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INTRODUCTION: CAPACITY BUILDING AND AGRICULTURAL TRADE POLICY CHALLENGES IN DEVELOPING COUNTRIES

Linda M. Young
Montana State University

This edition of the *Journal of International Agricultural Trade and Development* is devoted to papers prepared and submitted by fellows of a capacity building program for researchers in agricultural trade policy in developing countries. The program, funded by the Global Development Program of the William and Flora Hewlett Foundation, has been implemented by the International Agricultural Trade Research Consortium (IATRC) and is known as the Hewlett/IATRC Capacity Building Program.

The purpose of the program is to involve researchers in developing countries who are working in agricultural trade policy in an international research and networking program. The fellows were selected in 2006 through an international competitive process. Each fellow was then paired with an IATRC member who has acted as both mentor and partner in a joint research program over the duration of the three-year program. As part of the program, fellows have also attended workshops on trade policy issues and the semi- annual conferences of the IATRC.

The Hewlett/IATRC fellows have participated in a challenging research program that reflects the diverse and complex policy issues facing developing nations. Developing country governments frequently have multiple goals for their agricultural sectors. One goal is to reduce poverty in rural areas through increased agricultural productivity and exports. To achieve this goal, governments have reformed policies that have historically taxed the agricultural sector, as discussed by Salam and Abdel Karim Yousif and Abler. Governments may also seek greater integration into world markets through accession to the World Trade Organization (WTO). This accession process and the requirements of WTO membership have consequences both for a country's overall economy and the agricultural sector in particular, as illustrated in the paper on Sudan. At the same time that governments have sought greater involvement in world markets, they have also continued to pursue their goal of ensuring low food prices and food security for poor consumers. Both Weerahewa and Meilke and Salam highlight the use of policies to insulate consumers from volatility in world markets, as recently experienced in 2006-2008. Along with integration into world markets comes the need for governments to respond to the policy choices of their trading partners. Weerahewa and Meilke discuss the impact on small developing South Asian countries of India's restrictions on food exports, illustrating the vulnerability of small food importers. Miranda and Barros investigate the impact of the European Union's non-tariff barriers on Brazilian

beef exports. In different ways, the papers by Weerahewa and Meilke and Miranda and Barros demonstrate the challenge of designing WTO trade regulations that balance the concerns and needs of importers and exporters. The paper by Miranda and Barros also emphasizes the difficult task of assessing whether the imposition of a particular non-tariff measure violates WTO rules.

Papers authored or co-authored by five of the Hewlett/IATRC fellows are included in this issue of the journal. The paper by Abdul Salam investigates the changing nature of domestic agricultural policy choices in Pakistan. Salam notes that historically the government has taxed the production of several major crops in Pakistan, which has reduced the incentives facing farmers in their production decisions. He assesses the nature and extent of government policy interventions in the production and marketing of domestic wheat, rice, cotton, and sugarcane crops and estimates nominal protection coefficients for the period 1991 to 2008. The analysis indicates that both wheat and basmati rice production have been taxed over this period, while production of coarse rice varieties have been protected. The results for cotton and sugarcane are mixed. Salam finds that overall government intervention in commodity markets and taxation of agricultural production has declined. He concludes by highlighting the need for active government support for research and development to help increase the sector's productivity.

Abdel Karim Yousif and Abler analyze the consequences of Sudan's accession to the WTO. Sudan, like several least developed countries, is not food self-sufficient and faces numerous challenges in developing its agricultural sector, including political instability and the dominant role of oil in its economy. Over the past 15 years, taxation of the agriculture sector has been significantly reduced as the economy has been liberalized. Sudan does not currently face high tariffs for its exports and it is a member of several preferential trading arrangements. Thus the authors focus their analysis on the impact of accession on imports, and they estimate the consequences of Sudan's proposal to bind its import tariffs. They find that oilseed products would suffer the largest negative impact of tariff liberalization and conclude with a suggestion that Sudan reorient its trade policies to increase the competitiveness of its agricultural exports.

Motivated by the 2006-08 spike in world food prices, Weerahewa and Meilke examine the impact of India's possible agricultural trade policy choices on its trading partners. The increase in global food prices motivated many governments to restrict their agricultural exports in an attempt to moderate the impact on their consumers. Weerahewa and Meilke note three facts about trade in South Asia: India dominates regional trade; intra-regional trade is lower in South Asia than in other regions; countries in South Asia still trade more with each other than with other regions. The authors find that while the imposition of export taxes on agricultural commodities by India increases Indian welfare, importers usually suffer welfare losses. These results inform recommendations for policies to better address the issue of trade restrictions and their impacts through regional trade agreements and the WTO.

Miranda and Barros investigate the impacts of non-tariff trade barriers, especially sanitary measures, on Brazilian exports of fresh and chilled beef. The authors document the occurrence of these non-tariff measures and assess their impact on the price and quantity of Brazilian beef exports to the European Union between 1992 and 2000 using intervention models. The results indicate that a three-month embargo against Brazilian exports by the EU in early 1995 affected both the quantity and price of Brazilian exports. However, most of the sanitary measures did not appear to have significant effects. The authors conclude by

discussing reasons for the difficulty in capturing the impact of sanitary measures in econometric analysis.

The article by Echeverría, Gopinath, Moreira and Cortés is unique in this issue of the journal due to its focus on producers rather than national policy choice. The authors investigate the importance of producers' attributes and farms' geographical characteristics in the decision to produce exportable goods through a case study of blueberry producers in Chile. This evaluation from the producer perspective highlights the importance of government policy decisions in enhancing both human and physical capital. The authors find that education is strongly correlated with the decision to produce for export markets and that access to water and irrigation are the main physical variables affecting the export-production decision. The authors also find that the availability of labor has a strong effect on the decision to produce exportable goods.

We would like to thank the William and Flora Hewlett Foundation, and especially Ann Tutwiler, for recognizing the importance of skilled analysis in supporting decision making concerning agricultural trade policy. Indeed, the consequences of these policies reverberate throughout domestic economies as well as the global economy. The research presented in this volume strongly supports the conclusion that the governments of developing countries face diverse and difficult decisions. This effort would not have been possible without the support of the International Agricultural Trade Research Consortium and the expertise and willingness of its members who have participated as mentors. All papers in this volume benefited greatly from skilled editing by Suzanne Leonard. Finally, we want to thank Dragan Miljkovic, editor of the *Journal of International Agricultural Trade and Development*, for working with us to publish the initial results from this program of research and international collaboration.

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CAPACITY BUILDING PROGRAMS IN AGRICULTURAL TRADE POLICY

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ABSTRACT

Recent efforts to develop and offer capacity building programs for analysts concerned with agricultural trade policy have been prompted by the high level of skill required to design and implement a package of domestic agricultural and trade policies to achieve national goals. In this paper, capacity building is defined as the strengthening of the ability of individuals, organizations and governments to determine and achieve their development goals. The capacity of analysts to effectively inform all levels of the policy choice process, which include the underlying economic ideology, policy framework, and policy implementation, is an important requirement for national ownership of economic policies. The multitude of institutions offering capacity building programs has caused concern about coordination and duplication of efforts. Different types of institutions have a comparative advantage in different aspects of policy analysis. However, academia is better suited than other types of institutions to provide capacity building programs for all levels of the policy choice and analysis process.

Keywords: agricultural trade policy; capacity building.
JEL classification codes: F55, F13, Q17, Q18, O24.

INTRODUCTION

Recent efforts to develop and offer capacity building programs for analysts concerned with agricultural trade policy have been prompted by the high level of skill required to design and implement a package of domestic agricultural and trade policies to achieve national goals. In the case of the agricultural sector, the goals may include increasing agricultural production and exports, while at the same time, ensuring low food prices and increased food security for poor consumers. Many national governments, multilateral organizations and aid agencies have increased the priority given to agricultural sector investment and to implementing policies to support the agriculture sector (World Bank 2007). Increasing the level and diversity of agricultural production and the productivity of the sector are viewed as critical for

achieving food security, raising income in rural areas, and contributing to export earnings. The job facing agricultural trade policy analysts in developing countries is demanding and complex as the implementation of agricultural sector policies is often constrained by tight government budgets, which limit both direct expenditures and the scope of policy choice. In addition to identifying and assessing specific goals for food policy and the agricultural sector, analysts in agricultural trade policy may need to consider and balance overarching national goals such as active participation in international markets.

Developing countries currently account for three quarters of the membership of the World Trade Organization (WTO). Additionally, 32 least developed countries are WTO members, with another ten least developed countries in accession. Developing countries face the challenge of balancing their commitments to the WTO with their national goals for the development of their agricultural sectors. In current and past WTO negotiations, developing countries have had to address difficult issues concerning the goals for their agricultural sectors and how to achieve them within the framework of commitments required and opportunities presented by the WTO. Under the Uruguay Round Agreement, WTO members accepted constraints on their policies for supporting the domestic agricultural sector as well as those governing agricultural trade. Additional restrictions will be implemented if the Doha Round reaches a successful conclusion.

Given the complexity of meeting their WTO obligations, the governments of many developing countries have requested assistance programs from multilateral agencies, particularly the WTO, to increase their capacity to both meet their trade obligations and benefit more from trade. It is within this context that the term "trade-related capacity" was coined. It includes the ability to produce competitive exports, the business environment and transportation infrastructure necessary for trade, and the human capital required to analyze, negotiate, and implement trade agreements. The third component of trade-related capacity (i.e., human capital) is the focus of the analysis in this paper.

Recent efforts to build trade-related capacity building started with a 1994 request resulting from a meeting of African trade ministers who adopted the "Framework for Action for Implementation of the Uruguay Round Agreement by African Countries" (JITAP 2005). This document identified their needs for greater professional capacity to develop and manage their trade policy. A wide variety of academics, analysts and negotiators (e.g., Luke 2002; Kerr 2008; Shaffer 2005) from both developing and developed countries have argued that there is an urgent need for more professionals trained in the analysis of agricultural trade policy and the negotiation and implementation of trade agreements.

Programs to increase trade-related capacity are currently offered by a wide variety of institutions, including multilateral and bilateral aid agencies, non-governmental organizations, and academia. However, the number of institutions involved has prompted criticism of the duplication and lack of coordination of programs (de Sand 1996). Agencies offering these programs have responded through efforts to more effectively report and communicate their activities, as, for example, through the Doha Development Agenda Trade Capacity Database (WTO and OECD 2009). However, an efficient and productive distribution of efforts to provide trade-related assistance requires an assessment of institutions' strengths and weaknesses in building trade-related capacity.

This paper reviews past experience with trade-related capacity building programs and explores the unique role that academia can play in such programs. The next section defines the concept of capacity building. This is followed by discussions of the history and status of

trade-related capacity building programs. These discussions provide the basis for a review of recent criticism of trade-related capacity building programs and an examination of the potential role for academia in future programs.

DEFINING CAPACITY BUILDING

Capacity building has been defined as "the process through which individuals, organizations and societies obtain, strengthen and maintain the capabilities to set and achieve their own development objectives" (UNDP 2008). This emphasis on capabilities underlies a wide range of current development assistance programs and reflects Amartya Sen's argument that freedom, defined as the ability to exercise agency on behalf of oneself, is both the ends and the means of development (Sen 1999). More specifically, Sen argues that capabilities enhance freedom, as freedom depends on the free agency of people to make choices, and that the effective exercise of choice depends on capabilities. Sen develops his argument in terms of individual capability and freedom. However, his argument can be conceptually extended to the nation-state and its ability to be effective and to exercise sovereignty over its economic policy.

The recent economics literature supports Sen's framework, arguing that national ownership of economic policy is an important element in its eventual success. For example, Waeyenberge (2006) notes that the recent emphasis on sovereignty in the design of economic policies in developing countries is partly a reaction to the history of conditionality in foreign assistance and structural adjustment programs, which have shortchanged domestic policy processes in the past. Further criticism has been directed at the uniformity of the policies that were imposed under structural adjustment programs, which tended to neglect local conditions and needs (Jomo KS and Fine 2006). Rodrik (2003; 2007) argues that spurring and maintaining economic growth requires that economic policies be carefully adapted to local institutions. Rodrik (2002) also emphasizes that the proper yardstick for evaluating trade reform is the extent to which it fosters the development of high quality institutions at home. Stiglitz (1998) maintains that government ownership of economic policies is critical to sustaining policies over time. Finger and Schuler (2002) provide a specific example of Stiglitz's point, noting that many developing countries were not full participants in the negotiation of the Uruguay Round Agreement, and that because of this lack of ownership, some governments did not place a high priority on implementation.

National ownership of economic policies in general, and agricultural trade policy in particular, can occur at different points in the policy choice process. The first and most basic choice is the nature of the economic system to which a country aspires. Currently this choice is determined mostly by the extent to which a national government embraces the neoliberal economic model and is likely to be based on a combination of pragmatic and ideological factors. Pragmatically, the dominance of the neoliberal economic model makes it difficult to adopt and implement a radically different economic strategy. Ideologically, a country's decision makers may believe in the underlying tenets of the neoliberal model. An important issue at this point in the policy choice process is the significant variation that exists within capitalism itself, particularly with respect to the specific roles of the market and the state (Baumol, Litan and Schramm 2007; Gilpin 2001). This underlying policy choice has

implications for agriculture, including the degree to which agriculture is to be insulated from the market and how this insulation is to be achieved.

The next step in the policy choice process involves questions about how to implement the desired economic system. With respect to agricultural trade reform, this includes issues concerning the degree of trade liberalization and the level of commitment undertaken through the country's trade agreements. These decisions encourage the use of certain policies, such as tariffs and subsidies that are less distorting to world markets, and discourage the use of other polices that are considered too distorting to the market.

The third level of policy choice involves the actual implementation of policies. This includes choices about the level of tariffs or government subsidies, specific standards and regulations, and the functioning of institutions that support the implementation of trade liberalization.

For a nation to achieve national ownership of economic policy, it must have the skilled capacity to promote dialogue on the relevant questions at all levels of policy choice. The next two sections examine the history and recent status of capacity building programs and indicate a gradual but incomplete movement towards this goal.

EARLY MODELS OF CAPACITY BUILDING

The terms used to describe capacity building programs have changed as the underlying philosophy and nature of the programs have evolved. There has been a long-standing recognition of the need to increase the technical skills, education and 'know how' of the labor force in developing countries. The term "technical assistance" was used in the 1950s and 1960s and usually referred to foreign, donor-funded personnel providing expert advice to an institution in a recipient country, often in connection with the implementation of a development project (Berg 1993 p.43). This term was largely replaced in the 1970s with the term "technical cooperation" because of its positive connotation of partnership between donors and recipients. The term "capacity building" came into use in the 1990s, along with the recognition of the need to extend the concept of capacity beyond the individual to include the institutions where the individual works.

Early efforts to increase local capacity were usually a component of more comprehensive development programs undertaken by national and multilateral agencies. Technical assistance, characterized as the transfer of skills and systems, drew on expatriates to "inject knowledge" into the recipient country (Shaffer 2005). This characterization applies to the early efforts of the World Bank to develop expertise in government agencies and institutions concerned with the implementation of Bank projects (Kapur, Lewis and Webb 1997). The expert-counterpart system was extensively used, and the common format was for resident expatriate experts to work with a local counterpart to implement a larger aid project. The expert-counterpart model has been sharply criticized as being ineffective in transferring skills to the local counterpart because the expert was focused on meeting the main criterion for success, that is, the completion of the project (Berg 1993; Fukuda-Parr, Lopes and Malik 2002). Additionally, this system did not address the numerous constraints faced by the local counterpart, including lack of appropriate training, incentives, responsibilities, and institutional support (Fukuda-Parr, Lopes and Malik 2002).

In the 1990s there was a decided shift away from the use of expatriate expertise and the expert-counterpart model towards other models that included more participation by recipients in the design and implementation of programs. This was an attempt by donors to address a perception of past failures by increasing effectiveness through greater collaboration with recipients (Berg 1993) and emphasis on the development of the skills of both professional and non-professional recipient country workers. While it is widely acknowledged that the use of foreign experts in developing countries declined during this period and that the training and use of local experts increased, there are no systematic data available to analyze this shift.

Morgan (2006) discusses the recent and growing emphasis on capacity building, highlighting decisions and agreements resulting from international conferences under the auspices of the United Nations, and statements from multilateral institutions and international aid agencies. Capacity building has now been labeled "the missing link in development" (Morgan 2006) and has been roundly endorsed by a wide variety of institutions, including the World Bank, various agencies in the United Nations, the Organization for Economic Cooperation and Development (OECD) and national aid agencies. Data on the recent status of capacity building programs, which provide additional support for these claims, are presented below.

RECENT STATUS OF TRADE-RELATED CAPACITY BUILDING PROGRAMS

The WTO and the OECD have been charged with collecting data and improving the coordination of trade-related capacity building programs. They have developed three main categories for tracking trade-related capacity building activities: trade development (i.e., improving the business climate); trade infrastructure (i.e., improving the infrastructure needed to support trade); and trade policy and regulations. Total donor commitments for trade-related capacity building programs are currently around 14 percent of Official Development Assistance (OECD 2009). The analysis here is concerned with the "trade policy and regulations" category, which consists of programs to improve the effectiveness of developing countries' participation in multilateral trade negotiations, trade policy and technical standards analysis, and regional trade agreements (WTO 2006). Table 1 indicates that between 2001 and 2005, programs to support trade policy and regulations have accounted for a relatively small share of total expenditures for trade-related capacity building (i.e., always less than seven percent of the total), while infrastructure has consistently accounted for around eighty percent of total expenditures.

Table 2 provides additional detail on trends in donor expenditures on activities under the trade policy and regulations category. A large portion of expenditures have been dedicated to assisting in the implementation of current commitments, such as those undertaken in the categories of technical standards, trade facilitation and dispute settlement, trade related intellectual property rights and accession. Finger and Wilson (2006) detail the types of activities undertaken to facilitate trade, which include projects to improve customs valuation, and to strengthen the institutions responsible for sanitary and phytosanitary standards and intellectual property rights necessary to meet WTO commitments.

Table 1. Expenditures for Trade-Related Technical Assistance and Capacity Building (constant 2004 US$ million)

	2001	2002	2003	2004	2005
Trade Policy and Regulations	856	820	1,008	807	906
Trade Development	1,797	1,663	2,219	2,153	2,173
Infrastructure	11,397	11,277	10,154	14,808	12,317
Total	14,050	13,760	13,381	17,768	15,396

Source: WTO, 2006.

Table 2. Detailed Expenditures for the "Trade Policy and Regulations" Category (constant 2004 US$ million)

Category	2001-02	2003-04	2005
Trade mainstreaming in poverty reduction strategy and development plans*	113	129	110
Total Technical Standards	**130**	**103**	**103**
▪ Technical barriers to trade (TBT)	37	55	51
▪ Sanitary and phytosanitary measures (SPS)	93	48	52
Total Trade Facilitation	173	335	185
▪ Trade facilitation procedures	159	302	167
▪ Customs valuation	14	31	5
▪ Tariff reforms	0	1	13
Regional trade agreements (RTAs)	149	139	310
Total Multilateral Trade Negotiations and Agreements	214	135	138
▪ Accession	24	18	17
▪ Dispute settlement	4	3	2
▪ Trade-related intellectual property rights (TRIPS)	14	13	13
▪ Agriculture	9	11	5
▪ Services	14	5	5
▪ Tariff negotiations - non-agricultural market access	5	3	3
▪ Rules	9	1	2
▪ Training in trade negotiation techniques	7	6	6
▪ Trade and environment	73	29	36
▪ Trade and competition	40	31	30
▪ Trade and investment	13	8	12
▪ Transparency and government procurement	2	7	7
Trade education/training	57	66	60
TOTAL TRADE POLICY AND REGULATIONS	838	908	906

Source: WTO, 2006.

*This refers to research and training to explore how to use trade as an effective component of development and economic growth, to ensure that complimentary institutions and policies exist to facilitate growth from trade and to ensure that trade benefits the poor.

An examination of the Trade Capacity Building Database (WTO and OECD 2008) for expenditures by by donor indicates that the European Union (EU) is by far the largest donor,

accounting for US$509 million of the US$905 million total committed for 2005. The EU spent US$159 million on capacity building for regional trade agreements and US$146 million on trade facilitation. The US is a smaller donor, spending US$168 million in 2005, of which US$74 million was for multilateral trade negotiations and US$30.8 million was for regional trade negotiations. An examination of the data by implementing agency indicates that the World Bank spent US$62 million in 2005, the highest level of expenditure by any multilateral agency (WTO and OECD 2008). Other multilateral agencies had much lower expenditures, with the IMF spending US$12.8 million and the WTO spending US$15.9 million on trade-related capacity building in 2005.

In summary, the data available on trade-related capacity building programs indicate that in recent years these programs have focused on developing the skills needed to implement existing trade policy and to negotiate further regional and multilateral trade agreements. In terms of the three levels in the policy choice process, expenditures have largely been directed at the third level, that is, the implementation of policies and the rules and regulations needed to support them.

CRITICISM OF CAPACITY BUILDING PROGRAMS AND THE POTENTIAL ROLE FOR ACADEMIA

Current capacity building programs have been criticized because the multiplicity of donors has resulted in a lack of coordination and duplication of efforts. Much remains to be done to address these concerns. Critics have focused in particular on the legitimacy of WTO capacity building programs (Deere 2005; Shaffer 2005), which are aimed largely at providing assistance for the implementation of WTO agreements and the negotiation process. Shaffer (2005) argues that the basic structure and objectives of the WTO may not be appropriate for developing countries and that the WTO's programs for capacity building neglect the broader and more basic issue of whether developing countries should initiate negotiations to change the WTO's structure and the obligations assumed by members. Shaffer further argues that donors and the institutions implementing capacity building programs are perpetuating a system that is biased towards donors.

While Shaffer raises an important issue for WTO capacity building programs, I argue that it is appropriate for the WTO to continue to offer programs congruent with the current structure and agreements of the WTO, and that it would be difficult for members to support capacity building programs that are at odds with the fundamental basis of the organization. This practical concern is supported by economic theory that suggests that bureaucracies are fundamentally concerned with their own perpetuation, power and enlargement (Allison 1984; Niskanen 1971).

Institutions have different skills, strengths, and weaknesses, and offer varied perspectives for capacity building programs. This is important to consider in the discussion, design, coordination, and funding of future programs. The WTO is well suited to offer capacity building programs concerned with the implementation of policies required to meet WTO commitments, and the process of negotiating trade agreements. In contrast, given both the skills and the mission of academic institutions, they are better suited than the WTO to foster the capacity to address the more fundamental questions about overall economic policy (i.e.,

the first two levels of the policy choice process). Academics have a long history of both supporting and challenging the status quo with respect to key questions of economic philosophy and policy choice (Rosak 1968; Freire 1970). Academia also offers a variety of perspectives from disciplines beyond economics that offer additional insights into these questions. Thus academic institutions can play a role in capacity building programs that is unlikely to be undertaken by other agencies.

CONCLUSIONS

Decision makers in developing countries are faced with choices for their agricultural policies that need to simultaneously consider goals at both the sectoral and national level while being cognizant of their international obligations. Currently, many institutions offer capacity building programs to improve the ability to meet current commitments and to negotiate further trade agreements. However, successful implementation of policies requires a commitment by the government that reflects ownership of the policies and their adaptation to local contexts and institutions. This requires the ability of analysts to articulate the questions and consequences of broader economic policy choices. Academia has and should continue to make a contribution to supporting this level of analysis in capacity building programs.

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DISTORTIONS IN INCENTIVES TO PRODUCTION OF MAJOR CROPS IN PAKISTAN: 1991-2008

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ABSTRACT

This article describes the main policy interventions in the production and marketing of wheat, rice, cotton and sugarcane crops in Pakistan and estimates the incentives or disincentives faced by farmers in their domestic production during the period of 1991 to 2008. Empirical estimates of the protection coefficients suggest continuing taxation of wheat production. In the case of rice, production of long grain basmati has been taxed while that of coarse varieties somewhat protected. In the case of cotton and sugarcane crops, the major cash crops and sources of raw material for the textile and sugar industries, the picture emerging from the analysis is somewhat mixed. For cotton, which was taxed in the 1990s, the incidence of taxation has declined. As cotton imports have been on the rise, protection coefficients based on import parity prices still suggest implicit taxation of domestic production. For sugarcane, the analysis of export parity prices indicates protection of domestic production, but analysis of import parity prices indicates taxation.

Keywords: agricultural policy; major crops; markets; distortions; incentives; subsidy; implicit taxation; protection coefficients; Pakistan.
JEL classification codes: Q18, O13.

1. INTRODUCTION

Agriculture accounts for 21 percent of Pakistan's Gross Domestic Product (GDP) and is the main source of income for 68 percent of the population that lives in the countryside. Crop production, which covers an area of 23 million hectares and involves 6.62 million small, medium and large farms, accounts for about 50 percent of the agriculture sector's share of GDP. Most of Pakistan's crop production depends on irrigation, as rainfall is both low and concentrated during the summer months. Pakistan has a long history of government interventions in farm input and output markets. These interventions have included monopoly

procurement (inherited at the time of independence and continuing through the 1950s) of commodities such as wheat and rice (Niaz 1995); public sector monopolies of exports and imports; establishment of support prices for crops; restrictions on commodity movements; zoning for sugar mills; and subsidized issue price of wheat procured at support prices and imported in the public sector.[1] Some of these interventions, such as procurement and import monopolies, were aimed at providing cheap food to the urban population, while others, such as public sector monopolies of cotton and rice exports, were established to eliminate trade malpractices and develop export markets. Support prices were aimed at providing a floor for market prices in the post harvest season (Salam 2001). In addition, input subsidies were introduced to encourage the use of modern inputs and technology in order to promote agricultural development. Despite their intentions, however, these policy interventions have also distorted agricultural prices and producer incentives and lowered the real prices of tradable commodities (Hamid, Nabi and Nasim 1990, Dorosh and Valdes 1990).

Faced with a growing budget deficit, a rising debt burden, and mounting pressure from donors, as well as increasing evidence about the inefficiency of the public sector and the failure of public sector institutions to address emerging challenges, in the mid-1980s the government embarked on a series of economic reforms under a Structural Adjustment Program. The major thrust of these reforms was to reduce public sector interventions and increase reliance on market forces. Under these reforms, explicit taxes and tariffs were reduced (Nabi 1997). As a result, the average rate of applied customs duties declined from 47.2 percent in 1996-97 to 19.6 percent in 2002-03 for agricultural imports, and from 40.8 percent to 16.9 percent for industrial products (World Bank 2004).

This study estimates the distortions faced by farmers in their production of wheat, rice, cotton and sugarcane, important food and cash crops which are also major imports and exports, during the 1990-91 to 2007-08 period. While most of the period covered in the analysis is in the aftermath of the economic reforms, in some cases the reforms were under way but not fully implemented.

Together, the four crops under study account for about 64 percent of the annual crop area and about 90 percent of the value added by major agricultural crops in Pakistan (Government of Pakistan 2008).[2] These crops are also important for their forward and backward linkages in the economy and are the key to the performance of the crop sector. While the markets for these crops have faced many of the government interventions noted above, these interventions have seldom been based on in-depth analysis and their objectives have often conflicted with each other.

The remainder of this article is organized as follows. The methodology used to estimate the distortions faced by farmers is explained in section 2. Sections 3 through 6 describe the economic importance, discuss government policies and interventions, and estimate and discuss the distortions in producer incentives for each of the four commodities. In section 7, the empirical estimates of these distortions in incentives are compared with estimates from other studies. Limitations of the data and analysis are explained in section 8. The paper concludes in section 9 with a discussion of the implications of the distortions in incentives and some of the emerging challenges concerning commodity pricing in Pakistan.

[1] The issue price is the price at which the government releases wheat from its stocks to flour mills.

[2] Appendix Table 1 presents data on the area and production of these crops between 1991 and 2008.

2. METHODOLOGY AND DATA USED FOR ESTIMATING DISTORTIONS

International prices represent the opportunity cost to a country of producing various commodities domestically (Tsakok 1990). Thus, world commodity prices provide a reference and benchmark for domestic prices and indicate whether or not a country is an efficient producer of a particular commodity. The nominal protection coefficient (NPC) for a given commodity is the ratio of its domestic price to its international price. The NPC for a commodity *i* is defined as:

$$NPC_i = Pd_i / Pw_i$$

where Pd_i is the domestic price of commodity i and Pw_i is the international price of commodity i, converted into local currency, at a comparable point in space and time.

The NPC indicates any divergence between the domestic and international prices of a given commodity, which reflects the presence of market interventions such as taxes, subsidies, government controlled prices, and other policy instruments. Thus, the NPC provides an empirical estimate of any distortions (i.e., protection or taxation) for production of that commodity. It also provides a measure of the incentives or disincentives for the domestic production of a given commodity (Appleyard 1987). More specifically, if the NPC = 1, it is a neutral situation. That is, there is neither an incentive nor a disincentive for domestic production. If NPC > 1, there is positive protection (i.e., a subsidy) for domestic production. Conversely, if NPC < 1, there is negative protection (i.e., a tax) for domestic production.

To estimate the distortions affecting the production of wheat, rice, cotton, and sugarcane, for each commodity the producer prices prevailing in the domestic market during the harvest /post-harvest period were examined and compared with their relevant international prices. The corresponding international prices are calculated using the actual export or import parity prices of these commodities, estimated from the relevant export or import price data, but excluding any customs duties and other taxes. These international prices provide a measure of the opportunity cost of the resources used in the domestic production of a given commodity. Two important points about the domestic and international prices used in the analysis in this article are in order. First, concerning domestic prices, the government has followed a policy of annually reviewing and announcing support prices for wheat, rice, cotton, and sugarcane. These support prices have been intended to provide price floors during the harvest season, when market prices tend to fall, especially in good crop years. This price support policy was not meant to replace the market mechanism, but rather to correct market shortcomings and failures (Salam 2001). Thus, the analysis of domestic prices here has been confined to market prices prevailing during the harvest/post-harvest season (i.e., actual prices received by the growers). In addition, the prices used relate to the major producing area markets for each of the commodities. Second, regarding international prices, actual import and export prices have been used to estimate the import and export parity prices. Actual prices were preferred because quoted international prices may vary from those at which transactions actually occur, due to quality, timing, mode of payment and delivery, or other practical considerations. More specifically, in calculations of export / import parity prices, international prices were adjusted for the relevant domestic marketing, transport, handling, and processing charges in order to

make them comparable in space with the domestic prices. The use of actual export prices also helps to address the issue of quality differences and the resulting price differences between domestic and international commodities.

The exchange rate during the period covered in the analysis has been free and floating, and a recent estimate of the equilibrium exchange rate (Dorosh and Salam 2007) did not find much difference between the official and equilibrium exchange rates. Accordingly, the official exchange rate, as reported in the Pakistan Economic Surveys (Government of Pakistan, 2006, 2008), has been used to estimate import or export parity prices for the four commodities studied in this article.

