DISTORTIONS TO AGRICULTURAL MARKETS:

TRENDS AND FLUCTUATIONS, 1955 TO 2010

Signe Nelgen

A thesis submitted for the degree of

Doctor of Philosophy in

The School of Economics of

The University of Adelaide

July 2012

Table of Contents

Abstract

The thesis analyses the patterns and underlying political economy causes of long-run trends and short-run fluctuations in national distortions to agricultural incentives. It does so by exploiting, revising and expanding a dataset of agricultural distortion measures in developing and developed countries from 1955 to 2004 for developing and 2007 for high-income countries by Anderson and Valenzuela (2008). More specifically, it extends its time period to 2009 for developing countries and 2010 for high-income countries.

An essential contribution of the thesis is the update of this database to 2010 in order to capture the most recent international food price spike period. The large dataset makes it possible to analyse insulating behaviour in agricultural markets historically over the past 55 years, and to compare governments' reactions to food market shocks and upwards and downwards price spikes in the most recent years vis-a-vis those in the past.

The thesis examines the extent of domestic market insulating behaviour of governments by both food-exporting and food-importing countries. This is because the policies of both country groups contribute substantially to international food price volatility and therefore to economic instability and to trade and welfare fluctuations. The international-to-domestic food price transmission elasticity is used as one indicator of such policy action. The evidence also allows us to test to what extent the policy decisions of governments achieve the goal of protecting domestic producers or consumers from international price spikes in either direction. The results of the analysis are subdivided into the contribution of different regions, country groups and policy instruments.

The study also quantifies the extent of the contribution of changes in national agricultural trade restrictions to food price spikes internationally, over and above to the initial exogenous price shock. Reactions of food-exporting and food-importing countries at the same time exacerbate price spikes in international food prices and therefore are a concern for all trading nations because of their nontrivial contribution to domestic and international volatility and uncertainty.

To test empirically the political economy causes of such market insulating behaviour of governments, the loss aversion theory of Freund and Oezden (2008), with amendments by Jean, Laborde and Martin (2010) to ensure suitability for agricultural markets, is drawn upon. The focus of this part of the thesis is on the question as to why countries alter assistance levels through variations in trade restrictions to protect one domestic group at the cost to others within the nation, rather than more-direct, more-efficient domestic policy instruments to protect either producers or consumers from price spikes.

The final part of the thesis focuses on potential future developments in agricultural market distortions and provides an alternative agricultural protection counterfactual for trade policy modelling than the status quo. After identifying the crucial influencing factors on agricultural distortions in the past, projections of assistance measures are provided for the year 2030. These projections make it possible to model an alternative scenario of the costs based on newly estimated political econometric equations of trade-distorting policies in the future, to compare with one that assumes no future policy changes in their baseline.

Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution to Signe Nelgen and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the University library, being made available for loan and photocopying, subject to the provisions of the Copyright Act 1968.

The author acknowledges that copyright of published work contained within the thesis (as listed below) resides with the copyright holders of those works.

- Anderson, K. and S. Nelgen (2010), 'How do Governments respond to food price spikes? Lessons from the past', *Journal of International Commerce, Economics and Policy* 1(02): 265-285.

- Anderson, K. and S. Nelgen (2011), 'What's the Appropriate Protection Counterfactual for Trade Analysis', *Unfinished Business? The WTO's Doha Agenda.*

- Anderson, K. and S. Nelgen (2012), 'Trade Barrier Volatility and Agricultural Price Stabilization', *World Development* 40(1): 36-48, January.

- Anderson, K. and S. Nelgen (2012), Updated National and Global Estimates of Distortions to Agricultural Incentives, 1955 to 2010, Database uploaded in March 2012 at www.worldbank.org/agdistortions.

- Anderson, K. and S. Nelgen (2012), 'Agricultural Trade Distortions During the Global Financial Crisis', *Oxford Review of Economic Policy* (forthcoming).

I give permission for the digital version of my thesis to be made available on the web, via the University's digital research repository, the Library catalogue, the Australasian Digital Theses Program (ADTP) and also through web search engines, unless permission has been granted by the University to restrict access for a period of time.

Signed:

Date: 16 July 2012

Acknowledgments

This thesis would not have been possible without the support given by several people and organizations. On the financial side, I am grateful for support from the Australian Research Council, the World Bank, the School of Economics, as well as the University of Adelaide for the support provided by Adelaide Scholarships International. My sincere acknowledgement goes to Professor Kym Anderson for helpful advice, comments and good guidance throughout the past three years, and for the opportunity to work as a co-author on several papers. I am grateful also for discussion with my co-supervisor, Richard Promfred, and to Suraya Abdul Halim for comments on drafts of several chapters and constant encouragement during the development of this thesis.

On a personal note, a big thanks also to my friends at the School of Economics, Johanna Croser, Claire Hollweg, Lachlan Deer and Stefanie Schulte. I am also grateful for having shared the experience of the last three years with Jayanthi Thennakoon, who so often reminded me of deadlines for administrative matters. Thanks also to Rachael Anderson for encouraging me over coffees through the hours worked at home on the weekends.

Last but not least, I would like to thank my family, Gitta, Rüdiger and Anke Nelgen for the support and encouragement over a number of years, and Dr. Fritz Struth for his influence on my development as an economist. A special thanks also to Paul Mason for his support, for his persistent confidence in me, and the many nice home cooked meals throughout the thesis completion.

Structure of thesis

This thesis contains five chapters, which are stand-alone pieces, with self-contained references, tables and figures.

The first chapter gives an overview of empirical estimates of indicators of policy distortions to agricultural markets in the past, and of the revisions and updates to previous estimates that were estimated as part of this thesis (and which are detailed in Appendix A).

Chapter 2 and chapter 3 are based around the issue of price instability and trade barrier responses by governments to it. Chapter 2 is built upon a combination of two published papers: a preliminary analysis is published in the *Journal of International Commerce, Economics and Policy* in December 2010 and a subsequent analysis is published in the *World Development* in January 2012. Chapter 3 is forthcoming in a special issue of the *Oxford Review of Economic Policy* on altered protectionism during the recent financial crisis.

The fourth chapter has profited by comments given at its presentation at the Econometric Society Australasian Meeting (ESAM) in Adelaide (4-8 July 2011). Since then I have added empirical evidence for the loss aversion theory.

The fifth chapter focuses on the future pattern of distortions and has been published as a book chapter in the 2011 book edited by Will Martin and Aaditya Mattoo with the title *Unfinished Business? The WTO's Doha Agenda*.

The Appendices contain more detailed tables that are not included in the chapters and/or publications. They provide the interested reader with underlying data to some of the tables and figures in the chapters. Appendix A also explains the

methodology and provides some key data from the updated, expanded and revised dataset of the agricultural distortion database that was previously made publicly available by Anderson and Valuenzuela (2008). The full updated, revised and expanded database will be made available to the public from March 2012 via the website www.worldbank.org/agdistortions.

Statements of Contributions

Statement of Authorship

Chapter 2: 'Trade Barrier Volatility and Agricultural Price Stabilization',

(Revision of a paper published in *World Development*

40(1): 36-48, January 2012).

Signe Nelgen (Candidate)

Contributed to 60 %

Certification that the statement of contribution is accurate:

Signed ……..Date……

Kym Anderson

Contributed to 40 %

Certification that the statement of contribution is accurate and permission is given for the inclusion of the paper in the thesis:

Signed ……..Date……

Statement of Authorship

Chapter 3: 'How Much Do Trade Restrictions Responses Contribute to International Price Spikes?'

(Revision of a paper forthcoming in a special issue of the *Oxford Review of Economic Policy,* on protectionism during the recent financial crisis).

Signe Nelgen (Candidate)

Contributed to 60 %

Certification that the statement of contribution is accurate:

Signed ……..Date……

Kym Anderson

Contributed to 40 %

Certification that the statement of contribution is accurate and permission is given for the inclusion of the paper in the thesis:

Signed ……..Date……

Statement of Authorship

Chapter 4: 'Trade Policy for Loss Aversion: Evidence from Agriculture'

(Revision of a paper presented at the Econometric Society Australasian Meeting (ESAM) in Adelaide, 4-8 July 2011).

Signe Nelgen (Candidate)

Contributed to 75 %

Certification that the statement of contribution is accurate:

Signed ……..Date……

Kym Anderson

Contributed to 25 %

Certification that the statement of contribution is accurate and permission is given for the inclusion of the paper in the thesis:

Signed ……..Date……

Statement of Authorship

Chapter 5: 'What's the Appropriate Agricultural Protection Counterfactual for Trade Analysis?'

(Revision of a paper published as chapter 13 (pp. 325-54) in '*Unfinished Business? The WTO's Doha Agenda'* edited by Will Martin and Aaditya Mattoo (2011), London: Centre for Economic Policy Research and the World Bank, November 2011).

Signe Nelgen (Candidate)

Contributed to […] 60 %

Certification that the statement of contribution is accurate:

Signed ……..Date……

Kym Anderson

Contributed to 40 %

Certification that the statement of contribution is accurate and permission is given for the inclusion of the paper in the thesis:

Signed ……..Date……

Statement of Authorship

Appendix A: Distortions Revision, Expansion and Update to 2010'

(To be uploaded at www.worldbank.org/agdistortions)

Signe Nelgen (Candidate)

Contributed to 90 % to the revision, expansion and update of Anderson and Valenzuela (2008)

Certification that the statement of contribution is accurate:

Signed ……..Date……

Kym Anderson

Contributed to 10 % to the revision, expansion and update of Anderson and Valenzuela (2008)

Certification that the statement of contribution is accurate and permission is given for the inclusion of the paper in the thesis:

Signed ……..Date……

DISTORTIONS TO AGRICULTURAL MARKETS:

TRENDS AND FLUCTUATIONS, 1955 TO 2010

Contextual Statement

Food prices have a large impact on many people's daily lives, especially in many developing countries where some people's survival is a daily fight against hunger. Food price levels, volatility and extreme price spikes impact especially the population in countries where a large share of income is spent on food, which is the case in many African and other low-income countries.

The importance of international trade of agricultural goods is essential in a global world where extreme weather events make it necessary to compensate through trade for one another in the case of a poor harvest caused by, for example, floods, droughts, fires or other natural disasters.

However, agricultural price distortions are often initiated by national policy makers who are trying to insulate their country's domestic market against international price fluctuations. This strategy can make smoothing effects of international trade in the case of extreme weather periods more difficult to accomplish and can even contribute to undesired income redistributions and exacerbate the negative effects of volatility and/or extreme price spikes even further.

In addition to extreme weather events, there is now a high correlation between agricultural and highly volatile energy markets, thanks to biofuel subsidy policies in the United States, the European Union and elsewhere. This contributes to affected countries' food insecurity. It also contributes to the importance of gaining clearer insight into how distortive policies for agricultural products influence food supply and demand globally.

Agricultural trade policies and their effects on the mean and the variance of prices need to be measured and explained, so as to learn from past reactions of governments and to give future advice on how to improve food access in poor countries. This is especially important with regard to periods of price spikes, both up and down. Such trade distorting behaviour of governments can lower economic growth and raise income inequality not only in other countries but also in the country inflicting these policy variations.

Until recently, there has not been a dataset to allow economists to test the political economy theories of agricultural distortion decisions empirically over a large sample of high-income and developing countries for an extensive time period. Such a dataset was released in 2008 by Anderson and Valenzuela, but it includes data only up to 2004 for developing countries and to 2007 for high-income countries. The present study extends that dataset to ensure coverage of the recent food price spike. Thus a major contribution of this thesis is to incorporate at least the first part of the most recent price spike in 2008, by updating the database to 2010 for high-income countries and some larger developing countries and to 2009 for the remaining developing countries.

As Figure 1 illustrates, there has been another price spike since food prices peaked in June 2008. The lowest point following the 2008 spike, in February 2009, was higher than the highest points in the previous 15 years. From there, prices increased again and only started dropping back from their second recent peak in February 2011. An obvious area for further research, once the data become available, will be to update it further to include the second spike in 2011.

Figure 1: FAO food and cereals price index, 1990 to 2011

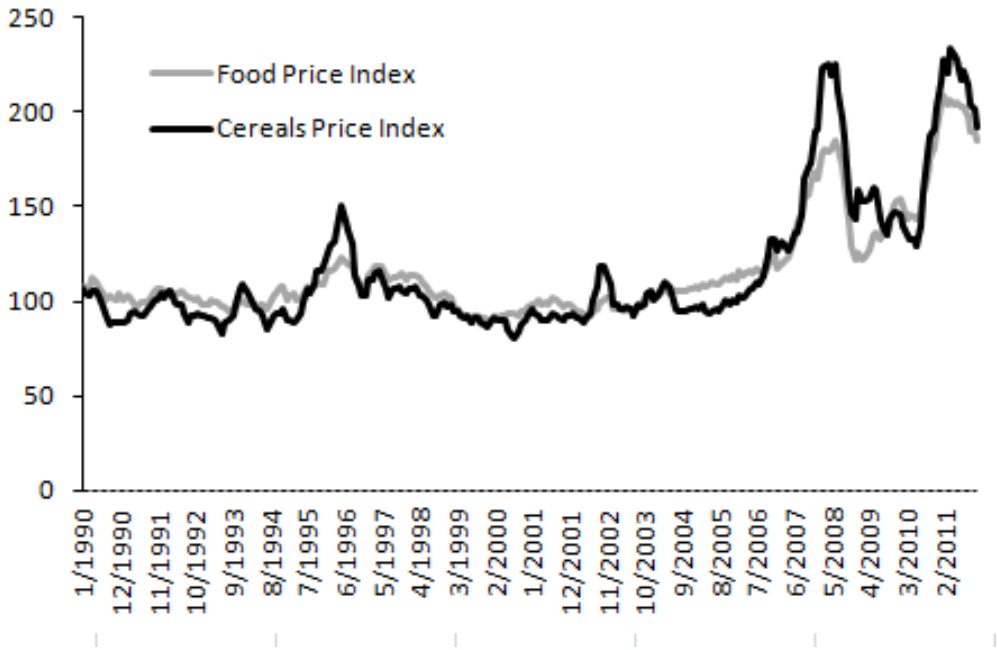


Figure 1: FAO, 2011.

The overarching aim of the thesis is to improve our understanding of countries' political economy reasons behind price distorting behaviour and to assist with policy advice to improve welfare globally. The findings can contribute to the goal of making more food available, and more accessible and affordable to the poor in developing countries in times of price fluctuations.

The five chapters in this thesis focus on the following aspects of this issue. The first chapter summarizes estimates of price distortions in the past, showing both long-run trends and year-to-year fluctuations. It also looks at a simple indicator of the welfare effects that result from different distortionary instruments over the period since the 1950s.

Chapter 2 focuses on how trade barrier variability is applied by governments in their attempts to reduce domestic price instabilization. Agricultural prices are

volatile, but so too are the policy responses to agricultural price changes. This chapter provides empirical evidence on the nature and extent of such behaviour and concludes with policy implications.

