower input costs had small depressing effects on world prices, consumption tax concessions actually lead to higher world prices (see Scenario 1 in Subsection 3.3.4).

Finally, a fifth claim may potentially be construed against US ethanol support based on the principle of nullification or impairment of benefits accruing directly or indirectly to WTO members under GATT 1994 (ASCM Article 5(b)). The claim addresses the fact that US blender tax credits, combined with the additional import duty, functions as a *de facto* import substitution subsidy, which is a prohibited subsidy under ASCM Article 3.1(b). When applied simultaneously, the tax credit and the additional duty provide financial incentives that encourage blenders to purchase domestic instead of foreign ethanol. The legislative history behind the additional import tariff in the US Congress provides evidence that it was created for exactly this purpose. The fact that the additional duty was only eliminated once the tax credit was removed further corroborates this claim. In *Canada – Autos*,[66] the Appellate Body found that ASCM Article 3.1(b) extends to subsidies contingent not only "in law" but also "in fact" upon the use of domestic over imported goods. Since the additional import duty on fuel ethanol was set at a prohibitive level, no or minimal amounts of MFN imports occurred in most years between 2002 and 2011 (Figure 3.1 and Figure

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[66] Appellate Body Report, *Canada – Certain Measures Affecting the Automotive Industry*, WT/DS139/AB/R (adopted May 31, 2000).

3.2). As the high additional import duty ensured Brazilian ethanol would not benefit from the blenders tax credit, the domestic tax concession functioned *de facto* as an import substitution subsidy, despite the fact it imposed no *de jure* limitations on the eligibility of Brazilian ethanol.

A general argument against multilateral challenges to biofuel subsidies is that WTO agreements do not properly account for the negative externalities of fossil fuel consumption. Subsidies to the ethanol industry could be construed to have a positive effect on society if they ultimately lead to the displacement of fossil fuel consumption and the reduction of greenhouse gas emissions. Under this prism, current international trade law is inadequate and should be amended to appropriately account for the role of renewable energy subsidies in addressing negative environmental externalities. Given the global nature of climate change, countries must tackle carbon emissions in a concerted multilateral effort. Attempts to address global warming unilaterally may lead to negative unintended outcomes, such as the economically and environmentally unsound two-way trade in ethanol between the United States and Brazil driven by uncoordinated environmental policies (Meyer *et al.*, 2012).

The measurement of ethanol subsidy equivalent values and the quantification of their effects on prices, production, consumption and trade provide critical inputs for policymakers and analysts not only in the area of international trade, but also in agriculture, energy and the environment. This chapter distinguishes itself as the only systematic, detailed and quantified comparative examination of ethanol support in the United States and Brazil, the two most prominent players in the biofuels sector. Its methodology and results remain relevant notwithstanding the removal of federal tax credits and the additional import tariff in the United States and the CIDE differential tax treatment in Brazil in 2012. The significant downturn experienced by the ethanol industry in Brazil in recent years has prompted calls for renewed support. Policy and market developments have shifted the political weight of the US ethanol industry towards new areas, such as advanced (non-corn starch) biofuels, cellulosic ethanol, and E85 blends, all of which are receiving expanding amounts of support at both the federal and state levels. While still small compared to the support once enjoyed by corn ethanol, these transfers could become very significant once these sectors become more widely established. Government support has played an important role in facilitating the growth in biofuels supply and demand and is likely to continue to do so in the near future.

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APPENDIX

Table A.1: Estimated Market Effects from Eliminating US Ethanol Consumption Tax Concessions, 2002-2012