The NPCs described above account only for the distortions in output markets; they do not consider interventions and any resulting distortions in input markets. This issue can be addressed by using effective protection coefficients (EPCs), which show how value added, rather than the gross value of production, is affected. Thus, the EPCs account for differences across industries in the value added share of output as well as distortions to intermediate input prices. However, estimating EPCs is much more demanding than estimating NPCs in terms of the data requirements, which may not be readily met. Moreover, compared to output distortions, farm input subsidies, on average, have a small overall impact on value added (Anderson et al 2007). During the bulk of the analysis period (1990-91 to 2007-08), most of the direct interventions in input markets and subsidies on seed, fertilizers, pesticides, credit, etc. had either been totally eliminated already or were in the process of being eliminated. However, in the wake of rising fertilizer prices in the world market, fertilizer subsidies were reintroduced in 2006. Nevertheless, these subsidies are common to all crops and are not crop specific. Thus, the protection coefficients (NPCs) estimated for the current analysis should provide useful insights about the levels of protection/assistance in place for the selected crops in general and the comparative picture in particular.

3. WHEAT: ECONOMIC IMPORTANCE, GOVERNMENT POLICIES, AND ESTIMATES OF DISTORTIONS

Wheat, which is the most widely grown crop in Pakistan and a staple food, is planted over an area of more than 8 million hectares annually and accounts for 66 percent of the total area planted for food grains, estimated at around 12 million hectares. The annual production of all food grains has averaged 31 million tons, with wheat production hovering around 21 million in the recent past, or 68 percent of total food grains production. The share of wheat in the total cropped area in Pakistan has ranged from 36 to 39 percent and it contributes 39 percent of the value added from major crops (Government of Pakistan 2008). Wheat is grown all over the country, under both irrigated and rain-fed conditions, and about 55 percent of its area is sown on farms operating less than 12.5 acres (Government of Pakistan 2003).

3.1. Government Policies and Interventions

Wheat production, milling, and marketing are all in the private sector. However, because of the importance of wheat to both consumers and producers, all governments since the

country's independence have intervened in the wheat market. The government interventions have been aimed, inter alia, at increasing production, maintaining incentives for wheat farming, keeping wheat prices within reach of consumers, and controlling inflation (Salam and Mukhtar 2008). In the wake of the deregulation of the economy and the increasing role of the private sector, most of the interventions in the wheat market have either been eliminated or are being phased out. Nevertheless, the government continues to announce support prices, procures substantial quantities of wheat in order to maintain the support price, holds stocks for food security reasons, and manages wheat import levels to achieve its consumer pricing goals. The issue price for the provision of domestically-procured and imported wheat from government stocks to the flourmills is subsidized to stabilize and exercise some control over market prices for wheat flour (Cornelisse and Naqvi (1987), Hamid, Nabi, and Nasim (1990), Dorosh and Valdes (1990), and Dorosh and Salam (2008).

3.2. Prices and Distortions in the Wheat Market

Data on the domestic market prices of wheat prevailing during the harvest season and the corresponding import parity prices are presented in Table 1. As Pakistan has been a regular wheat importer, the import parity price is the relevant measure of the opportunity cost of domestic wheat production. An examination of these data indicates that throughout the 1990-91 to 2007-08 period, producer prices of wheat in the domestic market have been substantially below the corresponding import parity prices.

As shown in Table 1, the NPCs ranged from 0.53 to 0.95, with an overall average value of 0.72. These coefficients reflect large transfers of resources from wheat farmers and surplus wheat-producing regions, adversely impacting the incomes and well being of wheat farmers. Such resource transfers have naturally discouraged investments in wheat farming and have had a negative impact on its production. Thus it is no surprise that Pakistan continues to have a wheat deficit and to rely on expensive imports to bridge the gap between wheat demand and supply.

Table 1 also presents data on the support prices of wheat along with government wheat procurements, which provide some useful insights about the wheat sector and wheat pricing policy. The support prices have been revised irregularly, 11 times in 18 years. However, two time periods stand out: (1) 1996-97 to 1998-99, when the price was raised from Rs. 173/40 kg to 240/40 kg for the 1996-97 crop and retained for the next two crop years; and (2) 1999-00 to 2002-03, when the price was raised to Rs. 300/40 kg in 1999-00 and maintained at the same level for the next three crop years (i.e., until 2002-03).

In 1992-93, when the NPC was 0.72 and the support price was raised in 1993-94 by 19 percent, the NPC rose to 0.95 but plunged to 0.53 by 1995-96. The NPC spiked to 0.78 during 1996-97 when producer prices in the domestic market rose in the wake of a 38 percent rise in the support price. For the 1999-00 crop, the NPC was estimated at 0.81, as the wheat support price was raised by 25 percent to Rs. 300/ 40 kg, which also pushed up producer prices. In 1999-00, there was a record procurement of 8.58 million tons, out of total production of over 21 million tons. As the Government had sufficient stocks of wheat, its support prices were not revised for the next three crop years. As a result, the NPCs fell sharply, from 0.81 in 1999-00 to 0.58 in 2003-04

Table 1. Domestic and International Prices of Wheat in Pakistan: 1991-2008

Year	Import parity price Rs/ 40 kg	Domestic market price Rs/ 40 kg	NPC	Support price Rs. / 40 kg	Procurements Million tons
1990-91	144	121	0.84	112	3.16
1991-92	183	134	0.73	124	3.16
1992-93	193	139	0.72	130	4.12
1993-94	178	170	0.95	160	3.64
1994-95	219	176	0.80	160	3.74
1995-96	349	185	0.53	173	3.45
1996-97	350	273	0.78	240	2.72
1997-98	346	259	0.75	240	3.98
1998-99	303	261	0.86	240	4.07
1999-00	365	297	0.81	300	8.58
2000-01	504	275	0.55	300	4.08
2001-02	523	292	0.56	300	4.04
2002-03	522	305	0.58	300	3.51
2003-04	567	385	0.68	350	3.40
2004-05	581	432	0.74	400	3.93
2005-06	458	411	0.90	415	3.88
2006-07	804	437	0.54	425	4.42
2007-08	1232	750	0.61	625	3.92
Average: 91-00			0.78		
Average: 01-08			0.65		
Average: 91-08			0.72		

Note: Import parity prices estimated from the actual import prices reported in Pakistan Economic Survey (Statistical Supplement) 2007-08. Incidentals and related costs of importing wheat adapted from various annual Wheat Price Policy reports of Agricultural Prices Commission. Data on support and domestic market prices and wheat procurements also obtained from the Agricultural Prices Commission's Wheat Price Policy reports. To represent the average situation in Pakistan, both domestic and import parity prices of wheat were estimated for Lahore, the major consumption centre located in the wheat producing region.

International prices of wheat have surged in the last couple of years. However, in spite of the substantial revisions in support prices, domestic producer prices have lagged far behind. The NPCs for the 2006-07 and 2007-08 crops are estimated at 0.54 and 0.61, respectively, reflecting the deterioration in incentives to wheat farmers. As the country was in the midst of a domestic food crisis and experiencing pressure from rising international wheat prices, the government was forced to abandon many of the market oriented policy initiatives in favor of administrative measures and interventions to insulate the domestic market from the

developments in world markets, which were a response to the worsening global food situation.

4. RICE: ECONOMIC IMPORTANCE, GOVERNMENT POLICIES, AND ESTIMATES OF DISTORTIONS

Pakistan is famous for producing and exporting long-grain aromatic "basmati" rice. It also exports substantial quantities of coarse rice. Pakistan ranks 12th in the world in terms of rice production and is the world's 5th largest rice exporter, accounting for 9 percent of global rice exports. Pakistan's rice exports, averaging 3.2 million tons in recent years, have earned over US$1 billion in foreign exchange annually (Government of Pakistan 2008). The rice crop, annually sown over an area averaging 2.5 million hectares, accounts for 18 percent of the area sown for food grains. Annual rice production averages 5.1 million tons and accounts for 18 percent of the total output of food grains.

4.1. Government Policies and Interventions

Rice production, marketing and trade have been subjected to several policy interventions, including monopoly procurements and exports in the public sector; levying of export taxes; restrictions on internal movements and the banning of the cultivation of certain varieties; and restrictions on rice sowing in certain areas and promotion of cultivation in others to reclaim saline lands. Until 2001-02, the government annually reviewed and announced the support price of rice (paddy).[3]

The support price was protected through market intervention and government procurements of paddy. In the wake of the economic reforms and the expanding role of the private sector in the economy, since 2003-04 the government's role in the rice sector has been limited to occasional and irregular announcements of indicative paddy prices, while the milling, marketing, and trade of rice are all in the private sector.[4]

Currently, there is no export tax on rice, but imports are subject to a 10 percent customs duty. Following the very high international and domestic prices experienced in 2007-08, in April 2008 the government fixed minimum export prices (MEP) for various varieties of rice: $1500/ton for Super basmati, $1300/ton for basmati, $1000/ton for IRRI-9, and $750/ ton for IRRI-6 (The World Trade Review 2008).[5] The MEP restrictions were lifted in August for IRRI rice and in October 2008 for other varieties.

[3] Paddy is unhusked rice.

[4] A lot of confusion remains about the concept of indicative price, which involves limited intervention in the market to protect a commodity's price. In contrast, with support prices, the government continues to intervene as long as is necessary to protect the commodity's price.

[5] Both IRRI-6 and IRRI-9, which were developed at the International Rice Research Institute (IRRI), are coarse varieties of rice.

4.2. Prices and Distortions in the Rice Market

To examine the wedge between the domestic and international prices of rice (paddy), export parity prices of rice paddy were calculated using the actual export prices for rice and compared with the domestic market prices for paddy (see Table 2). Because of the large differences between the quality and prices of long grain basmati and coarse varieties of rice, the two types of rice are analyzed and discussed separately below.

Table 2. Domestic Market and Export Parity Prices of Basmati and Coarse Paddy in Pakistan: 1991-2008

Year	Export parity price of basmati paddy Rs/ 40 kg	Domestic price of basmati paddy Rs/ 40 kg	NPC for basmati Paddy	Export parity price of coarse paddy Rs/40 kg	Domestic price of coarse paddy Rs/ 40 kg	NPC for coarse paddy
1990-91	167	143	0.86	72	78	1.08
1991-92	167	158	0.95	173	98	0.57
1992-93	184	190	1.03	108	112	1.03
1993-94	201	194	0.97	100	98	0.98
1994-95	198	192	0.97	115	137	1.19
1995-96	215	231	1.07	227	181	0.80
1996-97	315	296	0.94	161	164	1.02
1997-98	355	297	0.84	176	205	1.17
1998-99	395	362	0.92	195	234	1.20
1999-00	481	361	0.75	184	203	1.10
2000-01	477	300	0.63	175	180	1.03
2001-02	512	379	0.74	202	206	1.02
2002-03	509	495	0.97	198	218	1.10
2003-04	515	500	0.97	245	257	1.05
2004-05	565	543	0.96	293	338	1.15
2005-06	615	537	0.87	297	290	0.98
2006-07	671	594	0.89	325	310	0.95
2007-08	947	900	0.95	561	525	0.94
Average: 91-00			0.93			1.01
Average: 01-08			0.87			1.03
Average: 91-08			0.90			1.02

Note: Export parity prices estimated from export prices of rice reported in Pakistan Economic Survey (Statistical Supplement) 2007-08. Incidentals and related costs of exporting rice used in these estimations adapted from various annual Rice Price Policy reports of Agricultural Prices Commission. Export parity prices of basmati calculated at rice mills located in the basmati growing regions of the Punjab, while those of coarse paddy calculated at rice mills located in rice farming regions of Sindh. Domestic paddy prices are the averages of producer area markets located in the main basmati and IRRI growing areas of the Punjab and Sindh, respectively.

4.2.1. Basmati Rice (Paddy)

As shown in Table 2, with the exception of 1992-93 and 1995-96, the wholesale domestic market prices of basmati paddy were less than the corresponding export parity prices

throughout the reference period. Thus, the NPCs were less than one for all but those two years. The implicit taxation indicated by these coefficients ranges form 3 to 37 percent and averages 10 percent per year over the study period. From 1997-98 to 2001-02, the implicit taxation of basmati production was generally quite high, but has since declined following the economic liberalization. In the wake of international food shortages, of rice in particular, the domestic market has quite closely tracked the developments in world markets during 2007-08.

4.2.2. Coarse Rice (Paddy)

Export parity prices of coarse paddy since 1990-91, along with domestic prices, are also reported in Table 2. These data provide a mixed picture regarding the protection of IRRI production. The NPCs during the reference period have ranged from 0.57 to 1.20, with a mean value of 1.02. The mean value of 1.02 reflects a low level of protection for IRRI production. The NPC estimates indicate that the production of coarse rice enjoyed protection in twelve years of the reference period but faced implicit taxation in six years of the reference period. In recent years, as international rice prices have experienced a sharply rising trend and the share of rice exports in total production has increased, its domestic prices have been aligned quite closely with export markets.

There is a large domestic market in Pakistan for coarse rice, which, along with wheat, is a staple food for a large section of the country's population. This has helped fuel domestic demand and support high domestic prices for the commodity. In addition, the bulk of coarse rice exports are destined for low income countries. Exports of coarse rice to low income countries often have a higher proportion of brokens to cater to the demand from these importers. This may be one of the reasons for the resultant lower unit export prices of Pakistani coarse rice and may also partly explain why domestic prices have often been higher than the export parity estimates.

5. COTTON: ECONOMIC IMPORTANCE, GOVERNMENT POLICIES, AND ESTIMATES OF DISTORTIONS

Pakistan is the world's 4th largest producer of cotton. Cotton is Pakistan's largest cash crop. It is second only to wheat in terms of area planted, hovering around 3 million hectares and accounting for 15 percent of the total cropped area. Annual cotton production has averaged 2 million tons in recent years and its share in the value added by major crops is 24 percent (Government of Pakistan 2008). Textiles, the country's largest industry and the major source of employment in manufacturing, depends on cotton farming for raw material.[6] Cotton and cotton products contribute 65 percent of the foreign exchange earned from the export of merchandise goods. A valuable by-product of cotton farming is cottonseed, a raw material for the vegetable oil industry and feed for livestock and dairy farming. Cotton picking, a highly-labor intensive activity performed by female workers from both farm and non-farm households, is an important source of supplemental income for families in the countryside.

[6] Intersectoral linkages between the raw cotton, cotton lint and yarn and textile industries are modeled by Cororaton and Orden (2008).

According to the Agricultural Census (Government of Pakistan 2003), in 2000, 1.63 million of the 6.62 million total farms in the country were cotton growers. A great majority of cotton growing farms operated less than 12.5 acres, but these small farms account for 50 percent of the area under cotton. Among farm households that produce cotton, about 40 percent of their total income comes from cotton production. The 20 percent decline in world prices during the late 1990s adversely affected these households. [7] With its many forward and backward linkages, cotton production occupies a unique position in Pakistan's economy. Its performance holds the key to not only the growth and development of agriculture, but also to the robust health of the overall economy. A good cotton crop is essential for the sustainable development of agriculture, food security, and the success of poverty alleviation efforts.

5.1. Government Policies and Interventions

The Cotton Export Corporation (CEC), established in 1974, had a monopoly in cotton exports until 1986-87, when its role started to decline while the role of the private sector rose. Exports of cotton during the 1990s were subject to a MEP and a system of benchmark prices. The MEP for cotton was fixed daily by an inter-agency committee and announced by the State Bank of Pakistan. The benchmark price, determined on the basis of the ex-gin price of cotton lint, and export incidentals, provided the upper ceiling on the exporters' return, since the difference between the MEP and the benchmark price formed the basis for calculating the export tax. The MEP and system of benchmark prices were introduced to prevent under invoicing of exports and ensure a definite amount of revenue collection from export duties. But it suppressed the domestic prices of cotton relative to international prices, distorting the incentives to its production.

The system also insulated domestic markets from the developments in international cotton markets. Although the pricing system failed to provide any incentives to growers and exporters, the domestic processing industry benefited from the supply of cheap raw material. On the one hand, low cotton prices in the domestic market encouraged its wasteful uses, while on the other hand it discouraged its domestic production. The export duty on cotton was abolished in 1994. Both exports and imports are now in the private sector and government intervention is limited to an annual review of the support prices of seed cotton and limited public sector procurements (Salam 2008).

5.2. Prices and Distortions in the Cotton Market

Domestic market prices of seed cotton along with its export and import parity prices are presented in Table 3.[8]

[7] Household-level simulations suggest that if cotton prices had increased rather than declined 20 percent during the late 1990s, the percentage of cotton-producing households living below the poverty line in 2001 would have been reduced from 40 to 28 percent (Cororaton et al 2008).

[8] Because Pakistan has been importing as well as exporting cotton during the period covered in this study, both import and export parity prices were estimated to reflect the opportunity cost of domestic production.

Table 3. Domestic Market and International Prices of Seed Cotton in Pakistan: 1991-2008

Year	Domestic price Rs/40 kg	Export parity price Rs/40 kg	NPC 1	Import parity price Rs/40 kg	NPC 2
1990-91	327	464	0.70	669	0.49
1991-92	334	387	0.86	581	0.58
1992-93	384	383	1.00	560	0.69
1993-94	497	447	1.11	877	0.57
1994-95	785	918	0.86	1185	0.66
1995-96	754	816	0.92	1119	0.67
1996-97	793	879	0.90	1204	0.66
1997-98	843	821	1.03	1178	0.72
1998-99	914	918	1.00	1046	0.87
1999-2000	641	640	1.00	1060	0.60
2000-01	900	858	1.05	1302	0.69
2001-02	761	648	1.17	1017	0.75
2002-03	914	816	1.12	1297	0.70
2003-04	1219	1136	1.07	1583	0.77
2004-05	885	899	0.98	1246	0.71
2005-06	1017	995	1.02	1318	0.77
2006-07	1110	1089	1.02	1389	0.80
2007-08	1468	1268	1.16	1519	0.97
Average: 91-00			0.94		0.65
Average: 01-08			1.08		0.77
Average: 91-08			1.00		0.70

Note: Export and import parity prices estimated from the export and import prices reported in Pakistan Economic Survey (Statistical Supplement) 2007-08. Incidentals and related costs of exporting and importing cotton adapted from annual price policy reports of Agricultural Prices Commission on seed cotton. NPC 1 and NPC 2 are nominal protection coefficients estimated in relation to export and import parity prices, respectively. Export / import parity prices estimated at ginneries located in main cotton producing regions, while domestic prices are the average of wholesale prices prevailing in the main producer area markets during the harvest season.

The prices of seed cotton in both domestic and international markets were characterized by marked fluctuations during the 1990-91 to 2007-08 period. The nominal prices of seed cotton in the domestic market trended steadily upward through 1998-99, notwithstanding wide fluctuations in the international prices of cotton. This upward movement in domestic market prices seems to have been triggered by the 140 percent depreciation in the value of the Pak Rupee between 1990-91 and 1998-99, which outlasted the impact that fluctuations in international cotton prices had on domestic prices (Orden et. al 2005).

5.2.1. NPCs Based on Export Parity Prices

A comparison of export parity prices with the corresponding domestic market prices of seed cotton (see Table 3) provides a mixed picture. The NPC (NPC 1) averaged 0.94 during the 1990s and 1.08 from 2001 to 2008, while its average value for the entire period is 1.0. In 7 of the 18 crop years under study, export parity prices were higher than the domestic market prices, but in 11 of the years, domestic prices were higher than the export parity prices. In three of the years, domestic and export parity prices were so similar that the NPC was equal to 1. Thus, the NPC was less than 1.0 in 6 years but greater than 1.0 in 9 years. With the

exception of 2004-05, all the years when cotton production was subjected to implicit taxation (i.e., NPC<1) were in the 1990s, when domestic production was substantially greater than domestic demand and the country exported large quantities of raw cotton. With the increasing requirements of the expanding textile industry and the rising share of imports in the last ten years or so, farmers have benefited from domestic prices that have fairly consistently been higher than the corresponding export parity prices.

5.2.2. NPCs Based on Import Parity Prices

Generally speaking, years when significant quantities of cotton were exported were characterized by higher export parity prices, while those years when there were considerable imports featured lower export parity prices. These data on export parity prices suggest that the implicit taxation of cotton has been arrested since 1997-98. In contrast, the data on import parity prices do not support this claim, as import parity prices have consistently been significantly higher than the domestic prices received by cotton farmers throughout the period. Accordingly, the NPCs based on the import parity prices (NPC 2) have been less than 1.0 every year, ranging from 0.49 to 0.97, with an average value of 0.70. This underscores the importance of increasing domestic production of cotton, which is cheaper than importing cotton, through various incentives and other measures to meet the ever-increasing requirements of the industry. During 2003-04 cotton imports were approximately 393,000 tons and comprised 19.4 percent of domestic cotton consumption. Cotton imports increased to 898,818 tons in 2007-08 (Government of Pakistan 2008).

6. SUGARCANE: ECONOMIC IMPORTANCE, GOVERNMENT POLICIES, AND ESTIMATES OF DISTORTIONS

Sugarcane, which is cultivated under irrigated conditions on an area of about one million hectares, accounts for 4-5 percent of Pakistan's total cropped area. Farms operating less than 5 hectares account for about half of the area cultivated for sugarcane. Pakistan ranks 5th in the world in terms of area cultivated for sugar, but 15th in terms of sugarcane production (Pakistan Sugar Mills Association 2005). Pakistan's sugar industry, which is comprised of 79 sugar mills and is the country's second largest agro-based industry, depends on sugarcane cultivation for its supply of raw material. All of the sugar mills are in the private sector. The installed capacity in the industry is sufficient to produce about 5 million tons of sugar in a given crushing season provided that an adequate supply of raw material is available. As the number of sugar mills has increased over time, from 32 in 1980 to 79 in 2005, so too has the area under sugarcane. The sugar industry is located mostly in the countryside in and around small and medium-sized towns, and has played a catalytic role in the promotion of rural development. With its many forward and backward linkages, sugarcane farming has opened vast regular and seasonal employment opportunities for skilled, semi-skilled and unskilled labor. However, the production, marketing, and processing of sugarcane are confronted with a host of problems. First, the sector has been characterized by unstable production, of both sugarcane and sugar. Total production of sugar in Pakistan has ranged from 1.93 million tons (1990-91) to 4.75 million tons (2007-08), averaging over 3 million tons per year during the period of this study. The coefficients of variation of sugarcane production for Punjab and

Sindh, the major sugarcane producing provinces, are estimated at 19 and 17 percent, respectively. Second, relations between the farmers and sugar mills remain tenuous at best, which has adversely affected the development of sugarcane and its related sub-sectors. The growers, facing ever increasing input prices and energy costs and recurring water shortages, have been wary of the uncooperative and often exploitative attitude of the mills' management. The mills, facing increasing competition from cheap imports and troubled by an irregular cane supply, complain about the poor quality of the raw material and overcrowding in the peak season (i.e., long queues of sugarcane trucks waiting for days outside the mills to unload their sugarcane).

6.1. Government Policies and Interventions

The large variation in sugar production has often resulted in both large surpluses and shortages of the commodity, which has led to price instability and recourse to international trade and world markets.[9] This has also required frequent government policy measures and interventions. The principal interventions in the sugarcane sector have been rationing of sugar, licensing of sugar mills, zoning for sugar mills, regulating sugar exports and imports through tariff and non tariff measures, imposition of a central excise duty on manufacturing of sugar and a general sales tax on sugar, and fixation of support prices of sugarcane. These policies have caused distortions in incentives for both the producers and millers. The distortions in incentives for sugarcane production resulting from government policy measures and interventions are discussed below.

6.2. Prices and Distortions in the Sugar Market

Pakistan has been an active participant in the international sugar market, often importing and exporting large quantities of sugar simultaneously (see Appendix Table 2). As shown in Appendix Table 2, during nine of the 18 years in the study period, Pakistan was a net exporter of sugar, with net exports ranging from 24,481 to 896,950 metric tons. During the other nine years, net imports of sugar ranged from 35,638 to 1,456,786 metric tons.[10] In view of this import-export situation, determining the economic prices (i.e., the opportunity costs of domestic production) of sugarcane in Pakistan is rather complex, requiring estimation of both import and export parity prices. Moreover, because the processing of sugarcane into sugar also entails considerable costs, estimating the economic price of sugarcane requires representative data on the costs of processing, sucrose recoveries, etc., which are not readily available and are often unreliable. The data on processing costs used in the analysis here are from the reports and files of the Agricultural Prices Commission, while the data on average annual sucrose recoveries are from reports prepared by the sugar industry. Similarly, data regarding various costs involved in sugar imports were compiled and adapted from policy

[9] Sugarcane and sugar production, prices, and trade are also often at the center of press reports, controversy, and acrimonious debate in various forums, including the national press and other media.

[10] Another notable feature of the sugar market has been the wide fluctuations in the unit value of imports and exports over this period, in both rupee and dollar terms (see Appendix Table 2).

reports of the Agricultural Prices Commission and used to estimate import parity prices. Assuming symmetry of domestic costs in imports and exports, data on import costs were also used to calculate export parity prices for sugarcane.

The import and export parity prices, along with the domestic market prices of sugarcane, are reported in Table 4. Although the government announces support prices for sugarcane, the prices received by farmers have often differed from these, depending upon the crop situation and the prices of sugar in the market. Therefore, the average market price of sugarcane in Punjab and Sindh, the two provinces producing 90 percent of the country's sugarcane crop, has been used to represent the domestic market price and to estimate the NPCs presented in Table 4. Although in some years, the fob export cost of sugar was higher than the c and f costs of imported sugar, export parity prices have generally been much lower than import parity prices.

Table 4. Domestic Market, Export and Import Parity Prices of Sugarcane in Pakistan

Year	Export parity Rs/40 kg	Domestic price Rs/40 kg	NPC 1	Import parity Rs/40 kg	NPC 2
1991-92	NA	16.88	NA	21.76	0.78
1992-93	NA	18.63	NA	19.75	0.94
1993-94	18.48	19.70	1.07	25.72	0.77
1994-95	23.48	21.20	0.90	35.58	0.60
1995-96	24.58	25.00	1.02	39.98	0.63
1996-97	0.00	39.00	NA	37.17	1.05
1997-98	28.05	37.00	1.32	42.76	0.87
1998-99	23.62	34.00	1.44	35.79	0.95
1999-00	31.32	38.50	1.23	30.57	1.26
2000-01	NA	47.50	NA	41.36	1.15
2001-02	42.07	42.00	1.00	44.76	0.94
2002-03	27.22	35.50	1.30	48.08	0.74
2003-04	28.00	34.50	1.23	45.26	0.76
2004-05	40.08	40.50	1.01	54.08	0.75
2005-06	55.56	60.00	1.08	64.57	0.93
2006-07	NA	60.00	NA	69.98	0.86
2007-08	46.50	57.50	1.24	66.56	0.86
Average: 92-00			1.16		0.87
Average: 01-08			1.14		0.87
Average: 92-08			1.15		0.87

Notes: Sugar prices, which formed the basis of calculating export parity prices, were compiled from the Pakistan Sugar Mills Association's Annual Report 2007 and from data on sugar exports and imports along with their prices from the Federal Bureau of Statistics (FBS) . Import parity prices were calculated from the data on sugar imports obtained from the FBS and the Agricultural Price Policy Institute's (formerly the Agricultural Prices Commission) annual reports on sugarcane. NPC 1 and NPC 2 are the estimated nominal protection coefficients, based on export and import parity prices, respectively. Domestic prices represent the average of the ex-mill prices paid by sugar mills for the purchase of sugarcane in the Punjab and Sindh. Export / import parity prices were also worked back to the sugar mill level to represent the average situation in these two provinces.

N/A: negligible quantities of import/exports or data not available.

6.2.1. NPCs Based on Export Parity Prices

As shown in Table 4, domestic market prices are generally higher than export parity prices. Thus, the NPCs calculated by using the export parity prices (NPC 1) suggest considerable protection of sugarcane farmers. The NPC averaged 1.16 during the 1992-2000

period but declined to 1.14 during the 2001-08 period, reflecting the fall in marginal protection to sugarcane in the recent past.

6.2.2. NPCs Based on Import Parity Prices

As shown in Table 4, in most years, domestic prices of sugarcane were below import parity prices and the NPCs based on import parity prices (NPC 2) are generally considerably below one, suggesting implicit taxation of domestic sugarcane production. There were, of course, a few years when these NPCs were greater than one, implying protection to domestic production. However, the average value of NPC 2 throughout the entire period is 0.87.[11]

6.2.3. Conclusions about Distortions in the Sugarcane Market

In summary, the domestic prices of sugarcane have generally been higher than export parity prices, but somewhat lower than import parity prices. Thus, domestic prices of sugarcane fall between these two measures of its opportunity cost. While annual trade in sugar (exports as well imports) may appear to be large in absolute terms, it represents only a small fraction of total domestic production, with imports averaging 10 percent and exports only one percent of domestic production during the last eight years. Thus, both the domestic demand-supply situation and government interventions in the market play important roles in determining the sugarcane prices paid to farmers by the mills. If we use the average of the import and export parity prices to indicate the opportunity cost of producing sugarcane, then the value of NPC is on average close to one, which to a large extent eliminates the evidence of distortions in domestic sugarcane prices. The picture that emerges from the foregoing analysis is quite interesting, but continuous monitoring of developments in world sugar markets, the domestic sugar sector, and its related sub-sectors in the economy is required in order to keep track of the developments in these markets and address the emerging issues and challenges to sugarcane farming and processing.

7. COMPARISON OF NPC ESTIMATES WITH RESULTS FROM PREVIOUS STUDIES

For comparison purposes, Table 5 summarizes the NPC estimates from this study and some previous studies by the World Bank and the United Nations Food and Agriculture Organization (FAO).[12]

An examination of these NPCs suggests that, notwithstanding the trend towards liberalization, implicit taxation of wheat continues, with the average taxation remaining at about 25 percent of the border price.

The implicit taxation of basmati rice, an important export and food crop, has sharply declined over time. It is worth mentioning that in the past basmati rice was subject to numerous interventions at the marketing stage, including monopsony procurements, restrictions on its movements, and monopoly exports by the Rice Export Corporation of Pakistan (RECP) during the 1970s, which continued into the 1980s. Economic liberalization,

[11] It should be noted, however, that in the 1992-2000 period, there was greater variation in the annual NPC values than in the 2001-08 period.

the phasing out of trade restrictions, and the dismantling of the RECP have worked to greatly reduce the wedge between domestic and border prices and hence the implicit taxation of basmati. The coarse rice, which was subject to some of the same restrictions and interventions as basmati rice, as well as implicit taxation, has also benefited from the economic reforms. As shown in Table 5, coarse rice received a small amount of protection during the 1991-2008 period, while it was implicitly taxed during the 1970s and 1980s. Cotton was also heavily taxed in the 1970s and 1980s. However, starting in the late 1990s, incentives for cotton production seem to have improved significantly. With an average NPC of 1.00 during the 1991-2008 period, domestic prices appear to have tracked international prices rather well.

Economic liberalization and the program of policy reforms also seem to have benefited the country's sugarcane production. Between 1972 and 1977, the NPC for sugarcane averaged 0.58, reflecting a high level of implicit taxation of domestic production. However, during the 1976-84 period, with an average NPC of approximately 0.93, the situation for the domestic sugarcane industry had improved considerably. The situation for the 1991-2008 period is mixed. During this period, Pakistan both exported and imported sugar. Using export parity prices, the average NPC was 1.15, reflecting protection for domestic sugarcane production, while the average NPC based on import parity prices was 0.87, suggesting implicit taxation of domestic sugarcane farmers.