Chapter 3 explores how those trade restrictions can contribute to the exacerbation of the international price during price spike periods. It provides a theoretical model to analyse the economic effects of domestic market insulation and gives empirical evidence of the extent to which domestic insulating behaviour contributes to international food price spikes. Again, the last part of this chapter draws out policy implications from the analysis.

The main focus of chapter 4 is on the political economy reasons for distortionary policy behaviour. It draws on the approach to loss aversion theory by Freund and Oezden (2008) as applied to agriculture by Jean, Laborde and Martin (2010). It then undertakes panel data regression analysis to test that political economy theory.

The final chapter returns to the long-run trends in agricultural protection rates. Its point of departure is that modellers often use the assumption of unchanged trade policies when projecting economy wide CGE models into the future. This chapter is written with the intention to supply researchers with a counterfactual for trade analysis by projecting nominal rates of assistance from 2004 to 2030, based on political econometric analysis of the pattern of protection across countries as of 2004.

In summary, this research has made it possible to answer many questions with regards to countries' past agricultural policy decisions. It reveals patterns of distortions for different country groups, and it looks at the instruments those countries use when trying to achieve their governments' political objectives. The

richness of the dataset allows for the analysis of the contribution by different country groups and products to reductions in global trade and economic welfare. Altogether, this allows for a deeper understanding of intentions of governments that apply trade policies to protect their food producers and consumers from fluctuating prices of farm products.

As noted at the end of the thesis, where areas for further research are noted, the significance of this research is especially important in a time of changing climate trends, extreme weather events and biofuel usage, which all challenge the global agricultural market participants. Policies that distort agricultural markets have a large impact on the effects that result from the above named and similar events, particularly on global availability, affordability, and accessibility of agricultural products and therefore food.

Chapter 1:

Indicators of distortions to Agricultural Markets: Revisions, Expansions and Updates to 2010 of a Global Database

Signe Nelgen

Indicators of distortions to Agricultural Markets: Revisions, Expansions and Updates to 2010 of a Global Database

A. Introduction

There has been a long history of distortional behaviour in agricultural markets. Over the past 55 years, developing and high-income countries have shown tendencies to distort agricultural markets in opposite directions. Governments in developing countries made an effort to protect their consumers, often at the expenses of producers, whereas governments in high-income countries are continuously under pressure from strong domestic lobbying groups to support their farmers.

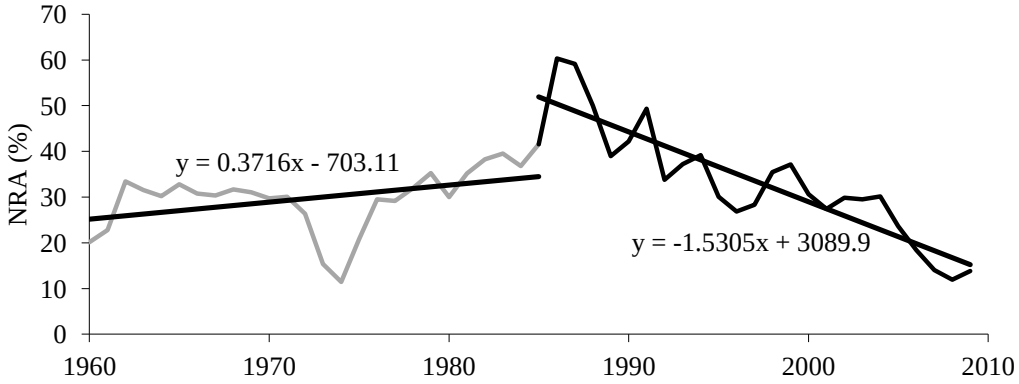
The sources of incentives to distort agricultural markets can be categorized into the long-term intentions of a government to support a certain domestic group, i.e. producers or consumers, and short-term reactions to certain events, such as exogenous shocks that cause fluctuation in the international prices of food. The main indicator used for the present study is the nominal rate of assistance to agricultural producers (NRA), defined as the percentage by which the domestic producer price exceeds the border price. The NRA is thus negative if farmers receive less than the price at the country's border for a similar product.

Figure 1 demonstrates the fluctuations of distortions to agriculture for high-income and developing countries around a linear trend. There is a clear break in 1985 for high-income countries, when major policy reforms began. Clearly there has been positive support to agriculture in high-income countries in the past and negative incentives on average for farmers in developing countries in most of the last 55

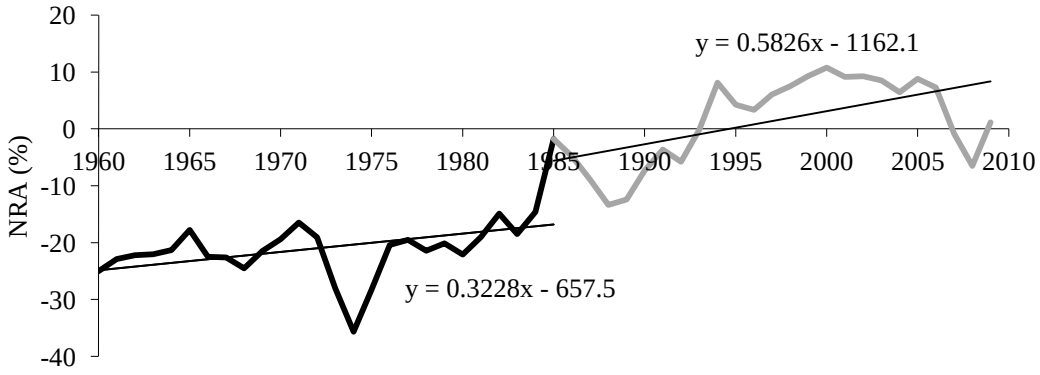
years, with a change in the mid-1980s. The coefficients of a linear regression suggest trends are rising at almost the same rate for high-income and developing countries in the pre-1985 period.

Figure 1: Nominal rate of assistance[a], high-income and developing countries, 1960 to 2010

(a) High-income countries



(b) Developing countries



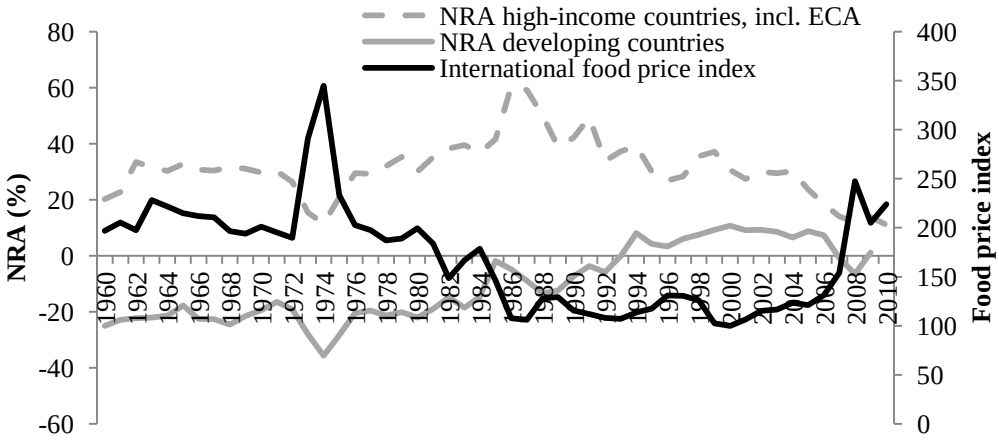
[a] The NRA is a weighted averages of the nominal rate of assistance to producers in each country, using production valued at undistorted prices as weights.

Source: Authors' compilation from Anderson and Nelgen (2012b).

Following the break in their series, the protection rates in high-income countries trace a steep decline while for developing countries there is also a moderate incline of support to agriculture, changing from negative support to positive within 10 years after the reforms began in 1985.

Figure 2: Nominal rate of assistance[a], high-income and developing countries, and international food price index, 1960 to 2011

(left axis is weighted averages NRAs in percent, right axis is the int'l food price index)



[a] The NRA is a weighted averages of the nominal rate of assistance to producers in each country, using production valued at undistorted prices as weights. The international food price index is from World Bank (2011).

Source: Authors' compilation from Anderson and Nelgen (2012b) and World Bank (2011).

Short-term fluctuations in distorting agricultural policies are most obvious during times of extreme events causing an upward or downward spike in the international price. Figure 2 shows how the distortion indicators move as prices

fluctuate, almost negatively mirroring the movement of the international food price index.

The original cause of an international price spike can be a natural disaster (due to, e.g. drought, bush fires or floods), or the result of policy interventions from the major global players.[1] This causes other countries to respond with short-term reactions through their agricultural policies to protect a domestic group from the economic aftermath of a price spike in either direction. Price spikes can have a very strong impact on developing economies, where a large share of the income is spent on food.

The international food price spike in 2008 was partly caused by policy interventions of two major global players, the United States and the European Union, who applied subsidies and mandates to support biofuels. This distorted markets of those agricultural products (e.g. maize, sugar and oilseeds) that are used as inputs into biofuels, as well as for other agricultural products that are their substitutes or complements in production or consumption. The sensitivity of prices to those government actions is particularly high during times when global stocks are low, as they were by 2008 (Wright 2011). Many countries felt threatened by those interventions and the resulting international price rise and tried to protect their consumers by policies that insulate their domestic price (i.e. export restrictions and tariff cuts or import subsidies). Those responses increase international prices further and give incentive to those countries that have not yet applied the tool of insulating policies, to do so. Again, this has a further increasing effect on the international price

[1] In 1973, the Soviet Union was trying to overcome a domestic grain shortfall by unexpectedly entering the international market for the first time. A major contributor to the downward spike in 1986 was the export subsidy war between the United States and the European Union.

and contributes to a continuous cycle of interventions resulting in higher prices and volatility.

Market insulation prevents the international price to be fully transmitted to the domestic markets, thereby preventing the smoothing mechanism of an integrated world market to diminish. However, policy makers seem to find it advantageous to distort agricultural markets to maximize their chance of staying in office. This occurs especially in poor countries who try to prevent the transmission of an international price rise to their domestic prices in order to avoid a price rises of basic food items for their consumers (Knudsen and Nash 1990).

It is thus important to analyse market interventions both in the long-run and the short-run. The underlying incentives to intervene and the goals behind do not only differ dependent on the circumstances of individual countries and country groups, but also depend on the time horizon.

Interventions from any economically influential country that aims to protect their agricultural sector disadvantage producers in other domestic industries and farmers in other countries by decreasing the international price and therefore also farmers' incomes in other countries. It is true that policy interventions have been reduced in recent decades, in both developed and developing countries, but they are far from having been vanished (Anderson 2009).

In the short run, especially at times of price spikes, governments try to prevent the transmission of the spike to the domestic market. The upward price spike in 2008 provides a very recent example of the immediate reactions of governments during and around the years of price spikes. This offers the possibility of comparing

those years with the upwards spike in international food prices in 1973 and the downwards spike in international food prices in 1986.

Given the costliness of those policies, especially for developing economies, it is important to understand why governments intervene in the ways they do. What are the political economy reasons for the observed patterns of trends and fluctuations in agricultural price distortions in the past, and what are their implications for the future, particularly as to their impact on world food markets and thereby the welfare for developing countries? Only with answers to these questions is it possible to be effective in suggesting more efficient ways to achieve the government's objective.

A recently released dataset by the World Bank's Agricultural Distortions project by Anderson and Valenzuela (2008) has since been expanded, revised and updated by the author (see Appendix A) to provide the indicators necessary to analyse the issues arising from policy interventions in agriculture on a broad level, covering over 90 percent of global agricultural production.

The result of high-income and developing countries' policy interventions in agricultural markets is that farmers in poor nations often get disadvantaged in two ways, by their own governments' anti-agricultural and pro-urban interventions and by the support farmers receive in many high-income countries. This leads to an overproduction of agricultural products in high-income countries and underproduction in often densely populated developing countries.

There is a wide variety of distortional behaviour between different countries and commodities and over time. Figure 3 shows the development of a distortions indicator for a selection of countries and agricultural commodities over the covered time period. Even though developing countries as a group had an anti-agricultural

bias over most of the past (see Figure 1), there are individual examples of countries and products with pro-agricultural behaviour. The case of rice in Malaysia is such an example, with positive agricultural protection rates for most of the past 55 years. Rice is an important and sensitive strategic agricultural commodity in Malaysia, as in many other Asian countries. Figure 3(a) shows the upward linear trend line for Malaysia in the period up to its financial crisis in the mid-1980s and the a downward trend in the later period. By coincidence, in absolute terms the slopes of both trend lines have similar coefficients.

In contrast to the example of Malaysia is the development of rice NRAs in the Philippines as shown in Figure 3(b), where rice is also the main staple commodity. Its government does not seem to follow a clear trend, but adjusts its policies accordingly to achieve consumer protection during international price spikes. The NRAs have been highly volatile in the Philippines in the past, with negative values over the first part of the graph, and then became postive until the 2008 price spike when they changed from positive to negative again.

As illustrated in Figure 3(c), wheat in Argentina, along with other domestic products, has been subject to high export taxes in the past. These were reduced in the mid-1970s, but reappeared strongly after 2001 following a large real depreciation of the peso. This was further intensified with quantitative export constraints in 2006, notwithstanding protests by farmers in recent years. The range of the NRAs goes from -63 percent to +8 percent in the period between 1960 and 2009.

All three graphs reveal large NRA fluctuations around trend. Governments seem to be unwilling to follow a constant policital economy goal, but adept to

different situations in different points in time. This can cause volatility in the incomes of the farmers.

All three examples in Figure 3 have a trend that is based on a long-term political economy goal, surrounded by year-to-year fluctuations. The volatitly of the distortion measure is very high. Governments seem to react to both international and domestic circumstances in a short time frame.

Figure 3: Nominal rates of assistance estimates for rice in Malaysia and in the Philippines and for wheat in Argentina, 1960-2009.

(percent)

(a) Rice in Malaysia

NOTE:
This figure is included on page 18 of the print copy of the thesis held in the University of Adelaide Library.