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Price											
World	-9.2%	-6.0%	-5.5%	-4.4%	0.0%	-3.7%	-3.5%	-1.3%	-0.8%	-1.0%	-0.1%
US	-7.9%	-5.0%	-3.5%	-3.7%	0.0%	-3.0%	-2.9%	-1.2%	-0.8%	-1.0%	-0.1%
Production											
US	-5.1%	-3.3%	-2.3%	-2.4%	0.0%	-1.9%	-1.9%	-0.8%	-0.5%	-0.6%	-0.1%
Brazil	-17.9%	-11.7%	-10.7%	-8.6%	0.0%	-7.2%	-6.9%	-2.6%	-1.5%	-2.0%	-0.2%
EU	-3.0%	-1.9%	-1.8%	-1.4%	0.0%	-1.2%	-1.1%	-0.4%	-0.3%	-0.3%	0.0%
China	-1.6%	-1.0%	-0.9%	-0.8%	0.0%	-0.6%	-0.6%	-0.2%	-0.1%	-0.2%	0.0%
ROW	-2.3%	-1.5%	-1.3%	-1.1%	0.0%	-0.9%	-0.9%	-0.3%	-0.2%	-0.3%	0.0%
World	-12.3%	-7.6%	-6.3%	-5.2%	0.0%	-4.0%	-3.7%	-1.3%	-0.8%	-0.9%	-0.1%
Consumption											
US	-45.5%	-28.0%	-20.0%	-16.9%	0.0%	-12.5%	-11.0%	-3.9%	-2.3%	-2.8%	-0.3%
Brazil	8.3%	6.5%	6.2%	5.7%	0.0%	5.6%	6.4%	2.5%	1.6%	2.3%	0.2%
EU	1.7%	1.1%	1.0%	0.8%	0.0%	0.7%	0.6%	0.2%	0.1%	0.2%	0.0%
China	2.4%	1.6%	1.4%	1.2%	0.0%	1.0%	0.9%	0.3%	0.2%	0.3%	0.0%
ROW	2.0%	1.3%	1.2%	1.0%	0.0%	0.8%	0.8%	0.3%	0.2%	0.2%	0.0%
World	-12.3%	-7.6%	-6.3%	-5.2%	0.0%	-4.0%	-3.7%	-1.3%	-0.8%	-0.9%	-0.1%
Net Trade											
US	-6774%	-5687%	-424.3%	-434.2%	0.0%	-170.1%	-171.5%	-173.5%	61.4%	26.4%	11.8%
Brazil	-409.0%	-340.4%	-96.0%	-82.7%	0.0%	-76.6%	-64.0%	-37.4%	-45.8%	-117.5%	-3.8%
EU	23.5%	11.7%	7.8%	3.2%	0.0%	2.8%	3.3%	1.8%	1.3%	1.3%	0.2%
China	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-25.9%	-2.6%
ROW	6.2%	4.7%	2.3%	2.7%	0.0%	17.5%	5.2%	2.4%	0.9%	1.0%	0.1%
World	311.5%	242.5%	-20.2%	-16.6%	0.0%	-43.6%	-36.0%	-20.7%	1.3%	4.2%	0.2%

Table A.2: Estimated Market Effects from Eliminating US Ethanol Import Tariffs, 2002-2012

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
					Price						
World	2.5%	3.2%	10.9%	3.4%	3.9%	6.0%	6.1%	2.8%	0.0%	1.6%	0.0%
US	-5.4%	-8.1%	-23.9%	-7.9%	-18.8%	-13.3%	-12.3%	-4.5%	0.0%	-2.3%	0.0%
					Production						
US	-3.5%	-5.3%	-15.6%	-5.1%	-12.2%	-8.7%	-8.0%	-2.9%	0.0%	-1.5%	0.0%
Brazil	4.8%	6.3%	21.1%	6.6%	7.6%	11.7%	11.8%	5.4%	0.0%	3.1%	0.0%
EU	0.8%	1.0%	3.5%	1.1%	1.3%	1.9%	1.9%	0.9%	0.0%	0.5%	0.0%
China	0.4%	0.5%	1.8%	0.6%	0.7%	1.0%	1.0%	0.5%	0.0%	0.3%	0.0%
ROW	0.6%	0.8%	2.7%	0.8%	1.0%	1.5%	1.5%	0.7%	0.0%	0.4%	0.0%
World	1.5%	1.3%	3.8%	1.0%	-2.1%	1.1%	0.7%	0.4%	0.0%	0.0%	0.0%
					Consumption						
US	7.3%	8.0%	20.2%	6.2%	0.0%	9.3%	8.3%	3.6%	0.0%	1.7%	0.0%
Brazil	-2.2%	-3.4%	-12.2%	-4.4%	-5.6%	-9.1%	-11.0%	-5.2%	0.0%	-3.6%	0.0%
EU	-0.4%	-0.6%	-2.0%	-0.6%	-0.7%	-1.1%	-1.1%	-0.5%	0.0%	-0.3%	0.0%
China	-0.6%	-0.8%	-2.8%	-0.9%	-1.0%	-1.6%	-1.6%	-0.7%	0.0%	-0.4%	0.0%
ROW	-0.5%	-0.7%	-2.4%	-0.7%	-0.9%	-1.3%	-1.3%	-0.6%	0.0%	-0.4%	0.0%
World	1.5%	1.3%	3.8%	1.0%	-2.1%	1.1%	0.7%	0.4%	0.0%	0.0%	0.0%
					Net Trade						
US	1811.4%	3038.6%	839.3%	332.6%	81.8%	275.5%	293.3%	364.4%	0.0%	-41.8%	0.0%
Brazil	109.4%	181.9%	189.9%	63.3%	63.3%	124.0%	109.5%	78.5%	0.0%	185.9%	0.0%
EU	-6.3%	-6.2%	-15.4%	-2.5%	-4.2%	-4.5%	-5.7%	-3.9%	0.0%	-2.1%	0.0%
China	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	41.1%	0.0%
ROW	-1.7%	-2.5%	-4.6%	-2.1%	17.1%	-28.3%	-8.9%	-5.1%	0.0%	-1.6%	0.0%
World	109.8%	183.3%	191.9%	64.0%	61.3%	125.3%	110.6%	79.3%	0.0%	-1.8%	0.0%