The results of the present study generally agree with the results reported in the World Bank study (Dorosh and Salam 2009) concerning the direction of support (i.e., implicit taxation or protection) for the four commodities, but are different in terms of the magnitude of that support. The differences in the magnitude or size of the coefficients of support arise for various reasons, for example due to the different time periods of the two analyses; variations in the reference prices used to calculate import or export parity prices; and variations in the costs used to calculate import or export parity prices. In addition, for commodities falling into both export and import categories, the use of the import versus the export parity price could significantly affect the resulting estimates of economic prices. The reference point of comparison can also affect the size of the protection coefficient. For example, one of the main reasons for the differences in the magnitude of support for wheat in the two studies is the point of comparison. That is, in the case of the World Bank study (Dorosh and Salam 2009), the point of comparison is the port city of Karachi, while in the present study the protection coefficient has been calculated at Lahore, which increases the costs for imports, as the wheat must be transported to an interior metropolitan area in the main wheat-producing region of Pakistan.

[12] For additional studies see Hussain, Anwar and Hussain (2006).

Table 5. Summary of Nominal Protection Coefficients from Different Studies

Period of analysis	Study by	Wheat	Basmati	IRRI	Cotton	Sugarcane
Avg. 1972 – 77	Gotsch and Brown (1980)	0.75	0.5	0.54	0.63	0.55
Avg. 1976 – 80	Appleyard (1987)	0.76	0.5	0.68	0.8	1
Avg. 1976 – 84	Appleyard (1987)	0.72	0.48	0.71	0.8	0.93
Avg. 1991-2000	Present study	0.78	0.93	1.01	0.94	1.16 (0.87)
Avg. 2001-08	Present study	0.65	0.87	1.03	1.08	1.14 (0.87)
Avg. 1991- 2008	Present study	0.72	0.90	1.02	1	1.15 (0.87)
Avg.1990-1994 [NRAs] %	Dorosh and Salam (2009)	-27.1	-17.9	-0.5	-19.9	52.1
Avg. 1995-994 [NRAs] %	Dorosh and Salam (2009)	-20.2	-1.7	8.1	-7.9	54.3
Avg. 2000-05 [NRA] %	Dorosh and Salam (2009)	-13.9	-25.3	12.5	7.0	86.5

Note: NRA refers to nominal rate of assistance and is calculated by subtracting 1.0 from the NPCs. Negative signs indicate cases where NPCs are less than one.

The figures showing NRAs indicate the percentage divergence between domestic and international prices.

NPCs given in parentheses in sugarcane column are based on import parity prices while those without parentheses are based on export parity prices.

8. LIMITATIONS OF THE DATA AND ANALYSIS

The estimation and analysis of NPCs require data on both the domestic and international prices of the commodities. In the current analysis, the domestic prices of wheat, basmati and IRRI paddy, seed cotton and sugarcane relate to the harvest and post harvest seasons of the respective commodities. Data from the price policy reports of the Agricultural Prices Commission (now the Agriculture Policy Institute), which report commodity prices as being those received by the farmers in the main producing area markets, were adopted for the analysis in this paper. Actual import / export prices of wheat, rice and cotton, as published in the Pakistan Economic Survey, were used to work back the import/export parity prices for wheat, rice (paddy) and seed cotton. In the case of sugar, import / export prices as reported by the Pakistan Sugar Mills Association in its annual reports for 2005 and 2007 were supplemented with data obtained from the Federal Bureau of Statistics.

The estimation of import/export parity prices of commodities like paddy, seed cotton and sugarcane from the international prices of their respective imported /exported products (i.e. rice, cotton and sugar) requires data not only on the various commodities' marketing costs, but also on their processing costs, technical coefficients, product recoveries and prices. The Agricultural Prices Commission has invested significant resources and time to collect, refine, and update such data for use in its policy related analysis. Because this data set has been scrutinized by many and was the best available, it was adapted for use in the current analysis.

The comparison of domestic and international prices has been done using data from comparable locations for the various commodities. For wheat, the producer prices used in the analysis represented the average of the producer area markets during the harvest season. The price of wheat imported at Lahore, a large consumer centre located in the heart of the wheat producing region, inclusive of transportation and other related costs, was adopted to represent the average situation. For basmati paddy, producer prices used in the analysis are harvest/post harvest season prices prevailing in producer area markets of the Punjab, where basmati production is concentrated. Export parity prices for paddy, based on the export prices of basmati rice, were estimated for rice mills located in the main basmati producing areas. For coarse varieties of rice, the domestic price was the average of prices prevailing in the producer area markets of Sindh, where the bulk of coarse rice is produced. Export parity prices of coarse rice were estimated for rice mills located in the producer areas of Sindh.

In the case of cotton, crop farmers produce and sell seed cotton. The domestic price used was the average of the wholesale prices of seed cotton prevailing in the main producing area markets during the harvesting and post harvesting season, normally extending from October to January. Ex-gin export prices of seed cotton were worked back from the actual export prices of cotton for ginneries located in the major cotton growing regions. For sugarcane, domestic prices represent the average of prices received by farmers in the major sugarcane growing areas of the Punjab and Sindh. The parity prices of sugarcane at the mill level were worked back from the export/import prices to represent a typical sugar mill using the weighted average of the transport and market costs for Punjab and Sindh. Given the wide dispersion of rice mills, cotton gins, and sugar mills across various areas, there is bound to be some variation that is not captured in the estimated export/import parity prices. However, this is also the case with domestic producer prices, which reflect the average situation in the main producing area markets for the respective commodities.

The actual export and import prices that were used to calculate the export or import parity prices of the commodities are annual averages and thus mask whatever variation occurred during the course of the year. But such variation is inescapable in this type of analysis and a precise calibration of the timing of import and export prices with domestic prices is well nigh impossible. Another point worth mentioning in this context is the impact of transportation, marketing, handling and other costs related to international trade. The structure of markets and the efficiency of the operations involved also affect the resulting import/ export parity prices of the commodities. Furthermore, the efficiencies and inefficiencies of the processing sub-sectors for commodities like paddy, seed cotton and sugarcane affect their parity prices since they are worked back from the prices of the final products. Thus, in addition to government policies, the kind of market infrastructure, the prevailing market structures, and the efficiency of the processing sector affect the degree of integration or the extent of insulation of domestic markets from developments in world commodity markets. Moreover, some of the distortions in producer incentives may be due to these factors.

CONCLUDING REMARKS

This article has reviewed domestic producer prices and international prices for wheat, rice, cotton and sugarcane during the 1991-2008 period. The data and analysis indicate that domestic production of wheat and basmati rice (and sugarcane when import parity is used as a measure of its opportunity cost) has been subject to implicit taxation. At times, these crops enjoyed protection, which coincided with falling prices in world markets. Clearly, the degree of taxation and resource transfers from producers and surplus regions has varied from year to year. Nevertheless, as a result of these transfers, farmers' incomes and well being have been adversely affected. The production of coarse varieties of rice has been somewhat protected during most years in the reference period. In the case of cotton, domestic production was heavily taxed in the 1990s, but in recent years, its domestic prices have been tracking world prices rather closely, thus reducing the implicit taxation. In view of the burgeoning demand for cotton in Pakistan, the domestic textile industry needs to enhance its support for research and development efforts to raise its productivity and expand domestic production.

Given current levels of production and processing efficiency, the data suggest that Pakistan will be hard pressed to export sugar competitively. Nevertheless, if sugar prices in world markets rise persistently to the levels witnessed in the recent past, it may be economically feasible to expand domestic production to meet domestic requirements. However, it may still be difficult to compete in export markets. The sugar sector would be well served by research and development efforts aimed at improving the efficiency of sugarcane production and processing.

The role of the public sector and government interventions in commodity markets has declined over time while that of the private sector has expanded. Nevertheless, the food crises experienced in 2006-07 and 2007-08 have highlighted the shortcomings of Pakistan's current production, marketing, and distribution systems. Wheat marketing witnessed the return to some of the old administrative measures in 2007-08: restriction of commodity movements and compulsory government procurements. The end result of these interventions has been a consistently inadequate market infrastructure and a lot of waste and malpractice in the public

sector. Unless and until the fundamental imbalance between demand and supply is addressed, these interventions will only aggravate rather than solve the problem. It is imperative to arrest the historical resource transfers from farmers and remove other distortions to incentives if the crop sector is to be able to play its proper role in agricultural development and the alleviation of rural poverty. If the economic environment for agriculture is not improved, the requisite farm investments will not occur. To some extent, there has been an improvement in the economic environment for agriculture in Pakistan, as evidenced by steps taken by the government to increase producer incentives during the 2008-09 crop year. However, this is only half of the story. The other half relates to the development, dissemination, and adoption of productivity-enhancing techniques and technologies. These measures will assume greater importance as domestic markets are increasingly aligned with world markets.

Appendix Table 1. Area and Production of Crops Under Study in this Paper

Years	Wheat	Rice	Cotton	Sugarcane
Area: 000 hectares				
Average: 1991-95	8,059	2,099	2,758	927
Average: 1996-2000	8,307	2,334	3,002	1,030
Average: 2001-05	8,169	2,339	3,004	1,020
Average: 2006-08	8,480	2,572	3,077	1,059
Average: 1991-2008	8,221	2,302	2,944	1,002
Production: 000 tons				
Average: 1991-95	15,724	3,412	1,641	40,902
Average: 1996-2000	18,238	4,487	1,673	48,371
Average: 2001-05	19,509	4,607	1,900	48,873
Average: 2006-08	22,107	5,516	2,127	54,443
Average: 1991-2008	18,895	4,506	1,835	48,147

Source: Calculations by the author based on data from Pakistan Economic Survey (Statistical Supplement) 2007-08.

Appendix Table 2. Exports and Imports of Sugar in Pakistan

Year	Imports	Unit value of imports		Exports	Unit value of exports		Imports- Exports
	Metric tons	Rs / ton	$/ton	Metric tons	Rs/ ton	$/ton	Metric tons
1990-91	434,730	8,269	369	NA	NA	NA	434,730
1991-92	116,741	7,830	315	NA	NA	NA	116,741
1992-93	75,018	7,356	291	NA	NA	NA	75,018
1993-94	47,754	9,320	312	125,265	9,912	329	(77,511)
1994-95	4,998	13,149	426	462,145	11,936	387	(457,147)
1995-96	3,299	15,519	454	29,134	12,016	358	(25,835)
1996-97	722,273	13,651	352	NA	NA	NA	722,273
1997-98	110,407	15,186	373	321,063	13,757	318	(210,656)
1998-99	9,652	14,936	299	906,602	12,739	272	(896,950)
1999-00	66,125	11,473	221	30,487	16,032	310	35,638
2000-01	926,856	15,558	271	NA	NA	NA	926,856
2001-02	84,049	17,185	271	3,800	20,184	329	80,249

2002-03	7,749	17,991	309	32,230	13,750	235	(24,481)
2003-04	9,818	16,196	281	116,160	13,679	238	(106,342)
2004-05	265,784	19,615	330	54,410	18,782	316	211,374
2005-06	1,517,743	24,469	408	60,957	26,055	435	1,456,786
2006-07	585,754	26,817	444	NA	NA	NA	585,754
2007-08	23,617	23,415	386	239,130	22,067	347	(215,513)

Sources: Federal Bureau of Statistics and Pakistan Sugar Mills Association Annual Report (2007).
Note: Values in parentheses indicate net exports, while values without parentheses are net imports.
N/A: negligible quantities of import/exports or data not available.

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SUDAN'S PROPOSAL TO ACCEDE TO THE WTO: IMPACTS ON AGRICULTURAL MARKETS

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ABSTRACT

This article analyzes the impacts on agricultural markets of Sudan's proposal to accede to the WTO. We find that Sudan has inflated its customs schedule in its offer for agricultural products, which provides room to maneuver during negotiation. Applied tariffs for commodities such as cottonseed, cotton meal, other oilseed meal, and beef and veal are actually higher in Sudan's offer than they are at present. Sudan has also proposed TRQs for some tariff lines. Using the Partial Equilibrium Agricultural Trade Simulator (PEATSim) model, we assess the impacts of Sudan's market access proposal on agricultural markets. A free trade case (zero tariffs) is simulated as well in order to determine which agricultural commodities are most sensitive to the elimination of border protection.

Model results indicate that the agricultural commodities most sensitive to trade liberalization in Sudan are oilseed products: peanut oil and meal, and other oilseed oil and meal. We suggest that in order to benefit from its accession to the WTO and overcome the negative impacts, Sudan should reorient its agricultural trade policy towards increasing the competitiveness of its exported agricultural commodities by raising productivity, reducing trade costs, and rationalizing the incentive regime for the agricultural sector.

Keywords: agricultural markets, Sudan, trade policy, WTO.
JEL classification codes: Q17, F55.

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INTRODUCTION

Sudan is a low-income, least developed country. Its economy is based largely on the production and export of primary commodities. The main agricultural commodity exports are cotton, gum Arabic, sesame, peanuts, sorghum, livestock, and sugar. Although Sudan has recently become an oil exporting country, agricultural trade remains an important part of overall economic activity and continues to play a major role in domestic agricultural production and employment.

In addition to depending on agriculture as a source of non-petroleum foreign exchange earnings, raw materials, and food, Sudan relies on the agriculture sector as a source of inputs used in other sectors and as a source of employment for more than two-thirds of the country's labor force (Abdel Karim 2002). While the agricultural sector contributed, on average, about 45 percent of gross domestic product (GDP) during the 1994-2006 period (see Appendix Table 1), Sudan has not been able to attain self-sufficiency in food.[1] This is due to many factors, including a lack of realistic policy priorities to exploit the country's comparative advantage in agriculture, a shortage of capital for investment, a lack of essential technical research, and, most importantly, political instability.

Agricultural exports were Sudan's main source of foreign exchange before the discovery of oil. During 1994-1998, agricultural products represented, on average, about 89 percent of the country's total exports, but this share declined to less than 8 percent in 2006 (see Appendix Table 2). Sudan is not currently a member of the World Trade Organization (WTO), but it has been in the process of accession since 1994.

This article has two objectives. First, we examine whether the tariff reductions in Sudan's WTO accession proposal fall under acceptable levels of WTO Agreements. Second, we assess the impacts on Sudan's agricultural markets of implementing the country's market access proposal. The analysis is based on the Partial Equilibrium Agricultural Trade Simulator (PEATSim) model developed by the Economic Research Service of the US Department of Agriculture in collaboration with Pennsylvania State University.

In the next section, we provide background on Sudan's agricultural trade policy. This is followed by a description of Sudan's accession process to the WTO. We then present the methodological approach used in our analysis. This is followed by a discussion of the results. The final section summarizes our findings and offers some policy recommendations to help Sudan benefit from its accession to the WTO.

AGRICULTURAL TRADE POLICY IN SUDAN

Over the last 15 years, the Sudanese government has undertaken economic liberalization, particularly in its foreign trade regime. The availability of domestic petroleum, together with trade liberalization, has allowed Sudan to begin integrating into the world economy more rapidly (Shafaeddin 2007). During the last two decades, Sudan has implemented different

[1] The main imported agricultural commodities are wheat and wheat flour, rice, and beverages.

development strategies and various policy reform programs. The major policies have targeted the agricultural sector, due to its major role in the economy. Generally, policies have been aimed at reducing total taxation on the agricultural sector and maintaining the stability of Sudan's exchange rate, especially against the dollar (State Ministry of Agriculture and Forestry 2004).

In the past, direct and indirect taxation of the agricultural sector was a major source of government revenue. However, efforts have been made by the Sudanese government in recent years to reduce this taxation. In 1998, total taxation (production tax, state development tax, Farmer's Union levy, etc.) of agricultural products was limited to 20 percent in the rainfed sector and 15 percent in the irrigated sector. From 1998 to 2004, the tax on agricultural profits (net returns) was reduced from 35 percent to 10 percent. Applied tariffs on imports of agricultural inputs were also reduced (Abdel Karim and Alfahl 2007).

Export Policies

Export taxes on agricultural commodities were reduced in the 1990s and then eliminated entirely in 2000 (Sudanese Custom Union 2002). Exports from Sudan are exempted from the country's 15 percent value added tax (VAT) and exporters are eligible for refunds of the VAT paid on imported inputs used to produce exports. However, in practice, VAT refunds are being delayed in most cases and are therefore acting as an indirect tax on exports. Many fees are still imposed on agricultural production and exports, such as administrative fees, transportation fees, production fees (only on sugar production), state support fees (0.5%), and port fees (1%); there is also zakat (10%).[2]

Few of Sudan's exports currently face high tariffs in foreign markets, but this may change if Sudan exports more processed foods and manufactured goods. Sudanese exports generally face low tariffs for two reasons. First, most favored nation (MFN) tariffs for its products are generally low because few of the countries to which Sudan exports impose high tariffs on oil or raw agricultural commodities. Second, Sudan is a member of several preferential trading arrangements (PTAs), including the Common Market for Eastern and Southern Africa (COMESA), the Greater Arab Free Trade Area (GAFTA), and the Economic Partnership Agreement (EPA) with the European Union (EU).[3]

Import Policies

On the import side, Sudan does not apply any quantitative import restrictions. All goods may be imported into Sudan except those that are prohibited by government regulations, Islamic values, or security considerations, e.g. imports of pork meat, wine and spirits are prohibited due to Islamic considerations. Sudan applies an 8-digit tariff nomenclature based on the Harmonized Commodity and Coding System (HS 96) as of July 1992. Sudan's tariff

[2] Zakat is an alms tax levied on five categories of property: food grains; fruit; camels, cattle, sheep and goats; gold and silver; and movable goods.

[3] The EPA is a relatively new agreement that replaces the old Cotonou Agreement between the EU and the African, Caribbean and Pacific (ACP) countries.

structure has two components: (1) the general rate of duty, and (2) preferential rates of duty. A certificate of origin for imports is required when tariff preferences are claimed.

Customs duty rates are *ad-valorem* duty rates applied to the cost, insurance, and freight (CIF) import value. There are five different rates of customs duty: zero percent, 3 percent, 10 percent, 25 percent and 45 percent. The zero percent rate is imposed mostly on agricultural and industrial inputs. The 3 percent rate applies to imports such as products of milling industries, wheat, plastic, and metal raw materials. The 10 percent rate is charged on fresh, chilled, or frozen meat and fish, wood and wood articles, and edible vegetable and animal oil. The 25 percent rate is levied on products such as oilseeds, plastic and rubber articles, raw hides and skins, leather, and domestic household electrical equipment and appliances. The 45 percent rate is imposed on textiles and textile articles, carpets and other floor coverings, edible fruits and nuts, sugar and sugar confectionary, perfumery, cosmetics and toilet preparations, footwear, furniture, and tobacco. Sudan's 15 percent value added tax (CIF plus other charges) is collected on most imported goods, with human and veterinary medicines exempted from the VAT. Other charges include 2 percent quay (dock) dues collected by the Seaport Corporation and 1.2 percent civil aviation charges.

Although current tariffs in Sudan are much less protectionist than those in place before the reforms of the 1990s, the import tariff regime in Sudan is still protectionist in comparison to most African and other developing countries (DTIS 2008).[4] In addition to high average tariffs, there is a considerable variation across industries and stages of production. For example, tariffs on final products are higher than those on intermediate inputs, which raise the prices of competing goods above world levels, encouraging local producers to supply the local market rather than selling internationally.

SUDAN'S ACCESSION TO THE WTO

Sudan is currently in the process of negotiating its accession to the WTO. As described in Article XII of the Marrakesh agreement, the accession process might be conceived as an easy and innocuous process whereby an agreement on the terms of accession is approved by the Ministerial Conference through a two-thirds majority vote by members of the WTO. However, because Article XII does not lay out any membership criteria, the accession process can be very problematic (Lanoszka 2001). The terms of accession are left to negotiations between WTO members and the candidate country. Moreover, Article XII does not provide any guidance on the procedures to be used for negotiating the terms of accession (Lanoszka 2001).

In order to facilitate accession to the WTO by less developed countries (LDCs), the Doha declaration (paragraph 42) states that negotiations for the accession of LDCs to the WTO be "facilitated and accelerated through simplified and streamlined accession procedures," with a view to concluding these negotiations as quickly as possible. All LDCs acceding to the WTO are subject to Special and Differential Treatment (SDT). In addition, a 2002 decision of the General Council on streamlining accession of LDCs stipulates that "WTO Members shall exercise restraint in seeking concessions and commitments on trade in goods and services

[4] Liberalization and privatization policies were adopted under the Economic Salvation Program.

from acceding LDCs, taking into account the levels of concessions and commitments undertaken by existing WTO LDCs' Members." However, the degree to which this stipulation is followed in practice is subject to debate (Adhikari and Dahal 2004).

Benefits of WTO Membership

There are three key benefits that an acceding country can obtain from WTO membership. The first benefit is a result of the accession process itself, namely, the systematic examination, streamlining, strengthening, and eventual lock-in of national trade-related laws and policies. This generally increases the availability and reduces the prices paid by domestic consumers for imported goods and services, enhancing consumer welfare. The second benefit is that, as a WTO member, a country will benefit from MFN access opportunities in other members' markets. The third benefit is access to a binding, rules-based multilateral dispute settlement process that is available by right to all WTO members. An important caveat is that, as currently set up, the WTO dispute settlement system is expensive and complex and therefore may be of little practical use to poor economies (Mosoti 2004).

Sudan's Accession Process

The working party on the accession of Sudan was established in 1994. Sudan's "Memorandum on the Foreign Trade Regime" was circulated in January 1999. The second meeting of the working party was held in March 2004. A "Factual Summary of Points Raised" (summarizing the discussions of the working party) was circulated informally in September 2004. Bilateral market access negotiations are underway on the basis of Sudan's revised offers on goods and services. The third meeting of the working party has been postponed, but as yet no date has been set.

Sudan has taken several steps to revive the accession process. In September 2006, it submitted updated versions of its "checklist" reports on the Trade Related Intellectual Property Aspects (TRIPS), Sanitary and Phytosanitary (SPS), and Technical Barriers to Trade (TBT) agreements. The latest versions of Sudan's market access proposals for goods and services were submitted in October 2006, and in November 2006 it initiated bilateral negotiations on market access with ten members of its accession working party.[5] Since 2004 the government has also maintained some momentum on trade reforms through significant liberalization in banking and telecommunications services as well as modest reductions in customs duty rates.

Sudan's Accession Proposal

Sudan has followed a tariff binding approach, and different ranges of tariffs have been proposed for agricultural products, including special rates for sensitive and seasonal products. The government's initial offer on agricultural commodities reflected its views on the

country's current level of economic development and future development prospects, its poverty reduction and food security requirements, and the need to protect small farmers and public health.[6]

The final offer on agricultural goods that Sudan submitted to the WTO includes 740 tariff lines (100 percent coverage) with bindings for nine tariff bands ranging from 25 percent to 300 percent. This compares to the current five tariff bands for agricultural products, with applied rates ranging from 0 percent to 45 percent. Table 1 presents the proposed bound and applied rates under Sudan's market access proposal, along with applied rates in 2004 (the base year for the analysis below). The bound tariff rates for 74 percent of the products covered in Sudan's offer are above their current applied rates; 18 percent are below their current applied rates; and the rest (8 percent) are equal to their current applied rates. The simple average bound tariff in the offer is 53 percent, compared to 35 percent for current applied rates. This average bound tariff rate is considerably less than the rates in other developing countries. For example, in 19 African countries the simple average bound agricultural tariff rate is 100 percent or more. In India, Pakistan, and Bangladesh the simple average bound rates are 122 percent, 101 percent and 200 percent, respectively (Basha 2004).

In addition to normal tariff bindings, other measures are included in the final offer for agricultural products, such as imposing peak tariffs for sensitive products, phasing in tariffs for a limited number of sensitive products, and proposing tariff rate quotas (TRQs) for five strategic food products (sorghum, broad beans (faba beans), millet, wheat flour and sugar) for food security reasons. Special safeguard measures are designated for 22 tariff lines, including frozen meat and dairy products. Sudan has also selected 17 agricultural products (mainly perishable agricultural products) on which seasonal tariffs will be applied.

It seems clear that Sudan has inflated its customs schedule in its offer for agricultural products, which is a good basis for negotiation. Using TRQs on some tariff lines (sensitive products) may not be acceptable under the Uruguay Round because TRQs typically replace non-tariff measures (e.g., quotas), and currently such measures do not exist for the selected products in Sudan. However, under the various Doha Round proposals, developing countries are allowed to protect special and sensitive products with TRQs.

Table 1. Sudan's Current Applied Tariff Rates and Proposed WTO Bound and Applied Rates

Commodity	Current Applied Rate (%)	Proposed Rates Under WTO Accession (%)	
		Bound Rate	Applied Rate
Rice	0	60	0
Wheat	3	60	3
Maize	25	60	3
Other Coarse Grains	10	80	10
Sunflower Seed	45	40	45
Cottonseed	25	40	45
Cottonseed Oil	45	80	45
Cottonseed Meal	19	25	25

[5] These are China, South Korea, Japan, India, Brazil, and some EU countries.

[6] Tariff binding refers to a commitment not to increase a rate of duty beyond an agreed-upon level. Once a rate of duty is bound, it may not be raised without compensating the affected parties.

Peanuts	25	50	25
Peanut Oil	45	80	45
Peanut Meal	31	25	10
Other Oilseeds	25	40	25
Other Oilseed Oil	45	80	45
Other Oilseed Meal	17	28	25
Cotton	25	40	25
Sugar	45	150	45
Beef and Veal	25	80	45
Poultry	45	70	45
Fluid Milk	45	60	45

Source: Sudan's Higher Commission for WTO Accession

METHODOLOGY

The appraisal of the impact of Sudan's market access proposal on agricultural markets in Sudan can be carried out at various levels and with different methodological approaches, for example general equilibrium (CGE) or partial equilibrium approaches. CGE models excel at capturing economy-wide linkages among producers and consumers. Changes in the agricultural sector could potentially have significant effects on national income and in turn demands for goods and services, including food. This is most likely to occur in developing countries such as Sudan where agriculture is a large percentage of national income. Changes in the agricultural sector could also have a significant impact on a country's real exchange rate, and in turn on prices of all goods and services (Abler 2007). However, CGE models require extensive data in order to construct a social accounting matrix, data that are not available or not reliable in Sudan. Partial equilibrium models also have an advantage in representing finely detailed sectors and policy details that are typically not captured in CGE models (Abler 2007). For these reasons, a partial equilibrium approach is a suitable and practical tool for country like Sudan.

The methodological framework adopted in this study is the Partial Equilibrium Agricultural Trade Simulator (PEATSim) model, which is a multi-country, multi-commodity, non-spatial, applied partial equilibrium model of global agricultural trade. The PEATSim model is non-spatial, meaning that it does not distinguish a region's imports by their source or a region's exports by their destination. It is a gross trade model that accounts for total exports and total imports of each commodity in every region. This is accomplished in most cases by having the smaller of the two (exports or imports) in a region governed by an Armington-like equation that is consistent with historical trade, while the larger of the two (exports or imports) adjusts as needed to help clear global agricultural markets. The nature of PEATSim as a non-spatial, gross trade model means that it cannot incorporate PTAs such as COMESA or GAFTA. This is a limitation of our modeling approach because Sudan's joining the WTO would likely alter the trade creation and trade diversion effects of these PTAs.

The PEATSim model was developed through a collaborative project involving Pennsylvania State University and the Economic Research Service (ERS) of the US Department of Agriculture. Researchers have previously used the model to analyze a number of agricultural trade and policy reform scenarios, including global agricultural trade

liberalization in all commodities, trade liberalization in global dairy markets, and trade liberalization in coarse grain markets (e.g. see Abler and Blandford 2007).

Countries and Commodities Included in the Analysis

The PEATSim model applied in this study covers 13 countries or regions: Argentina, Australia, Brazil, Canada, China, the European Union (EU-25), Japan, Mexico, New Zealand, South Korea, the United States, Sudan, and an aggregate for the rest of the world (ROW). Sudan is not classified as a separate region in the core version of the PEATSim model, but it was included separately in this study in order to depict the potential impacts of its market access proposal.

The model includes 35 commodities: 13 crops (rice, wheat, maize, other coarse grains,[7] soybeans, sunflower seed, rapeseed, peanuts, cotton [fiber and oilseed], other oilseeds,[8] tropical oils,[9] and sugar); 12 oilseed products (soybean oil and meals, sunflower seed oil and meal, rapeseed oil and meal, cottonseed oil and meal, peanut oil and meal, and other oilseed oil and meal); 3 meat products (beef and veal, pork, and poultry); raw milk and 6 processed dairy products (fluid milk, butter, cheese, nonfat dry milk, whole dry milk, and other dairy products[10]). Raw milk, fluid milk, and other dairy products are treated as non-traded commodities in the core version of the PEATSim model. The other 32 commodities are traded internationally.

Sudan produces and consumes negligible quantities of 15 of the 35 commodities: soybeans, soybean oil, soybean meal, sunflower seed oil, sunflower seed meal, rapeseed, rapeseed oil, rapeseed meal, tropical oils, pork, butter, cheese, nonfat dry milk, whole dry milk, and other dairy products. Thus, these products are excluded from the results for Sudan. Furthermore, because Sudan's production of dairy products other than fluid milk is negligible, and raw milk is almost entirely used as fluid (drinking) milk, the results presented for milk are only for fluid milk.

The Model

The PEATSim model is a synthetic policy simulation model in which the behavior of producers, consumers, and other economic agents is represented by elasticities and other model parameters. The behavioral equations in the model are largely constant-elasticity in nature. Constant-elasticity functions are used because of their ease of interpretation and consistent properties (provided the elasticities are chosen appropriately). The structure of the behavioral equations is the same for all countries in the model, but the parameters of the equations and the values of the variables vary by country.

The PEATSim model is different from other partial equilibrium trade models in that it explicitly incorporates a wide range of domestic and trade policies related to agriculture. The

[7] The "other coarse grains" aggregate is primarily barley, sorghum, millet and oats.
[8] The "other oilseeds" aggregate includes canola, flaxseed and others.
[9] "Tropical oils" include olive oil, palm oil, coconut oil, and others.
[10] The "other dairy products" aggregate includes ice cream, yogurt, whey, and other miscellaneous dairy products.

core set of policies included for all countries are specific and *ad valorem* import tariffs, TRQs, and producer and consumer subsidies. Export subsidies are not explicitly included in the model. However, they are included implicitly because products that have intervention or other support prices requiring government purchases must have some mechanism for disposing of government stocks through subsidized sales abroad. The model uses applied tariff rates rather than WTO bound rates, recognizing that bound rates significantly exceed applied rates in many cases.

Within-quota and over-quota tariffs for TRQ commodities are treated explicitly in the model with a discontinuity in the tariff rate at the threshold where the quota amount is reached. There are three possible regimes for a TRQ commodity in PEATSim: imports are less than the quota, so that the relevant tariff is the in-quota tariff; imports are greater than the quota, so that the relevant tariff is the over-quota tariff; and imports are exactly equal to the quota, in which case there is a difference between the domestic price and the world price plus the over-quota tariff that is commonly referred to as "water" in the over-quota tariff. The model endogenously determines the amount of water in the tariff in the third case. The model also endogenously determines the regime in which a TRQ commodity lies, so that the regime can switch depending on the scenario being analyzed.