(b) Rice in the Philippines

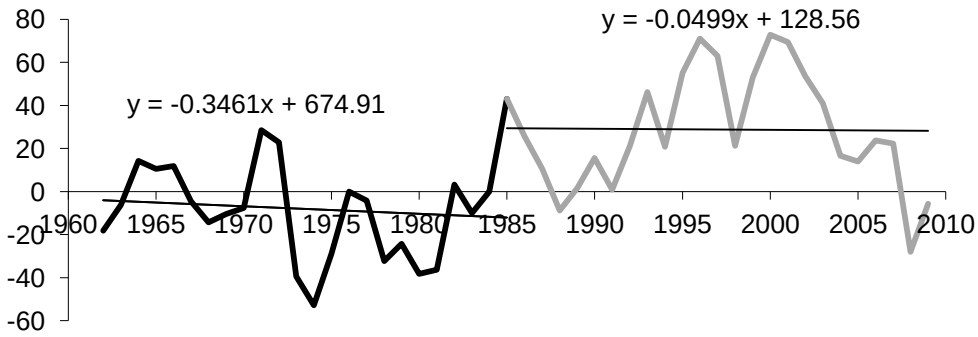
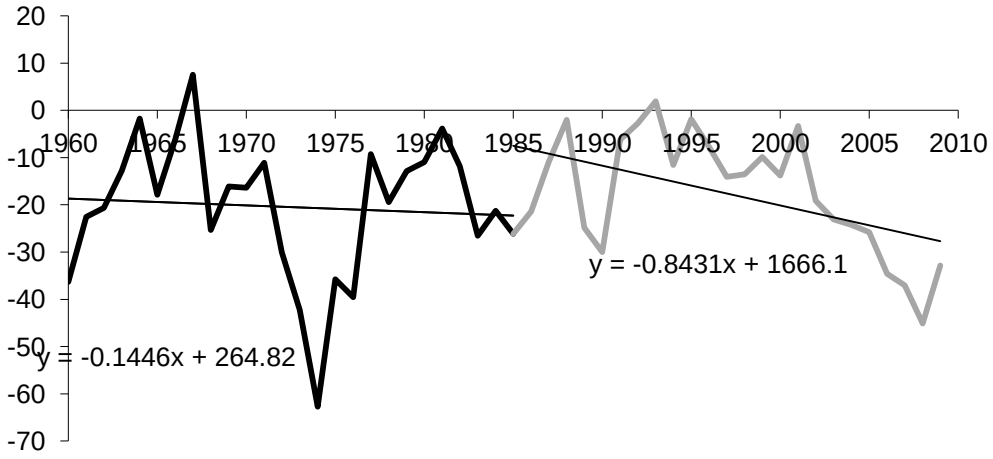


Figure 3 (continued): Nominal rates of assistance estimates for rice in Malaysia and in the Philippines and for wheat in Argentina, 1960-2009.

(c) Wheat in Argentina



Source: Figure 3(a) Anderson 2009, Chap. 1, updated from estimates in Anderson and Nelgen 2012b, figures 3(b) and (c) compiled from Anderson and Nelgen 2012b.

This chapter is structured as follows: The next section describes the database and the methodology that is used to measure agricultural distortions over time. Then, the long-run trends in indicators of agricultural distortions are summarized, followed by a section summarizing year-to-year fluctuations around this trend.

B. Summary of Methodology for Estimating Distortions to Agricultural Markets

A research project by the World Bank that culminated in a large panel dataset, compiled by Anderson and Valenzuela (2008) is the main data source for this thesis. The database quantifies distortions in agricultural prices for 75 developing and high-income countries for their main agricultural products over 50 years. Those countries account for over 90 percent of global agricultural GDP and provide the instruments to analyse agricultural prices, trade policy changes and their effects on global markets, farm incomes and welfare. The wide range of countries included in the study, as well as the large set of covered products and the long time period (1955-2007), provide a rich framework of panel data and the opportunity to formally analyse those in detail.

Estimations of indicators can be calculated for different regions, country groups and product groups, either unweighted or weighted using e.g., production value at undistorted prices as weights. The coverage of the agricultural distortions database exceeds any database that has been used before to evaluate price distortions and variability in agriculture. Each individual country's coverage is about 70 percent of the national agricultural GDP, covering a total of 75 products, an average of 11 major agricultural products in each country. Summary estimates are provided in Anderson (2009) and of Anderson (2010, Chapter 2).

The database also allows looking at agricultural distortions by policy instruments. The range of distortion indicators and their break-down to different policy instruments provided by the Agricultural Distortions database is wide. The

main and most aggregated indicator of policy interventions in agriculture is the NRA. The NRA can be described as the domestic-to-border price ratio, the gap between the international market price at the country's border and the distorted domestic price at the same point in the marketing chain. Its estimates include all tariff and non-tariff trade measures, and also domestic price support measures. It accounts for direct interventions on input and where multiple exchange rates create an additional distortion, their equivalent of an import or export tax will be accounted for in the NRA calculations. The estimates are expressed as the percentage by which the gross returns to farmers with government interventions exceed (positive NRAs) or fall below (negative NRAs) their returns if there were no government interventions in place. The policy instruments included on the border price side are export subsidies, import and export tax equivalents (where multiple exchange rates are in place) and import subsidy equivalents. The domestic distortions contain production taxes and subsidies, as well as input subsidies and non-product specific assistance.

The consumer tax equivalent (CTE) estimates include the effects of domestic consumer taxes and subsidies plus trade and exchange rate policies, all of which drive a wedge between the price that consumers pay for each commodity and the comparable international price at the border. The CTE is calculated as the percentage by which policies have raised domestic prices paid by consumers of agricultural outputs compared to international prices (with a negative value implying a subsidy to consumers). The CTEs are the same as the NRAs if trade policy interventions are the only distortionary government actions in place. The difference between the two measures occurs through domestic interventions in the production or the consumption side. These two valuable measures allow for the assessment of

whether government interventions are aimed at domestic price stabilization from the consumer or the producer side. Note that the two measures are highly correlated over the time period covered in the analysis of this thesis.[2] This indicates that interventions in agricultural markets occur at the border, rather than in the form of domestic consumer or producer subsidies or taxes.

Lloyd, Croser and Anderson (2010) develop a welfare reduction index (WRI) and a trade reduction index (TRI) to provide indicators that better capture the trade and welfare effects of distortions in agricultural markets than NRA and CTE distortions indicator that they use as components. Both indexes have been estimated for the range of covered products in Anderson and Valenzuela (2008) and the methodology and estimates have been made available by Anderson and Croser (2009).

The WRI accounts for the welfare cost of government-imposed price distortions by relating those to the square of the price wedge and therefore captures the higher welfare costs at peak levels of protection or taxation. The TRI is that ad valorem tax rate that, if applied to all farm products in a country, would generate the same reduction in trade as the actual cross-commodity structure of agricultural NRAs or CTEs. The WRI indicates the economic welfare reduction instead of the trade reduction.

The original dataset by Anderson and Valenzuela (2008) was finalized in 2008, with data reaching up to 2007 for high-income countries and 2004 for developing countries. It therefore does not include the most-recent price-spike period. Price data for sufficient countries have been made available since then, which

[2] The coefficient of correlation between the NRA and CTE for the 75 countries and products over the five decades covered by Anderson and Valenzuela (2008) is 0.93. For details of the methodology for estimating the NRAs, CTEs, and related indicators, see Anderson et al. (2008).

makes it possible to update the database with a generic methodology to cover the price spike in 2008 and generate the main indicators of price distortions up to 2010. A detailed description of the method used to do that is provided in Appendix A. The new estimates for high-income countries (including those that recently joined the European Union), are based on producer support estimates reported in OECD (2011). For developing countries, the updated estimates make use of FAO and World Bank data sources for producer and border prices, respectively.

To prevent breaks in the time series through discrepancies in the prices of the Agricultural Distortions database and the FAO, the FAO producer prices in current US dollars were converted into an index set at 100 for the last available year in the Agricultural Distortions database. The changes in that index were used to update the estimates of prices for each country and product through to 2009. To calculate the border prices, one must rely on the trade volume and value data. The trade status of countries' products had to be derived first, using the self-sufficiency ratio (SSR). Once the SSR defines whether a country is an exporter or importer of a certain product, border prices can be computed and the index methodology can be applied to derive the updates through to 2009, using FAO trade data.

The data provided by the OECD, FAO and the World Bank made it possible to generate new NRA estimates (with all sub-categories) for the most recent years and therefore allows for significant update of the currently uploaded version of the Agricultural Distortions database. The updated version used in this thesis includes the years up to 2009 for developing countries and up to 2010 for high-income countries and for a few large developing countries for which OECD estimates are

available. It also expands the dataset by adding seven additional countries (which increases the coverage to 82 countries, listed by region in Appendix Table A.1).

C. Long-Run Trends in National Distortions to Agricultural Markets

Distortions to agricultural markets have a major impact on food prices, which is particularly important in poor countries where a large share of the income is spent on nutrition, but also, where a large share of the population depends on farming for their income. Therefore, price distortions in both directions affect particularly the part of the world population that depends heavily on agriculture for their living. Figure 4 reveals that over the past 55 years, governments in high-income countries have supported their farmers, while developing country governments chose the opposite path, trying to protect their consumers at the expense of their farmers. Additionally, many developing countries pursued an import-substituting industrialization strategy in the past and therefore indirectly taxed their tradable farm product producers even more by overvaluing their currency. The dotted line presents the NRA measure for high-income countries if decoupled payments are included, which are forms of support that deemed to be less distortive of resource allocation.

After crossing the zero axes in the 1990-94 period, developing countries increased their support to farmers on average, but that support decreased in 2005-10 period as international food prices rose. Similarly, there has been a decline in the nominal rate of assistance for high-income countries in the updated period. Thus the high-income and developing country groups' NRAs were moving towards each other

up to the 2000-04 period but in the latest period have moved in the same direction. This downward trend in NRAs is similar to the downward trend in the price spike period in 1970-74, and even the steepness of the decline is similar for high-income countries.

Figure 4: Nominal rate of assistance[a] to agriculture in high-income plus Europe's transition economies and developing countries, 1955–2010

Source: Anderson (2009, Chap. 1), updated from estimates in Anderson and Nelgen 2012b.

The gross subsidy equivalents presented in Figure 5(a) for developing and high-income countries reveal a similar picture. That figure illustrates how developing countries changed from negative to positive support of their agricultural sector between the periods of 1990-94 and 1995-99. Developing countries as a group

initially followed a decreasing trend of gross subsidy equivalents, reaching their lowest point in the 1975-79 period with negative support reaching just over 150 billion US dollars per year on average for the whole group. The slight increase in the following period is followed by a larger increase in the 1985-89 period, just before the group gets to the zero line. The net global support line that was around zero until the late 1970s (and negative during the 1973 price spike) has been increasing steadily since then, meaning that the world's farmers have received net government support on average over the past three decades. There has been a decrease in the most recent period 2005-10, just as there was when prices previously spiked (1970-74).

Analysing the gross subsidy equivalents by region in figure 5(b) shows that Asia and Western Europe have been the major contributors to this distortion measure in the earlier period, in opposite directions. In the period of 2005-10, Japan, Western Europe, North America and the transition economies of Eastern Europe and Central Asia (ECA) have provided similar aggregate support and developing country regions have positive but much smaller gross subsidy equivalents except for Asia (which is mainly driven by China and India).

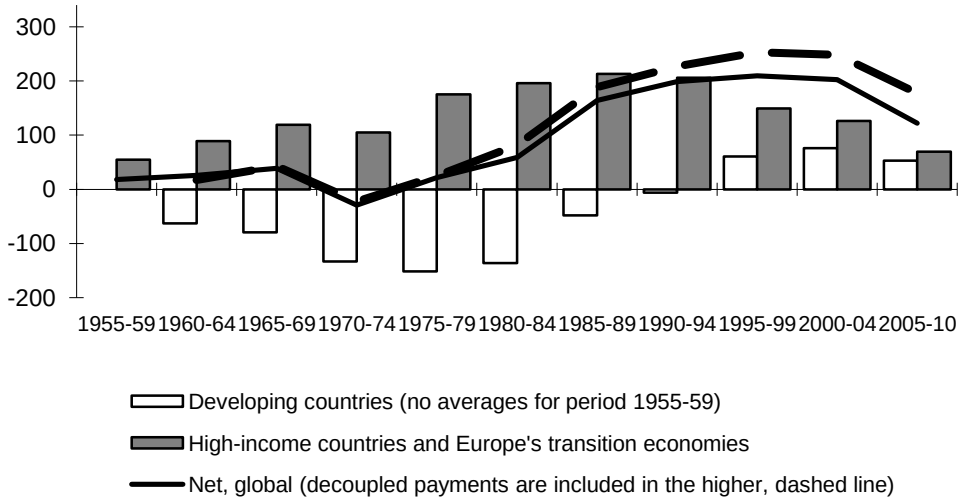
Table 1 summarizes various components of agricultural and non-agricultural policy measures. The NRAs for covered products in developing countries have moved from highly negative values to positive support by 1995-99. For high-income countries, a decline can be observed over the time period covered. The NRA "guesstimates" for non-covered agricultural products tend to be less than for covered products, which can be explained by the fact that the database covers the main tradable products subject to intervention. Decoupled assistance plays a very minor

role in developing countries but, after the 1980s, it adds non-trivially to the total agricultural NRA in high-income countries.

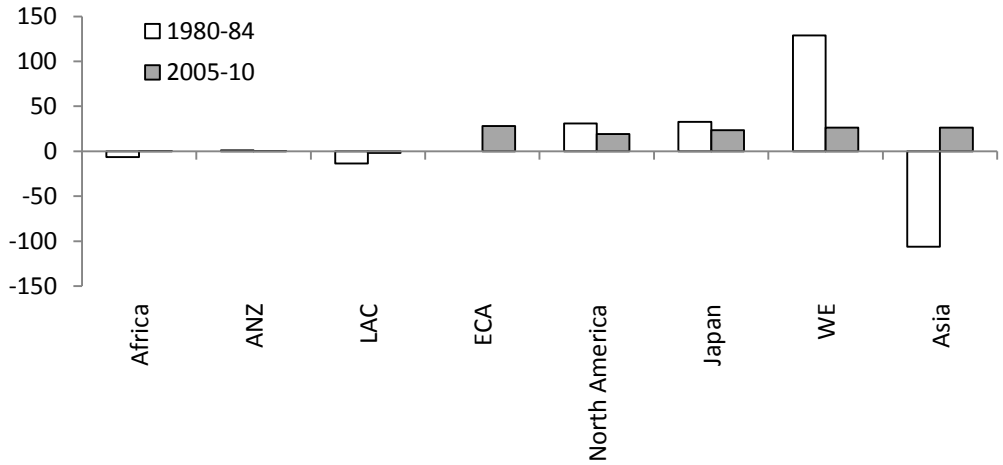
Figure 5: Gross subsidy equivalents of assistance to farmers, over time and by region,[a] 1955 to 2010

(constant 2000 US$ billions)

(a) over time



(b) by region



Source: Compiled from indicators in Anderson and Nelgen (2012b).