Table A.3: Estimated Market Effects from Eliminating US Ethanol Consumption Tax Concessions and Import Tariffs, 2002-2012

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
					Price						
World	-6.8%	-2.8%	5.4%	-1.0%	3.9%	2.3%	2.5%	0.2%	-0.8%	0.0%	-0.1%
US	-13.3%	-13.1%	-27.5%	-11.6%	-18.8%	-16.3%	-15.1%	-6.8%	-0.8%	-3.9%	-0.1%
					Production						
US	-8.6%	-8.5%	-17.9%	-7.5%	-12.2%	-10.6%	-9.8%	-4.4%	-0.5%	-2.5%	-0.1%
Brazil	-13.1%	-5.4%	10.4%	-2.0%	7.6%	4.5%	4.9%	0.4%	-1.5%	-0.1%	-0.2%
EU	-2.2%	-0.9%	1.7%	-0.3%	1.3%	0.7%	0.8%	0.1%	-0.3%	0.0%	0.0%
China	-1.1%	-0.5%	0.9%	-0.2%	0.7%	0.4%	0.4%	0.0%	-0.1%	0.0%	0.0%
ROW	-1.7%	-0.7%	1.3%	-0.3%	1.0%	0.6%	0.6%	0.1%	-0.2%	0.0%	0.0%
World	-10.8%	-6.3%	-2.5%	-4.3%	-2.1%	-2.9%	-3.0%	-2.2%	-0.8%	-1.5%	-0.1%
					Consumption						
US	-38.2%	-20.0%	0.3%	-10.7%	0.0%	-3.3%	-2.7%	-3.9%	-2.3%	-2.8%	-0.3%
Brazil	6.0%	3.0%	-6.0%	1.3%	-5.6%	-3.5%	-4.6%	-0.4%	1.6%	0.1%	0.2%
EU	1.2%	0.5%	-1.0%	0.2%	-0.7%	-0.4%	-0.5%	0.0%	0.1%	0.0%	0.0%
China	1.8%	0.7%	-1.4%	0.3%	-1.0%	-0.6%	-0.7%	-0.1%	0.2%	0.0%	0.0%
ROW	1.5%	0.6%	-1.2%	0.2%	-0.9%	-0.5%	-0.6%	0.0%	0.2%	0.0%	0.0%
World	-10.8%	-6.3%	-2.5%	-4.3%	-2.1%	-2.9%	-3.0%	-2.2%	-0.8%	-1.5%	-0.1%
					Net Trade						
US	-4962%	-2649%	414.9%	-101.7%	81.8%	105.3%	121.9%	27.3%	61.4%	0.9%	11.8%
Brazil	-299.6%	-158.6%	93.9%	-19.3%	63.3%	47.4%	45.5%	5.9%	-45.8%	-3.8%	-3.8%
EU	17.2%	5.4%	-7.6%	0.8%	-4.2%	-1.7%	-2.4%	-0.3%	1.3%	0.0%	0.2%
China	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.8%	-2.6%
ROW	4.6%	2.2%	-2.3%	0.6%	17.1%	-10.8%	-3.7%	-0.4%	0.9%	0.0%	0.1%
World	199.8%	56.2%	94.9%	-19.0%	61.3%	47.9%	45.9%	5.9%	1.3%	0.0%	0.2%

Table A.4: Estimated Market Effects from Eliminating the US Subsidy Equivalent Value for Ethanol, 2002-2012