The basic version of the PEATSim model used here is not a projections model. Changes over time in population, per capita income, crop and livestock yields, and other factors that shift supply and demand are not included. However, the model does incorporate future changes in agricultural policy in key regions, such as the US and EU, that have already been announced.

The model's base year is 2004. The analysis period over which the model runs is 2005-2014, with Sudan's accession to the WTO assumed to occur in 2009. The results reported below are for the year 2014.

Baseline data on area, yields, production, consumption, stocks, and trade are drawn from USDA and country sources, including USDA's PSD (Production, Supply and Distribution) database.[11] Base-period data on Sudan's production, consumption, exports, and imports are shown in Table 2. World prices are drawn from the ERS baseline projections database.[12] Tariffs and TRQs are drawn from the Agricultural Market Access Database (AMAD).[13] World prices are in US dollars and all domestic prices and policies are expressed in US dollars. Exchange rates are treated as exogenous. Sudan's baseline data are taken from the State Ministry of Agriculture and annual reports of the Bank of Sudan (Table 2).

Table 2. Base-Period (2004) Data for Sudan (1000 MT)

Commodity	Production	Consumption	Exports	Imports
Rice	9	45	0	36
Wheat	398	1464	0	1066
Maize	46	46	0	0
Other Coarse Grains	5458	5441	17	0
Sunflower Seed	7	0	7	0

[11] See http://www.fas.usda.gov/psdonline/.
[12] See http://www.ers.usda.gov/Data/Baseline/.
[13] See http://www.amad.org/.

Table 2. (Continued)

Commodity	Production	Consumption	Exports	Imports
Cottonseed	155	155	0	0
Cottonseed Oil	18	18	0	0
Cottonseed Meal	15	15	0	0
Peanuts	790	797	3	0
Peanut Oil	77	77	0	0
Peanut Meal	87	87	0	0
Other Oilseeds	401	183	218	0
Other Oilseed Oil	92	92	0	0
Other Oilseed Meal	81	81	0	0
Cotton	88	9	79	0
Sugar	755	748	24	17
Beef and Veal	1672	1666	6	0
Poultry	22	239	0	217
Fluid Milk	7406	7406	0	0

Source: PEATSim model database.

Note: There is one case (peanuts) where production plus imports does not equal consumption plus exports because of changes in stocks.

In the PEATSim model, the domestic price of a commodity is a weighted average of the commodity's import and export prices. The export price is the world price plus (or minus) any export subsidies (or taxes), while the import price is the world price plus tariffs and transportation costs. The weights in the model are endogenous and depend on a commodity's current-year exports relative to imports. If exports are large relative to imports, most of the weight will be on the export price; if imports are large relative to exports, most of the weight will be on the import price.

The model includes five types of consumption activities: food/consumer demand, feed demand, crush demand, dairy processing demand, and other use demand (which includes biofuels, seed use, and waste). The model in this respect follows the logic of the PSD database. The parameter values for the model come from various sources, including the European Simulation Model (ESIM), the ERS baseline projections model, the Food and Agricultural Policy Simulator (FAPSIM), OECD's AGLINK model, FAO's World Food Model, the International Food Policy Research Institute's IMPACT model, the Policy Analysis System-Economic Research Service (POLYSYS-ERS) model, and the Static World Policy Simulation Model (SWOPSIM). A number of restrictions were imposed on the model's elasticities to ensure that the requirements of economic theory were satisfied at the baseline values for the data. These requirements include symmetry and homogeneity in the output supply equations, land demand equations (crop production), feed demand equations (livestock production), and consumer food demand equations.

Scenarios

To assess the possible impacts of Sudan's accession to the WTO on domestic agricultural markets and to determine which agricultural products are the most sensitive to trade

liberalization, three scenarios were simulated. The first is a *market access scenario* in which the applied rates are set equal to those in Sudan's accession proposal. The second is a *modified market access scenario* in which the applied tariff rate for each commodity is set equal to either the rate in Sudan's proposal or the current applied rate, whichever is lower. The rationale for including this scenario is the instability in global agricultural prices that has existed since Sudan submitted its most recent market access offer in October 2006. Many developing countries moved to partially insulate domestic consumers from higher prices by lowering applied tariffs on agricultural products. One could argue that in the current environment it is hard to envision applied rates being increased. The third scenario is a *zero tariff scenario*, which serves as a point of reference and helps identify the products most sensitive to trade liberalization.

RESULTS AND DISCUSSION

This section presents and discusses the results of the analysis under the three scenarios described above. In particular, we examine the impacts of the three scenarios on domestic prices, production, consumption, and the export-import situation.

Impacts on Prices

Table 3 indicates percentage changes in Sudan's domestic prices of agricultural commodities (from the baseline) under the three scenarios.

Table 3. Domestic Agricultural Prices in Sudan (Percentage Change from Baseline)

Commodity	Market Access Proposal	Modified Market Access Proposal	Zero Tariff Scenario
Rice	0	0	0
Wheat	0	0	-3
Maize	-16	-16	-18
Other Coarse Grains	0	0	-1
Sunflower Seed	0	0	0
Cottonseed	2	0	-27
Cottonseed Oil	0	0	-30
Cottonseed Meal	5	0	-15
Peanuts	0	0	-4
Peanut Oil	0	0	-27
Peanut Meal	-1	-2	-7
Other Oilseeds	0	0	-1
Other Oilseed Oil	0	0	-23
Other Oilseed Meal	0	0	12
Cotton	0	0	0
Sugar	0	0	-9
Beef and Veal	0	0	-8
Poultry	0	0	-30
Fluid Milk	0	0	-17

Source: PEATSim model results.

Both producer and consumer prices are equal to domestic prices because the model contains no specific policies for Sudan (e.g., producer or consumer subsidies) that would drive a wedge between producer and consumer prices.

The only two commodities whose prices decline under the two market access scenarios are maize and peanut meal. These are also the only two commodities whose import tariffs are reduced under these scenarios. Tariffs for some commodities (cottonseed, cottonseed meal, other oilseed meal, and beef and veal) actually increase in the market access scenario, and these tariff increases translate into increases in domestic prices for cottonseed and cottonseed meal.[14] The modified market access scenario is constructed in such a way that no applied tariffs are increased, and the results in Table 3 show that no domestic prices increase in this scenario.

With the exception of rice, sunflower seed, and cotton, domestic prices of commodities decline in the zero tariff scenario. The result for rice is due to the fact that its applied tariff is already zero. Sunflower seed and cotton are commodities that Sudan exports but does not import, either currently or under this scenario. Thus, the elimination of import tariffs has no impact on domestic prices. The largest percentage declines in prices in this scenario occur for cottonseed, cottonseed oil, peanut oil, other oilseed oil, and poultry.

Impacts on Production and Consumption

Tables 4 and 5 indicate the percentage changes in Sudan's production and consumption from the baseline. The decline in the price of maize in the two market access scenarios leads to a drop in maize production and a rise in maize consumption. The decline in the production of cottonseed oil and cottonseed meal under the market access proposal appears to be due to the rise in the price of cottonseed in that scenario, which drives up cottonseed crushing costs and hence reduces the amount of cottonseed crushed. As shown in Table 5, the decline in cottonseed crushing is also manifested in a decline in cottonseed consumption in this scenario. Consumption of other coarse grains declines slightly in percentage terms in the two market access scenarios, as consumers switch from other coarse grains to maize.

Large percentage declines in production occur in the zero tariff scenario for peanut oil, peanut meal, other oilseed oil, other oilseed meal, and poultry. These declines are a response to the declines in domestic prices for peanut oil, other oilseed oil, and poultry. It should be noted that in the PEATSim model, oil and meal from each oilseed are joint products that are produced in fixed proportions. Prices of cottonseed oil and cottonseed meal also decline significantly in the zero tariff scenario, but output of these two products does not decline much because output price declines are offset by lower production costs in the form of lower cottonseed prices. A significant percentage decline in other oilseed consumption occurs in the zero tariff scenario. This occurs in spite of a small percentage decline in the other oilseed price because the percentage declines in prices for cottonseed and peanuts are larger, which causes domestic crushing plants to cut back more on other oilseeds relative to cottonseed and peanuts.

[14] Prices of other oilseed meal and beef & veal also rise but the percentage increases are very small and, after rounding to a whole number, are zero in Table 3.

Table 4. Agricultural Production in Sudan (Percentage Change from Baseline)

Commodity	Market Access Proposal	Modified Market Access Proposal	Zero Tariff Scenario
Rice	0	0	1
Wheat	0	0	0
Maize	-6	-6	-6
Other Coarse Grains	0	0	1
Sunflower Seed	0	0	0
Cottonseed	0	0	1
Cottonseed Oil	-3	0	-2
Cottonseed Meal	-3	0	-2
Peanuts	0	0	-1
Peanut Oil	0	0	-31
Peanut Meal	0	0	-31
Other Oilseeds	0	0	1
Other Oilseed Oil	0	0	-31
Other Oilseed Meal	0	0	-31
Cotton	0	0	1
Sugar	0	0	-4
Beef and Veal	0	0	-6
Poultry	0	0	-22
Fluid Milk	0	0	0

Source: PEATSim model results.

Table 5. Consumption of Agricultural Products in Sudan (Percentage Change from Baseline)

Commodity	Market Access Proposal	Modified Market Access Proposal	Zero Tariff Scenario
Rice	0	0	-1
Wheat	0	0	0
Maize	4	4	4
Other Coarse Grains	-1	-1	-3
Sunflower Seed	0	0	0
Cottonseed	-3	0	-2
Cottonseed Oil	0	0	11
Cottonseed Meal	0	0	-2
Peanuts	0	0	-10
Peanut Oil	0	0	10
Peanut Meal	0	0	-3
Other Oilseeds	0	0	-31
Other Oilseed Oil	0	0	7
Other Oilseed Meal	0	0	-5
Cotton	0	0	0
Sugar	0	0	0
Beef and Veal	0	0	-6
Poultry	0	0	5
Fluid Milk	0	0	0

Source: PEATSim model results.

Impacts on Exports and Imports

Table 6 presents the percentage change (from the model's baseline in 2014) in Sudan's exports and imports of key traded commodities under the three scenarios. The results indicate an increase in other coarse grain exports relative to the baseline in the two market access scenarios, and an even larger increase in exports in the zero tariff scenario. In all three scenarios, domestic consumers shift some grain consumption from other coarse grains to maize, while in the zero tariff scenario producers shift some land from maize to other coarse grains. The result in all three scenarios is an increase in other coarse grain production relative to consumption, leading to an increase in exports. Maize imports increase in all three scenarios, and while the absolute increase is small (4,000 metric tons) the increase in percentage terms is quite large (200%). The increase in maize imports is approximately the same in all three scenarios because the applied tariff for maize is the same or about the same in all three cases (3% in the two market access scenarios and 0% in the zero-tariff scenario).

Table 6 also shows an increase in exports of peanuts and other oilseeds relative to the baseline in the zero tariff scenario. In both cases there are significant percentage decreases in domestic consumption, leading to an increase in exports. The decline in domestic consumption of other oilseeds is due to a decline in domestic crushing demand. When Sudan liberalizes its trade regime it is profitable to source some oilseed oil and meal from lower-cost foreign crushing facilities, a result reflected in the increase in imports of other oilseed oil and meal in Table 6.

Most Sensitive Commodities

If we examine the results across all three scenarios, it appears that the agricultural commodities most sensitive to trade liberalization in Sudan are oilseed products: peanut oil and meal, and other oilseed oil and meal. Significant percentage declines in domestic prices and production occur for all of these products in the zero tariff scenario, except for the price of other oilseed meal (its production drops anyway in response to the decline in the price of other oilseed oil). Significant percentage declines in domestic prices and production also occur for maize and poultry in the zero tariff scenario, but only small quantities of these commodities are produced in Sudan.

SUMMARY AND CONCLUSIONS

This article has analyzed the impacts on agricultural markets of Sudan's proposal to accede to the WTO. We find that Sudan has inflated its customs schedule in its offer for agricultural products, which provides room to maneuver during negotiation. Applied tariffs for commodities such as cottonseed, cotton meal, other oilseed meal, and beef and veal are actually higher in Sudan's offer than they are at present. Sudan has also proposed TRQs for some tariff lines.

Table 6. Sudan's Exports and Imports (1000 MT)

Commodity	Model Baseline (2014)		Market Access Proposal		Modified Market Access Proposal		Zero Tariff Scenario	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Rice	0	36	0	36	0	36	0	35
Wheat	0	1068	0	1063	0	1063	0	1062
Maize	0	2	0	6	0	6	0	6
Other Coarse Grains	60	0	114	0	115	0	252	0
Sunflower Seed	6	0	6	0	6	0	6	0
Cottonseed	0	4	0	0	0	4	0	0
Peanuts	5	0	6	0	6	0	78	0
Other Oilseeds	272	0	273	0	273	0	334	0
Other Oilseed Oil	0	0	0	0	0	0	0	36
Other Oilseed Meal	0	0	1	0	1	0	0	21
Cotton	76	0	76	0	76	0	77	0
Sugar	49	17	50	17	50	17	23	17
Beef and Veal	4	0	7	0	4	0	2	0
Poultry	0	218	0	218	0	217	0	234

Source: PEATSim model results.

Note: Exports and imports of all commodities not listed are zero.

The results of the three scenarios indicate that the agricultural commodities most sensitive to trade liberalization in Sudan are oilseed products: peanut oil and meal, and other oilseed oil and meal. Significant percentage declines in domestic prices and production occur for all of these products in the zero tariff scenario, except for the price of other oilseed meal (its production drops anyway in response to the decline in the price of other oilseed oil). Significant percentage declines in domestic prices and production also occur for maize and poultry in the zero tariff scenario, but only small quantities of these commodities are produced in Sudan. We suggest that in order to benefit from its accession to the WTO and overcome the negative impacts, Sudan should reorient its agricultural trade policy towards increasing the competitiveness of its exported agricultural commodities by raising productivity, reducing trade costs, and rationalizing the incentive regime for the agricultural sector.

One limitation of this study is the use of a partial equilibrium model that does not capture general equilibrium effects of changes in the agricultural sector on national income and in turn demands for goods and services, or effects on Sudan's real exchange rate. As we indicated earlier the necessary data to implement a CGE model for Sudan are lacking, but should the data become available in the future it would be useful to readdress this study's questions using a CGE model.

Appendix Table 1. Sudan's Gross Domestic Product and Contribution of Agriculture, 1990 – 2006, at 1981/82 constant prices

Year	Gross Domestic Product		Agricultural GDP		Share of Agriculture in GDP (%)
	Value (m SDG)	Growth rate (%)	Value (m SDG)	Growth rate (%)	
1990	661.4		200.3		30.3
1991	669.1	1.2	191.8	-4.2	28.7
1992	744.7	11.3	252.2	31.5	33.9
1993	836.4	13.1	318.8	26.4	38.1
1994	900.2	5.6	360.5	13.1	40.0
1995	985.0	12.7	424.5	17.7	43.1
1996	1043.7	4.7	469.4	9.6	45.0
1997	1107.1	6.1	527.4	12.3	47.6
1998	1173.0	6.0	571.2	8.3	48.7
1999	1243.4	6.0	619.7	8.5	49.8
2000	1346.2	8.3	624.4	0.8	46.4
2001	1432.2	6.4	658.7	4.7	45.6
2002	1524.6	6.5	701.6	7.3	46.0
2003	1617.3	6.1	738.1	5.2	45.6
2004	1801.1	9.1	706.4	3.5	39.2
2005	1904.7	8.1	754.2	7.2	39.6
2006	2221.7	9.3	816.9	8.3	39.9
2007	2455.3	10.5	867.0	6.0	35.3

Source: Bank of Sudan Annual Reports, various issues.

Appendix Table 2. Sudan's Agricultural Exports, 1990 – 2006

Year	Agricultural exports (m US$)	Share in total exports (%)
1990	368.0	98.0
1991	299.0	98.0
1992	310.0	97.0
1993	390.0	93.0
1994	471.0	90.0
1995	488.0	87.0
1996	536.0	86.0
1997	518.0	87.0
1998	532.0	89.0
1999	428.0	55.0
2000	378.7	21.0
2001	248.3	14.0
2002	363.4	18.6
2003	401.0	15.8
2004	470.7	12.5
2005	482.6	10.0
2006	437.4	7.7
2007	357.5	4.0

Source: Bank of Sudan Annual Reports, various issues.

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SOUTH ASIAN TRADE INTEGRATION: THE WELFARE IMPLICATIONS OF EXPORT TAXES

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ABSTRACT

The unprecedented rise and fall in global food prices from late 2006 to 2009 has raised concerns about food security in poor countries and the appropriate policy response to price shocks. As a short term response to higher commodity prices many major food exporting countries imposed export restrictions to protect their consumers from soaring food prices. Using the Global Trade Analysis Project (GTAP) model, this study investigates the economic and welfare impacts of the imposition of export taxes on agricultural commodities by India and all South Asian countries. In general, export taxes imposed by India on food and agricultural products have adverse effects on food importing countries. However, the export taxes offset the effects of existing domestic distortions in the paddy and rice sectors of India and hence lead to welfare improvements in India. It is recommended that actions be taken to mitigate the effects of such restrictive trade policies through either the World Trade Organization or regional trading agreements.

Keywords: GTAP, South Asia, trade integration.
JEL classification codes: Q17, F55.

1. INTRODUCTION

South Asia is characterized by unique inter- and intra-regional trade relationships. The South Asian nations[1] account for less than two percent of total world trade and the region is believed to be the least integrated in the world, with intra-regional trade accounting for less than five percent of its total trade (World Bank, 2008a). India is the largest country in the South Asia region, not only in terms of physical size (total land area of 3,287,590 km²) and population (1.15 billion), but also in terms of economic size. India accounts for US$1.2

[1] Eight countries comprise the South Asian Association for Regional Cooperation (SAARC): Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka.

trillion of the region's total GDP of $1.4 trillion (World Bank, 2008a). The other countries in South Asia are either geographically and/or economically linked to India. Bangladesh, Bhutan, Nepal, and Pakistan have common borders with India, and Sri Lanka is becoming increasingly dependent on India for international trade. As a result, any trade policy actions taken by India have significant implications for the rest of South Asia.

Over the past two decades, South Asia has made several attempts to liberalize regional trade. The South Asian Preferential Trading Arrangement (SAPTA) was ratified in 1995 and was followed in 2004 by the South Asian Free Trade Area (SAFTA), which had the objective of creating a Free Trade Agreement (FTA) that includes all eight South Asian countries. However, SAFTA contains a negative list of trade restrictions[2] and is not expected to attain complete free trade area status until 2013. Moreover, many South Asian countries are pessimistic about the prospects for SAFTA and have instead negotiated, or are in the process of negotiating, various bilateral and regional trading agreements. In particular, many countries, both within and outside the region, have entered into agreements with India, which has shown a willingness to strengthen its trade relationships. For example, India has signed bilateral arrangements with three South Asian countries: Sri Lanka (a FTA in 1998 and the Comprehensive Economic Partnership Arrangement (CEPA) to be formed in the near future), Bangladesh (a FTA in 2006), and Nepal (a FTA in 1991). In addition, the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), which consists of both South Asian (Bangladesh, Bhutan, India, Nepal and Sri Lanka) and other Asian (Myanmar and Thailand) partners, links these countries economically. India has also signed a number of bilateral trade agreements with non-South Asian countries, including Thailand (a FTA in 2003 and a Comprehensive Economic Cooperation Agreement (CECA) in 2005), Chile (a Preferential Trade Agreement (PTA) in 2006), Afghanistan (a PTA in 2003), and Mercosur[3] (a PTA in 2004). India is currently negotiating trade agreements with Japan, China, the European Union (EU), and the Association of Southeast Asian Nations (ASEAN).

The escalation of world food prices during 2007-2008 caused many South Asian countries to reverse their previous trade policies, which had been intended to liberalize trade. For example, many net food exporting countries imposed export bans, export taxes, and export embargos. India has been no exception, and the imposition of export restrictions, particularly on rice and wheat, has adversely affected food security in countries that rely on India to meet their food needs. World food prices have declined since mid-2008 and some food exporting countries, including India, have rescinded the embargoes introduced on food exports. Although there are a number of studies evaluating the implications of trade integration in South Asia, few have evaluated the extent to which South Asian countries are economically dependent on India. The purpose of this article is to investigate the extent to which the economies of South Asian countries are affected by trade with India and its trade

[2] A "negative list" approach to trade liberalization is common in South Asia. Under this approach, certain items are not subject to liberalization (i.e., they are included in the negative list of the trading agreement) for health, moral, environmental, or national security reasons or due to concerns about protecting vulnerable parts of the farming community.

[3] Mercosur is a South American common market created in 1991. Its member countries are Argentina, Brazil, Paraguay and Uruguay.

policy actions. More specifically, we use the Global Trade Analysis Project (GTAP)[4] database and model (version 7) to: (i) document the pattern of food and agricultural trade within South Asia and the extent to which trade is restricted; and (ii) investigate the economic and welfare effects of hypothetical export restrictions (modeled as export taxes) imposed by a large country like India and by the South Asian region as a whole on India, smaller trade-dependent nations in the region, such as Bangladesh and Sri Lanka, and the rest of the world.

The remainder of the paper is organized as follows. The next section presents trade data for South Asia and highlights India's relative position in the region. Section 3 presents the nature and extent of the food crisis and the policy responses of food exporting and importing countries, both globally and in the South Asia region. The GTAP model, the data, and the results of the analysis of export taxes are presented in sections 4 and 5. The final section presents our conclusions and policy recommendations.

2. SOUTH ASIAN REGIONAL TRADE AND INDIA'S DOMINANCE

India is the world's second largest rice producer, third largest wheat producer, and seventh largest corn producer. As shown in Table 1 India trades more with countries outside the region than with countries inside the region. As far as total trade is concerned India's largest trading partners are the major industrial nations in the EU. The United States and the United Arab Emirates (UAE) the second and third largest export destinations and the European Union and China are the second and third largest import sources. A substantial portion of India's trade also takes place with countries in the Asia-Pacific region, including Australia, New Zealand, and the high-income East Asian countries (Hong Kong, Japan, Korea, Singapore, and Taiwan). None of the South Asian countries are included among the top ten import sources and export destinations of India (Table 1).

Table 1 also shows India's major trading partners according to the value of exports and imports of food and agricultural commodities. Compared to many developed countries, India's trade is not highly concentrated by source or destination. Indonesia (18.99 percent), Argentina (10.88 percent) and Canada (8.28 percent) are the major suppliers of India's food and agricultural imports. The EU (18.32 percent), the United States (9.44 percent), and the UAE (5.77 percent) are the major destinations for India's agricultural and food exports. Among South Asian countries, Sri Lanka is the tenth largest import source and Bangladesh and Pakistan are the fifth and sixth largest export destinations as far as food and agricultural trade is concerned.

[4] The GTAP is a global data base that contains complete bilateral trade information and transport and protection linkages among regions for 57 sectors for the year 2004. The standard GTAP model is a computable general equilibrium model (Hertel,1997)

Table 1. India's top ten trading partners by value of total trade and food and agricultural trade, 2006 ('000 US dollars)

Imports				Exports			
Import Source	Value of total imports	Import Source	Value of Imports of Food and Agricultural Items	Export Destination	Value of total exports	Export Destination	Value of Exports of Food and Agricultural Items
European Union (EU 27)	29,782,482 (16.07)	Indonesia	1,175,446 (18.99)	European Union (EU 27)	29,782,482 (23.61)	European Union (EU 27)	2,108,645 (18.32)
China	17,427,948 (9.40)	Argentina	673,735 (10.88)	United States of America	18,862,084 (14.96)	United States of America	1,086,379 (9.44)
Saudi Arabia	13,358,831 (7.21)	Canada	512,495 (8.28)	United Arab Emirates	12,003,386 (9.52)	United Arab Emirates	664,064 (5.77)
United States of America	11,721,040 (6.32)	Myanmar	496,146 (8.02)	China	8,278,968 (6.56)	Japan	627,993 (5.46)
Switzerland	9,090,356 (4.90)	Russian Federation	474,260 (7.66)	Singapore	6,057,952 (4.80)	Bangladesh	541,698 (4.71)
United Arab Emirates	8,641,323 (4.66)	European Union (EU 27)	430,428 (6.95)	Hong Kong (SAR)	4,672,113 (3.70)	Pakistan	540,538 (4.70)
Iran (Islamic Republic of)	7,613,523 (4.11)	Australia	346,366 (5.60)	Japan	2,857,529 (2.27)	Saudi Arabia	539,447 (4.69)
Nigeria	7,013,769 (3.78)	United States of America	28,0044 (4.52)	Saudi Arabia	2,583,497 (2.05)	Viet Nam	378,039 (3.28)
Australia	6,994,988 (3.77)	Malaysia	237,617 (3.84)	Republic of Korea	2,510,179 (1.99)	Malaysia	364,126 (3.16)
Kuwait	5,980,923 (3.23)	Sri Lanka	146,758 (2.37)	South Africa	2,242,426 (1.78)	Indonesia	346,949 (3.01)
World	185,384,928 (100)	World	6,190,203 (100)	World	126,125,504 (100)	World	11,510,070 (100)

Source: Trade Map (downloaded in February, 2009).

Numbers in parentheses are percentages of total trade value and agricultural trade value.

Table 2. South Asian intra-regional trade of food and agricultural commodities (in 000' US Dollars), 2005

Import / Export	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka	South Asia
Afghanistan	.	6,678 (8.06)	.	57,037 (68.85)	.	.	19,113 (23.07)	10 (0.01)	82,838 (100.00)
Bangladesh	754 (1.37)	.	1163 (2.12)	34,347 (62.56)	0 (0.00)	8 (0.01)	18,443 (33.59)	189 (0.34)	54,904 (100.00)
Bhutan		0 (0.00)	.	9,881 (99.90)	.	.	10 (0.10)	.	9,891 (100.00)
India	13,927 (1.34)	527,356 (50.58)	15889 (1.52)	.	13,788 (1.32)	125,861 (12.0)	166,240 (15.94)	179,629 (17.23)	1,042,690 (100.00)
Maldives	.	0 (0.00)	.	14 (0.09)	.		0 (0.00)	16,052 (99.91)	16,066 (100.00)
Nepal	.	.	.	.	.	.	.	.	.
Pakistan	344,203 (70.59)	9,559 (1.96)	0 (0.00)	111,789 (22.93)	1,977 (0.41)	765 (0.16)	.	19,323 (3.96)	487,616 (100.00)
Sri Lanka	1,155 (0.51)	2,183 (0.97)	.	184,043 (81.90)	10,292 (4.58)	195 (0.09)	26,854 (11.95)	.	224,722 (100.00)

Source: Trade Map (Downloaded in April, 2009).

Note: The figures in parentheses indicate the value of exports as a percentage of aggregate exports to all South Asian countries.

Within the region, India is the largest food and agricultural commodities trading partner for most countries, with the exception of the Maldives and Pakistan as shown in Table 2. As far as exports of food and agricultural commodities from Bhutan are concerned, India is almost its sole South Asian partner. Out of total exports of food and agricultural commodities from Sri Lanka, Afghanistan, Bangladesh and Pakistan to South Asia, 82 percent, 68.85 percent, 62.56 percent and 22.93 percent respectively is shipped to India. Out of total imports into Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka, 3.87 percent, 96.62 percent, 93.18 percent, 52.91 percent, 99.24 percent, 72.07 percent and 83.47 percent respectively originate in India (not shown in the table). Despite the presence of a variety of regional and multilateral trade agreements, there are still a number of tariff and non-tariff barriers in the region.

Table 3 shows the most favored nation (MFN) tariff rates for agricultural and non-agricultural products applied by South Asian (i.e., SAARC) countries. In general, the applied tariffs on agricultural products are higher than on non-agricultural products, implying a higher level of protection for agriculture than for manufactured goods. This is particularly true for Sri Lanka. The import tariffs charged by Bhutan and India on agricultural items imported from the SAARC countries are significantly lower than for imports from non- SAARC countries.

Non-tariff barriers to trade between South Asian countries (e.g., quantitative restrictions, trade facilitation and customs procedures, technical barriers to trade, sanitary and phytosanitary measures, financial measures, para-tariff measures) are still a major obstacle to regional trade integration, although these barriers vary among countries. The likelihood of the agricultural sector as a whole being restricted through these non-tariff trade restrictions is much higher than for other sectors because of the legitimate concerns surrounding the health and safety of plant and animal products as well as the opportunity to use these measures as disguised trade barriers (UNCTAD, 2008).

Table 3. Applied MFN -tTariffs for -fFood and -aAgriculture -pProducts in 2007

Country	Product	SAARC countries (%)	Non-SAARC Countries (%)
Afghanistan	Agriculture	6.48	6.48
	Non Agriculture	5.05	5.08
Bangladesh	Agriculture	12.66	12.84
	Non Agriculture	13.02	13.16
Bhutan	Agriculture	33.86	50.14
	Non Agriculture	13.91	17.10
India	Agriculture	47.47	62.83
	Non Agriculture	12.04	15.67
Nepal	Agriculture	15.48	15.94
	Non Agriculture	12.11	12.61
Maldives	Agriculture	26.98	27.17
	Non Agriculture	24.19	24.32
Pakistan	Agriculture	16.20	18.76
	Non Agriculture	11.34	12.89
Sri Lanka	Agriculture	25.82	27.02
	Non Agriculture	5.47	6.31

Source:

Market Access Map (downloaded in October 2007).

3. THE GLOBAL FOOD CRISIS AND POLICY RESPONSES

The unprecedented increase in commodity prices that peaked in early 2008 raised concerns about the future level of food prices and food security in poor countries. The International Monetary Fund's (IMF) index of internationally traded food commodity prices increased by 130 percent from January 2002 to June 2008 and by 56 percent from January 2007 to June 2008. World rice prices almost tripled from January to April 2008 and wheat prices nearly tripled between late 2006 and early 2008. There are several reasons for this dramatic rise in commodity prices: 1) crop shortfalls in a number of major producing regions; 2) continued strong demand from developing countries, particularly India and China; 3) increased demand for grain to be processed into bio-fuels (see Yang et al., 2008 for global impacts due to bio-fuel); and 4) the depreciation of the United States dollar (ADB, 2008). Grain and most other commodity prices dropped sharply beginning in the fall of 2008 as a result of generally good harvests and a serious global financial crisis that appears to have pushed the world into a major recession. Still, agriculture remains highly energy dependent and the impact of the rapid rise in the cost of imported foodstuffs around the world - 21 percent higher in 2007 than in 2006 - will continue to be felt (FAO, 2008).

Price Trends in South Asia

During 2007 and early 2008 the rise in domestic prices in South Asia was not as pronounced as in world markets. The sharply higher international prices were not fully transmitted to domestic prices in these countries because of the strong role played by political and economic factors in the setting of food policy and prices (ADB, 2008). According to the ADB (2008), between March 2007 and March 2008, domestic rice and wheat prices increased by 70 percent and 16 percent, respectively, in Afghanistan; 100 percent and 74 percent, respectively, in Bangladesh; 60 percent and 38 percent, respectively, in Pakistan; and 55 percent and 36 percent, respectively, in Sri Lanka. However, in India, rice prices increased by only 9.3 percent and wheat prices actually decreased by 2.5 percent. The wide variation in domestic price increases across countries is due to the specific food policy and price measures adopted in each country. Still, these increases in commodity prices led to significant inflation in food and general prices in the South Asian region. Between 2005 and 2008, overall inflation and food price inflation were 16 percent and 22 percent, respectively, for India; 17 percent and 21 percent, respectively, for Bangladesh; and 33 percent and 42 percent, respectively, for Pakistan (World Bank, 2008b).