Table 1: Nominal rates of assistance to agricultural relative to non-agricultural industries, 1955 to 2010

(percent, weighted averages)

(a) Developing countries[c]

	1955-59	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09
Covered products	-33.4	-29.6	-28.8	-30.2	-27.6	-23.3	-13.2	-4.9	4.1	6.7	2.2
Non-covered products	-9.0	-7.9	-7.6	-9.8	-9.8	-7.1	0.3	0.1	4.3	6.6	6.7
All agricultural products[a]	-27.1	-24.0	-23.1	-24.9	-23.1	-19.1	-9.8	-3.5	4.2	6.7	4.1
Total agricultural NRA (incl. NPS)[a]	-25.8	-22.7	-21.8	-23.7	-22.0	-17.8	-8.3	-1.8	6.1	8.8	4.7
Decoupled assistance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.3	0.2
Total agric. NRA (incl. NPS + decoup)	-25.8	-22.7	-21.8	-23.7	-22.0	-17.8	-8.3	-1.6	6.3	9.1	5.0
Assistance to just tradables:											
All ag tradables	-27.9	-25.4	-25.3	-28.2	-25.7	-20.9	-10.3	-2.2	6.6	9.3	5.1
Non-ag tradables	56.9	43.1	45.0	30.6	27.3	18.8	14.0	12.7	9.1	6.2	5.2
Relative rate of assistance, RRA[b]	-54.1	-47.7	-48.4	-44.9	-41.6	-32.9	-21.2	-13.1	-2.2	2.9	0.0

Table 1 (continued): Nominal rates of assistance to agricultural relative to non-agricultural industries, 1955 to 2010

(b) High-income countries [incl. ECA]

	1955-59	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-10
Covered products	20.7	30.2	36.8	26.7	33.8	39.2	56.3	43.6	32.2	28.6	13.2
Non-covered products	9.0	13.4	13.8	10.4	13.3	13.7	21.1	17.0	17.0	16.8	9.6
All agricultural products	17.2	25.1	29.6	21.7	27.7	31.4	46.0	36.0	27.7	25.2	12.3
Total agricultural NRA (incl. NPS)[a]	21.1	27.6	31.3	22.6	29.3	35.9	50.0	40.3	31.6	29.5	15.5
Decoupled assistance	0.0	0.0	0.0	0.0	0.5	4.5	5.8	5.4	8.0	9.5	9.4
Total agric. NRA (incl. NPS + decoup)	21.1	27.6	31.3	22.6	29.9	40.5	55.8	45.8	39.6	39.0	24.8
Assistance to just tradables:											
All ag tradables	21.7	29.0	33.1	23.9	31.4	37.5	52.5	42.0	32.8	30.1	14.6
Non-ag tradables	7.5	8.7	9.1	6.3	4.5	3.8	3.7	2.5	2.1	1.8	0.3
Relative rate of assistance, RRA[b]	13.1	18.6	22.0	16.4	25.7	32.5	47.0	38.5	30.1	27.8	14.4

[a] NRAs including non-product-specific (NPS) assistance, that is, the assistance to all primary factors and intermediate inputs as a percentage of the total primary agricultural production valued at undistorted prices. [b] RRA is defined as $100*[(100+NRAag^t)/(100+NRAnonag^t)-1]$, where $NRAag^t$ and $NRAnonag^t$ are the percentage NRAs for the tradables parts of the agricultural and non-agricultural sectors, respectively. [c] Estimates for the NRA and RRA for China pre-1981 and India pre-1965 are based on the assumption that the agricultural NRAs in those years were the same as the average NRA estimates for those countries for 1981-84 and 1965-69, respectively, and that the value of production in those missing years is that which gives the same average share of value of production in total world production in 1981-84 and 1965-69, respectively.

Source: Authors' compilation from Anderson and Nelgen (2012b).

The last three rows of tables 1(a) and (b) present a relative distortion measure, the relative rate of assistance (RRA), which is a ratio of the distortions, applied to agricultural and non-agricultural tradables. Not only can a pro- or anti-agricultural bias be caused by agricultural policies directly, but also indirectly through border protection of the manufacturing sector. If agricultural and non-agricultural traded products are treated equally, the RRA is zero. This measure therefore gives a good indication of whether a country supports the domestic agricultural sector (RRA above zero) or burdens domestic farmers through their policies (RRA below zero).

High-income countries' RRAs peak in the period of 1985-89, which includes the downward price spike in 1986. However, developing countries have an overall anti-agricultural bias with an RRA below zero over the whole time period, which is caused partially by the non-trivial levels of non-agricultural assistance rates, as shown in table 1(b). The extent of developing countries' anti-agricultural bias gradually decreases over the years from 1955 to 2009 though, averaging zero in the last covered period of 2005-09. This happens through both the decline in protection of non-farm producers predominantly manufacturers) and an increase of the negative NRAs in the agricultural sector.

Figure 6(a) and (b) illustrate this development of the weighted averages of RRAs through the changes of agricultural versus non-agricultural protection over time. Both graphs show a movement in the same downward direction of the NRA for agricultural tradables in the 1970-74 period as in 2005-10.

Figure 6: Nominal rates of assistance to agricultural and non-agricultural tradable products and relative rate of assistance,[a] all focus countries, 1955 to 2010

(percent)

(a) Developing countries[b]

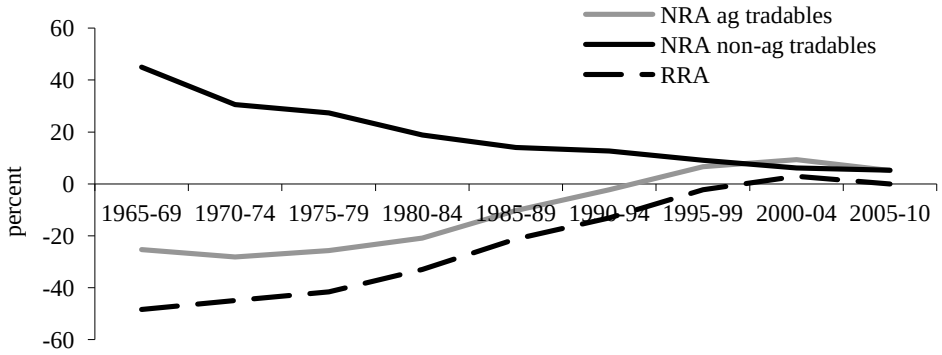
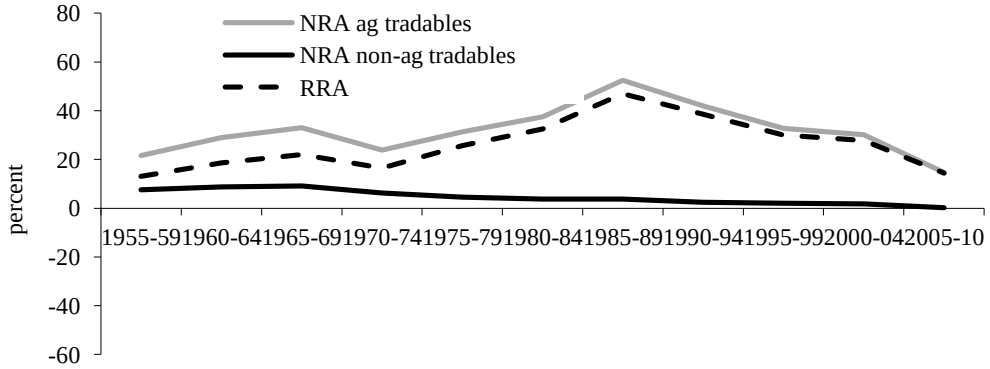


Figure 6 (continued): Nominal rates of assistance to agricultural and non-agricultural tradable products and relative rate of assistance,[a] all focus countries, 1955 to 2004

(b) High-income countries



a. The RRA is defined as 100*[(100+NRAag^t)/(100+NRAnonag^t)-1], where NRAag^t and NRAnonag^t are the percentage NRAs for the tradables parts of the agricultural and non-agricultural sectors, respectively.
b. Assumes China's NRA values pre-1981 were the same as in 1981-84.

Source: Compiled from indicators in Anderson and Nelgen (2012b).

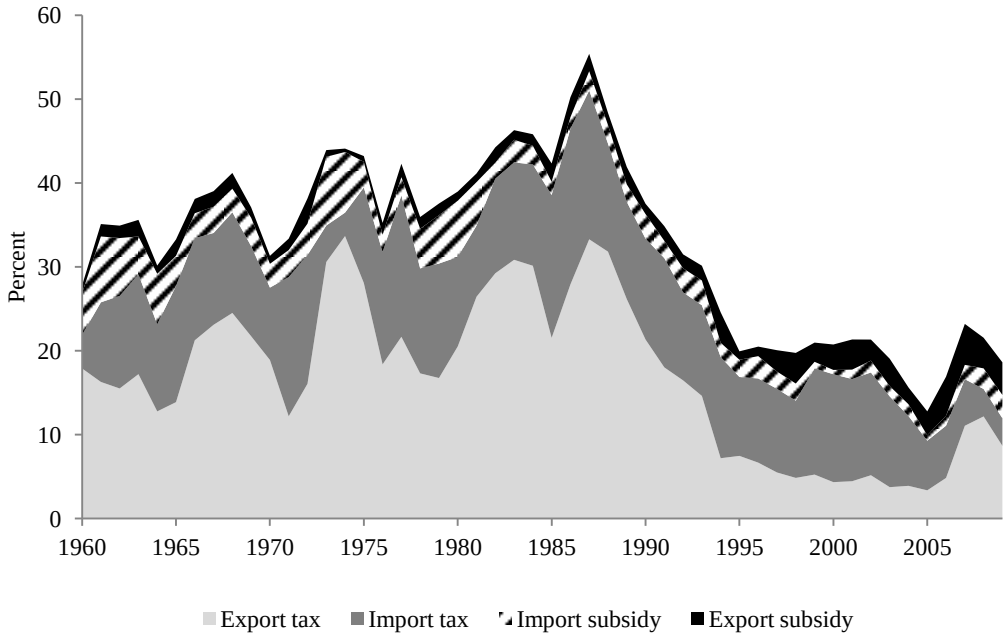
The graph also shows the approach of the two lines for agricultural and non-agricultural NRAs in developing countries and therefore an increasing RRA, coming from the negative area and reaching zero in the most recent period. Both sectors start off highly distorted in 1955, and come closer to each other over time. Part (b) of Figure 6 shows those two lines approaching each other in the high-income country case, but with a positive protection level for both sectors of the economy. It has to be kept in mind though that the RRAs differ greatly across countries and this graph only illustrates the average for those diverse country groups.

Figure 7 illustrates the WRI, described in section (a) of this chapter, by policy instrument for developing countries. The overall measure of the WRI indicates a decline of this indicator from the mid-1980, which is mainly caused by the major decline in export taxes. Export taxes are the main contributor to this measure, followed by import taxes, import subsidies and export subsidies. But when prices spiked in 2008, so did too the export taxes contribution to the WRI, while import taxes diminished (for more detailed estimates, see Appendix D).

Past reforms clearly have contributed to a reduction in distortions to agricultural incentives at the global level. The trend of distorting policies has been declining, coming from different directions for the two country groups of developing countries and high-income countries. The anti-agricultural and anti-trade bias of many developing countries' policies has been reduced and the support that farmers in high-income countries have been given in the form of export subsidies has been reduced or shifted to less-distorting forms of support.

Figure 7: Contributions of various instruments to the border component of the welfare reduction index (WRI) for developing countries, 1960–2009 (%).

:



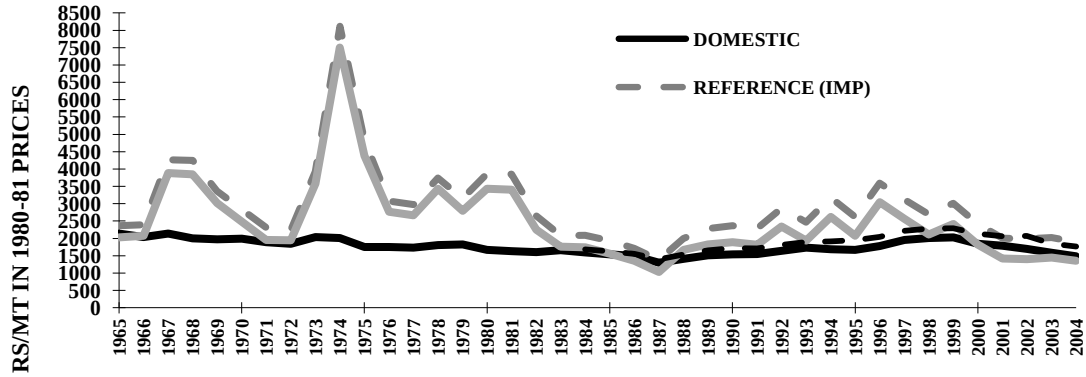
Source: Derived from estimates reported in Croser and Anderson 2009, updated from Anderson and Nelgen (2012b).

However, it is not clear in what direction the trend of agricultural protection will develop in the decades ahead. The attempt by both country groups, high-income and developing countries, to protect domestic producers from import competition seems to be increasing, even though the NRA for the exporting sector is close to zero in recent years (see Figure 10 in the following section of this chapter).

D. Short-Run Fluctuations in National Distortions to Agricultural Markets

This section focuses on year-to-year fluctuations of policy interventions around the long-run trends discussed in the previous section. A major reason for governments to intervene is to reduce the risk and uncertainty of volatile domestic price implications. International prices of agricultural products are highly volatile, and so too are governments' responses to such price fluctuations. This insulation strategy aims to stabilize prices for both the domestic producer and consumer, and therefore to reduce the impacts of fluctuating international prices on growth and welfare. As an example, Figure 8 illustrates the effort of India's government to keep the domestic rice price stable by intervening in the agricultural market, while the border prices are exposed to fluctuations.

Figure 8: Real domestic producer and international reference price for rice, India, 1965-2004



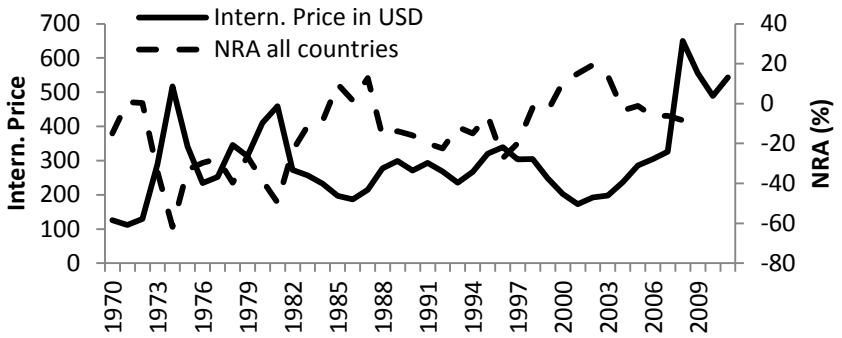
Source: Anderson and Martin (2009, Figure 10.4)

Understanding price stabilization is an important part of understanding policy interventions in agriculture. The correlation between the international price and the NRAs is very highly negative, as figure 9 shows for rice in South and South East Asia and for all focus countries. The correlation coefficient is as high at -0.52 for South Asia, -0.45 for South East Asia and -0.74 for all focus countries. This indicates that there is a strong relationship between the fluctuations in international prices and NRAs. The causality of this relationship could go in both directions. Changes in the international price can cause governments to adjust their trade restrictions to protect domestic producers or consumers from the international price change. However, there is also evidence of a reverse relationship, as insulating policies can exacerbate international price changes (See chapter 3 of this thesis). In the latter case, policy interventions of multiple countries contribute to international price fluctuations and variability, which, at least partially, is transmitted back to the domestic market. With the rise in international food prices in 2011, the NRAs can be expected to drop again (but data are not yet available to confirm this at the time of writing).