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
					Price						
World	-5.8%	-1.9%	6.2%	-0.2%	4.8%	2.7%	2.8%	0.8%	-0.4%	0.3%	0.1%
US	-19.6%	-18.7%	-31.7%	-16.1%	-22.7%	-18.3%	-16.6%	-8.8%	-2.2%	-4.8%	-0.9%
					Production						
US	-12.8%	-12.1%	-20.6%	-10.4%	-14.8%	-11.9%	-10.8%	-5.7%	-1.4%	-3.1%	-0.6%
Brazil	-11.3%	-3.8%	12.0%	-0.4%	9.2%	5.3%	5.5%	1.5%	-0.7%	0.5%	0.2%
EU	-1.9%	-0.6%	2.0%	-0.1%	1.5%	0.9%	0.9%	0.2%	-0.1%	0.1%	0.0%
China	-1.0%	-0.3%	1.0%	0.0%	0.8%	0.5%	0.5%	0.1%	-0.1%	0.0%	0.0%
ROW	-1.4%	-0.5%	1.5%	-0.1%	1.2%	0.7%	0.7%	0.2%	-0.1%	0.1%	0.0%
World	-11.3%	-6.8%	-2.9%	-4.8%	-2.5%	-3.2%	-3.2%	-2.6%	-1.1%	-1.7%	-0.3%
					Consumption						
US	-38.1%	-20.1%	0.2%	-10.9%	0.0%	-3.3%	-2.8%	-3.9%	-2.3%	-2.8%	-0.4%
Brazil	5.2%	2.1%	-6.9%	0.3%	-6.8%	-4.1%	-5.1%	-1.4%	0.8%	-0.6%	-0.3%
EU	1.0%	0.3%	-1.1%	0.0%	-0.9%	-0.5%	-0.5%	-0.1%	0.1%	0.0%	0.0%
China	1.5%	0.5%	-1.6%	0.1%	-1.2%	-0.7%	-0.7%	-0.2%	0.1%	-0.1%	0.0%
ROW	1.3%	0.4%	-1.4%	0.1%	-1.0%	-0.6%	-0.6%	-0.2%	0.1%	-0.1%	0.0%
World	-11.3%	-6.8%	-2.9%	-4.8%	-2.5%	-3.2%	-3.2%	-2.6%	-1.1%	-1.7%	-0.3%
					Net Trade						
US	-4260%	-1829%	477.1%	-22.6%	98.7%	123.4%	137.3%	98.5%	29.2%	-7.2%	-13.8%
Brazil	-257.2%	-109.5%	108.0%	-4.3%	76.4%	55.6%	51.3%	21.2%	-21.8%	31.9%	4.5%
EU	14.8%	3.8%	-8.8%	0.2%	-5.1%	-2.0%	-2.7%	-1.0%	0.6%	-0.4%	-0.2%
China	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	7.0%	3.1%
ROW	3.9%	1.5%	-2.6%	0.1%	20.7%	-12.7%	-4.2%	-1.4%	0.4%	-0.3%	-0.2%
World	156.5%	6.0%	109.1%	-19.6%	74.0%	56.1%	51.7%	21.4%	0.6%	-0.3%	-0.2%

Table A.5: Estimated Market Effects from Eliminating the Brazilian Subsidy Equivalent Value for Ethanol, 2002-2012

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
					Price						
World	-5.8%	-5.1%	-7.5%	-6.8%	-7.3%	-8.5%	-5.0%	-6.9%	-6.9%	-5.3%	-3.5%
US	-5.4%	-4.5%	-5.1%	-6.0%	-5.7%	-6.9%	-4.1%	-6.4%	-6.9%	-5.1%	-3.5%
					Production						
US	-3.2%	-2.7%	-3.2%	-3.7%	-3.5%	-4.4%	-2.6%	-4.1%	-4.4%	-3.3%	-2.3%
Brazil	-11.3%	-9.9%	-14.6%	-13.2%	-14.2%	-16.5%	-9.7%	-13.4%	-13.4%	-10.3%	-6.8%
EU	-1.9%	-1.6%	-2.4%	-2.2%	-2.3%	-2.7%	-1.6%	-2.2%	-2.2%	-1.7%	-1.1%
China	-1.0%	-0.9%	-1.3%	-1.2%	-1.2%	-1.4%	-0.9%	-1.2%	-1.2%	-0.9%	-0.6%
ROW	-1.4%	-1.2%	-1.8%	-1.7%	-1.8%	-2.1%	-1.2%	-1.7%	-1.7%	-1.3%	-0.9%
World	-7.8%	-6.5%	-8.7%	-8.0%	-7.9%	-9.2%	-5.2%	-7.0%	-7.0%	-4.9%	-3.3%
					Consumption						
US	-0.5%	0.3%	0.2%	1.2%	0.0%	1.6%	1.1%	1.6%	2.0%	1.6%	1.5%
Brazil	-14.3%	-13.2%	-21.9%	-22.2%	-23.4%	-29.1%	-19.0%	-27.1%	-27.9%	-23.6%	-17.7%
EU	1.0%	0.9%	1.4%	1.2%	1.3%	1.5%	0.9%	1.2%	1.2%	1.0%	0.6%
China	1.5%	1.3%	2.0%	1.8%	1.9%	2.2%	1.3%	1.8%	1.8%	1.4%	0.9%
ROW	1.3%	1.1%	1.7%	1.5%	1.6%	1.9%	1.1%	1.5%	1.5%	1.2%	0.8%
World	-7.8%	-6.5%	-8.7%	-8.0%	-7.9%	-9.2%	-5.2%	-7.0%	-7.0%	-4.9%	-3.3%
					Net Trade						
US	452.1%	702.7%	76.6%	144.1%	23.4%	91.5%	66.5%	311.6%	-220.5%	-65.2%	-211.4%
Brazil	33.3%	50.0%	22.3%	33.4%	24.5%	51.2%	30.5%	81.0%	192.9%	349.5%	82.6%
EU	14.8%	9.9%	10.7%	4.9%	7.9%	6.4%	4.7%	9.5%	11.5%	6.9%	7.1%
China	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-134.3%	-92.3%
ROW	3.9%	4.0%	3.2%	4.1%	-31.8%	39.9%	7.4%	12.5%	7.9%	5.2%	5.1%
World	33.3%	50.0%	22.3%	33.4%	21.1%	51.2%	30.5%	81.0%	64.3%	6.2%	34.2%