Global Policy Responses

The immediate policy responses of food importing and exporting countries around the world exacerbated the problem of high international prices. A number of countries, including Argentina, Cambodia, India, Indonesia, Kazakhstan, Pakistan, Russia, Thailand, Ukraine, and Vietnam, imposed export restrictions or bans on grain exports to help constrain domestic price increases (Oxfam, 2008 and World Bank, 2008c). The spike in the world prices of cereals, particularly rice and wheat, elicited policy responses that exaggerated rather than reduced international price volatility as governments rushed to restrict exports, control

domestic prices, and attempted to rebuild stocks in the face of price increases (ADB, 2008; Zwart and Meilke, 1979). According to the International Food Policy Research Institute (IFPRI, 2008a), these export restrictions played a major role in the high price of rice and to a lesser degree, wheat. According to Heady and Fan (2008), export restrictions by countries accounting for 40 percent of global rice exports proceeded price rises. The goal of the export restrictions was to lower domestic food prices, maintain consumption by net food buyers, and increase government revenue if export taxes were used. However, these policies also resulted in lower incomes for net food sellers, reduced incentives for food production, and decreased availability of food on world markets. To a large degree, the ability to enforce export restrictions and the difficulty of applying export taxes for countries with limited administrative capacity determined the choice of policy instrument (IFPRI, 2008b).

The Policy Response in South Asia

When large countries like India impose trade restrictions, there are implications for other countries, specifically countries in South Asia. India's immediate policy response to the rise in commodity prices was to impose export bans on non-Basmati rice (on September 10, 2007). India is the world's second largest rice producer. Thus world rice prices started to escalate (World Bank, 2008c). India exempted Bangladesh from its rice export ban, but India still faces the prospects of a neighbor with a humanitarian food crisis on its hands. Virtually all of Nepal's imports, including energy, come through India. Pakistan banned wheat exports, and Afghanistan was particularly hard hit by this export ban because Pakistan is its major wheat supplier. The restrictions imposed by other South Asian countries included export bans on edible oil in Bangladesh, an export ban on paddy rice, wheat, maize and flour in Nepal, and an export ban on rice and coconuts in Sri Lanka (World Bank, 2008d).

The empirical model presented in the next section illustrates the extent to which the policy actions taken by India and other South Asian countries in response to the food crisis influence their own economies as well as the economies of other countries throughout the region and the rest of the world.

4. THE GTAP MODEL, DATA, AND POLICY SCENARIOS

This study uses a general equilibrium approach to assess the impacts of export taxes. Given the objective of the study, i.e., an assessment of the implications of export taxes, this approach was chosen as it allows us to calculate welfare changes at a regional level taking into consideration changes in price levels and resource reallocations in the total economy/world. The general equilibrium model results illustrate long-run equilibrium outcomes – it suffers from not being able to track the short-run dynamics of adjustment.

This section describes our specification of the GTAP model, the data set used in our analysis, and the hypothetical policy scenarios used to assess the economic impacts of export restrictions.

The Model

The GTAP model is a neo-classical multi-region, multi-sector, static, applied general equilibrium model that assumes perfect competition and constant returns to scale (Hertel, 1997). The GTAP database and model has become a standard tool for trade policy analysis. The most recent (which relates to policies in 2004) and by far the most comprehensive release is version 7 (Narayanan, 2008).

Economic welfare is represented in the GTAP model as being derived from the allocation of national income between private consumption, government consumption, and savings (Hertel, 1997). This approach recognizes that households benefit from their own current consumption expenditure, net national savings (which increases future household consumption), and government provision of public goods and services. How much a policy change actually benefits a region depends on how the change affects regional income. It also depends on the effect of the policy change on prices and hence the purchasing power of that income.

The welfare decomposition in the GTAP model shows welfare changes in relation to:

(i) Allocative efficiency: Due to changes in the allocation of resources relative to pre-existing distortions.
(ii) Terms of trade: Arising from changes in relative prices (export prices relative to import prices) as producers and consumers adjust their purchasing and sales patterns in response to a policy change.
(iii) Effects of production and terms of trade changes on foreign income flows.

The Data

The GTAP database (pre-release of version 7) is used to run the policy scenarios, with 2004 as the base year. GTAP allows for the inclusion of 57 sectors and 110 regions. As far as small Asian countries are concerned, the current version is a clear improvement over previous GTAP versions, as it includes data for Pakistan and the data for Sri Lanka have been updated to 2000.

Our specification of the GTAP model includes:

1. Eight individual countries: Sri Lanka, India, Pakistan, Bangladesh, China, Vietnam, Thailand, and Brazil[1];
2. Seven regions: South East Asia, Rest of South Asia, Oceana, North America, EU(25), and the Rest of the World;
3. Fourteen sectors: ten for agriculture and food (paddy rice,[2] wheat, other cereals,[3] other crops,[4] milk, dairy products, cattle, meat,[5] rice, processed food), and four non-agricultural sectors (textiles and apparel, oil, manufacturing, and services); and

[1] Brazil was included because it is a sizeable developing country that exports agricultural items and is a potential competitor for India.
[2] Paddy rice is unmilled rice.
[3] Other cereals includes maize, barley, rye, oats, and those cereals that are not included elsewhere.
[4] Other crops includes vegetables, fruits, nuts, oilseeds, sugar cane, sugar beet, and plant-based fibres.

4. Five factors of production (land, unskilled labor, skilled labor, capital, and natural resources).

The GTAP data for 2004 indicate that India is the largest country in the South Asia region accounting for 78 percent of the region's factor endowment (the sum of the value of land, skilled labor, unskilled labor, capital, and natural resources). India is followed by Pakistan, accounting for 11.6 percent of the region's factor endowment, and Bangladesh, accounting for 6.4 percent. Sri Lanka is the smallest South Asian economy, with only 2.4 percent of the region's endowment. The rest of South Asia is aggregated into one region and accounts for 1.6 percent of the region's endowment.

Imports of agriculture and food products represent 8.36 percent of total imports for the South Asia region, ranging from a high of 19.48 percent for Bangladesh to a low of 5.92 percent for India (see Appendix Table 1).

Processed food represents 4.62 percent of total agriculture and food imports. Other crops and rice are generally the most important agricultural imports across all South Asian countries, especially in Bangladesh, where other crops and rice represent 8.10 percent and 1.80 percent, respectively, of the country's total imports. South Asian imports account for 1.91 percent of total imports and 2.15 percent of agricultural and food imports.

Exports of agriculture and food products represent 9.44 percent of the region's total exports, ranging from a high of 16.38 percent in Sri Lanka to a low of 5.57 percent in Bangladesh (see Appendix Table 2).

Processed food represents 4.05 percent of the region's total agriculture and food exports, with other crops and rice generally being the most important agricultural exports across all of the countries. South Asian exports account for 1.39 percent of total exports and 1.92 percent of agricultural and food exports. Interestingly, the value of the region's textile and apparel exports ($37.49 billion) is 2.84 times the value of the region's agricultural and food exports ($13.19 billion).

The GTAP data also show that South Asia is a rather small player in the world market. The main items exported from South Asia are paddy rice (raw product) and rice (processed product), comprising 11.92 percent and 23.62 percent, respectively, of the world's total paddy rice and rice exports. The main imports into South Asia are rice and other crops, comprising 3.74 percent and 3.01 percent, respectively, of global rice and other crops imports. The intra-regional trade of agricultural goods is quite small. According to the bilateral trade statistics in the GTAP database, of the total exports of rice from India, Sri Lanka is the destination for 5 percent, Bangladesh for 16 percent and rest of South Asia one percent. Of the total imports of rice by Sri Lanka, 70 percent comes from India and 27 percent is from Pakistan (Appendix Table 3). Of the total imports of rice by Pakistan, Bangladesh, and rest of South Asia 76 percent, 98 percent and 30 percent respectively come from India. India accounts for 14 percent of the world's rice exports (Not shown in Appendix Table 3). No export taxes/subsidies are present for food and agricultural commodities exported by South Asian countries, except for milk in Pakistan, which receives an export subsidy of two percent. Import tariffs on rice from India are 35 percent in Sri Lanka, 9 percent in Pakistan, 22.5

[5] Meat includes wool, silk-worm cocoons, and meat of cattle, sheep, goat, and horse.

percent in Bangladesh and 3.96 percent in the rest of South Asia (GTAP database) [6]. Output subsidies and output taxes on food and agricultural items are prevalent. In India, output subsidies are provided at the rates of 6.38%, 10.42%, 3.52%, 3.38% and 6.38% for paddy, wheat, other crops, grain crops and rice respectively. Output taxes are charged at the rates of 0.63%, 0.64%, 0.33%, 0.24% and 1.91% from milk, dairy, cattle, meat and livestock, and processed food respectively (GTAP database).

Policy Scenarios

The following hypothetical policy scenarios are used to compare and contrast the impacts of various export restrictions imposed by South Asian countries, particularly India, on welfare, price levels, and bilateral trade flows in the region. Export restrictions are modeled as export taxes so that the exporting country reaps the welfare gains accruing from the export tax revenue.

In the preliminary analysis we experimented with export tax rates of 5 percent, 25 percent, and 50 percent and with a complete removal of output subsidies on rice and paddy in India. However, to illustrate one potential outcome here, we present only the results for the 25 percent export tax and hold output subsides on rice and paddy constant. The three policy scenarios are:

(i) A 25 percent export tax on rice and paddy by India. This is one policy option selected by India during the food crisis.[7]
(ii) A 25 percent export tax on all agriculture and food products by India. This scenario is designed to highlight the regional importance and impacts of India's trade policy.[8]
(iii) A 25 percent export tax on agriculture and food products by all South Asian nations. This scenario illustrates the effects of all South Asian nations (Bangladesh, India, Pakistan, Sri Lanka, and "Other South Asia") implementing restrictive export policies.[9]

5. SIMULATION RESULTS

As stated earlier, the baseline equilibrium is characterized by the presence of import tariffs charged by almost all the regions on all the products except for services. There are no export subsidies or export taxes in South Asia except for milk in Pakistan. There are output subsidies on paddy, wheat, other crops, grains and rice in India. Consequently, the counterfactual equilibrium resulting from the imposition of export taxes could lead to either welfare improvements or welfare reductions, as the baseline equilibrium is distorted.

[6] It should be noted that GTAP database uses tariff equivalents that capture tariff as well as non-tariff barriers rather than applied or MFN rates as presented in figure 5.

[7] The restriction was only on rice—not on paddy.

[8] During the crisis period, India imposed export restrictions on wheat as well—so this scenario is not entirely hypothetical.

[9] During the crisis period, not only India, but also Pakistan imposed export restrictions. Countries like Sri Lanka have tightened their more liberal policies and the country is becoming more protectionist.

In a world free of distortions, the imposition of an export tax will reduce the incentive to export and to produce domestically. Therefore, with the introduction of an export tax, a reduction in exports and a reduction in local production is expected. A reduction in exports will lead to higher international prices but lower domestic prices in the sector under consideration. Lower domestic prices will attract resources away from the sector and will increase the production in other sectors leading to an increase in exports in other sectors despite the potential for lower exports in aggregate. A decline in total imports is expected so as to fulfill the balance of trade condition. Such a change could depress the prices of these other imports if the country under consideration is relatively large. This potential increase in international export prices and a reduction in international import prices, for the country imposing the export tax, leads to an increase the terms of trade facing the country. It is possible that such an increase could lead to welfare improvements if they are large enough to offset allocative efficiency losses.

The magnitude of above changes is determined mainly by the elasticity of substitution between domestic goods and imported goods. If domestic goods and imported goods are highly substitutable, an export tax can lead to significant changes both within the economy and in the rest of the world.

It is clear from the above discussion that as far as welfare changes are concerned, an export tax will lead to a reduction in global welfare, however, it has the potential to improve the welfare in the country imposing the export tax, depending upon its ability to influence international price levels. To sum, if export taxes are imposed in a perfect world there are allocative efficiency losses, however, it is still possible that the country will improve its welfare due to favourable terms of trade effects. However, when export taxes are imposed on a distorted economy the consequences are less clear. For example, if there are domestic output subsidies, it is possible for an export tax to offset its distortionary effects. An output subsidy draws resources from other sectors and expands the sector under consideration. This leads to allocative efficiency losses and there will be a reduction in export prices due to the expansions in exports. When an export tax is imposed on this sector, which is already distorted by an output subsidy, exports are reduced and production is curtailed. The extent to which such effects offset each other is mainly determined by the relative magnitude of policy levels, the elasticities of demand and supply and the degree of substitutability between the domestic good and the import good. When an export tax is imposed on a sector which receives output based production subsidies government spending/earnings are also influenced and welfare improvements are possible.

The following sections presents the modeling results for each of the three scenarios described in section 4. They show the percentage changes in prices and quantities produced, exported, and imported, in various regions by sectors, due to imposition of export taxes. It should be noted that even though the percentage changes are large, the absolute changes could be very small in certain cases (like paddy exports) as the baseline values are very small. The resulting welfare changes in each region along with the welfare decomposition results are presented.

Table 4. Percentage change in market prices due to the imposition of a 25 percent export tax, by product

	Export Taxes on Paddy and Rice by India					Export Taxes on all Agri Food by India					Export Taxes on Agri Food by South Asia				
Prices	Sri Lanka	India	Pakistan	Bangla-desh	Rest SA	Sri Lanka	India	Pakistan	Bangla-Desh	Rest SA	Sri Lanka	India	Pakistan	Bangladesh	Rest SA
Paddy	1.94	-1.15	1.20	1.11	0.20	2.26	-5.59	1.29	1.49	0.62	-8.78	-5.5	-6.73	0.00	-2.83
Wheat	-0.04	-0.27	0.19	0.36	0.08	3.17	-3.9	0.34	1.71	0.8	-3.25	-3.86	-2.17	0.12	-2.16
Other cereals	0.30	-0.33	0.20	0.60	0.12	3.43	-4.63	0.42	3.88	0.86	-5.27	-4.58	-2.04	2.51	-3.15
Other crops	0.38	-0.33	0.21	0.60	0.11	1.03	-4.92	0.41	1.22	0.81	-13.11	-4.85	-2.48	-0.51	-3.26
Milk	0.48	-0.34	0.24	0.70	0.12	1	-4.63	0.38	1.17	0.87	-9.71	-4.52	-2.31	-0.07	-1.77
Dairy products	0.13	-0.16	0.11	0.11	0.05	0.61	-1.44	0.15	0.43	0.55	-3.68	-1.42	-0.97	-0.04	-0.18
Cattle	0.55	-0.27	0.23	0.74	0.13	1.06	-3.88	0.35	1.21	0.77	-11.33	-3.83	-2.15	-0.04	-1.43
Other livestock and meat	0.20	-0.30	0.19	0.56	0.10	0.51	-4.31	0.31	1.99	0.62	-5.84	-4.26	-1.94	0.83	-2.62
Rice	1.67	-0.32	0.58	0.72	0.14	1.98	-1.78	0.62	0.85	0.35	-7.7	-1.76	-3.38	-0.23	-2.14
Processed food	0.10	-0.18	0.12	0.17	0.04	0.79	-2.05	0.18	0.71	0.59	-3.75	-2.02	-1.13	0.03	-0.37
Textile and apparel	0.01	-0.15	0.09	0.09	0.03	-0.05	-1.45	0.14	0.18	0.05	-1.32	-1.43	-0.86	-0.23	-1.05
Oil	-0.01	0.03	-0.02	-0.02	0.01	0.04	0.3	0.03	0.06	0.06	0.63	0.31	0.30	0.09	0.03
Manufacturing	0.01	-0.08	0.06	0.05	0.02	-0.03	-0.6	0.05	-0.18	-0.09	-1.35	-0.59	-0.52	-0.52	-0.77
Services	0.02	-0.12	0.08	0.05	0.03	-0.01	-0.85	0.04	-0.24	-0.08	-2.20	-0.85	-0.76	-0.63	-1.02

Source: Results of simulations performed using GTAP version 7.

Table 5. Percentage change in output in South Asian countries due to imposition of a 25 percent export tax, by product

Policy Scenario	Export Taxes on Rice by India					Export Taxes on all Agri Food by India					Export Taxes on Agri Food by South Asia				
Region Product	Sri Lanka	India	Pakistan	Bangladesh	Rest of South Asia	Sri Lanka	India	Pakistan	Bangladesh	Rest of South Asia	Sri Lanka	India	Pakistan	Bangladesh	Rest of South Asia
Paddy	4.21	-2.17	4.03	1.4	0.35	3.7	-1.89	3.88	1.17	0.16	9.89	-1.84	-19.31	1.2	0.24
Wheat	0.41	0.1	-0.09	-1.04	-0.15	-10.75	-2.15	0.08	6.51	2.7	-87.5	-2.17	-0.58	1.79	-0.62
Other cereals	-0.45	0.08	-0.04	-0.94	-0.09	10.11	-1.12	0.42	10.22	1.35	17.07	-1.15	0.23	11.35	-1.62
Other crops	-0.52	0.13	-0.11	-0.63	-0.15	-0.17	-1.67	0.11	0.29	0.85	-8.02	-1.62	-0.43	-1.06	-3.24
Milk	-0.14	0.06	0.01	0.1	-0.02	-0.22	0.34	-0.04	0.18	0.2	4.58	0.32	0.07	-0.02	-0.16
Dairy products	-0.32	0.04	0.01	-0.22	-0.1	-0.94	-0.43	0.04	0.14	3.21	4.36	-0.44	-0.21	0.44	6.94
Cattle	-0.02	-0.46	0	0.1	0.04	-0.11	-1.77	-0.02	0.19	0.21	0.02	-1.73	-0.01	-0.01	-0.53
Other livestock and meat	-0.16	0.13	-0.04	-0.32	-0.15	-0.31	-1.98	-0.08	-1.04	-0.34	-0.27	-2	-1.03	-1.14	-8.74
Rice	4.61	-2.98	4.52	1.55	0.37	4.08	-2.82	4.43	1.29	0.16	10.66	-2.73	-21.85	1.37	0.32
Processed food	-0.16	0.12	-0.03	-0.24	-0.06	-0.39	-4.4	0.23	0	0.86	-10.28	-4.32	-3.26	-7.31	-4.42
Textile and apparel	-0.07	0.47	-0.45	-0.61	-0.19	0.06	4.48	-0.82	-1.39	-1.18	7.54	4.32	3.99	0.87	3.32
Oil	-0.01	0.08	-0.05	-0.03	-0.01	0.01	0.58	0	0.13	0.09	0.72	0.58	0.52	0.29	0.55
Manufacturing	-0.09	0.19	-0.16	-0.13	-0.08	-0.09	1.57	-0.14	0.14	-0.12	3.68	1.55	1.46	0.41	1.28
Services	-0.05	0.06	-0.01	-0.04	-0.01	-0.09	0.38	-0.01	-0.05	-0.05	0.84	0.37	0.12	-0.07	0.06

Source: Results of simulations performed using GTAP version 7.

Table 6. Percentage change in exports from South Asian countries due to the imposition of a 25 percent export tax, by product

Policy Scenario	Export Taxes on Rice by India					Export Taxes on all Agri Food by India					Export Taxes on Agri Food by South Asia				
Region Product	Sri Lanka	India	Pakistan	Bangla-desh	Rest of South Asia	Sri Lanka	India	Pakistan	Bangla-desh	Rest of South Asia	Sri Lanka	India	Pakistan	Bangla-desh	Rest of South Asia
Paddy	-3.67	-89.92	17.6	11.92	13.26	-6.02	-84.75	16.03	8.04	5.08	-81.14	-82.99	-81.07	-90.42	-90.58
Wheat	0.42	2.33	-1.44	-2.36	-1.7	-11.05	-85.84	16.91	-10.51	-19.57	-90	-86.3	-87.91	-90.55	-89.8
Other cereals	-0.71	0.74	-0.57	-1.45	-0.4	-6.25	-37.35	12.96	-8.54	-3.73	-43.5	-37.77	-40.49	-54.48	-47.11
Other crops	-1.51	1.51	-0.74	-2.06	-0.57	-2.9	-62.08	1.21	-2.79	-5.33	-45	-62.33	-64.06	-64.72	-67.13
Milk	-3.33	2.6	-1.66	-4.88	-0.79	-5.29	-82.51	-0.83	-6.35	-4.36	-73.51	-82.48	-85.06	-87.19	-85.7
Dairy products	-0.88	1.18	-0.62	-0.7	-0.59	7.68	-85.32	14.05	10.12	-5.88	-78.06	-85.09	-78.04	-82.75	-86.82
Cattle	-2.12	1.05	-0.67	-2.83	-0.61	-3.32	-33.47	14.09	-4.06	-4.01	-48.17	-27.72	-55.4	-67.7	-64.57
Other livestock and meat	-1.34	2.17	-1.24	-3.8	-0.65	0.61	-81.51	-0.38	-12.32	-4.03	-79.05	-81.54	-84.22	-87.26	-84.62
Rice	-1.76	-62.27	11.56	3.53	5.08	-3.06	-60.04	11.37	3.05	4.13	-59.73	-58.16	-57.27	-72.53	-72.69
Processed food	-0.35	0.73	-0.37	-0.62	-0.21	-2.02	-62.97	1.88	-1.87	-1.77	-59.3	-62.87	-59.39	-66.37	-63.97
Textile and apparel	-0.07	1.08	-0.66	-0.65	-0.28	0.13	10.54	-1.19	-1.42	-1.34	9.24	10.18	5.82	1.19	6.4
Oil	0.13	-0.33	0.24	0.2	-0.01	0.14	-2.41	0.3	-0.03	0.09	-5.06	0.34	-2.32	-0.25	0.54
Manufacturing	-0.06	0.58	-0.4	-0.35	-0.19	0.17	4.41	-0.33	1.32	0.18	9.93	4.39	3.61	3.78	4.99
Services	-0.07	0.4	-0.3	-0.19	-0.1	0.06	2.97	-0.1	1	0.33	8.51	2.96	2.93	2.51	3.87

Source: Results of simulations performed using GTAP version 7.

Table 7. Percentage change in imports from South Asian countries due to imposition a 25 percent export tax, by product

Policy Scenario	Export Taxes on Rice by India					Export Taxes on all Agri Food by India					Export Taxes on Agri Food by South Asia				
Region Product	Sri Lanka	India	Pakistan	Bangla-desh	Rest of South Asia	Sri Lanka	India	Pakistan	Bangla-desh	Rest of South Asia	Sri Lanka	India	Pakistan	Bangla-desh	Rest of South Asia
Paddy	-15.07	-6.27	-0.7	4.95	-10.99	-13.04	-25.8	-0.43	6.09	-9.41	-49.2	-27.65	-38.4	-2.16	-23.55
Wheat	-0.17	-1.25	0.46	0.97	0.51	-0.38	-16.68	0.08	-9.77	-10.31	-9.61	-18.1	-6.76	-19.78	-25.96
Other cereals	0.18	-0.42	0.23	0.14	0.25	-8.55	-5.98	-1.79	-7.01	-13.48	-12.47	-8.26	-5.18	-7.98	-18.04
Other crops	0.72	-0.73	0.23	0.65	0.21	-8.49	-10.29	-1.71	-3.19	-6.9	-34.2	-13.08	-8.33	-6.32	-20.29
Milk	1.53	-1.24	0.85	2.63	0.44	1.97	-15.74	-0.08	3.03	1.16	-29.89	-16.13	-9.74	-2.73	-10.78
Dairy products	0.15	-0.56	0.39	0.19	0.11	0.52	-5.16	-0.64	-1.04	-4.65	-7.66	-6.56	-4.69	-2.34	-13
Cattle	0.8	-0.84	0.42	1.99	0.35	-0.07	-8.85	-0.06	-27.31	-13.46	-20.02	-16.67	-5.21	-29.35	-30.42
Other livestock and meat	0.92	-0.77	0.51	1.24	0.15	0.66	-11.28	0.42	4.29	-1.83	-13.89	-11.41	-6.46	1.15	-9.77
Rice	-23.19	-1.15	-28.58	-42.3	-11.45	-21.84	-4.91	-27.46	-40.46	-10.83	-46.32	-6.81	-43.89	-42.19	-43.21
Processed food	0.08	-0.3	0.21	0.14	0.01	-1.87	-3.67	-1.65	-2.48	-1.3	-11.97	-5.16	-4.16	-4.56	-10.68
Textile and apparel	-0.06	-0.42	0.05	-0.19	0.05	0.06	-3.83	-0.04	-0.34	0.13	6.19	-3.55	-0.57	0.34	-0.93
Oil	-0.09	0.22	-0.19	-0.13	-0.08	-0.09	1.85	-0.18	0.14	-0.16	3.69	1.83	1.76	0.41	1.01
Manufacturing	0	-0.14	0.08	0.11	0.04	0.01	-0.87	0.02	-0.34	-0.02	-0.11	-0.86	-0.72	-1.17	-0.94
Services	-0.05	-0.15	0.15	-0.01	0.04	-0.27	-1.12	0.03	-0.67	-0.27	-4.42	-1.12	-1.38	-1.43	-2.27

Source: Results of simulations performed using GTAP version 7.

Scenario 1

As shown in Table 4, when India imposes a 25 percent export tax on rice and paddy, the domestic price of rice is lowered (the primary objective of the policy), but by only 0.32 percent, and the price of rice increases elsewhere (e.g., 1.67 percent in Sri Lanka and 0.72 percent in Bangladesh). In this and the other scenarios we assume that other countries do not retaliate by changing their own import/export or domestic policies. India's export tax on rice leads to a 2.98 percent reduction in domestic rice production[1] and a 62.27 percent reduction in Indian rice exports (see Tables 4 and 5).

The lower level of exports from India results in a significant drop in rice imports by countries such as Sri Lanka (23.19 percent) and Bangladesh (42.3 percent), and a 4.61 and 1.55 percent increase in domestic rice production in Sri Lanka and Bangladesh (Tables 5 and 7). The summary welfare results are presented in Table 8 and the welfare decomposition results are presented in Appendix Table 4, which indicates the losses and gains associated with changes in allocative efficiency (A1), terms of trade (E1: relative prices for exports and imports), and relative prices of savings and investment (F1). The imposition of a 25 percent rice export tax results in an increase in Indian welfare of $74.17 million dollars. The result for the 25 percent tax is clearly dependent on the elasticities of substitution included in the GATP model.[2] The welfare decomposition results indicate that India incurs allocative efficiency losses. However, favorable terms of trade turn the total welfare effects positive. The terms of trade effect is quite prominent for rice in India.

Table 8. The change in equivalent variation (EV) associated with the imposition of a 25 percent export tax (US$ million), by region

Policy Scenario	Export Taxes on Rice by India	Export Taxes on all Agri Food by India	Export Taxes on Agri Food by South Asia
Sri Lanka	-16.73	-45.38	-124.72
India	74.17	252.45	210.77
Pakistan	21.61	-4.56	-64.94
Bangladesh	-54.85	-142.21	-183.96
Rest of South Asia	-0.17	-32.84	-112.91
China	-3.28	-98.95	-137.24
Vietnam	10.08	6.81	11.72
Thailand	16.15	-10.67	-24.98
South East Asia	-34.17	-363.21	-444.22
Oceana	0.48	52.51	56.08

[1] As a reviewer indicated, the supply elasticity is quite high and it is due to the default elasticitiy parameters used.

[2] The Armington elasticities for domestic imports were set for paddy rice (5.05), wheat (4.45), other cereals (1.30), other crops (2.32), milk (3.65), dairy (3.65), cattle (2.00), other livestock and meat (3.18), rice (2.60) and processed food (1.88). The Armington elasticity shows the degree of substitution between domestic and imported goods (Armington,1969). The standard GTAP model uses the above elasticities as the default.

Table 8. (Continued)

Policy Scenario	Export Taxes on Rice by India	Export Taxes on all Agri Food by India	Export Taxes on Agri Food by South Asia
North America	9.78	-88.64	0.83
EU_25	-44.61	-508.4	-620.98
Brazil	1.86	39.41	53.54
Rest of World	-197.93	-186.49	-410.94
Total	-217.6	-1130.18	-1791.94

Source: Results of simulation performed using GTAP version 7.

When India imposes export taxes on rice, the terms of trade improve for all rice exporting countries and it decreases for rice importing countries. Furthermore, India loses terms of trade in all other sectors, except for oil (not shown in the tables). Of course, rice-importing countries in South Asia suffer welfare losses as a result of India's export tax on rice. For example, Sri Lanka loses $16.73 million, Bangladesh loses $54.85 million, and Other South Asia loses $0.17 million. Pakistan, a net rice exporting country, gains $21.61 million. The "rest of the world" region has the greatest welfare loss ($197.93 million), while total worldwide losses are $217.6 million (Table 8).[3]

Scenario 2

As shown in Tables 4-6, when India imposes a 25 percent export tax on all agriculture and food products, there are reductions in its domestic market prices and production and exports of agricultural and food commodities. The decline in domestic prices in India ranges from 1.44 percent for dairy products to 4.92 percent for other crops (Table 4). However, prices of all agricultural and food products rise in Sri Lanka (ranging from 0.51 percent for other livestock and meat to 3.43 percent for other cereal products), Pakistan (ranging from 0.15 percent for dairy products to 1.29 percent for paddy rice), and Bangladesh (ranging from 0.43 percent for dairy products to 3.88 percent for other cereal crops). The export tax leads to reductions in the production of almost all food and agriculture products in India (ranging from -0.43 percent for dairy products to -4.4 percent for processed products) and increases in the production of most food and agricultural products in Sri Lanka, Pakistan, Bangladesh, and the rest of South Asia. With an export tax of 25 percent, India's exports of all agricultural and food products decline significantly, ranging from a 33.47 percent decrease for cattle to a 84.75 percent decrease for paddy rice (Table 6). The reductions in rice imports by Sri Lanka and Bangladesh are high, 21.84 percent and 40.46 percent, respectively (Table 7). Other cereal imports decline by 8.55 percent and 7.01 percent, respectively, in Sri Lanka and Bangladesh, while imports of other crops show reductions of 8.49 percent and 3.19 percent. As shown in Table 8, with an export tax of 25 percent on all agricultural and food products, India still enjoys welfare gains ($252.45 million), but losses are heavy in Sri Lanka ($45.38

[3] Our analysis shows that large export tax rates decrease welfare in India. For example, if India imposes a 50 percent export tax on rice, holding other policies constant, India's welfare decreases by $43.31 million, with allocative inefficiencies amounting to $241.78 million. When India imposes a 60 percent export tax on rice, welfare in India decreases by $168.79 million, of which allocative inefficiencies account for $384.62 million.

million), Bangladesh ($142.21 million), South East Asia ($363.20 million), and the EU ($508.40 million), and worldwide welfare losses total $1,130.16 million.