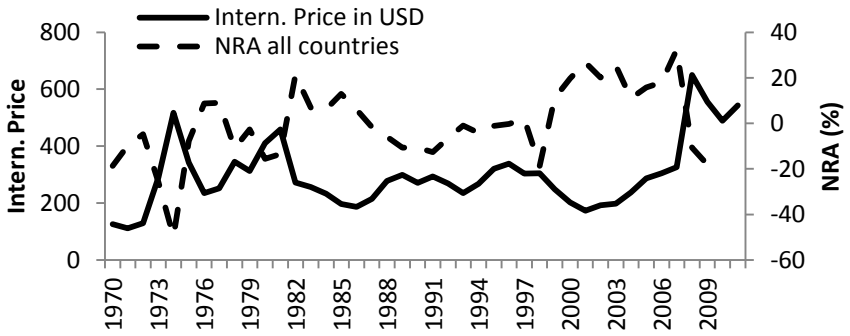
On the producer side (the supply side), higher food price volatility increases the variance over time of incomes of farmers, while on the demand side, consumer expenditure faces uncertainty in the presence of volatile prices. The impact of price volatility on welfare is higher for products with low elasticities of demand and supply. The price elasticity of domestic demand for staples, which by definition supply the main share of caloric intake in low-income countries, is generally smaller than 0.5 (Schiff and Valdez 1992).

Figure 9: Nominal rate of assistance [a] and international price for rice for South Asia, South East Asia and all focus countries, 1970-2011.

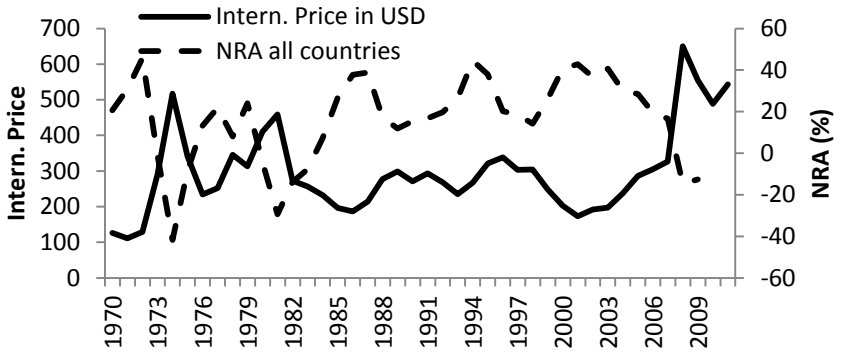
(a) South Asia



(b) South East Asia



(c) All covered countries



[a] The NRA is a weighted averages of the nominal rate of assistance to producers in each country, using production valued at undistorted prices as weights.

Source: Compiled using indicators by Anderson and Nelgen (2012b), and the World Bank (2011).

Developing countries tend to show greater fluctuations in prices than high-income countries. This has negative effects on their growth path. Commodity prices have been the key driver of this problem throughout history. Less policy interventions and a pro-global attitude has been shown to be advantageous for reducing international price fluctuations and therefore contribute to thereduction of negative effects on economic development (Jacks, O'Rourke and Williamson 2011).

Because a greater share of household income is spent on the essential requirements of nutrition in developing countries, inter-temporal consumption smoothing is not possible to the same extent as in developed countries. Therefore, governments show a tendency to intervene to stabilize their populations' expenditure for the basic food intake, to take away the risk of struggling with the daily food supply and therefore to increase domestic welfare. Tyers (1991) points out that reducing risk is the main aim behind agricultural protection policies for developing countries, rather than activist redistribution of domestic wealth (as might be the case in developed countries).

Such price stabilization policies can distort the efficient allocation of resources within countries, which can outweigh the positive effects of stabilizing prices for the country. However, as shown in Newbery and Stiglitz (1981), price stabilization is more beneficial for an individual country if trade restrictions and distortions are present because often the international market cannot absorb the volatility if distortions are present. This builds a vicious circle.

Figure 10 illustrates the differences in policy interactions, not only between high-income countries and developing countries, but also between import-competing and exportable covered products. The linear trend line is almost horizontal for high-

income countries. Exportables have been highly taxed in developing countries in the past, but are slowly moving towards zero from 1980s onwards. There has been hardly any intervention for those products on average in the high-income country group. However, import-competing products have been highly assisted throughout the time period in both country groups. The price spike periods in 1973, 1986 and 2008 are clearly visible when looking at the policy distortion measure. This means that countries react promptly to such events to protect the consumer side in upwards price spikes and the producer side in downwards price spikes.

Figure 10: Nominal rates of assistance to exportable, import-competing and all covered agricultural products, high-income and developing countries, 1955-2010[a]

(percent)

(a) Developing countries

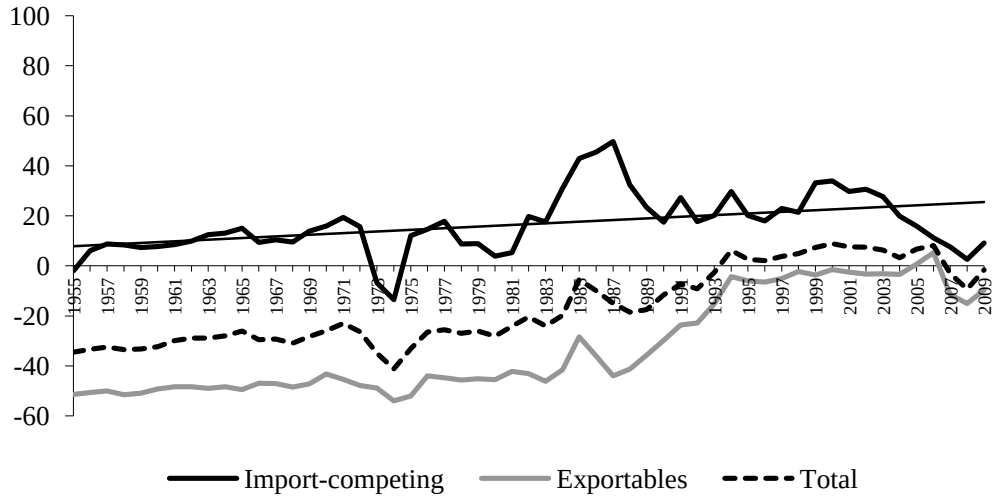
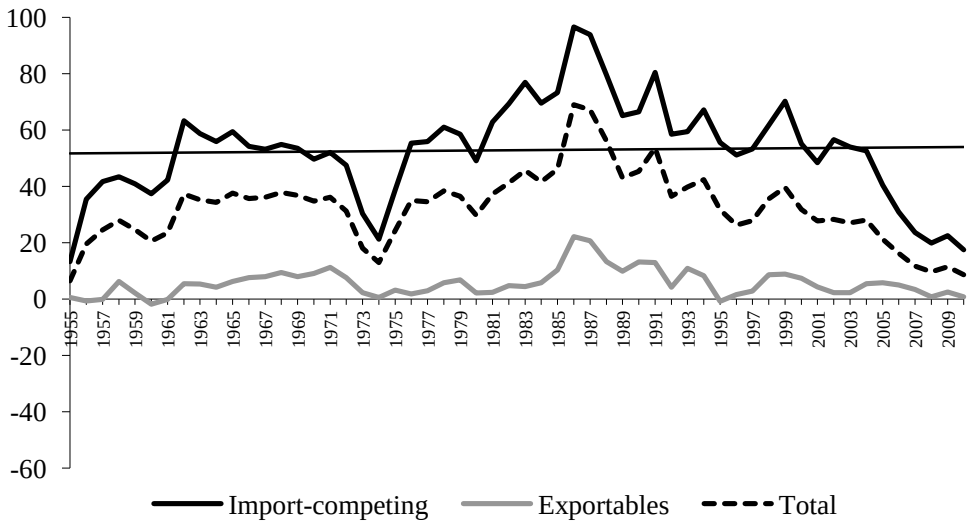


Figure 10 (continued): Nominal rates of assistance to exportable, import-competing and all covered agricultural products, high-income and developing countries, 1955-2010[a]

(percent)

(b) High-income countries plus Europe's transition economies



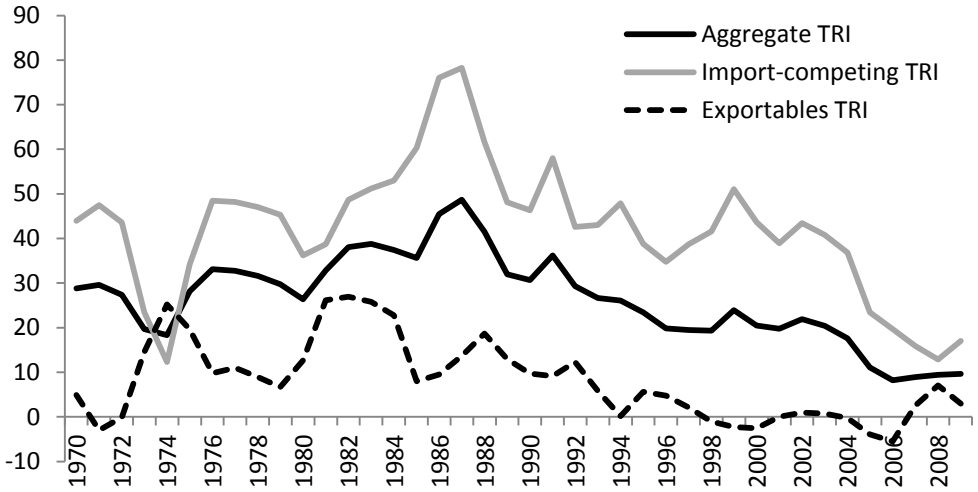
[a] Straight trend line is based on a linear regression equation for the entire period.

Source: Compiled using indicators by from Anderson and Nelgen (2012b).

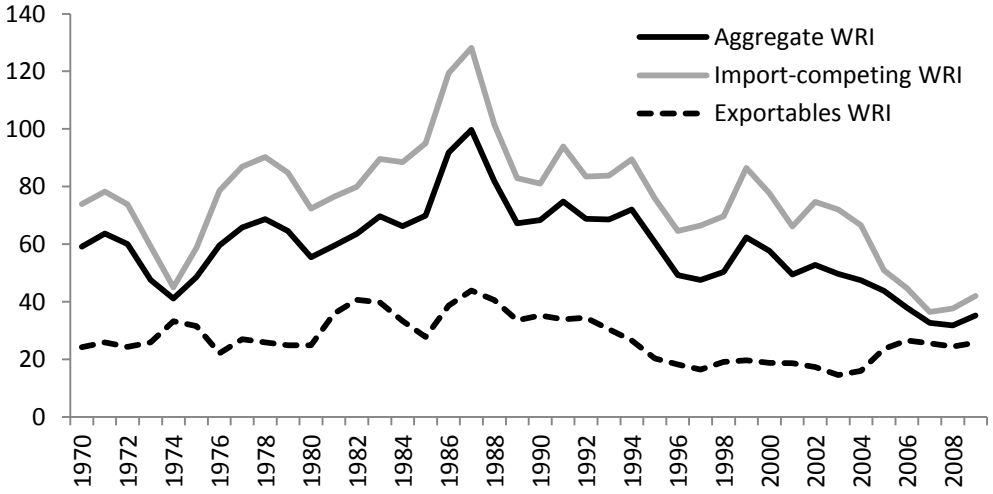
Figure 11 shows the global TRI and WRI for import-competing and exportable products, revealing the negative correlation between the two groups particularly in the case of the TRI. The exporter country group contributes to raising TRIs and WRIs during the two upwards price spikes and lowers them during the mid-1980s downwards price spike. The opposite is the case for import-competing countries.

Figure 11: Global welfare reduction index and trade reduction index for 29 main commodities, 1970-2009.

(a) Trade Reduction Index



(b) Welfare Reduction Index



Source: Derived from estimates reported in Croser and Anderson 2009, updated from Anderson and Nelgen (2012b).

The fluctuations of policy interventions in agriculture are strongly correlated to volatility and to spikes of international prices. Since agricultural prices are highly volatile, the reactions of governments are showing significant movement around the trend line as well. Given that the goal of such interventions in many countries is often to insulate the domestic market from this volatile international price to stabilize the domestic producer or consumer price, the global welfare effects need to be considered by the international community. From a global welfare point of view, the effect of any one country's domestic price insulation is to 'burden' other countries by increasing international price variability. Price stability policies can also lead to inefficient allocations of resources within economies. This suggests a need for the global community to come to a multilateral agreement that prevents the exacerbation of price changes and therefore volatility in the world's agricultural markets.

References

Abbott, P. (1979), Modeling International Grain Trade with Government Controlled Markets. *American Journal of Agricultural Economics* 61(1), 22-31.

Anderson, K. and E. Valenzuela (2008), *Global Estimates of Distortions to Agricultural Incentives, 1955 to 2007*, data spreadsheets at www.worldbank.org/agdistortions

Anderson, K. and J.L. Croser (2009), National and Global Agricultural Trade and Welfare Reduction Indexes, 1955 to 2007, database at www.worldbank.org/agdistortions.

Anderson, K. (ed.) (2009), *Distortions to Agricultural Incentives: A Global Perspective, 1955–2007*, London: Palgrave Macmillan and Washington DC: World Bank.

Anderson, K. and J.L. Croser (2009), *National and Global Agricultural Trade and Welfare Reduction Indexes, 1955 to 2007,* database at www.worldbank.org/agdistortions.

Anderson, K., J.L. Croser, D. Sandri and E. Valenzuela (2010), 'Agricultural Distortion Patterns Since the 1950s: What Needs Explaining', Ch. 2 in K. Anderson (ed.), *The Political Economy of Agricultural Price Distortions*, Cambridge and New York: Cambridge University Press.

Anderson, K. and S. Nelgen (2012a), 'Trade Barrier Volatility and Agricultural Price Stabilization', *World Development* 40(1): 36-48, January.

Anderson, K. and S. Nelgen (2012b), 'Updated National and Global Estimates of Distortions to Agricultural Incentives, 1955 to 2010', Database uploaded in March 2012 at www.worldbank.org/agdistortions.

Deaton, A. (1999), 'Commodity Prices and Growth in Africa', *Journal of Economic Perspectives* 13(3): 23-40, Summer.

Jacks, D.S., K.H. O'Rourke and J.G. Williamson (2011), 'Commodity Price Volatility and World Market Integration since 1700', *Review of Economics and Statistics* 93(3): 800-813, January.

Knudsen, O. and J. Nash (1990), 'Domestic Price Stabilization Schemes in Developing Countries', *Economic Development and Cultural Change* 38(3) 539–558, April.

Lloyd, P.J., J.L. Croser and K. Anderson (2010), 'Global Distortions to Agricultural Markets: New Indicators of Trade and Welfare Impacts, 1960 to 2007', *Review of Development Economics* 14(2): 141-60, May.