Table A.6: Estimated Market Effects from Eliminating US and Brazilian Subsidy Equivalent Values for Ethanol, 2002-2012

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
						Price					
World	-11.6%	-7.0%	-1.4%	-7.0%	-2.6%	-5.8%	-2.2%	-6.7%	-8.0%	-5.6%	-3.4%
US	-24.6%	-22.9%	-36.5%	-21.8%	-28.1%	-25.1%	-20.6%	-15.5%	-9.6%	-10.4%	-4.4%
						Production					
US	-16.0%	-14.9%	-23.8%	-14.2%	-18.3%	-16.3%	-13.4%	-10.1%	-6.3%	-6.7%	-2.9%
Brazil	-22.6%	-13.6%	-2.7%	-13.6%	-5.0%	-11.3%	-4.2%	-13.0%	-15.4%	-10.9%	-6.6%
EU	-3.7%	-2.3%	-0.4%	-2.3%	-0.8%	-1.9%	-0.7%	-2.1%	-2.5%	-1.8%	-1.1%
China	-2.0%	-1.2%	-0.2%	-1.2%	-0.4%	-1.0%	-0.4%	-1.1%	-1.4%	-1.0%	-0.6%
ROW	-2.8%	-1.7%	-0.3%	-1.7%	-0.6%	-1.4%	-0.5%	-1.6%	-1.9%	-1.4%	-0.8%
World	-19.0%	-13.3%	-11.6%	-12.8%	-10.3%	-12.4%	-8.4%	-10.0%	-8.7%	-7.2%	-3.6%
						Consumption					
US	-38.6%	-19.7%	0.4%	-9.6%	0.0%	-1.7%	-1.7%	-3.9%	-2.3%	-2.8%	1.1%
Brazil	-9.1%	-11.1%	-28.8%	-21.9%	-30.2%	-33.2%	-24.2%	-27.5%	-25.8%	-22.9%	-18.0%
EU	2.1%	1.3%	0.2%	1.3%	0.5%	1.0%	0.4%	1.2%	1.4%	1.0%	0.6%
China	3.0%	1.8%	0.4%	1.8%	0.7%	1.5%	0.6%	1.7%	2.1%	1.5%	0.9%
ROW	2.6%	1.5%	0.3%	1.5%	0.6%	1.3%	0.5%	1.5%	1.7%	1.2%	0.7%
World	-19.0%	-13.3%	-11.6%	-12.8%	-10.3%	-12.4%	-8.4%	-10.0%	-8.7%	-7.2%	-3.6%
						Net Trade					
US	-3808%	-1126%	553.7%	121.5%	122.2%	215.0%	203.8%	340.3%	-138.7%	-56.8%	-225.2%
Brazil	-223.9%	-59.5%	130.3%	29.1%	100.9%	106.7%	81.7%	87.2%	131.9%	311.9%	87.1%
EU	29.6%	13.6%	1.9%	5.1%	2.7%	4.4%	2.0%	9.2%	13.3%	7.4%	6.8%
China	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-142.6%	-89.2%
ROW	7.8%	5.5%	0.6%	4.3%	-11.1%	27.2%	3.2%	12.1%	9.1%	5.6%	4.9%
World	128.6%	-37.1%	130.0%	-14.7%	93.7%	105.5%	81.4%	85.3%	13.1%	6.3%	5.6%