Scenario 3

When all of South Asia imposes a 25 percent export tax on all agricultural and food products there is a welfare loss of $1,791.95 million (see Table 8), but this hides the fact that India gains welfare ($210.77 million) while all other countries in the region lose welfare: $124.72 million in Sri Lanka, $64.94 million in Pakistan, $183.96 million in Bangladesh, and $112.91 million in the Other South Asia region. This export tax on all food and agricultural products results in significant reductions in domestic price and production levels for most food and agricultural items in all South Asian countries (see Tables 4 and 5). As shown in Table 6, with a 25 percent export tax, exports of food and agricultural products fall precipitously across the region. Although the largest reductions in exports are in the paddy rice, wheat, milk and dairy product sectors, these sectors' contributions to total exports are relatively small in most cases. The reduction in rice imports into Sri Lanka and Bangladesh are as high as 46.32 percent and 42.19 percent, respectively. Wheat imports decline by 9.61 percent and 19.78 percent, other cereals show reductions of 12.47 percent and 7.98 percent, and other crops show reductions of 34.20 percent and 6.32, for Sri Lanka and Bangladesh, respectively (Table 7). Overall, the impacts of export restrictions imposed by exporting countries on the welfare of their non-South Asian trading partners are mixed. As shown in Table 8, when one or more countries in South Asia imposes export taxes, a welfare gain can be observed for a few of their competitors (Vietnam and Brazil) and a welfare loss for their close trading partners (South East Asia, European Union and the Rest of the World). Thailand, the key rice exporting country in the world, incurs a welfare gain when India imposes an export tax on rice.

CONCLUSIONS AND POLICY IMPLICATIONS

The results presented above show the importance of India and its trade policies for the South Asian economy. Although our results depend on the base parameters and assumptions contained in the GTAP model, particularly the Armington elasticities, which significantly influence the terms of trade effects, they illustrate that while India's implementation of trade restrictions through export taxes may improve India's welfare, these policies harm other countries in South Asia and elsewhere. Even though the primary objective of these restrictive policies was to reduce domestic price levels in the country imposing them, the reductions in the country's food and agricultural output and export levels can be larger than the reductions in domestic price levels as evident in India. Thus, although such consequences may be unintended, export taxes could allow a country to achieve welfare gains through the effects of the taxes on their terms of trade. Given the fact that the WTO currently has no rules to restrict these "beggar-thy-neighbor" trade-restricting policies, and that the latest draft text from the Doha Development Round proposes scant improvements, there appears to be little hope that countries will limit the use of such policies during periods of high prices (Meilke, 2008). In our view, improving the WTO rules dealing with trade restrictions and ensuring that export restrictions are prominently addressed in regional trade agreements should be a high priority.

Appendix Table 1. South Asian imports valued at market prices ('000 US dollars), 2004*

Product	Sri Lanka	India	Pakistan	Bangladesh	Rest SA	All South Asia	World
1 Paddy	3.90	0.37	0.14	14.56	0.39	19.40	2,387.54
	(0.00)	(0.00)	(0.00)	(0.10)	(0.00)	(0.01)	(0.02)
2 Wheat	184.69	0.96	247.14	197.44	13.33	643.56	25,411.30
	(1.70)	(0.00)	(0.80)	(1.30)	(0.20)	(0.31)	(0.24)
3 Other cereals	20.82	3.17	19.66	45.23	2.24	91.12	22,744.73
	(0.20)	(0.00)	(0.10)	(0.30)	(0.00)	(0 .04)	(0.21)
4 Other crops	300.62	2,128.85	1,467.33	1,283.85	245.80	5,426.45	180,226.20
	(2.80)	(1.50)	(4.70)	(8.10)	(3.80)	(2.64)	(1.68)
5 Milk	0.13	1.55	0.54	0.08	0.12	2.42	252.85
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
6 Dairy products	188.58	48.75	44.33	96.75	52.96	431.37	48,751.35
	(1.80)	(0.00)	(0.10)	(0.60)	(0.80)	(0.21)	(0.45)
7 Cattle	0.11	2.34	1.10	0.76	9.11	13.42	7,360.11
	(0.00)	(0.00)	(0.00)	(0.00)	(0.10)	(0.01)	(0.07)
8 Meat and livestock	18.27	341.67	98.55	43.86	59.20	561.55	107,230.53
	(0.20)	(0.20)	(0.30)	(0.30)	(0.90)	(0.27)	(1.00)
9 Rice	134.98	4.46	4.31	290.75	55.28	489.78	13,090.48
	(1.30)	(0.00)	(0.00)	(1.80)	(0.90)	(0.24)	(0.12)
10 Processed food	590.45	5,856.97	1,319.84	1,100.57	635.03	9,502.86	390,313.25
	(5.50)	(4.10)	(4.30)	(7.00)	(9.90)	(4.62)	(3.64)
Sub Total Ag and Food	1,442.59	8,389.09	3,202.94	3,073.85	1,073.46	17,181.93	797,768.34
	(13.45)	(5.92)	(10.36)	(19.48)	(16.79)	(8.36)	(7.43)

Product	Sri Lanka	India	Pakistan	Bangladesh	Rest SA	All South Asia	World
11 Textiles and apparel	1,969.01	3,081.94	1,062.25	3,354.40	596.12	10,063.72	520,497.09
	(18.40)	(2.20)	(3.40)	(21.30)	(9.30)	(4.89)	(4.85)
12 Oil	615.51	27,099.94	2,265.76	424.32	0.01	30,405.54	531,846.63
	(5.70)	(19.10)	(7.30)	(2.70)	(0.00)	(14.79)	(4.95)
13 Manufactured	5,524.73	83,998.85	18,454.32	8,041.15	4,016.19	120,035.24	7,081,379.00
	(51.50)	(59.20)	(59.70)	(51.00)	(62.80)	(58.38)	(65.96)
14 Services	1,175.16	19,252.21	5,916.22	882.29	709.39	27,935.27	1,805,029.38
	(11.00)	(13.60)	(19.10)	(5.60)	(11.10)	(13.59)	(16.81)
Total	10,727.00	141,822.03	30,901.50	15,776.00	6,395.16	205,621.69	10,736,520.00
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

*Numbers in parentheses are percentages of total value of imports. Source: GTAP database, version 7.

Appendix Table 2. South Asian exports valued at market prices ('000 US dollars), 2004*

Product	Sri Lanka	India	Pakistan	Bangladesh	Rest SA	All South Asia	World
1 Paddy	0.85	127.10	47.22	2.00	0.04	177.21	1,486.76
	(0.00)	(0.10)	(0.30)	(0.00)	(0.00)	(0.13)	(0.01)
2 Wheat	1.60	460.91	0.61	0.05	0.03	463.20	21,443.79
	(0.00)	(0.50)	(0.00)	(0.00)	(0.00)	(0.33)	(0.21)
3 Other Cereals	0.07	220.13	0.26	0.00	0.47	220.93	18,404.88
	(0.00)	(0.20)	(0.00)	(0.00)	(0.00)	(0.16)	(0.18)
4 Other Crops	690.00	2,726.54	314.81	149.44	116.82	3,997.61	146,015.64
	(9.40)	(2.70)	(1.90)	(1.40)	(4.20)	(2.86)	(1.45)
5 Milk	0.02	4.71	3.48	0.01	0.56	8.78	251.95
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
6 Dairy products	2.97	110.15	7.92	0.29	1.59	122.92	45,816.03
	(0.00)	(0.10)	(0.00)	(0.00)	(0.10)	(0.09)	(0.46)
7 Cattle	0.07	3.61	3.57	0.28	2.22	9.75	6,535.69
	(0.00)	(0.00)	(0.00)	(0.00)	(0.10)	(0.01)	(0.07)
8 Other Livestock and meat	4.45	627.83	54.25	2.68	24.84	714.05	91,919.31
	(0.10)	(0.60)	(0.30)	(0.00)	(0.90)	(0.51)	(0.91)
9 Rice	3.61	1,195.75	607.97	2.09	12.06	1,821.48	7,713.07
	(0.00)	(1.20)	(3.60)	(0.00)	(0.40)	(1.30)	(0.08)
10 Processed Food	504.25	4,023.35	539.02	445.02	149.71	5,661.35	344,897.41
	(6.80)	(3.90)	(3.20)	(4.10)	(5.40)	(4.05)	(3.43)
Subtotal Ag and Food	1,207.89	9,500.08	1,579.11	601.86	308.34	13,197.28	684,484.53
	(16.38)	(9.29)	(9.47)	(5.57)	(11.15)	(9.44)	(6.81)

Product	Sri Lanka	India	Pakistan	Bangladesh	Rest SA	All South Asia	World
11 Textile and apparel	3,019.39	15,981.99	9,778.08	8,193.01	522.64	37,495.11	451,486.19
	(40.90)	(15.60)	(58.70)	(75.90)	(18.90)	(26.81)	(4.49)
12 Oil	0.00	0.27	2.93	0.00	330.51	333.71	485,114.66
	(0.00)	(0.00)	(0.00)	(0.00)	(11.90)	(0.24)	(4.83)
13 Other Manufacturing	1,813.12	58,438.08	2,489.79	821.40	417.60	63,979.99	6,624,134.50
	(24.60)	(57.20)	(14.90)	(7.60)	(15.10)	(45.75)	(65.91)
14 Services	1,335.01	18,331.38	2,821.37	1,180.12	1,187.44	24,855.32	1,804,984.50
	(18.10)	(17.90)	(16.90)	(10.90)	(42.90)	(17.77)	(17.96)
Total	7,375.42	102,251.81	16,671.28	10,796.41	2,766.53	139,861.45	10,050,204.00
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

* Numbers in parentheses are percentages of total value of imports. Source: GTAP database, version 7.

Appendix Table 3. Bilateral imports of rice

Country	1 Sri Lanka	2 India	3 Pakistan	4 Bangladesh	5 Rest SA	Total
1 SriLanka	-	0.02	0.01	-	0.11	6.91
	-	0	0	-	0.02	(100)
2 India	94.24	-	3.26	286.24	16.32	1812.68
	(0.05)	-	0	(0.16)	(0.01)	(100)
3 Pakistan	36.61	0.03	-	0.6	37.01	888.1
	(0.04)	-	-	0	(0.04)	(100)
4 Bangladesh	0.02	0.01	-	-	-	3.1
	(0.01)	0	0	-	0	(100)
5 RestSA	0.01	0.1	0.03	0.01	-	12.06
	-	(0.01)	0	-	-	(100)
6 China	0.11	0.87	0.31	0.04	0.08	1013.67
	-	0	-	-	-	(100)
7 Vietnam	0.01	0.18	0.06	0.01	0.02	878.71
	-	-	-	-	-	(100)
8 Thailand	0.83	0.54	0.12	1.86	0.59	4494.89
	-	-	-	-	-	(100)
9 SEAsia	1.14	1.07	0.3	1.89	0.13	297.55
	0	0	0	(0.01)	-	(100)
10 Oceana	0.05	-	-	0.01	0.01	292.2
	-	-	-	-	-	(100)
11 NAmerica	0.58	0.11	0.03	0.07	0.83	1679.37
	-	-	-	-	-	(100)
12 EU_25	1.36	0.59	0.04	-	0.04	814.11
	0	0	-	-	-	(100)

Country	1 Sri Lanka	2 India	3 Pakistan	4 Bangladesh	5 Rest SA	Total
13 Brazil	-	0.02	0.01	-	-	16.16
	-	0	-	-	-	(100)
14 Rest of World	0.03	0.94	0.15	0.01	0.14	880.97
	-	0	-	-	-	(100)
Total	134.98	4.46	4.31	290.75	55.28	13090.48
	(0.01)	-	-	(0.02)	0	(100)

* Numbers in parentheses are percentages of total value of imports.
Source: GTAP database, version 7.

Appendix Table 4. The change in the equivalent variation (EV) associated with the imposition of a 25 percent export tax (US$ million), by region

Policy Scenario	Export Taxes on Rice by India				Export Taxes on all Agri Food by India				Export Taxes on Agri Food by South Asia			
Region	Allocative efficiency (A1)	Terms of Trade (E1)	Savings and Investment (F1)	Total EV	Allocative efficiency (A1)	Terms of Trade (E1)	Savings and Investment (F1)	Total EV	Allocative efficiency (A1)	Terms of Trade (E1)	Savings and Investment (F1)	Total EV
Sri Lanka	-8.96	-7.94	0.18	-16.72	-14.74	-29	-1.64	-45.38	-114.38	31.63	-41.97	-124.72
India	-53.43	140.37	-18.73	68.21	-457.94	849.47	-139.08	252.45	-476.86	826.14	-138.51	210.77
Pakistan	1.23	18.37	4.92	24.53	-1.49	-2.4	-0.67	-4.56	-147.58	138.17	-55.53	-64.94
Bangladesh	-21.31	-33.89	1.05	-54.14	-39.95	-95.68	-6.58	-142.21	-141.33	-26.9	-15.73	-183.96
Rest of SA	0.76	-1.12	0.3	-0.05	-8.14	-21.14	-3.57	-32.84	-55.3	-35.34	-22.27	-112.91
China	-7.64	0.28	2.53	-4.83	-58.01	-74.1	33.16	-98.95	-90.31	-101.22	54.28	-137.24
Vietnam	-0.46	10.57	0.44	10.55	7.45	-1.26	0.61	6.81	5.98	4.99	0.75	11.72
Thailand	-16.2	30.3	2.23	16.33	-11.44	-7.31	8.08	-10.67	-29.21	-7.92	12.15	-24.98
South East Asia	-20.8	-32.03	10.84	-41.98	68.6	-519.47	87.66	-363.21	44.13	-617.88	129.52	-444.22
Oceana	0.3	0.6	-0.11	0.79	4.64	44.89	2.97	52.51	6.1	44.73	5.25	56.08
North America	-12.15	31.43	-8.38	10.9	-125.59	77.81	-40.86	-88.64	-119.1	157.43	-37.49	0.83
EU_25	-73.67	-16.67	0.23	-90.11	-315.84	-217.24	24.68	-508.4	-403.08	-268.47	50.56	-620.98
Brazil	-0.62	2.26	0.32	1.97	-9.29	52.02	-3.32	39.41	-11.25	68.11	-3.32	53.54
Rest of World	-58.37	-142.4	4.14	-196.63	-173.73	-50.33	37.57	-186.49	-264.66	-206.6	60.32	-410.94
Total	-271.31	0.14	-0.02	-271.19	-1135.46	6.27	-0.98	-1130.18	-1796.83	6.87	-1.98	-1791.94

Source: Results of simulations performed using GTAP version 7.

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THE APPLICATION OF INTERVENTION MODELS TO NON-TARIFF TRADE BARRIERS: A CASE STUDY OF BRAZILIAN BEEF EXPORTS[1]

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ABSTRACT

This paper proposes a methodology for evaluating the impacts of non-tariff trade barriers on Brazilian beef exports. The hypothesis is that sanitary issues influence Brazilian beef exports. Intervention models are applied to price and quantity series to obtain direct impact estimates and to establish the influence pattern of the intervention variables. The analysis considers the European Union market for Brazilian exports of fresh and chilled beef cuts, and covers the period from January 1992 through December 2000. In the intervention analysis, the March 1995 point was significant and indicates a reduction effect on export prices for three months, which was related to the European embargo against Brazilian exports. In general, the results suggest that most of the interventions related to sanitary events were not significant or conclusive for the time period studied.

Keywords: beef, sanitary barriers, intervention model, Brazil, export.
JEL classification codes: Q17, Q18.

INTRODUCTION

As indicated by Miranda (2001), the beef market is heavily protected all around the world by tariffs and tariff-rate quotas (TRQ), import licensing mechanisms, domestic support prices, domestic production subsidies, and export subsidies, particularly in the developed countries.

[1] An earlier version of this paper was presented at the 2006 IATRC Winter Meeting, held in St.Petersburg, Florida, 2nd to 5th December 2006.

Trade in bovine meat products is strongly affected by technical and sanitary regulations and quality standards. During the 1990s, sanitary issues became more relevant in determining the nature and extent of global trade in beef. It is important to note that sanitary issues, for instance, those raised by disease outbreaks, can cause significant changes in the behavior of consumers, policymakers, producers, exporters and importers.

The United States (US), Australia, New Zealand, Argentina, and the European Union (EU) are the world's main beef exporters. According to Gordon (2000), there are great differences in production costs between the southern and northern hemispheres in this sector. While this could encourage trade, the international meat market is also highly regulated and protected.

Since 2004, Brazil has been the major world beef exporter. Meat exports ranked 6th among Brazil's exports in 2005. In that year, Brazil exported about 2.4 million tons of beef in carcass-weight equivalent, which generated US$3.15 billion in income (ABIEC, 2006). Brazil competes with Argentina in the European and Chilean markets for fresh and chilled beef, and in the US market for processed products.

Suppliers are differentiated according to quality and consumer preferences. Countries such as Australia, New Zealand, Canada, US, Japan, and South Korea, which are considered to be part of the Pacific Rim region, face better prices in the international beef market because of the high quality of their product, which is also closely related to their successful image concerning their sanitary status. Moreover, these countries do not buy meat products from countries that have not completely eradicated foot and mouth disease (FMD). Unlike Brazil, Argentina and Uruguay have access to the Pacific Rim markets, even though in recent years they have faced temporary bans because of FMD outbreaks.

Given the direct effects of sanitary and technical trade barriers on exports, as well as their direct and indirect income and employment consequences, measuring the impacts of these barriers on trade in goods and services is a challenge. This is particularly true for developing countries, where there is a scarcity of financial resources and human capital to deal with the diversity and complexity of sanitary and technical issues. Although economists have used several methodologies to measure the impacts of sanitary and technical trade barriers on exports, there is still potential for further developments in this specific area of research, including its public policy applications.

The main objective of this article is to present a new application of the Box and Tiao (1975) methodology, which employs intervention variables to evaluate the trade impact of non-tariff trade barriers, particularly sanitary measures, and use it to analyze the case of Brazilian beef exports. The first challenge of such an analysis is to propose a methodology that is capable of capturing the impacts of such sanitary and technical requirements or barriers, which are not always very clear or well identified. A second challenge is to gather enough information and data to provide the necessary input to the quantitative models, without sacrificing the qualitative features that are so relevant to an analysis of these kinds of non-tariff barriers.

With these challenges and requirements in mind, the analysis here uses the results of Miranda (2001) to select the variables for the transfer functions in time-series models. Then,

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using monthly data, an intervention model[2] is applied to verify the influence of selected non-tariff barriers on Brazilian beef exports to the European Union (EU) for the period from January 1992 through December 2000. The hypothesis is that sanitary events and related regulations affect the prices or the quantities (or both) of beef exported by Brazil. It is important to note that applying these models requires a detailed knowledge about the problem being analyzed, in particular details about the general and specific determinants of trade for the product or group of products considered, the nature and structure of protectionism concerning these products, the sanitary and other regulations imposed on them, and any other events that could affect the time-series being studied.

This article proposes using intervention variables rather than econometric models with dummies to analyze the impacts of non-tariff barriers to trade. The greatest advantage of intervention models over the traditional dummy variables approach is that intervention models can represent the dynamic effects of shocks. Such intervention models have been applied in particular to environmental issues. However, they have not been used for evaluating the effects of the sanitary or technical barriers on trade flows. The major motivation for this article's focus on identifying and measuring the impacts of sanitary and technical barriers are the complaints from Brazilian exporters that sanitary and technical requirements have damaged trade, particularly trade in livestock. Thus, the use of economic models to analyze the empirical evidence would be very helpful in informing the debate on this issue.

The remainder of this article is organized as follows. The next section presents background on sanitary and technical barriers. This is followed by a discussion of the methodology used in our analysis. This discussion is divided into two parts: the first describes the choice of the determinants of Brazilian beef exports and the second presents the analytical approach used in this article (i.e., the transfer function and intervention analyses). The next section describes the data and the interviews conducted with export-oriented slaughterhouses in Brazil. Following the description of the data, we present and interpret the results of the models run for quantities of beef exports and prices of beef exports. We offer some concluding remarks in the final section.

BACKGROUND ON SANITARY AND TECHNICAL BARRIERS

The discussion of sanitary and technical barriers imposed on tradable agribusiness products is based on the Sanitary and Phytosanitary (SPS) and Technical Barriers to Trade (TBT) multilateral agreements implemented under the World Trade Organization (WTO). These two agreements, in particular the SPS, encourage countries to harmonize their regulations with the international scientific and technical references developed by international scientific organizations, such as the *Codex Alimentarius* Commission (established by the U.N. Food and Agriculture Organization and the World Health Organization), the World Organization for Animal Health (OIE), and the International Plant Protection Convention (IPPC).

[2] Intervention analysis and transfer function analysis are techniques that "generalize the univariate methodology by allowing the time path of the "dependent" variable to be influenced by the time path of an "independent" or "exogeneous" variable" (Enders, 1995, p.269).

The SPS provisions deal with some of the most important principles to protect human, animal, and plant health and food safety. Additionally, SPS establishes the regionalization and equivalence provisions, which help facilitate world trade.[3] The goal of the TBT provisions is to prevent technical requirements from creating unnecessary barriers to trade and also to handle origin certification, environment protection, pesticide residues in food, conformity assessment procedures, traceability, and other requirements.

Because of the complexity of the harmonization and equivalence processes, Brazilian exports (including beef) face a large diversity of requirements imposed by importers. Meeting these varied requirements is difficult, increases the costs of production, and results in more bureaucracy. This situation also contributes to a misapplication of technical and sanitary requirements, which goes beyond the reasonable objectives of protecting human and animal health and in this way becomes a kind of non-tariff barrier.

In addition, it is important to note that sanitary and technical policies should focus primarily on protecting consumers (with respect to their health and security), animal and plant health, and the environment, as well as achieving other legitimate objectives established by the SPS and TBT provisions. The fact that in some cases sanitary and technical regulations have not been aligned with SPS and TBT provisions has raised suspicion that these policies are being used solely to restrict commerce. However, evaluating the legitimacy of a sanitary or technical requirement is seldom a simple task, and there have been numerous debates in Brazil among the media and politicians about whether the country is facing increasing sanitary barriers. This further illustrates the importance of analyzing the empirical evidence on this issue.

According to Ferraz Filho (1997), the slaughter sector was one of the most directly affected by the technical requirements imposed on Brazil by importers. A sample of firms, which were all private and had foreign trade background, considered sanitary rules to be a very important obstacle to their export growth rates. Procópio Filho (1994) carried out a survey of the Brazilian private sector and found that sanitary and environmental requirements were perceived as a way to negotiate a decrease in prices. Lima, Miranda, and Galli (2005) found that due to its FMD status, Brazil was not part of the beef niche market, which was valued at US$7.5 billion in 2004 and included the Pacific Rim countries. These studies indicate that sanitary and technical requirements may sometimes result in an import ban on a product or, more often, price reductions or decreases in traded volumes.

METHODOLOGY

The economics literature has proposed some tools for evaluating the impacts of non-tariff barriers. These include partial equilibrium models, general equilibrium models, frequency and coverage indexes, as well as case studies. Laird (1996) and Beghin and Bureau (2001) review the literature on these methodological alternatives.

[3] The regionalization provision recognizes that "pest or disease free areas are largely determined by geographic and other ecological conditions, and therefore may be part of a country, or all or parts of several countries" (see Article 6 of the SPS Agreement). The equivalence provision (Article 4 of the SPS) states that members are obliged to recognize that measures adopted by other members, although different, provide "equivalent levels of protection for plant, animal and human health, if this is objectively demonstrated by the exporting country" (Roberts, 1998).

Econometric models, including those using dummy variables, can address events or actions whose effects are not directly quantifiable (e.g. a new sanitary regulation). As an alternative, it is also possible to evaluate the effects of this kind of event by applying a time-series method that uses intervention models and intervention variables to explain specific events that are identified by observing the behavior of time-series data.

Our discussion of the methodology for our analysis is divided into two parts, with the first relying on the previous results of Miranda (2001) to explain how the explanatory variables were selected, and the second describing the transfer function analysis and the intervention analysis, and explaining in detail which dummies (intervention variables) were included in the analysis and how they were addressed in the models.

Identifying the Determinants of Brazil's Beef Exports

In order to identify the main determinants of Brazilian beef exports, Miranda (2001) estimated an econometric model through a reduced form. This model was generated from a structural model based on the domestic market surplus, which can be used to indicate Brazil's foreign beef sales. The volume exported in the equilibrium was determined through the balance between this foreign sales equation and the foreign demand for Brazilian beef. Miranda (2001) acknowledges that the imported good is not a perfect substitute for the domestic good and that there is not perfect substitution between Brazilian beef and beef from other countries in the international market.

The analysis by Miranda (2001) assumed perfectly elastic international demand and the functional model forms were estimated through an ordinary least square (OLS) estimation method. The first equation estimated by Miranda (2001) had the exported volume as the dependent variable. The second equation used the average price of Brazilian beef exports as the dependent variable. The residuals were examined in order to identify the presence of outliers, which might indicate the effects of non-tariff barriers. Miranda (2001) found that the following explanatory variables were significant in determining Brazil's beef exports to the EU: the steer price in the Brazilian domestic market (which had a negative coefficient, indicating a negative price elasticity relative to the quantity of beef exports to the EU); the real exchange rate between the Brazilian currency and the U.S. dollar lagged by one period (which had a positive coefficient); seasonality (which indicated that in the livestock harvest months--February until July--exports increase); beef exports from Argentina (with a negative coefficient, indicating substitution between Brazilian and Argentinean beef suppliers in the European market); and domestic income (with a negative coefficient, indicating that income has a negative correlation with the quantities of beef exported).

Approach Used in the Current Analysis

In the current analysis, the same explanatory variables found to be significant by Miranda (2001) were introduced as transfer functions in the Box-Jenkins model.[4] These explanatory variables are presented in the next section. It is also important to mention that we did not

[4] For details on Box Jenkins models see Box and Jenkins (1976) and Enders (1995).

assume perfectly elastic demand since Miranda (2001) concluded that Brazilian beef exports had influenced the prices of beef exports to the EU.

Other variables representing sanitary events, technical requirements, and other types of events relevant to the beef export sector, such as changes in foreign agricultural policies, were modeled through intervention variables, following Box and Tiao (1975), Jenkins (1979), and Vandaele (1983).

Thus, we included some dummy variables (representing specific events or actions) in the intervention model. These dummies were selected based on interviews (see below) and the main events that occurred in the domestic and international markets that could affect beef exports. These dummy variables are presented in Table 1.

Table 1. Summary of the intervention variables tested in the model for beef exports

Year	Month	Event (Intervention variable)
1995	January	The WTO, the SPS and the Agriculture Agreement took effect
	March	Temporary three-month restriction by the European Community on importing fresh beef from São Paulo and Minas Gerais states (Brazil)
1996	March	EU bans beef imports from United Kingdom
	June	The government rule nº 304 (Brazil) took effect to set up the requirements of the bovine meat commercialization in quarters, and standard, classified, identified, and packaged cuts
1998	March	FMD outbreaks in Porto Murtinho/Mato Grosso do Sul (MS) – Brazil
	May	Rio Grande do Sul (RS) and Santa Catarina (SC) states (Brazil) declared free from FMD with vaccination
	June	Partial interruption of the ban on British beef exports
	October	FMD outbreak in Naviraí County/MS - Brazil
1999	July	Ending of the *Calf Processing Aid Scheme* (CPAS) in the European Community
	December	Release on the reforms of the Common Agriculture Policy (CAP) - Agenda 2000, to be implemented in July 2000
2000	May	Argentina, RS, and SC recognized as FMD free zones without vaccination; and the Center-West Circuit (Brazil) recognized as FMD free with vaccination
	July	Final reduction in import tariffs on beef imported by the European Community, according to the tariff reduction schedule under the Uruguay Round Agreement
	August	FMD outbreaks in Jóia County/RS (Brazil)
	September	Canada, US, Central America, Venezuela, and Caribbean lifted bans on Argentinean beef exports that had been due to FMD problems

Using a time-series approach we can identify the intervention effects directly through the own data generating process of the time-series. Consider a stochastic process Z_t, with the exported volume to the EU in one case, and the average export price in the other case. Then, following Jenkins (1979) and Vandaele (1983):

$$Z_t = U_t + N_t \quad (1)$$

where U_t is the share of Z_t explained by X_t (the explanatory variable responsible for that part of the change that occurred in Z_t, due, for instance, to the exchange rate, income, and so on) and by ε_t (representing the intervention variables), and N_t is the error term. Thus we can also write:

$$U_t = f(X_t, \varepsilon_t, k) \tag{2}$$

where k represents the deterministic term.

The following transfer function is used to represent the relationship between U_t, X_t, and ε_t. The lags' parameters comprise b and d, which are the moment the explanatory and the intervention variables start, respectively, to influence U_t:

$$U_t = c + \frac{\omega(B)}{\delta(B)} X_{t-b} + \frac{\lambda(B)}{\gamma(B)} \varepsilon_{t-d} = c + V(B)X_t + W(B)\varepsilon_{t-d} \tag{3}$$

The transfer function V(B) comprises a moving average operator $\omega(B)$; an autoregressive operator $\delta(B)$; and a lag parameter b, describing the total number of delays necessary for X_t to have an effect on Z_t. Additionally V(B) must be convergent, that is, the roots of $\delta(B) = 0$ and $\omega(B) = 0$ must be within the unit circle.

The W(B) function is a specific case of a transfer function, a dynamic representation of the intervention variable that also comprises a moving average operator $\lambda(B)$, an autoregressive operator $\gamma(B)$, and a lag parameter d, describing the delay necessary for ε_t to have an effect on Z_t.

The residual term can also be represented by an ARIMA[5]:

$$N_t = \frac{\theta(B)}{\phi(B)} a_t \tag{4}$$

Substituting equations 2, 3 and 4 into equation 1 results in the transfer function, which includes the special case for intervention variables:

$$Z_t = c + \frac{\omega(B)}{\delta(B)} X_{t-b} + \frac{\lambda(B)}{\gamma(B)} \varepsilon_{t-d} + \frac{\theta(B)}{\phi(B)} a_t \tag{5}$$

It is worth mentioning that the identification of the model structure consists of determining the order of all the polynomials in equation 5.

The first step in analyzing the impact of intervention variables is to check if the event or intervention being analyzed shifts the level of the time-series (for export volumes or export prices) smoothly or drastically, or if it shifts its trend. Afterwards, the intervention analysis is applied. Shifts in series Z_t caused by an exogenous event may be immediate or lagged, temporary or permanent. So the representation of these intervention variables can be classified into two types: pulse (effect occurs only in a single time T) and step (continuous

[5] ARIMA is an autoregressive integrated moving average model, which becomes stationary by differencing the data (see Enders, 1995, p.95).

from the time T forward). There is also an intermediate case when the intervention occurs during a time break, which causes changes in the level or steepness of the Z_t series. Vandaele (1983, p.335) describes the different types of responses to a step or pulse intervention function, which is important for modeling each intervention listed in Table 1.

Miranda (2001) applied causality tests, as indicated by Granger (1969) and described in Gujarati (1995), in order to support the choice of variables in the models, particularly in the transfer functions. This paper has adopted Miranda's choice of variables.

In order to evaluate whether or not the series are stationary, all the time-series data were also checked for unit roots using the augmented Dickey-Fuller test (ADF).[6] The procedure employed to verify unit roots as well as to test for cointegration[7] between each pair of time-series variables follows Engle and Granger (1987) and is described in Enders (1995). All the models and tests were run through the 4.0 Regression Analysis Time Series (RATS) program (Doan 1994). The Box-Jenkins estimation was done through an interactive process, which uses the Gauss-Newton algorithm.