Nerlove, M. (1972), 'Lags in Economic Behaviour', *Econometrica* 40(2): 221-52, March.

Newbery, D. M. G. And J. E. Stiglitz (1981), *The Theory of Commodity Price Stabilization: A Study in the Economics of Risk*, London and New York: Oxford University Press.

OECD (2011), *Producer and Consumer Support Estimates, OECD Database 1986-2010*, http://www.oecd.org, accessed 26 September.

Ramey, G. and V.A. Ramey (1995), 'Cross-Country Evidence on the Link between Volatility and Growth', *American Economic Review* 85(5): 1138-51, December.

Schiff, M. and A. Valdés (1992), 'The Effects of Intervention on Price Variability', Ch. 3 in M. Schiff and A. Valdés, *The Political Economy of Agricultural Pricing Policy, Volume 4: A Synthesis of the Economics in Developing Countries,* Baltimore: Johns Hopkins University Press for the World Bank.

Tyers, R. (1991), 'On the Neglect of Dynamics, Risk and Market Insulation in the Analysis of Uruguay Round Food Trade Reforms', *Australian Journal of Agricultural Economics* 35(3): 295-313, December.

Tyers, R. and K. Anderson (1992), *Disarray in World Food Markets: A Quantitative Assessment*, Cambridge and New York: Cambridge University Press.

World Bank (2012), *Pink Sheets,* http://econ.worldbank.org, accessed 29 January.

Wright, B.D. (2011), 'The Economics of Grain Price Volatility', *Applied Economic Perspectives and Policy* 33(1): 32-58, Spring.

Chapter 2:

Trade Barrier Volatility and Agricultural Price Stabilization

Signe Nelgen

(with Kym Anderson)

Revision of a paper published in

World Development 40(1): 36-48, January 2012

Abstract

National barriers to agricultural trade are often varied to insulate domestic markets from international price variability, especially following a sudden spike. This paper examines the extent of that behavior by governments using new annual estimates of agricultural price distortions in 82 countries. Responses to price spikes are shown to be equally substantial for agricultural-importing and agricultural-exporting countries, thereby weakening the domestic price-stabilizing effect of their interventions. Bringing discipline to export restrictions through new World Trade Organization rules could help alleviate the extent to which government responses to exogenous upward price spikes exacerbate those shocks.

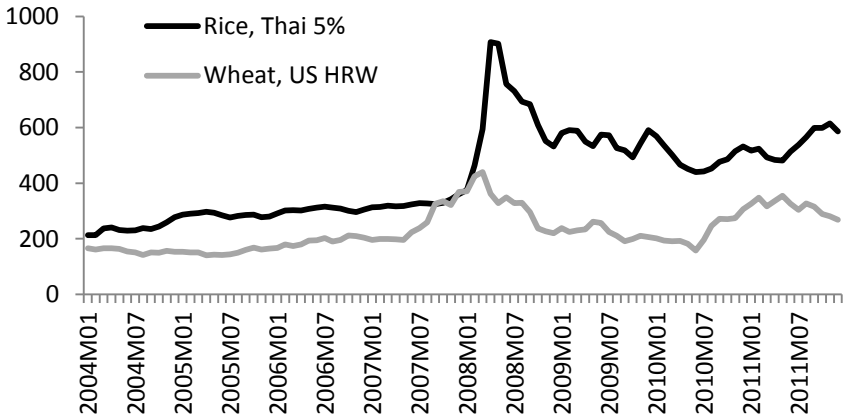
Trade Barrier Volatility and Agricultural Price Stabilization

A. Introduction

Restrictions on food exports received much publicity when prices in international food markets rose from 2005 and spiked in mid-2008 and then again early 2011. The rapid rise during 2007-08 was fueled in part by the news that some developing countries – so as to slow the rise in domestic prices – were suspending their grain exports. Agricultural prices came down somewhat in the final few months of 2008, but the US dollar price of wheat rose by more than half again in the northern summer of 2010, despite the replenishment of global stocks (Figure 1).

Figure 1: International prices for rice and wheat, 2004 to 2011

(current US dollars)



Source: World Bank, *Pink Sheets*, http:// econ.worldbank.org, accessed 29 January 2012.

The 2010 rise was triggered by Russia's announcement to suspend wheat exports in the wake of its drought and wildfires, in combination with Ukraine, Belarus, Uzbekistan and Kazakhstan also restricting or banning their wheat exports. Meanwhile, India effectively retained an export ban on both wheat and rice since 2008.

Figure 2 reveals that magnitudes of the real international price rises of rice and wheat, and the speed of the subsequent fall back to trend (leaving out the second peak in the most recent period) were similar to those experienced in 1974. On both occasions, the rising price generated panic buying by individual households, especially of rice in Asia, which exacerbated the international price spike (Anderson and Nelgen, 2010).

Figure 2: Indexes of real international prices of rice and wheat, 1972-76 (1972 = 100) and 2006-10 (2006 = 100)

(a) Rice

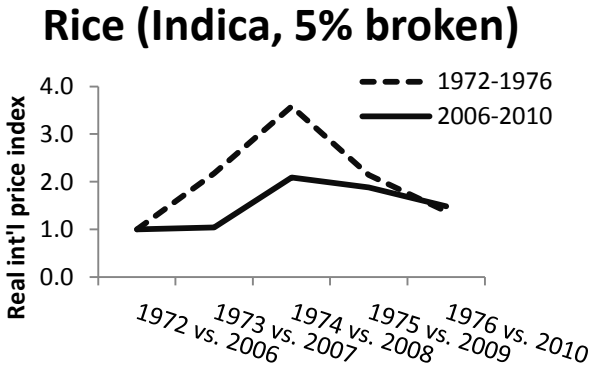
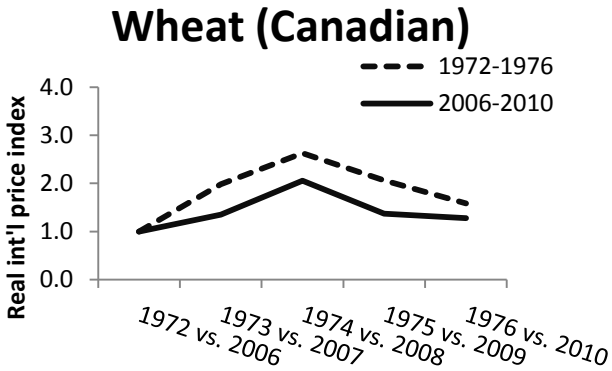


Figure 2 (continued): Indexes of real international prices of rice and wheat, 1972-76 (1972 = 100) and 2006-10 (2006 = 100)

(b) Wheat



Source: Authors' derivation drawn from World Bank *Pink Sheets* of nominal prices deflated by the United States GDP implicit price deflator (see Anderson and Nelgen 2010, Appendix Table A).

This chapter reviews the domestic market insulation impacts of agricultural policies used in the past and in the most recent price spike by governments attempting to stabilize their domestic food market. Governments of almost all countries deliberately seek to reduce fluctuations in domestic food prices and in the quantities available for local consumption. There is a huge analytical literature on the economics of such price stabilization efforts. Its connection with trade policy was highlighted by Johnson (1975) immediately following the upward spike in world food prices in 1973-74. His analysis of grain prices suggested that if free trade in grain was in place in 1975, prices would be so much less variable – because trade could mitigate local supply variability – that only negligible quantities of carryover/storage would be profitable. A subsequent study of global food trade

provided complementary results: using a stochastic model of world markets for grains, livestock products and sugar, Tyers and Anderson (1992) found that instability of international food prices in the 1980s was three times greater than it would have been under free trade in those products.

Such government intervention is in response to lobbying efforts from and society's concern for groups destined to otherwise lose from exogenous shocks (Thompson et al. 2004, Freund and Özden 2008) – although it needs to be kept in mind that stabilizing prices is not the same as stabilizing real incomes of the target households. An additional justification sometimes given for such intervention in poor countries is that credit markets are underdeveloped or inefficient because of local monopoly lenders, so low-income consumers and producers have difficulty smoothing their consumption over time as prices fluctuate.

However, the events following such price spikes suggest sudden export restrictions can contribute to spikes in international food prices. Sharp price rises also prompt food-deficit countries to reduce their import restrictions (or even subsidize imports) temporarily, which can further exacerbate an international price spike. And the opposite tends to occur when international food prices spike downwards: some food-surplus countries lower their export barriers or subsidize exports while some food-importing countries raise their import barriers. In each case the aim of national governments appears to be to insulate the domestic market from international price volatility. However, when many countries so intervene, their combined effect adds to the cost of exogenous supply or demand shocks to food buyers or sellers in the rest of the world. Such beggar-thy-neighbor behavior of national governments thus is a concern for all trading nations, because it reduces the stability and predictability of

trade opportunities. In addition, typically it is also not in the best economic interests of the intervening countries, as there are almost always more-efficient instruments than trade measures to avert losses for politically significant interest groups.

The participants of the G20 meeting in November 2011 in Cannes emphasize in their final declaration the importance of a transparent and distortion free multilateral trading system, particularly to reduce the effects of price volatility to the most vulnerable producers and consumers. The declaration encourages the international organizations to work closely together to strengthen international policy coordination and transparency (G20, Cannes Summit Final Declaration, 2011). The recognition of those required changes to the current policy framework in agriculture is an important step to improve the efficiency of agricultural markets, but it is necessary to analyze the policy reactions of the past to prevent price exacerbating effects in the future, especially during periods of already high prices. The purpose of this paper is to provide evidence for government's policy reactions in the past, by drawing on a new database of annual distortions to agricultural incentives in 82 countries since the 1950s.

Specifically, this chapter addresses the following empirical questions: How much do countries try to dampen international-to-domestic food price transmission? Has this tendency lessened since many countries began reducing their trade barriers in the 1980s? How different are trade restrictions in periods of international price spikes? Do food-deficit countries vary their trade restrictions more than food-surplus countries? Do governments respond differently in periods of upward versus downward spikes in international food prices? Do developing countries vary their trade restrictions more than high-income countries? How much do the various trade

policy instruments, and domestic measures, contribute to NRA changes during price surges? And how successful have national governments been in stabilizing domestic agricultural prices relative to those in international markets?

The chapter begins by briefly explaining the potential price, trade and welfare impacts of such trade barrier variability. It then addresses the above questions by comparing indicators of recent trade barrier changes with those associated with the upward price spike around 1973-74, and also with the downward spike in international food prices in the mid-1980s. Responses by food-importing and food-exporting countries are shown to be almost equally substantial, ensuring that each group reduced the effectiveness of the other's domestic market stabilizing intervention effort while exacerbating the international price spike. The paper concludes by exploring more-effective national policy options than trade measures for reducing the harm to key groups that are at risk of being hurt by such prices spikes, and new initiatives that might be undertaken multilaterally.

B. Impacts of trade restriction responses to international food market shocks

Fluctuations are to be expected in commodity markets subject to periodic supply or demand shocks, especially if adverse supply shocks occur when stocks are at low levels (Deaton and Laroque 1992). They are even more likely in the presence of sporadic changes in government storage activity. Many governments seek to shield their domestic market somewhat from those fluctuations, and especially from severe spikes in international prices, by altering the restrictiveness of their trade policies.

An export tax or its equivalent lowers the domestic price below the border price of a tradable product such as grain (as does an import subsidy), whereas an import tax or its equivalent raises its domestic price above the border price (as does an export subsidy). Hence it is not surprising that governments, in seeking to protect domestic consumers from an upward spike in international food prices, consider a change in trade measures as an appropriate response, since that can lower the consumer tax equivalent of any such measure.

However, an import tax (or export subsidy) is the equivalent of a consumer tax and a producer subsidy, hence lowering it also reduces the extent to which the measure assists producers of the product in question. Likewise, since an export tax (or import subsidy) is the equivalent of a consumer subsidy and a producer tax, raising it not only helps consumers but also harms farmers. If farming is discouraged, the demand for labor on farms falls, and with it the wages of unskilled workers not only in farm jobs but also in non-farm jobs – and more so the more agrarian is the economy. Thus while poor households may benefit on the expenditure side from a measure that reduces the extent to which the price of food would otherwise rise, they could be harmed on the earnings side if they are sellers of food or suppliers of unskilled labor. Such trade policy responses therefore could add to rather than reduce poverty.[3] In the case of small intervening countries unable to influence their terms of trade, such trade measures also are likely to reduce their national economic welfare, because they distort domestic production in addition to lowering the consumer price

[3] Recent empirical studies provide numerous cases of where trade restrictions have added to or would add to poverty. See, for example, Warr (2005), Hertel and Winters (2006), Anderson, Cockburn and Martin (2010) and Aksoy and Hoekman (2010).

of food.[4] They are also wasteful if it is only the poorest consumers who need to be helped, since a trade measure affects all food consumers in the country. Conversely, in the case of opposite changes to trade measures aimed at protecting farmers from a spike downwards in international prices, it is consumers who are inadvertently harmed by such trade policy responses, and all producers rather than just the poorest are helped – and in proportion to their output, thereby adding to farm income inequality.

Trade measures are not only *inefficient* at protecting a needy group from being harmed by a temporary shock to international food markets, they are also *ineffective* if many countries respond similarly. The ineffectiveness comes about because trade barriers of *both* food-exporting and food-importing countries often are altered in an effort to prevent the transmission of the international price shock. If only food-exporting countries respond to an upward price spike, the international terms of trade would turn even further in their favor because of the additional reduction in available supplies on the international markets (and conversely if only food-importing countries alter their trade restrictions when the world price of food collapses); and the extent of that extra terms of trade benefit is greater, the larger the proportion of global trade so affected by the exporting countries' policy response. Such action would thus add both to the extent of the international price spike and to the transfer of welfare from food-deficit to food-surplus countries (or from food-

[4] Variable trade restrictions can also affect long-term investments and hence economic growth rates. Drawing on a broad range of developing country case studies, Bevan Collier and Gunning (1990) and Collier, Gunning and Associates (1999) suggest that faster economic growth would result from allowing producers access to high prices in those rare occasions when they spike, rather than taxing it away. According to the evidence in their case studies, this is because governments are more prone than farm households to squander the windfall either in poor investments or in extra consumption.

surplus to food-deficit countries when the price spike is downward and only food-deficit countries respond).

However, Martin and Anderson (2011) show that when both sets of countries seek to insulate their domestic markets from an external shock, their impacts on the international price spike are reinforcing but their impacts on the volume they trade internationally – and hence on their domestic prices – are offsetting. In the extreme case in which food-deficit countries expand their imports to exactly the same extent as food-surplus countries reduce exports, the domestic price in both sets of countries would be no different than if neither country altered their trade measures following the exogenous shock. That is, the initial international price change from the initial shock would be fully transmitted to both sets of countries, despite their efforts to fully insulate their domestic markets in that extreme case. Moreover, the more countries that participate and thus the more the international price spike is accentuated, the more compelled will other countries feel to join the bandwagon and push that price even higher.

C. Empirical evidence

This section first describes a new database of distortions to agricultural incentives in 82 countries (listed by region in Appendix Table A.1) and then addresses sequentially the questions posed in the introduction.

(a) Database on government distortions to domestic prices of farm products

A recently compiled World Bank database provides, in a single source, a set of indicators of the extent to which trade restrictions and other price-distorting border and domestic policies have altered annual average domestic producer and consumer prices of farm products away from their international price levels over the past half century (Anderson and Valenzuela 2008, with summary estimates in Anderson 2009 and Ch. 2 of Anderson 2010). The original sample includes 75 countries that together account for all but one-tenth of global agriculture, and the 75 most important products so as to cover around 70 percent of the gross value of agricultural output in each focus country.

While the original database only went up to 2007 (and only to 2004 for most developing countries), and so did not include the most-recent price-spike period, price data are now available for sufficient countries to enable us to update (and extend) the estimates in Anderson and Valenzuela (2008). These new estimates are based, for high-income countries (including those that recently acceded to form the EU-27) and some large developing countries, on producer support estimates reported in OECD (2010). For developing countries, the updated estimates make use of FAO and World Bank data sources for producer and border prices, respectively.[5]

[5] The new developing country estimates are less reliable than the high-income country ones, and the earlier estimates for developing countries in Anderson and Valenzuela (2008), for several reasons. One is that, to do the update promptly, producer and border prices reported to or derived from FAO had to be used for developing countries rather than more-nuanced prices available only in national statistical agencies. To minimize the errors this might introduce, the prices in US current dollars were converted into an index set at 100 for the most recent available year Anderson and Valenzuela (2008), and the following years where updated using the changes in that index for each country through to 2009.

The key indicator used for present purposes is the national nominal rate of assistance to agricultural producers (NRA). This is the extent to which the domestic producer price exceeds the border price, and hence is negative if farmers receive less than the price at the country's border for a similar product (adjusted for such things as distribution costs and quality differences). That is the appropriate indicator in times of international price downturns when governments seek to provide more assistance to farmers; but it turns out to be very highly correlated with the appropriate indicator of consumer protection (the consumer tax equivalent, or CTE) in times of upward international food price spikes when governments seek to provide more protection to consumers.[6] The high correlation between the NRA and CTE reflects the fact that most interventions in national food markets occur at the border, rather than in the form of domestic food consumer or producer subsidies or taxes.

Since part of our interest is in examining proportional changes in the NRA, that can best be done by converting it to a nominal assistance coefficient, where NAC = 1+NRA/100. This is especially so when some NRAs are negative, in which case the NAC is below rather than above one.

(b) How much do governments insulate their domestic agricultural markets?

As pointed out in Chapter 1, governments do not limit their interventions in markets for farm products to periods of extreme prices. In the past developing countries have tended to set NRAs below zero, especially if they are food-surplus,

[6] The coefficient of correlation between the NRA and CTE for the 75 countries and products over the five decades covered by Anderson and Valenzuela (2008) is 0.93. For details of the methodology for estimating the NRAs and CTEs, see Anderson et al. (2008).

while high-income countries have tended to assist their farmers (NRAs above zero), especially if they are food-deficit. That is, NRAs tend to be higher the higher a country's income per capita and the weaker the country's agricultural comparative advantage. This is evident from the first 3 columns of Table 1, which reports regressions of product NRAs on various explanatory variables in the panel dataset for six key crop products. Those highly significant regression coefficients suggest NRAs tend to rise over time as a country's per capita income rises, and more so the more that growth is accompanied by a decline in agricultural comparative advantage.

Agricultural policy regimes tend also to have an anti-trade bias. In high-income countries, that has manifested itself predominantly in import restrictions. There have been few export restrictions on high-income countries' farm products since the 1950s (examples being the US Russian grain embargo in 1980 and the 1973 Nixon soybean embargo) and, even where export subsidies have been used, they have provided much less assistance to exporters than that enjoyed by import-competing farmers of high-income countries. For the developing country group, the anti-trade bias manifests itself mostly as taxes and other restrictions on agricultural exports, although their impact has declined since the 1980s and there has also been some growth in agricultural import protection by developing countries. This anti-trade bias is reflected in the negative coefficient on the dummy variable for exportables in column 5 of Table 1 (as well as in the anti-trade bias and trade reduction indexes reported in Anderson 2009).

More pertinent to the present chapter is the fact that around the long-run trends in NRAs for each country there is much fluctuation from year to year in individual product NRAs. A change in NRA may not require any policy action on the

part of the government, but rather be part of the original policy design. For example, the use of specific rather than ad valorem rates of trade taxation or trade subsidization automatically ensures some insulation of the domestic market from international price changes, as does the use of quantitative restrictions on trade such as fixed import or export quotas or bans. Explicit formulae for varying the import or export duty according to international price movements also may be part of the policy regime. And in some cases explicit provisions for restricting or relaxing trade barriers in price spike periods also are part of a policy's legislation– even though the use of that provision may lay dormant in all but extreme periods. In what follows such possibilities will be treated no differently than any formal change of policy: both will show up as a change in the NRA.

Table 1: Regressions aimed at understanding variations in product NRAs across 75 countries, 1955 to 2007

(no country fixed effects)

	Log of real GDP per capita	Log of real GDP per capita, squared	Log of arable land per capita	% deviation of int'l price from its trend	Dummy if exportable	Constant	No. of obs.	Adjusted R^2
Rice	-2.022***	0.157***	-0.390***	-0.320***	-0.732***	5.988***	1281	0.514
	(0.152)	(0.00988)	(0.0219)	(0.0532)	(0.0447)	(0.562)		
Wheat	-0.921***	0.0707***	-0.158***	-0.317***	-0.424***	2.823***	1661	0.347
	(0.116)	(0.00728)	(0.0159)	(0.0529)	(0.0368)	(0.454)		
Maize	-0.432***	0.0334***	-0.167***	-0.236***	-0.195***	1.307***	1525	0.208
	(0.0937)	(0.00602)	(0.0145)	(0.0504)	(0.0292)	(0.354)		
Soybean	0.957***	-0.0424**	-0.548***	-0.0372	-0.128	[illegible]	703	0.310
	(0.345)	(0.0212)	(0.0368)	(0.155)	(0.0893)	(1.366)		
Sugar	-1.021***	0.0843***	-0.244***	-0.582***	-0.414***	3.180***	1648	0.413
	(0.178)	(0.0113)	(0.0255)	(0.0338)	(0.0554)	(0.670)		
Cotton	-0.370***	0.0320***	0.00829	-0.274***	-0.270***	1.057***	883	0.275
	(0.0897)	(0.00607)	(0.0159)	(0.0363)	(0.0429)	(0.315)		

*** indicates statistically significant at the 1% level

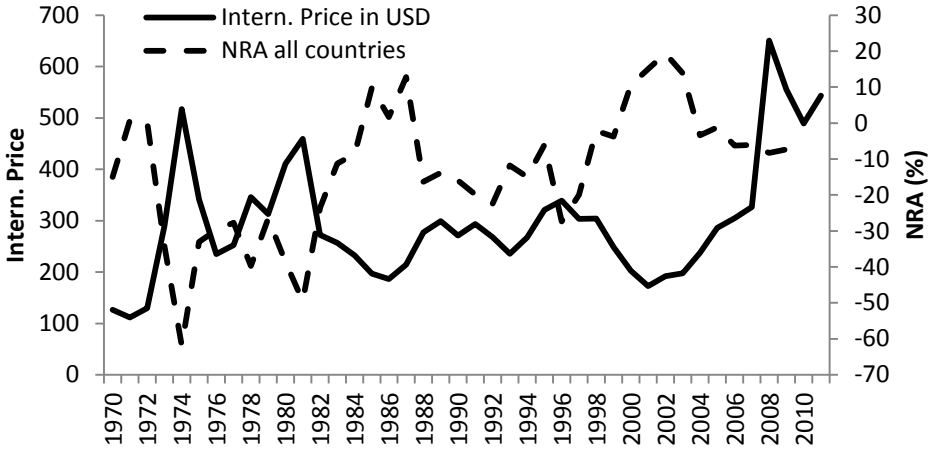
Source: Authors' revision of Table 2.14 in Anderson (2010).

NRAs are negatively correlated with deviations from trend in the international price of the product in question (column 4 of Table 1).[7] Perhaps the most notable case is rice in Asia (Figure 3), where the negative coefficient of correlation between the NRA and international price is around 0.5; but, during 1965-2007, it is also around 0.5 globally for cotton, maize and sugar, and is 0.41 for wheat and 0.2 for soybean (Anderson 2010, Table 2.7).

Figure 3: Rice NRAs and international rice price, South and Southeast Asia, 1970 to 2011

(left axis is int'l price in current US dollars, right axis is weighted average NRA in percent)

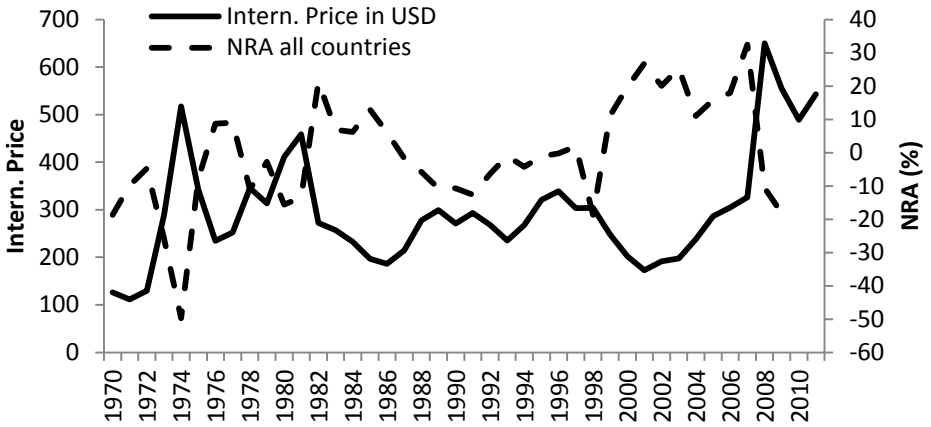
(a) South Asia[a]



[7] There is a risk that the estimations are biased by including the deviation of international price from trend as an explanatory variable. When it is excluded, the coefficients are very similar and the adjusted R^2 values are just one or two points lower (see Table 2.14 in Anderson 2010).

Figure 3 (continued): Rice NRAs and international rice price, South and Southeast Asia, 1970 to 2011

(b) Southeast Asia[b]



[a] Correlation coefficient is -0.52. Countries included are Bangladesh (except for 1970-73), India, Pakistan and Sri Lanka.
[b] Correlation coefficient is -0.45. Countries included are Indonesia (except for 1970-74), Malaysia, Philippines, Thailand and Vietnam (except for 1970-85 and 2005-08).

Source: Authors' compilation based on their update of data in Anderson and Nelgen (2012b).

This domestic price-insulating behavior by governments is of concern because it means there is less international trade in farm products than would be the case otherwise. Such 'thinning' of international markets for these weather-dependent products in turn makes prices and quantities traded more volatile. Using a stochastic model of world food markets, Tyers and Anderson (1992, Table 6.14) found that instability of international food prices in the early 1980s was three times greater than it would have been under free trade in those products. A further simulation exercise by Tyers (1991) suggests that between three-fifths and three-quarters of the global cost of agricultural protection in high-income countries in the early 1980s was due to the insulating component of their policies.

To examine how much that behavior has continued since the early 1980s, we estimate the elasticity of transmission of the international product price to the domestic market for key farm products. Following Nerlove (1972) and Tyers and Anderson (1992, pp. 65-75), we use a partial-adjustment geometric distributed lag formulation to estimate elasticities for each key product for all focus countries for the period 1985 to 2010. Specifically, we assume that associated with the border price P_t there is a 'target' domestic price p_t^*, towards which policy ensures that the actual domestic price, p_t, moves only sluggishly. Changes in this target price might respond incompletely, even in the long run, to corresponding changes in the border price. If all prices are expressed in logarithms, the target domestic price then has the following relationship with the border price:

$$p_t^* = p_0 + \phi_{LR}(P_t - P_0) \qquad (1)$$

where ϕ_{LR} is the long-run price transmission elasticity and the values of p_0 and P_0 are the domestic and border prices in the base period. In the short-run, the inflation-deflated domestic price adjusts only partially each year to any change in the target domestic price:

$$p_t - p_{t-1} = \delta(p_t^* - p_{t-1}) \qquad (2)$$

where the parameter δ gives the fraction of the ultimate adjustment that takes place in one year. By substituting (1) into (2) to eliminate the unobservable target price, the following reduced form, which is suitable for fitting to data, is obtained:

$$p_t = \delta(p_0 - \phi_{LR}P_0) + (1-\delta)p_{t-1} + \delta\phi_{LR}P_t \quad = \quad a + b\, p_{t-1} + c\, P_t \qquad (3)$$

where, again, if the prices are expressed in logarithms, the short-run (one year) elasticity of price transmission is simply δ times the long-run elasticity. Thus the

short-run elasticity estimate is the regression coefficient c and the long-run elasticity estimate is c/(1-b). If the policy objective was to hold the level of protection constant on average over time but to stabilize the domestic price around the trend border price, ϕ_{SR} would be less than one and ϕ_{LR} would be one. But in general even ϕ_{LR} could be less than one, for example if the government sought to raise the trend level of agricultural protection as per capita income grew (as suggested by the first two columns of Table 1).

An important feature of the price transmission elasticity estimate is that it accounts for changes in relative domestic prices that result from policy changes and can be entirely unrelated to international price movements. It does so by comparing domestic with border prices in a time series regression analysis, estimating the degree to which international price changes are transmitted to the domestic market.

Table 2 summarizes the estimates. The global average of the estimates for the short-run elasticity range from a low of 0.3 for sugar to around 0.5 for rice, wheat and pork, not quite 0.6 for cotton, cocoa, maize and poultry, and around 0.7 for beef, soybean and coffee. The unweighted average across all of those key products is 0.58, suggesting that within one year, little more than half the movement in international prices of those farm products has been transmitted domestically on average over the past quarter century.[8] Even the long-run elasticity appears well short of unity after full adjustment: the average of the elasticities for those eleven products across the 82 sample countries is just 0.78 (last row of Table 2).

[8] In a recent study of 11 Sub-Saharan African countries and using a somewhat different methodology, Minot (2011) estimated short-run price transmission elasticities for key staple foods which averaged 0.63.