DESCRIPTION AND SOURCES OF DATA

Table 2 lists the explanatory variables as they appear in the tables of results, and also includes brief descriptions and sources of data for each variable.

Table 2. Explanatory variables used as transfer functions in the models

Name of variable in the model	Description	Source of data
VDTUE (Dependent)	Quantity of front/back special cuts exported by Brazil to the EU	ABIEC
SAZ and SAZON	Seasonality variables	RATS program
TXREAL	Real exchange rate (R$/US$)	IPEA
VXARG	Quantity of fresh/chilled beef exported by Argentina	SAGyP
PBREAL	Real Brazilian steer prices	IEA
RPBRARG	Ratio of Brazilian export price (to the EU) to Argentinean price	Calculated using pdtuen and pnarg
PRDIANT	Real wholesale beef price (front quarters)	Boletim Intercarnes
RBRAS	Proxy for domestic income: real average revenue of workers (over 15 years old)	IBGE
PDTUEN (Dependent)	Average nominal export price for Brazilian special cuts (fresh and chilled beef) to the EU	ABIEC (calculated)
PNARG	Average export price for Argentinean fresh/chilled beef	SAGyP
TREND	Trend	_
D_mmyy{}	Intervention results. D means dummy and the four numbers after this letter (see results in Table 3 and 4) correspond to the month (mm) and the year (yy) of the shock. The number in {} is the lag of the term's numerator (or denominator)	Table 1

[6] For more details, see Enders (1995, p.225).

[7] If two non-stationary sequences yt and zt are integrated of the same order and the residual sequence is stationary, they are said to be cointegrated. For more details, see Enders (1995, p. 355).

The study used monthly data for January 1992 through December 2000. This period was chosen primarily because of the availability of data provided by Miranda (2001). Moreover, this period was significant in terms of sanitary issues in Europe (i.e., Bovine Spongiform Encephalopathy outbreaks) and South America (i.e., FMD outbreaks), and because it coincided with the Uruguay Round results and the launch of the SPS Agreement under the scope of the WTO.

Export Volumes and Prices

Monthly data on quantities and average prices (calculated from the exported values and quantities) for fresh and chilled cuts of beef exported to the EU were obtained from the Associação Brasileira das Indústrias Exportadoras de Carne Bovina (Brazilian Association of Beef Exporting Companies) or ABIEC. Figure 1 presents quantities of exports and highlights some events or potential intervention variables.

Brazil's domestic steer prices and beef wholesale prices were obtained from the Instituto de Economia Agrícola (IEA) and the Boletim Intercarnes[8], and deflated by an index of general prices[9] based on prices in January 2001 (IPEADATA, 2001). Monthly data for Argentinean prices and exported volumes of beef *in natura*, which is comprised of fresh, chilled, frozen and edible offal, were collected from the Secretaria de Agricultura Ganaderia y Pesca (SAGyP).[10]

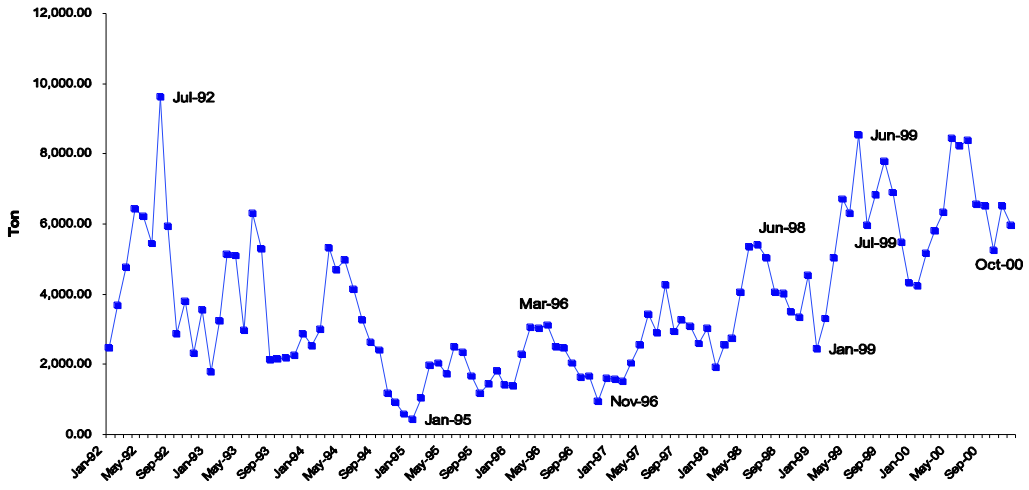

Figure 1. Brazil's exports of special cuts (fresh and chilled) to the EU (in tons), January 1992 - December 2000. Source: ABIEC.

Figure 1 indicates that Brazil's beef exports may also have a seasonal component. Miranda (2001) calculated seasonality indexes (based on the geometric moving average) for bovine prices in Brazil and beef exports to the EU, and found that harvest and non-harvest

[8] INTERCARNES. Data Bulletin. Several issues (1992-2000). Published daily and released through fax.

[9] The index is the Índice Geral de Preços – Disponibilidade Interna (IGP-DI)/Fundação Getúlio Vargas (FGV).

[10] See http://siiap.sagyp.mecon.ar/http-hsi/bases/expmes.htm.

periods clearly affected both steer prices in Brazil, which tend to be low from February to July, and exports, which are high from March to August. This suggests that seasonal variables should be included in the model.

Exchange Rates

The source for the nominal exchange rate series (R$/US$) was the Instituto de Pesquisas Avançadas (IPEA, 2001). The exchange rate was deflated to real values by the IGP-DI (Brazilian General Price Index) and by the Producer Price Index (U.S. Bureau of Labor Statistics, available at http://stats.bls.gov/datahome.htm).[11]

Figure 2 shows the real exchange rate time series.

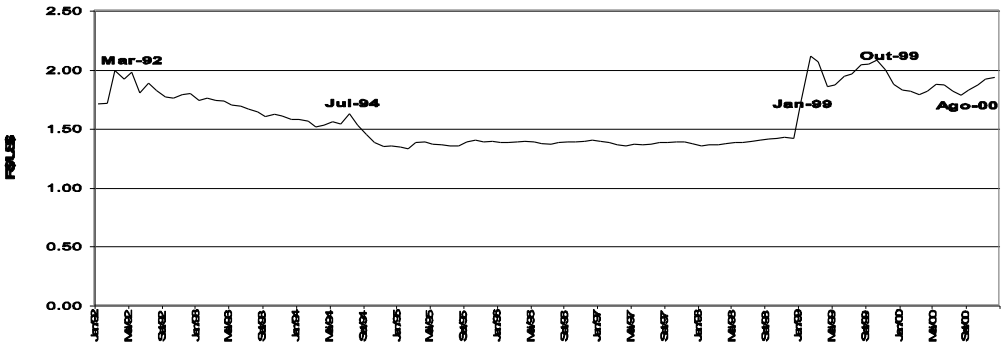

Figure 2. Real exchange rate for Brazil. January 1992 – December 2000. Source: IPEA.

Domestic Income

The proxy for domestic income was the nominal average revenue for people who were both employed and over 15 years old (Pesquisa Mensal de Preços – IBGE, 2001), also converted to real values using the IGP-DI.

Interviews with Brazilian Beef Exporters

Ten slaughterhouses involved in the beef exporting business were visited and interviews conducted in order to collect information on sanitary and technical issues affecting the beef market. This sample of slaughterhouses, which all belong to ABIEC, represented about 70.1 percent of the total value and 66.5 percent of the total volume of beef exported *in natura* in 2000. According to Miranda (2001), from 1990 to 1998, the companies belonging to ABIEC accounted for at least 90 percent of Brazilian beef exports, on a volume basis. Figure 3 shows

[11] A better choice for the exchange rate may be the real to ECU rate (the Euro-only rate started in 1999), that is, an effective real exchange rate based on a basket of European currencies. Thus the results presented here that are related to the exchange rate should be interpreted with caution. Nonetheless, the evolution of the real to dollar rate was similar to the effective real rate for most of the period (www.ipeadata.gov.br).

the trends in exports for all companies belonging to ABIEC,[12] which accounted for 67 percent of all Brazilian beef sold in 2005.

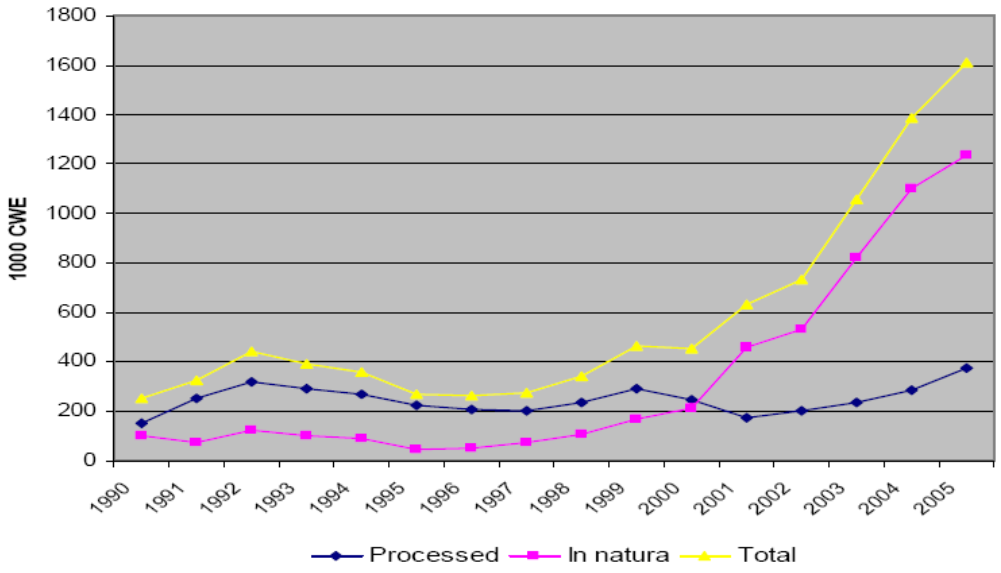

Figure 3. Beef exports by companies belonging to ABIEC, by type (in thousand tons of carcass-weight equivalent (CWE)), 1990 to 2005. Source: ABIEC.

RESULTS AND DISCUSSION

In order to better understand the impacts of sanitary and technical events on Brazil's export performance, the results presented here focus on those models estimated with variables in logarithms and in level form. A similar procedure was adopted in Marsh (2003), which estimated the structural equations for the domestic beef market in the US with variables in level form, based upon the findings of DeJong et al. (1992) and Johnson and DiNardo (1997).

Tests indicated that some variables have unit roots, suggesting the need to difference the time-series data. However, as pointed out by Vandaele (1983), with differenced time-series data it becomes more difficult to identify the exact time when an intervention or shock takes place. Indeed, he cites this as a caveat to his analysis. In addition, DeJong et al. (1992) shows that for small samples the ADF test is weak against the trend-stationary alternative. Such could be considered to be the case for this study. Moreover, Vandaele (1983) and DeJong et al. (1992) do not recommend performing cointegration tests for sample sizes with fewer than 100 observations. With about 108 observations, the time series used in this paper is on the edge of what is recommended.

Nonetheless, unit root and cointegration tests were carried out in the current analysis. Most of the time-series were found to be non-stationary and integrated of first order, except for the dependent variable *vdtue* (quantity of beef exported by Brazil to the EU) and the explanatory variable *pbreal* (domestic price of steer in Brazil), which were found to be

[12] Data on the total number of companies belonging to ABIEC in 2005 were not available.

stationary.[13] Additionally, the results of the cointegration tests indicated that none of the pairs of variables tested were cointegrated.

Model for Quantity of Beef Exported to the EU

The first case analyzed concerns the fresh and chilled cuts exported to the EU and the first model was fitted for their exported volumes (*vdtue*). All the series were transformed to logarithms. Following the approach of Miranda (2001), the transfer functions were constructed using the variables presented in Table 3, which also shows the best fit when the Box-Jenkins model was applied to quantities of *in natura* beef (fresh and chilled cuts) exported to the EU.

The results of the intervention model were quite similar to those in Miranda (2001), when an econometric model was used to estimate the elasticities of the explanatory variables relative to Brazilian beef exports. The Q test (Ljung and Box, 1979, described in Gujarati, 1995) showed goodness-of-fit of the model. The quantity exported by Argentina showed a significant and negative coefficient (-0.48), which indicates a substitution effect between Brazilian and Argentinean exports of fresh and chilled beef to the European market. Another important result is that an increase in Brazilian domestic income during the time period may have caused a reduction of –1.62% in Brazilian exports of beef to the EU. Although Miranda (2001) found the exchange rate to be a very relevant determinant of foreign sales of beef, it was not very significant in the transfer function and intervention model estimated here.

The seasonality variables were also significant in explaining exports, confirming that in the dry months (lower pasture availability) for bovine production, exports tend to be positively affected.

The intervention variables presented in Table 1 were modeled as pulse or step variables. In general they did not show relevant impacts over the volume traded. Although one can notice the outcomes for the shocks in January 1995, March 1996, and July 2000 presented in Table 3, only the intervention for January 1995 had statistically significant coefficients. This variable (shock) relative to January 1995 was defined as (m,l,d) = (0,1,0), where *m* is the auto-regressive component, *l* is the moving average component and *d* is the lag. This profile determines the way this intervention acts on the dependent variable. This shock had an immediate and negative impact on Brazilian exports to the EU (*vdtue*), estimated at -0.76 percent, from the time it occurred in January 1995. In the next period this shock was attenuated by a positive effect, reducing the original negative shock on exports to 0.52 percent. This kind of intervention pattern is illustrated in Figure 4, which is based upon the work of Vandaele (1983).[14] It is called a "step" intervention variable and acknowledges that since January 1995, there has been a permanent effect on exported volumes, which originated with the initial shock in January 1995. However, these results must be interpreted carefully because even when the effect of a shock is identified, there can be other simultaneous

[13] As the Akaike and Schwartz tests were not conclusive for *vdtue* and *pbreal*, the unit root tests were performed twice. The first test considered a lag of 1 for both variables. In this case, the outcome was stationary. However, when the tests were performed again with a lag of 7, these two time-series became non-stationary of order 1.

[14] This author presents several representations of simulated dynamic effects of intervention variables.

occurrences in the market that diminish or augment the previous effects and interact with them.

Table 3. Results of Box-Jenkins model for Brazilian beef exports to the EU. January 1992 –December 2000

Model: Q(24,1) = 24.89* $\overline{R^2}$ = 0.92 Dependent variable = LVDTUE[1]		
Variables	Coefficient	Test "t"
Constant	25.62*	4.41
AR(1)	0.28**	2.16
N^2_SAZ{0}	0.13	1.28
N_SAZ{1}	0.008	0.05
N_SAZ{2}	0.12	0.89
N_SAZ{3}	0.46*	3.15
N_SAZ{4}	0.62*	3.92
N_SAZ{5}	0.60*	3.10
N_SAZ{6}	0.70*	3.57
N_SAZ{7}	0.43*	2.24
N_SAZ{8}	0.19	1.26
N_SAZ{9}	0.15	1.19
N_SAZ{10}	0.08	0.73
N_TXREAL{1}	0.59	1.27
N_VXARG{1}	-0.48**	-2.47
N_PBREAL{1}	-0.80	-1.46
N_RPBRARG{0}	-0.23	-0.77
N_PRDIANT{1}	-0.47	-1.50
N_RBRAS{1}	-1.62**	-2.17
N_TREND	0.002	0.12
N_D0195{0}	-0.76*	-2.90
N_D0195{1}	0.52**	2.13
N_D0396{1}	-0.01	-0.06
N_D0396{2}	-0.35	-1.27
N_D0396{3}	0.03	0.12
N_D07{0}	0.32***	1.75
N_D07{1}	1.42*	4.41
N_D07{2}	-0.44	-1.39

* Significant to 1%; ** Significant to 5% *** Significant to 10%.

[1]Data in logarithms. See Table 2 for variable definitions. The "N" in front of the intervention variables means that the coefficient is related to a numerator term from the transfer function established to represent the intervention variable itself. The number that follows the name of the intervention variable indicates the order of this term in the numerator. So, the {0} means that the coefficient expresses the effect of the own intervention when it occurs. When the number 1 follows the first term of the numerator, the corresponding coefficient represents the intervention effect that is only felt in the following time, that is, the lag is equal to one.

The coefficients presented in Table 3 also indicate that the intervention variable July 2000 had a positive effect on *vdtue*. Three parameters in the numerator of the mathematical expression represent this intervention. The coefficients for the intervention at the time period it occurred (N_D07 {0}) and in the following period (N_D07 {1}) were both positive and significant.

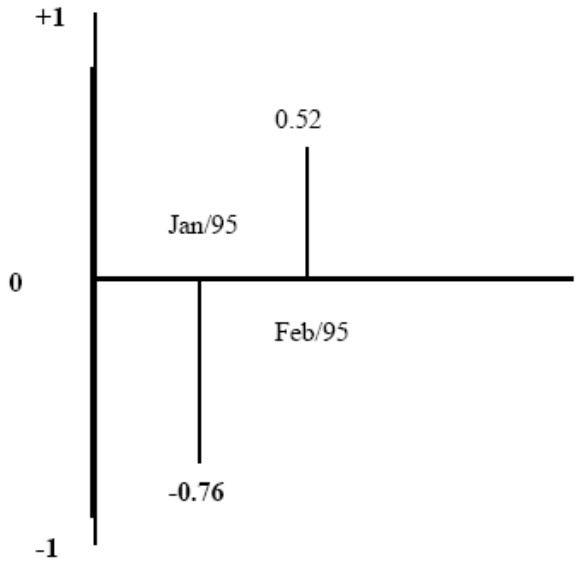

Figure 4. Pattern showing effect of intervention variable (shock in January 1995) on exports (vdtue). (Adapted from Vandaele, 1983).

The residuals series from the model in Table 3 suggests that although several interventions and explanatory variables were statistically significant, there were still some outliers that could not be explained, either in the literature or from the interviews. More specifically, there were outliers in May 1993, December 1994, and November 1996 (see Figure 5), which did not appear to be related to any relevant event in the beef market.

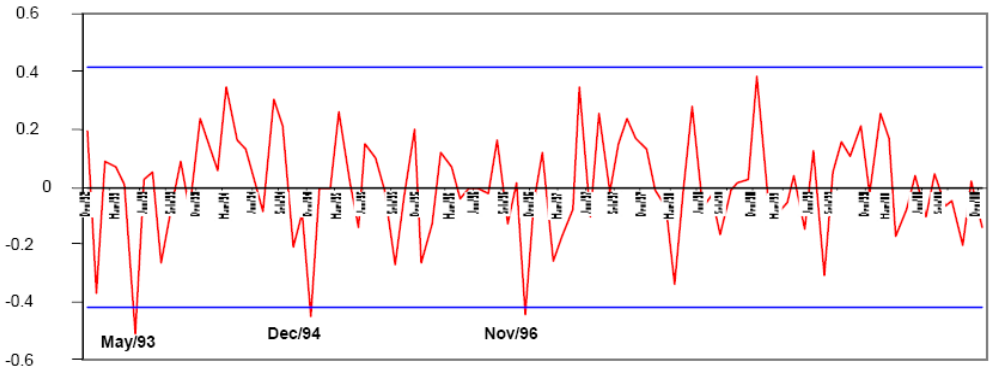

Figure 5. Residuals series for the intervention model (Table 3) for Brazilian beef exported to the EU.

Model for Export Prices

In addition to applying the Box-Jenkins model to the exported quantities, we ran a model for the average prices negotiated for beef exports to the EU market (*pdtuen*), Again, we employed transfer functions built around variables identified by Miranda (2001) as being determinants of Brazilian export prices for beef.

Miranda (2001) found negative and significant coefficients for the real exchange rate lagged by one period, indicating that the expectation of exchange rate devaluation induces a reduction in the export price in dollars. This conclusion was also supported by findings from the interviews with Brazilian slaughterhouses that export beef. Moreover, according to Miranda (2001), the negative coefficient for the real lagged exchange rate in the model run for export prices and the positive coefficient found for the exchange rate variable in the model for export volumes imply that an exchange rate devaluation causes an increase in the quantity of exports and a reduction in the prices for those exports, suggesting that Brazil has some influence on this market. As a result, Miranda (2001) notes that it is possible to question if, in fact, the EU demand for Brazilian beef is perfectly elastic.

The same procedure for estimating the Box-Jenkins model for *vdtue* was adopted to estimate the model for the nominal average export price (*pdtue*)[15]. In this case, the variables considered were: domestic cattle prices; the prices for Argentina's beef exports to the EU; the real exchange rate; and the intervention variables presented in Table 1. As with the quantity of exports model, the explanatory variables were transformed into logarithms and run in level in order to observe the impacts of shocks directly on the time-series analyzed.

In the Box-Jenkins models with transfer functions and intervention variables, the domestic prices for cattle in Brazil and the prices for Argentina's beef exports to the EU both had significant and positive coefficients, suggesting that when these variables change, the prices for Brazil's beef exports will move in the same direction (see Table 4).

The estimated coefficient for the shock in March 1995 indicates a reduction of 0.07 percent in the average export price in the three following months, starting from March (Table 4). In March 1995, the European Community suspended beef imports from Brazil's São Paulo and Minas Gerais states for sanitary reasons. This ban lasted for three months and might have been responsible for the statistically significant negative effects identified by the model presented above. Viglio (1996) emphasizes that commercial sanctions due to FMD vary a lot. Reporting on the EU's temporary ban on Brazilian beef imports in 1995, she notes that although a European inspection of sanitary conditions resulted in the removal of the ban after three months, it would have been impossible to change the herd sanitary conditions in such a short time.

Concerning the result for May 1998, an intervention "step" variable was modeled for subsequent months to account for the fact that an increase of Brazilian exports was expected to happen, because the OIE had just declared Brazil's South-Circuit to be a FMD free area with vaccination. It was expected that this declaration could favor Brazil's performance in export markets. However, only the denominator of the coefficient for the intervention variable

[15] The use of nominal prices in this context is recommended because the objective of the analysis is to capture the change in prices as an effect of changes in intervention variables. The use of real prices would lead to variations in prices due to inflation, and not necessarily related to specific changes in the market, being analyzed and thus make it more difficult to detect the effects of interest in this study. It is important to note that as is true for the sample period as a whole, the dollar inflation rate was very low: 1.8 percent per year.

May 1998[16] (see Table 4) was statistically significant, which is very difficult to interpret in economic terms.

Table 4. Results of Box-Jenkins model for Brazilian beef exports to EU. Dependent variable: nominal average prices of beef exports (US$/ton). January 1992 – December 2000

Q(26,2) = 27.74 Dependent variable = LPDTUE		
Variable	Coefficient	Test "t"
Constant	6.88*	6.39
AR(1)	0.61*	5.91
AR(2)	0.32*	3.08
N_SAZON{0}	0.002	0.15
N_TREND{0}	0.001	0.24
N_PBREAL{1}	0.25*	2.55
N_PNARG{1}	0.20**	2.28
N_PNARG{2}	-0.15	-1.62
N_TXREAL{1}	0.08	0.53
N_D0395{0}	-0.07***	-1.71
N_D0598{1}	0.08	1.22
N_D0598{2}	-0.10	-1.56
D_D0598{1}	0.94*	11.36

* Significant to 1%; ** Significant to 5% *** Significant to 10%.
[1]Data in logarithms. D denotes denominator and N denotes numerator.

CONCLUDING REMARKS

The objective of this article has been to propose a new approach that uses intervention models to evaluate the impacts of non-tariff trade barriers, particularly sanitary measures, and to apply it to the case of Brazilian beef exports. The results suggest that the volume of Brazilian exports of *in natura* beef products to the European Union are influenced by European demand conditions and both Brazilian supply and demand conditions, in particular those related to the cattle and wholesale markets. The real exchange rate and domestic income also help to explain changes in the quantities exported between 1992 and 2000.

Concerning the sanitary events examined and their impact on trade, the intervention model showed significant coefficients only for a few events that had been previously suggested by the literature and the interviews conducted for this study. The most remarkable outcome was the intervention variable estimated for March 1995, when exports of Brazilian beef were suspended by European countries for three months due to FMD. Export prices were also pushed downwards for all of that period.

At least three reasons may explain the difficulty in measuring the impact of this type of intervention variable (i.e., sanitary events). First there are limitations to establishing the exact

[16] The transfer function to represent the shock in May 1998 and its behavior since then was defined by the following parameters: (m,l,d) = (1,1,1).

time pattern of the shock in order to specify its correspondent intervention function. Second there is the regionalized effect of sanitary events on trade flows: impacts could be distinct according to the exporting zone and its specific sanitary status. Finally, other events or actions that occur around the same time as a specific sanitary event can jeopardize the observation of its distinct impact and make it very difficult to isolate its consequences.

Even though the results of this case study were not very statistically significant, we still find intervention models to be a useful instrument and recommend them for evaluating the impacts of sanitary and other non-tariff barriers. This approach improves on the use of simple dummy variables in econometric models, which miss the dynamic effects of intervention variables that are captured through the use of transfer functions.

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THE EXPORT-PRODUCTION DECISION OF CHILEAN FARMERS: THE CASE OF BLUEBERRY PRODUCERS

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ABSTRACT

This article analyzes the relative importance of producers' attributes and farms' geographical characteristics in the decision to produce an exportable good (blueberries) in the southern region of Chile. Using farm-level data, a logit model is estimated to identify factors influencing the export-production decision. Results show that the probability of producing blueberries increases with the educational level of producers (a proxy for productivity), the presence of irrigation and drainage systems, and the availability of labor. The last factor, which arises from the proximity to large and urbanized regions, has a stronger effect on the export-production decisions of Chilean farms than either farmers' education or farms' physical characteristics.

Keywords: Agricultural Trade, Export Production, Geography.
JEL Codes: F11, Q17, O13.

INTRODUCTION

The integration of Chile's economy into international markets during the last few decades has led many local firms to orient their production towards foreign markets. Agriculture, particularly the fruit sector, has responded very positively to this trend, taking advantage of selling in the northern hemisphere's off-season markets. In fact, Chilean fresh fruit exports have grown from $160 million in 1980 to more than $1.8 billion in 2006 (ODEPA, 2008).

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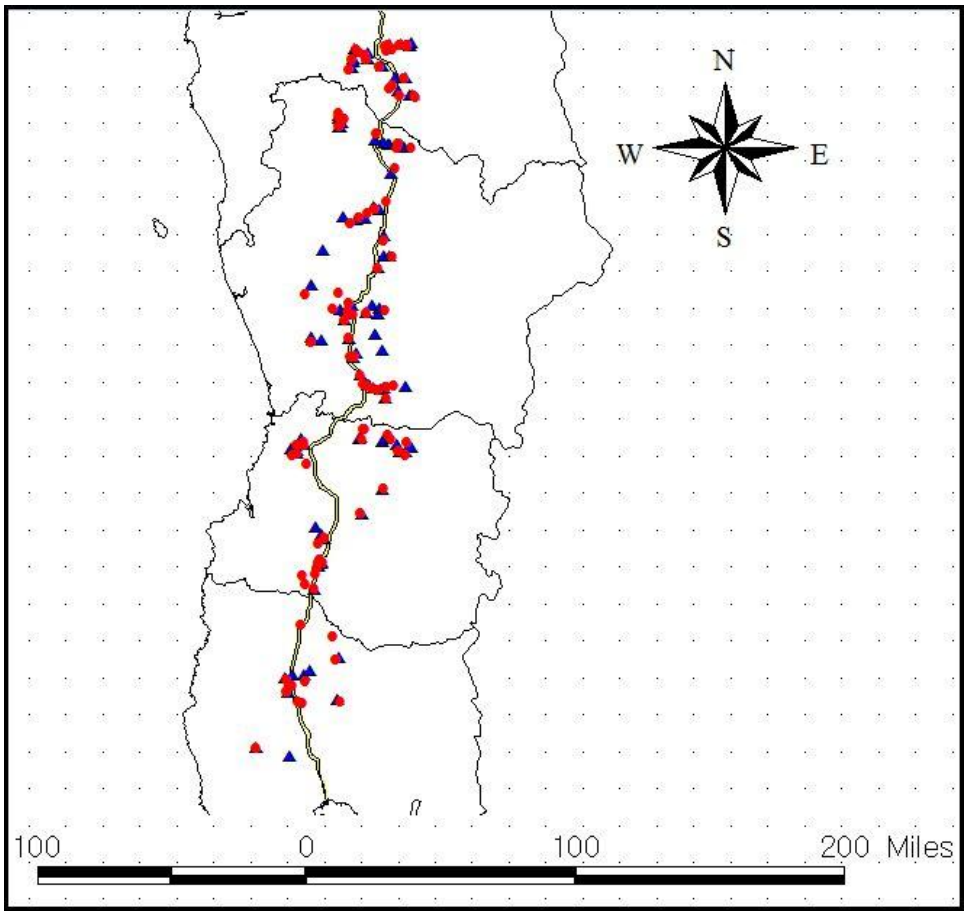
The growth of agricultural production and exports in Chile has been geographically uneven. For example, producers located in the north and central Chilean zones (the Tarapacá and El Maule regions) have witnessed rapid growth in agricultural production and exports. In fact, more than 90 percent of agricultural exports in 2007 were produced in these zones. On the other hand, southern farmers are considered to be traditional producers, i.e. their production of beef, wheat and dairy products is aimed mainly at the domestic market. The most common reason cited by southern farmers for not producing export-oriented products such as fruits is that the region's geographic characteristics (e.g., soil type) severely limit the production possibilities of their farms.

Nevertheless, the production of blueberries - a product that is mostly exported - has expanded considerably in Chile's southern regions in recent years. Moreover, the spatial distribution of farms producing blueberries indicates that blueberry producers and traditional producers are located side by side in several micro-regions (see figure 1).



▲ Traditional producers.
● Blueberry producers.
Source: Centro de Información de Recursos Naturales (2007).

Figure 1. Spatial distribution of traditional and export-oriented producers in southern Chile.

This conflicts with the common perception that regional geographic characteristics are the major determinant of the choice between producing exportable versus traditional products. In particular, the finding about the spatial distribution of blueberry production raises the possibility that other factors, such as producer-specific attributes and farm-specific geographic characteristics, may play an important role in the export-production decision.

The firm's decision to produce for foreign markets and export, commonly called the export decision, has been studied extensively for manufacturing industries. In general, these studies have found that exporting firms are larger and more capital intensive, pay higher wages, hire more skilled workers, and, importantly, are more productive than non-exporters (Bernard and Jensen, 1995; Bernard et al., 2007; Wagner, 2007). Previous studies have placed special emphasis on the role of productivity in the export decision because productivity is related to firms' competitiveness and economic growth. In fact, productivity seems to be the main factor that differentiates exporters from non-exporters (Melitz, 2003), although the causality between productivity and exports is not clear. Several studies have focused on whether productivity is a cause of exports (the self-selection hypothesis) or export activity is the cause of higher productivity (the learning-by-exporting hypothesis) (Aw, Chung and Roberts, 2000; Bernard and Jensen, 1999; Clerides, Lach and Tybout, 1998; Delgado, Farinas and Ruano, 2002; Girma, Greenaway and Kneller, 2004).

Some studies have focused on factors other than productivity that could be relevant to firms' export decisions. For example, in a study of spillover effects of exporters on non-exporters due to their proximity to each other, Aitken, Hanson and Harrison (1997) found that the presence of multinational companies in a specific geographical area positively affects the decision to export by domestic firms that are located in that area. On the other hand, using a dynamic model, Roberts and Tybout (1997) found that a firm will export only if the expected benefits of exporting are greater than the sunk costs involved in the export process. Although there has been extensive research on the impact of geographic characteristics on industrial production decisions (e.g., Fujita, Krugman and Venables, 1999; Fujita and Thisse, 2002), few studies have used firm level data to consider the role of such factors in firms' export decisions. Most research has controlled for the effect of geographic characteristics using only categorical variables such as regional or provincial indicators (e.g., Aitken, Hanson and Harrison, 1997).

While there have been advances in the study of the export behavior of manufacturing firms, little is known about the export behavior of agricultural firms. Some studies have explored the link between productivity and agricultural exports, but only at an aggregated level (Arnade and Vasavada, 1995; Gopinath and Carver, 2002). And, although some studies have analyzed the production decisions of agricultural firms (Katchova and Miranda, 2004), none of them has focused on the export-orientation of production.[1] Any analysis of farms' export behavior must recognize that agriculture differs considerably from the manufacturing industry. In fact, in the Chilean case, most farmers do not export directly. Rather, exporting agribusiness firms buy farmers' products, make the export decision, and sell the products in foreign markets (Echeverria and Gopinath, 2008, Forthcoming). This implies that Chilean farmers only produce with an "orientation" towards foreign markets.

[1] An exception here is the study by Echeverria (2006), who found that farm-specific characteristics were more relevant than regional geographic characteristics in the export-production decisions of Chilean farmers.

The objective of this study is to analyze the export-production decision of Chilean farmers. In particular, we evaluate the relative impact of producers' attributes and farm-specific physical and geographic characteristics on the decision to produce an exportable good - blueberries - in southern Chile.[2] It is important to note that this study does not examine the *absolute* effect of geographic variables on the decision to produce exportables, but rather the *relative* effect of these variables when the production decision is compared among neighboring farms. More specifically, using farm level data, we evaluate whether farm-specific geographical variables make a farm inherently better suited for export production rather than traditional production. If this is not the case, we attempt to identify those producer-specific characteristics that affect the production choice.

The rest of the article is organized as follows. In the next section, we present a simple logit model for analyzing the export-production decision of farms. We then describe the dataset. This is followed by a discussion of the analysis and the results of the modeling exercise. In the final section, we present some policy implications of our findings.

THE MODEL

Although existing export-decision models work well in the context of manufacturing industries, they are generally not well suited for explaining the export-production behavior of agricultural firms (farms).

As mentioned above, Chilean farms often do not export their products directly. Instead, marketing firms make the export decision, with farms' export participation limited to producing the commodities or goods that will subsequently be exported. Thus, because it is these marketing firms that actually make the export decision in Chile, we employ a simple model that is based on the approach of Aitken, Hanson and Harrison (1997), who studied the export behavior of manufacturing firms in a static context.[3]

We assume that farms can produce domestic-oriented products (i.e., traditional products), exportables, or both. The production of exportables differs from the production of traditionals in both prices and costs.

The production of exportables is desirable because of their higher prices. However, production is constrained by the cost function, which is determined by farm-specific geographic characteristics (e.g. soil type, availability of water for irrigation) and some producer-specific attributes (e.g. productivity, age of the farmer). We assume that the production cost function of traditionals is also constrained by geographic characteristics and/or producer attributes.[4] Thus, to make its production decision, a profit maximizing farm *i* will calculate the following:[5]

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[2] Unlike Echeverria (2006), the focus here is only on blueberry production, more than 90 percent of which is exported. Clearly, farmers that produce only blueberries have more of an export orientation than other farms.

[3] Dynamic models, such as the one proposed by Roberts and Tybout (1997), cannot be used in this study due to the nature of data.

[4] In practice, geographic characteristics seem to have less of an effect on traditionals than exportables because all farms produce at least a traditional product. However, for the sake of simplicity, we do not include this factor in our model.

[5] For simplicity, we have suppressed the superscript i in this equation.

$$\max_{q_t, q_e} \{[p_t q_t - c_t(q_t, S, G)] + [p_e q_e - c_e(q_e, S, G)]\}$$
$$s.t. \quad q_t, q_e \geq 0 \tag{1}$$

where *t* and *e* indicate traditional and exportable production, respectively, *p* represents product prices (not necessarily specific to the farm), *q* represents the quantity of production, c(·) are the production cost functions, *S* represents the producer-specific attributes, and *G* represents the farm-specific geographic characteristics. We assume that the production cost functions are increasing and convex in their respective arguments.

The optimal output choice may be zero for either kind of production. All firms produce positive quantities of traditional products but, in practice, firms can produce zero export-oriented products. Using this framework, we estimate the probability that a farm will produce exportables. Let the dummy variable y^i be:

$$\begin{cases} y^i = 1 & \text{if} \quad q_e^i > 0 \\ y^i = 0 & \text{otherwise,} \end{cases} \tag{2}$$

which indicates whether or not a farm *i* has positive production of exportables. Equation (2) assumes that the decision to produce exportables is a continuous latent variable (q_e^i) that can be observed only in two stages: produce exportables ($y = 1$), or not ($y = 0$). The estimation of the discrete choice model in equation (2) allows us to obtain consistent estimates of factors underlying the optimal solution to q_e^i . Note that the probability that *y* will take the value 1 is equal to the probability that the latent variable q_e^i is greater than zero (Long, 1997). So, it follows from equation (2) that the probability that the *i*-th farm will produce exportables is given by:

$$\Pr(y^i = 1) = \Pr(y_e^i > 0) = \Pr(\alpha + \beta S^i + \gamma G^i + \varepsilon^i > 0), \tag{3}$$

where ε^i is the random error; S^i is a vector of farm- or producer-specific characteristics (e.g. education, size, age) arising from the production cost function, and β is the associated parameter vector that measures the relative importance of these characteristics to the probability of export production; G^i is the vector representing farm-specific geographic characteristics, and the parameter vector γ measures their relative importance to the probability of export production.

THE DATA

The analysis of farms' export-production decisions requires data on both export-oriented and domestic-oriented producers. Export-oriented producers are relatively rare, which means that a completely random sample may not allow for a comparison between the two types of

producers (Bernard et al., 2007). Indeed, according to the 2007 Chilean Agricultural census (Instituto Nacional de Estadísticas, 2007), only 5 percent of farmers export directly or indirectly. Thus, in order to include export-oriented producers in the sample, we first selected a random set of producers from all export-oriented producers and then randomly selected another set of producers from those that are domestic oriented. This two-step process is explained in more detail below.

Selection of Producer Samples

In the first step, export-oriented producers were selected from a database of the Natural Resources Information Center of Chile (CIREN) (Centro de Información de Recursos Naturales, 2007), which contains information about Chilean fruit producers, including the final destination of production (i.e., domestic or foreign markets). An analysis of these data shows that more than 90 percent of blueberry production is exported. Thus, blueberry producers were treated as export-oriented producers, despite the fact that these farmers can also produce some traditional products. Blueberry producers receive invoices with prices that are based on foreign sale prices. That is, farmers are aware that they are producing for foreign markets. This implies that they know the risks, costs and benefits of making the production decision. CIREN's data are reported in a geographical information system format. This means it is possible to know the exact location of each farm. Using this geographical information, for each export-oriented producer, a traditional producer (within a 5 km radius of the export-oriented producer) was selected randomly. This method of selecting farmers guarantees that the comparison of export-oriented and traditional producers will be based on farm-specific geographic characteristics, because we have controlled for those geographic variables that are regional (e.g. temperature or precipitation levels) and hence not specific to individual farms. In this way, a random sample of 100 export-oriented producers and 100 domestic-oriented or traditional producers was selected. Figure 1 shows the spatial distribution of these producers.

Each of the farms in our sample was visited between November 2007 and January 2008, and a brief interview was conducted with each producer to obtain the farm-specific geographic characteristics and producer attributes. Next, the data for each farmer were linked to the data from the 2007 agricultural census. Because of several inconsistencies in the census data, complete information was available for only 70 farmers. It is important to note that farmers were not willing to answer personal questions about producer-specific attributes such as their educational levels, their age, and whether there is a separate farm manager, because they had already been asked these questions in the 2007 census. Thus, our econometric analysis is based on two samples: one with 200 producers, which includes only farm-specific geographic characteristics, and another with 70 producers, which includes both producer attributes and the geographic characteristics.

Geographic Variables

Farm-specific geographic variables were analyzed based on the particular location of each farm. Some of these variables had to be collected and interpreted directly by the

interviewer (with the collaboration of the farmer). In the case of blueberry producers, the analysis of variables was restricted to the area of the farm where blueberries were being produced. For traditional producers, farmers were asked to identify an area that could potentially be used to produce blueberries. This area was used to identify the value of some geographic variables, such as "irrigation", "drainage", "slope", "acidity of soil", and "access to the farm."

Irrigation is an important factor in the production of blueberries. In our analysis, this variable includes the availability of water as well as the water rights owned by farmers. It takes the value 0 if it is not possible to irrigate (i.e., no water and/or no water rights), and 1 otherwise. "Drainage" indicates the capability of soils to drain water. Soils with insufficient drainage are not suitable for producing blueberries. Thus, the variable takes the value 0 if the soil has drainage problems, and 1 otherwise. It is important to note that the irrigation and drainage variables are closely related because irrigation projects must include a drainage system.

The "slope" variable represents the slope of the area that is used for producing blueberries (or, in the case of traditional producers, the area that could potentially be used for producing them). It takes the value 0 if the terrain is almost flat (slope less than 30º), and 1 otherwise. An important characteristic of blueberries is that they grow well in acidic soils, so the variable "acidity of soil" is also included. Farm-specific soil acidity was obtained using a dataset from the Centro Tecnológico de Suelos y Cultivos (CTSyC). Soils with strong acidity received the value of 0, and 1 otherwise. The variable "access to the farm" represents the quality of roads for accessing the farm. Good quality roads make the transportation of products and labor easier. Thus, this variable takes the value of 0 if access is poor, and 1 otherwise.

Given that production of blueberries is highly labor intensive, another geographic variable included in the study was a farm-specific index of labor availability. This index depends not only on the labor supply that a geographical area can offer, but also the cost of commuting to the farm. A labor availability index (LAI) that considers labor supply and commuting is given by:

$$LAI = \left[\left(\frac{1}{DNC} \right) \times PNC + \left(\frac{1}{DNT} \right) \times PNT \right] \div 1000 \qquad (4)$$

where DNC is the distance to the nearest city, PNC is the population of the nearest city, DNT is the distance to the nearest town, and PNT is the population of the nearest town. The index is standardized by dividing by 1000. This index was created considering that farmers hire people from either the nearest city (high labor supply) or town (low labor supply). In general, a city was considered as such if its population was above 50,000 people.

It is important to note that the index captures the availability of labor in relative terms. That is, it compares labor constraints between farms based on their geographical location. For example, a farm that is located close to a big city will have higher labor availability than a farm that is located far away from this city. In the same line, if a farm is located very close to a town, it will have lower labor availability than a farm located close to a city.

Producer Attributes

Data on producers' characteristics were collected from the 2007 Chilean Agricultural Census. Variables such as education (years of schooling of the farmer, gender (male/female), age of farmer, presence of a farm manager, and farm size are included. Although the trade literature argues that productivity is an important factor that determines the export decision (Wagner, 2007), it was not possible to obtain a measurement of productivity (e.g. total factor productivity) for this study. In particular, although technical efficiency could be used as a proxy for productivity, the nature of the data made such an analysis impossible.

Farmers operate in a multi output-input context, i.e., they produce several products (e.g., grains, cattle) and use many inputs (e.g., fertilizers, labor), but each product requires a unique set and level of inputs. The techniques available to address this issue require disaggregated data on quantities of main products and inputs. However, such data are not available. Nevertheless, several studies have found a strong and positive correlation between highly-skilled workers and productivity (Munch and Skaksen, 2008; Turcotte and Rennison, 2004). Thus, we have used the educational level of farmers as a proxy for productivity. This approach also has the advantage of avoiding the need to correct for endogeneity caused by any causality between productivity and exports (i.e., self-selection and learning-by-exporting hypotheses).

Descriptive statistics of the variables for our samples of 70 and 200 producers are presented in Table 1. For the sample of 70 farms, these statistics indicate that average farm size and years of education are considerably higher for export-oriented producers than for domestic-oriented producers.

On the other hand, age, slope, drainage and the labor availability index are higher for domestic-oriented producers than for export-oriented producers. Since all export-oriented producers in this sample had irrigation facilities and none of the domestic oriented producers had irrigation (i.e., there is a perfect match), we dropped this variable from the econometric analysis of this sample. Statistics for the sample of 200 farms follow the same pattern that the sample of 70 farms. However, it is important to note that a 60% of traditional producers have irrigation, while 99% of blueberry producers have irrigation (only 1 producer of blueberries does not have irrigation).

In all cases studied, farmers sold their products to marketing firms that were private entities. In most cases (about 80%) farmers had contract sales with theses firms which guarantee that firms will buy (and consequently export) their products.

These contracts include an estimated price that the producer will receive. However, final prices paid to farmers will correspond to the actual prices paid in the final market (after deducting transaction costs and earnings of marketing firms). Thus, exporting firms assume the risk of having to sell all production abroad, and farmers assume the risk of potential low final prices.

Table 1. Descriptive Statistics of Export-Oriented (Blueberry Producers) and Domestic-Oriented Producers in Southern Chile; Sample of 70 farms

Variable	Domestic-oriented producers				Export-oriented producers			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Sample of 70 farms	*n = 48*				*n = 22*			
Farm area (hectares)	48.1	75.5	0.5	400.0	123.5	165.5	0.8	550.0
Gender (0: female; 1: male)	0.8	0.4	0.0	1.0	0.8	0.4	0.0	1.0
Age of farmer (years)	63.1	13.1	37.0	90.0	58.1	17.1	32.0	88.0
Education (years)	9.3	3.5	0.0	17.0	13.9	3.6	8.0	17.0
Manager (0: No; 1: Yes)	0.1	0.3	0.0	1.0	0.3	0.5	0.0	1.0
Irrigation (0: No; 1: Yes)	0.7	0.5	0.0	1.0	1.0	0.0	1.0	1.0
Acidity of soil (0: Strong; 1: Weak)	0.4	0.5	0.0	1.0	0.6	0.5	0.0	1.0
Drainage (0: Poor; 1: Good)	0.3	0.5	0.0	1.0	0.1	0.3	0.0	1.0
Slope (0: Flat; 1: Steep)	0.4	0.5	0.0	1.0	0.2	0.4	0.0	1.0
Access to farm (0: Poor; 1: Good)	0.8	0.4	0.0	1.0	0.8	0.4	0.0	1.0
Labor availability index	5.4	6.8	0.6	39.4	5.1	6.8	0.6	31.2
Sample of 200 farms	*n = 101*				*n = 99*			
Irrigation (0: No; 1: Yes)	0.6	0.5	0.0	1.0	1.0	0.10	0.0	1.0
Acidity of soil (0: Strong; 1: Weak)	0.5	0.5	0.0	1.0	0.6	0.5	0.0	1.0
Drainage (0: Poor; 1: Good)	0.3	0.5	0.0	1.0	0.2	0.3	0.0	1.0
Slope (0: Flat; 1: Steep)	0.4	0.5	0.0	1.0	0.3	0.4	0.0	1.0
Access to farm (0: Poor; 1: Good)	0.9	0.3	0.0	1.0	0.9	0.3	0.0	1.0
Labor availability index	4.7	5.6	0.6	39.4	7.1	10.7	0.6	31.2

Source: Authors' calculations based on sample's data.

DISCUSSION OF ANALYSIS AND RESULTS

The export-production decision is analyzed through logistic regression. Two logit models are estimated in our analysis. The first model uses the complete sample of producers (200 farms) and includes only those variables that are related to farm-specific geographic characteristics. The second model adds producer-specific attributes to the geographic characteristics, but considers only the sample of 70 producers.[6] The two models were regressed using robust standard errors (Huber-White standard errors), since a plot of residuals showed some degree of heteroskedasticity.

The results are presented in Table 2. A comparison of the two specifications reveals that model 2 has a higher likelihood value (-27.47) and higher pseudo R^2 (0.37) than model 1 (-106.19 and 0.25, respectively). These results suggest that the export production decision is better explained when both producer-specific attributes and geographic characteristics are included in the model. The results for each model are discussed in more detail below.

[6] Some interaction effects were analyzed, but no significant effect was found.

Table 2. Export-production decision of Chilean farmers analyzed through a Logit Model

	Model 1		Model 2	
Producer-specific attributes				
Education			0.403	***
			(0.112)	
Sex			0.556	
			(0.744)	
Age			-0.021	
			(0.030)	
Manager			-0.361	
			(1.204)	
Area			0.004	
			(0.004)	
Farm-specific geographic characteristics				
Irrigation	4.177	***		
	(1.035)			
Drainage	0.912	**	2.222	**
	(0.415)		(0.942)	
Labor Availability Index	0.042	*	0.088	*
	(0.022)		(0.050)	
Slope	-0.203		-0.934	
	(0.347)		(0.946)	
Access	-0.382		-0.055	
	(0.519)		(0.960)	
Acidity	0.046		0.950	
	(0.359)		(0.745)	
Constant	-3.743	***	-7.383	***
	(0.961)		(2.443)	
Number of observations	200		70	
Wald chi[1]	34.51		21.59	
Log-likelihood value	-106.19617		-27.47	
Pseudo R^2	0.2339		0.3694	

Source: Authors' calculations.

Numbers in parentheses are standard errors.

* Significant at 10%; ** Significant at 5%; *** Significant at 1%.

[1] 6 and 10 degrees of freedom, respectively.

Results for Model 1

In model 1, the "irrigation" variable has a positive coefficient, which is statistically significant at the 1 percent level. As explained above, irrigation in a commercial orchard depends on having both physical access to water and the property rights for using it. The coefficient on "drainage" is also positive and significant at the 5 percent level. In practice, Chilean farmers treat irrigation and drainage as part of one, interconnected system, because irrigation projects include the drainage of water derived from irrigation. Thus, these two variables should be considered complementary factors.

The "availability of labor" variable deserves special attention. In a preliminary analysis, distance from the farm to the closest city or town and the sizes of these urban areas were included in the estimation. However, none of these variables was significant, despite the fact that in interviews both domestic-oriented and export-oriented farmers indicated that labor is an important factor in the decision to produce blueberries. Thus, in the subsequent analyses, the labor availability index was included to capture the effect of this factor. In model 1, this index has a positive and significant effect at the 10 percent level. This means that the probability of producing blueberries will be higher if farms are located near urban areas that have abundant labor and/or the cost of transporting labor is low (i.e., the distances between farms and sources of labor are short).

Results for Model 2

As indicated above, we excluded the "irrigation" variable from model 2 because there was a perfect match between this variable and the production of blueberries (that is, all blueberry producers had irrigation, but no domestic-oriented producers had irrigation). As in model 1, "drainage" had a positive sign and was significant at the 5 percent level and the "labor availability index" had a positive sign and was significant at the 10 percent level. None of the other farm-specific geographic variables had a significant effect on the export-production decision.

Regarding the producer-specific attributes included in model 2, "education", the proxy for productivity, was the only variable with a positive and significant effect (at the 1 percent level) on the decision to produce exportables. That is, producers with an orientation toward foreign markets appear to be more productive than domestic-oriented producers. This result is consistent with previous studies on the export decision in the manufacturing sector (Bernard and Jensen, 2004), which find that firms with higher productivity tend to be exporters. The coefficients on other farm-specific attributes (i.e., age, gender, manager, and farm size) in model 2 were not statistically significant.

Analysis of Marginal Effects

The previous discussion of the export-production decision has focused on the signs of the coefficients (i.e., whether a variable has a positive or negative effect on the decision to produce exports) rather than on the relative magnitude of the impacts of producer attributes versus farm-specific geographic characteristics. To estimate these relative impacts, marginal

effects are calculated for each of the explanatory variables. Formally, the marginal effect of the l^{th} element of a vector X_{jl} is:

$$\frac{\partial \Phi(\beta' X_j)}{\partial X_{jl}} = \phi(\beta' X_j)\beta_l, \tag{5}$$

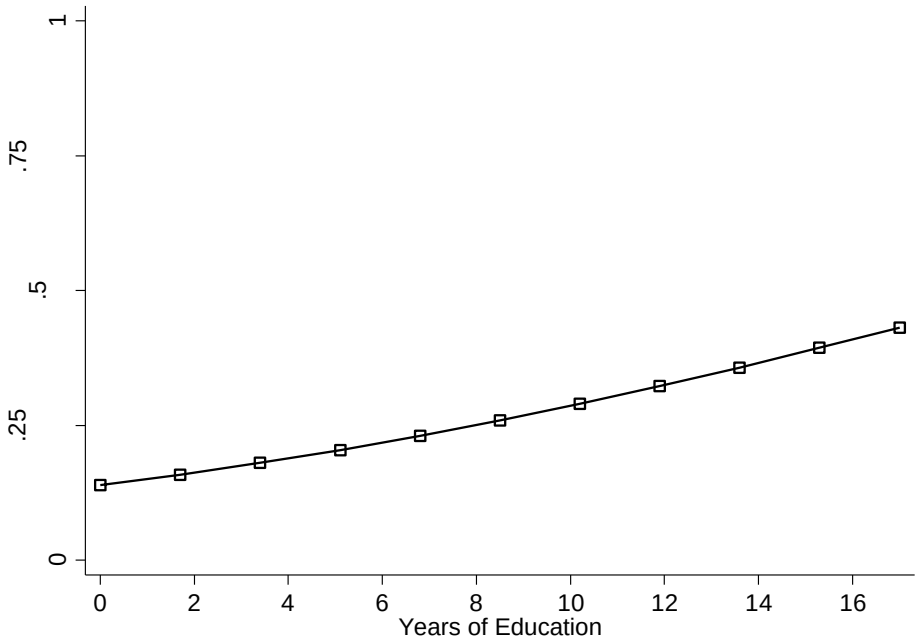
where the partial derivative of the non-linear cumulative distribution function with respect to a particular variable (X_{jl}) will depend on the level at which the other independent variables are evaluated (Wooldridge, 2002). For model 2, the marginal effects for the three variables that were significant in the regression analysis—education, the labor availability index, and drainage--are 0.0645, 0.0142, and 0.3560, respectively (these marginal effects were evaluated with the other variables held at their means). Thus, drainage seems to be relatively more important in the export-production decision than the other two variables. However, given the nonlinearity of variables in discrete choice models, the marginal effects can mask the true magnitude of the variable of interest when it is analyzed for values other than its mean. To address this problem, the predicted probabilities of export participation arising from each significant variable are derived as:

$$\hat{P}(y = 1 | \overline{X}_j,\ X_{jl}) = \Phi(\hat{\beta}' X_j) \tag{6}$$

where $\hat{P}(\cdot)$ is the predicted probability when all variables except X_{jl} are evaluated at their respective means. Thus, holding all other variables at their means, the effect on export participation of changing X_{jl} can be illustrated with a plot of $\hat{P}(.)$

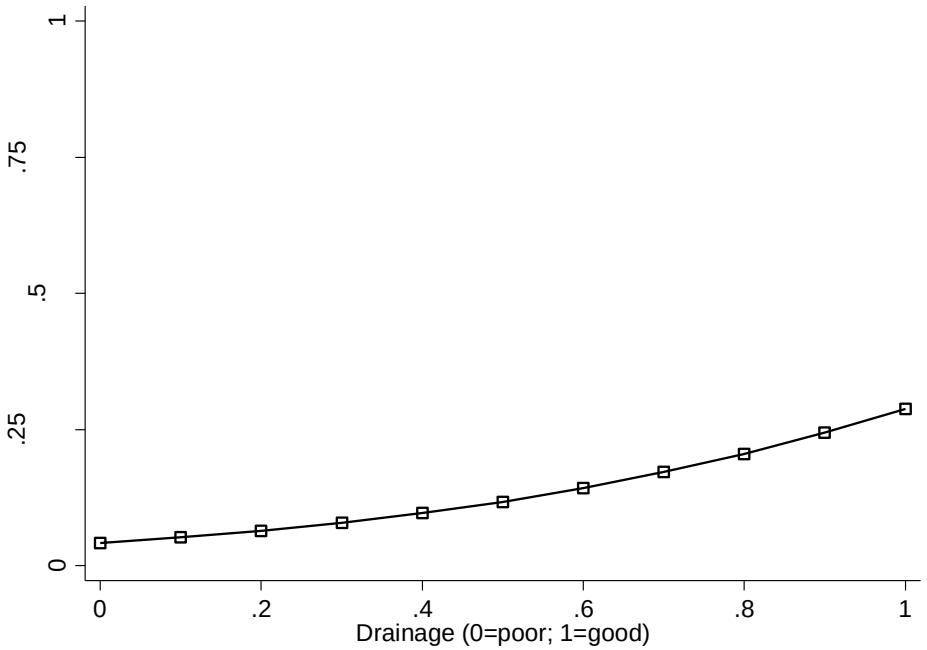
Figures 2, 3(a) and 3(b) show the predicted probabilities of export participation due to changes in education, drainage, and the labor availability index. Figure 2 indicates that education has a positive relationship with the probability of producing exportables. That is, farmers with more education, who are thus more productive, are more likely to produce exportables. In fact, when farmers have a college-level education, the probability of producing exportables can reach up to 50 percent. In the case of "drainage" (see figure 3(a)), the probability of producing blueberries reaches up to 30 percent when there is no problem with soil drainage. The labor availability index seems to have the strongest effect on the decision to produce exportables. As shown in figure 3(b), when there is a high availability of labor (the combined effect of being close to the source of labor and having this source of labor be abundant) the probability of a farm deciding to produce exportables can be close to 90 percent.

It is important to note that when the drainage variable is close to zero, that is, when soil drainage is very bad, the probability that a farmer will produce exportables is very low (this is very similar to the case of irrigation, which is essential for producing blueberries). On the other hand, the analysis indicates that when the other two variables (education and the labor availability index) are at their minimum values, there is still some probability of participating in blueberry production. In the case of labor, this result can be explained by the use of family labor, which will be available even when it is not possible to hire off-farm labor.



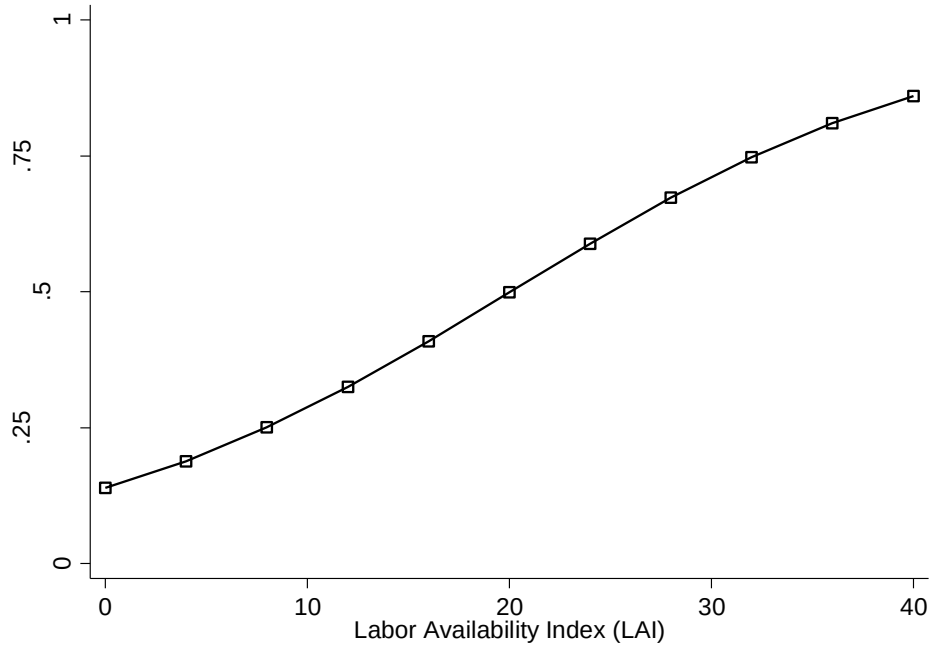
Source: Authors' calculations.

Figure 2. Predicted Probabilities Due to Changes in Years of Education



(a)

Figure 3. Continued on next page.



(b)

Source: Authors' calculations.

Figure 3. Predicted Probabilities Due to Changes in Drainage and Labor Availability Index.

SUMMARY AND POLICY IMPLICATIONS

The purpose of this study has been to evaluate the relative importance of producers' attributes and farm-specific geographic characteristics on the export-production decision of Chilean farmers through a case study of blueberry producers in southern Chile. The spatial distribution of blueberry producers -who represent export-oriented producers- and traditional farmers suggests that the export-production decision is likely influenced more by producer-specific attributes and farm-specific geographic characteristics than by regional geographic characteristics.

Results obtained from the logistic regression suggest that education, a proxy for productivity, is a producer-specific attribute that is key to the export-production decision. Thus, policies aimed at encouraging agricultural exports should include efforts to improve farmers' formal education as well as technical training.

Irrigation and drainage appear to be the main physical geographic variables that affect the export-production decision. The positive effects of these factors on agricultural production are well known in Chile. In fact, since 1985 there has been a national program that encourages irrigation and drainage projects by subsidizing up to 75 percent of the costs of such projects (Law 18,450). Although this policy has been successful in helping many farmers increase their production possibilities, it appears that traditional farmers have not benefited from it. Thus, another way to encourage export production would be to improve the availability of

and access to water, which expands farmers' production choices. It is necessary to note that although the blueberry production requires irrigation, the presence of irrigation does not necessarily imply production of blueberries. This is evident when the sample of 200 farms is analyzed and 60% of traditional producers have irrigation.

Finally, the results of the analysis suggest that distance from metropolitan areas influences the export-production decision through its effects on labor costs, which arise from variations in both wages and commuting costs. Since fruit production is labor intensive, farms with lower labor costs have a higher probability of engaging in exportable production. This geographic effect, arising from proximity to larger and more urbanized regions, is particularly strong in our sample of blueberry producers, who export 90 percent of their production.

In summary, this research has provided new insights into the factors that determine the export-production decision of Chilean farmers. By focusing on export-oriented and domestic-oriented farms that are located near each other, we control for regional climatic factors and are thus able to assess the relative impact of producers' attributes and farm-specific geographic characteristics on the decision to produce exportables. We find that farmers' educational levels, their access to water, and the availability of labor are key to expanding farmer's production choices to include export products. In the short run, farmers who have high levels of education, good labor availability and irrigation should be targeted to promote export-oriented production. However, in the long-run, policies should be directed at eliminating education and irrigation as a barrier facing farmers. However, as labor availability is associated with the geographical location of farms and is determined by many factors influencing the economy at large and so is difficult to address.

Although the present study was conducted based on the blueberry production, their results can be easily extended to any other similar product (e.g., most berries). Indeed, this research methodology can be adapted to investigate the factors that are related to the export-production decision in other products or crops.

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