Table 2: Price transmission elasticities, key agricultural products, by country group, 1965-85 and 1985-2010

(weighted average using value of national production at undistorted prices as weights)

	Developing countries				High-income countries				All focus countries			
	1985-2010		1985-2010		1965-85		1985-2010		1985-2010		1985-2010	
Product	Short-run	Long-run	Short-run	Long-run	Short-run	Long-run	Short-run	Long-run	Short-run	Long-run	Short-run	Long-run
Rice	0.54	0.58	0.54	0.83	0.75	0.96	0.18	0.24	0.57	0.63	0.51	0.79
Wheat	0.38	0.46	0.6	0.93	0.56	0.77	0.55	0.75	0.51	0.69	0.58	0.84
Maize	0.66	0.75	0.54	0.88	0.95	0.95	0.72	0.79	0.87	0.9	0.63	0.83
Soybean	0.79	0.84	0.70	0.95	1.00	1.00	0.76	0.82	0.96	0.97	0.73	0.89
Sugar	0.49	0.6	0.42	0.59	0.44	0.52	0.45	0.70	0.48	0.58	0.43	0.62
Cotton	0.32	0.37	0.61	0.64	0.76	0.76	0.53	0.82	0.56	0.59	0.57	0.73
Milk	0.17	0.17	0.69	0.74	0.7	0.86	0.42	0.47	0.6	0.73	0.51	0.55
Beef	0.76	0.98	0.51	0.88	0.62	0.87	0.73	0.79	0.64	0.89	0.66	0.82
Pigmeat	0.51	0.77	0.36	0.92	0.72	0.83	0.69	0.72	0.71	0.82	0.51	0.83
Poultry	0.66	0.69	0.63	0.88	0.84	0.89	0.73	0.89	0.82	0.86	0.68	0.89
Unweighted average	**0.53**	**0.62**	**0.56**	**0.82**	**0.73**	**0.84**	**0.58**	**0.7**	**0.67**	**0.77**	**0.58**	**0.78**

Source: Authors' estimates based on NRA estimates from Anderson and Nelgen (2012b).

The long time series enables an assessment of the stabilizing effect of policies pre- and post-Washington consensus. For developing countries, the short-run price transmission of international to domestic prices is low in both periods (0.53 and 0.56, respectively), whereas the long-run transmission elasticity has increased from 0.62 to 0.82 from the earlier to the later period. For the group of high-income countries, surprisingly, the price transmission is lower in the latter period than in the period before reforms began. Globally, this results in an almost unchanged estimate for the long-run price transmission elasticity and a slight decrease in the short run between the two periods.

Appendix Table B.7 reveals patterns of price insulation for key commodities for the individual focus countries. In the Malaysian rice market for example, the short-run price transmission is only 6 percent, which only increases to 20 percent in the long-run for the period between 1985 and 2010. Maize in South Africa has a short-run price transmission elasticity of 15 percent and only 20 percent for the long run, whereas Ethiopia, the largest African cotton producers gets an estimate of 100 percent price transmission. Australia stands alone as a country with little insulation in both the short- and the long-run.

This means that governments still insulate their domestic markets from the movements in the international price, rather than using trade as an opportunity to share risks during times of variability in prices. Through this behaviour, insulating countries contribute to international price variability and create a burden for other countries.

(c) Has the extent of insulation diminished since the 1980s?

The tendency for each country to alter its individual product NRAs from year to year around their long-run trend does not appear to have diminished since trade-related policy reforms began in the mid-1980s. In Table 3 we focus on the NRA's annual average deviation from trend in the two decades before and after 1985.

Table 3: Deviation of national NRA around its trend value,[a] key farm products,[b] developing and high-income countries, 1965–84 and 1985–2010

	Deviation of national NRAs around trend[a]				Weighted average of NRAs (%)			
	Developing countries		High-income countries		Developing countries		High-income countries	
	1965–84	1985–09	1965–84	1985–10	1965–84	1985–09	1965–84	1985–10
Rice	32	59	66	186	-20.1	0.9	136.8	351.8
Wheat	33	43	52	76	5.5	9.1	12.2	20.5
Maize	36	33	40	48	-3.4	2.3	6.9	11.9
Soybean	46	120	75	54	2.7	-2.1	0.1	5.2
Sugar	53	64	168	152	17.2	18.0	107.6	108.1
Cotton	38	32	42	30	-16.0	-2.7	21.3	10.4
Coconut	22	34	na	na	-11.5	1.2	na	na
Coffee	41	29	na	na	-37.3	-11.6	na	na
Beef	45	56	84	109	-12.4	2.6	22.7	37.9
Pork	81	58	73	69	23.6	-4.6	37.1	15.0
Poultry	109	69	91	175	26.3	11.8	24.5	25.4

[a] Deviation, measured in NRA percentage points, is computed as the absolute value of (residual – trend NRA) where national trend NRA in each of the two sub-periods is obtained by ordinary least squares linear regression of the national NRA on time. [b] Estimates shown are an unweighted average of national NRA deviations each year, averaged over the number of years in each period.

Source: Authors' compilation based on NRAs from Anderson and Nelgen (2012b).

The average deviation from trend NRA is more than one-tenth higher in the latter two decades than in the earlier two decades in just as many cases as it is more than one-tenth lower. This suggests the tendency for each country to alter its

individual product NRAs from year to year around their long-run trend has not diminished, despite the trade-related policy reforms that began in many countries in the 1980s. Nor is there much difference as between developing and high-income countries. Notice too that the deviations are non-trivial: except for rice in high-income countries, the average deviation is well above the mean NRA for each product (which is reported in the right-hand half of Table 3).

(d) How different are trade restrictions in periods of international price spikes?

We move now to a closer examination of periods of extreme spikes in international food prices. The only such periods prior to 2008 in the World Bank's distortions database are those around 1974 (an upward price spike) and in 1986 (a downward price spike).

In Table 4 we focus on the annual average nominal assistance coefficient (NAC = 1 + NRA/100)[9] in the spike year plus the two years each side of it, relative to the longer period either side of each spike period. The expectation is that the NAC would be lower in the upward spike periods than in the average of the two adjoining longer non-spike periods, and conversely for the downward spike period around 1986. That is indeed what is evident in Table 4, where the spike periods are shown in bold italics and the percentage change in their average NACs from the prior non-spike period are shown in the lower half of the table.

[9] The national NACs are averaged across countries without using weights, so that each polity is treated as an equally interesting case. The aggregate estimates therefore differ from those reported for country groups in Anderson (2009 and 2010), where production weights are used to calculate NRA averages (and consumption weights for CTE averages).

Table 4: Average annual NACs[a] and percentage changes in them, key crops, developing and high-income countries, 1965 to 2010 (1 + NRA/100)

(a) Average annual NACs (1 + NRA/100)

	Developing countries						High-income countries					
	1965-1972	***1972-1976***	1976-1984	***1984-1988***	1988-2006	***2006-2009***	1965-1972	***1972-1976***	1976-1984	***1984-1988***	1988-2006	***2006-2010***
Rice	0.97	***0.91***	1.02	***1.27***	1.29	***1.14***	1.23	***1.07***	1.37	***2.37***	2.19	***1.25***
Importers	1.06	***0.99***	1.09	***1.35***	1.34	***1.20***	1.85	***1.70***	2.28	***4.20***	4.84	***1.71***
Exporters	0.76	***0.65***	0.78	***1.02***	1.13	***0.87***	0.99	***0.81***	1.01	***1.92***	1.50	***1.03***
Wheat	1.10	***0.90***	1.10	***1.18***	1.19	***1.05***	1.37	***0.91***	1.38	***1.95***	1.43	***1.06***
Importers	1.12	***0.89***	1.09	***1.18***	1.23	***1.07***	1.41	***0.90***	1.46	***2.09***	1.71	***1.38***
Exporters	1.01	***0.94***	1.24	***1.36***	0.91	***0.97***	1.20	***0.97***	1.08	***1.46***	1.18	***0.99***
Maize	1.09	***0.99***	1.03	***1.13***	1.07	***1.08***	1.39	***1.22***	1.36	***1.60***	1.34	***1.07***
Soybean	1.20	***0.99***	1.19	***1.27***	1.45	***1.45***	0.97	***1.00***	1.45	***1.93***	1.22	***1.03***
Sugar	1.39	***0.78***	1.10	***1.49***	1.37	***1.42***	2.96	***1.17***	2.21	***3.25***	2.29	***1.55***
							1.23	***1.07***	1.37	***2.37***	2.19	***1.25***

(b) Percentage change in NAC from previous non-spike period

	1972-1976	**1984-1988**	**2006-2009**	**1972-1976**	**1984-1988**	**2006-2010**
Rice importers	-6	24	-10	-8	84	-65
Rice exporters	-14	31	-23	-18	90	-32
Wheat importers	-21	9	-13	-37	44	-19
Wheat exporters	-6	9	6	-20	36	-16
Maize	-9	10	1	-12	18	-20
Soybean	-18	7	0	4	33	-15
Sugar	-44	35	3	-60	47	-32

[a] Unweighted average of national NACs each year, averaged over the number of years in each period.

Source: Authors' calculations based on updated NRA estimates from Anderson and Valenzuela (2008).

Looking more closely at rice and wheat, and their NAC estimates for the period since 2004 when their international prices were gradually rising before spiking in mid-2008 and late 2010, they too are lower than in the preceding 1988-2006 non-spike period. In both country groups, the proportional extent to which the rice NACs were lowered is greater in the recent period than in the 1970s' spike period. For the case of wheat, they react to a slightly smaller extent in the recent price spike compared to the first covered price spike period and compared to the reaction of the high-income country group. The proportional changes in NACs for all focus countries for maize, soybean and sugar are slightly lower than in the 1974 price spike period.

(e) Do food-deficit countries vary their trade restrictions more than food-surplus countries?

Evidence on whether food-exporting and food-importing countries both alter their trade restrictions in offsetting ways is easiest to see in periods of extreme price spikes. NACs before and during the three price spike periods in our dataset are shown in Table 4.

Part (b) of that table reveals that for both rice and wheat, exporting and importing countries do indeed alter their NACs in the same direction, reducing them when prices spike up, raising them when international prices slump. The changes are somewhat larger for importers in the case of wheat and for exporters for rice (except for high-income countries in the most recent price spike period). The reactions of both groups, exporters and importers, are non-trivial and thus tend to offset each

other's efforts to avoid transmitting the international price shock to their home markets. These changes can be seen on an annual basis in the first pair of rows in Table 5 not only for rice and wheat but also for all covered agricultural products.

(f) Do developing countries vary their trade restrictions more than high-income countries?

Historically, governments in developing countries have tended to discriminate against farmers and in favour of food consumers whereas in high-income countries they have tended to do the opposite (Anderson 2009).

That suggests in developing countries consumers are more likely to be protected from an upward price spike than producers would be from a downward spike in international prices, and conversely in high-income countries. Assuming the CTE is the same as the NRA (that is, only border distortions matter), that in turn might lead one to expect the percentage change in the NAC to be less for developing countries and more for high-income countries in the 1980s downturn period than in the two upward spike periods. That indeed is what is shown for all cases reported in the bottom part of Table 4 for high-income countries, and is also evident in the cases of rice and wheat illustrated in Figure 4(a), much stronger in the downwards spike period than in the upwards spike periods. When the developing country group was subdivided into low- and middle-income countries (not shown in the table), the expected result for rice and wheat held true for three-quarters of the cases.

Table 5: Annual NACs (1 + NRA/100) for rice, wheat and all farm products, by country group, 1972 to 2010

(a) Rice

	1972	1973	1974	1975	1976	1984	1985	1986	1987	1988	2005	2006	2007	2008	2009	2010
World importers	1.37	1.03	0.75	1.07	1.17	1.45	1.61	1.62	1.64	1.49	1.57	1.41	1.36	1.19	1.20	1.45
World exporters	0.87	0.62	0.56	0.73	0.88	1.11	1.31	1.58	1.79	1.66	1.01	0.97	1.03	0.99	0.86	1.01
High-income countries	1.29	0.95	0.77	1.07	1.26	1.70	1.97	2.53	2.84	2.82	1.60	1.38	1.24	1.26	1.17	1.23
Developing countries	1.11	0.83	0.64	0.91	1.03	1.24	1.37	1.28	1.29	1.15	1.29	1.26	1.22	1.04	1.03	na
Asia	1.15	0.84	0.58	0.89	1.02	1.26	1.42	1.35	1.46	1.25	1.23	1.20	1.05	0.81	0.90	na
Africa	1.10	0.84	0.66	0.99	1.06	1.21	1.17	1.16	1.29	1.12	1.12	1.16	1.25	1.05	0.91	na
Latin America	1.05	0.81	0.75	0.82	0.96	1.27	1.65	1.34	0.90	0.96	1.57	1.45	1.47	1.40	1.36	na

(b) Wheat

	1972	1973	1974	1975	1976	1984	1985	1986	1987	1988	2005	2006	2007	2008	2009	2010
World importers	1.09	0.73	0.76	0.96	0.93	1.28	1.46	1.77	2.07	1.80	1.40	1.37	1.09	1.05	1.25	1.25
World exporters	1.14	0.88	0.83	0.97	0.98	1.17	1.19	1.71	1.70	1.41	0.98	1.00	0.97	0.98	1.00	1.00
High-income countries	1.10	0.79	0.80	0.92	0.94	1.42	1.65	2.13	2.46	2.10	1.17	1.14	1.03	1.02	1.07	1.06
Developing countries	1.10	0.72	0.74	1.01	0.95	1.06	1.09	1.22	1.33	1.20	1.14	1.11	1.00	0.96	1.11	na
Asia	1.35	0.80	0.89	1.21	1.01	1.20	1.20	1.28	1.42	1.46	1.03	1.13	0.99	0.79	1.14	na
Africa	0.99	0.73	0.64	0.87	0.84	0.92	0.91	1.20	1.38	1.11	1.27	1.18	1.06	1.12	1.16	na
Latin America	1.02	0.63	0.72	0.96	1.07	1.14	1.27	1.20	1.16	1.09	1.04	1.03	0.93	0.91	1.03	na

(c) All covered farm products

	1972	1973	1974	1975	1976	1984	1985	1986	1987	1988	2005	2006	2007	2008	2009	2010
World importers	1.51	1.31	1.23	1.40	1.60	1.73	1.88	2.06	2.24	1.88	1.56	1.43	1.37	1.28	1.30	1.21
World exporters	0.95	0.83	0.81	0.87	0.80	0.86	1.00	1.17	1.16	1.05	1.15	1.12	1.14	1.08	1.07	1.07
High-income countries	1.46	1.34	1.26	1.40	1.61	1.77	1.91	2.19	2.37	1.97	1.41	1.32	1.28	1.21	1.19	1.15
Developing countries	1.02	0.88	0.86	0.95	0.93	0.99	1.09	1.10	1.11	1.05	1.23	1.18	1.17	1.11	1.15	na
Asia	1.30	1.04	0.98	1.09	1.16	1.29	1.45	1.46	1.42	1.36	1.45	1.50	1.37	1.21	1.38	na
Africa	0.90	0.80	0.78	0.83	0.80	0.80	0.85	0.90	0.97	0.91	1.16	1.08	1.10	1.07	1.04	na
Latin America	1.01	0.92	0.92	1.08	1.06	1.10	1.28	1.16	1.03	0.99	1.04	1.03	0.93	0.91	1.03	na

[a] Unweighted average of national NACs.

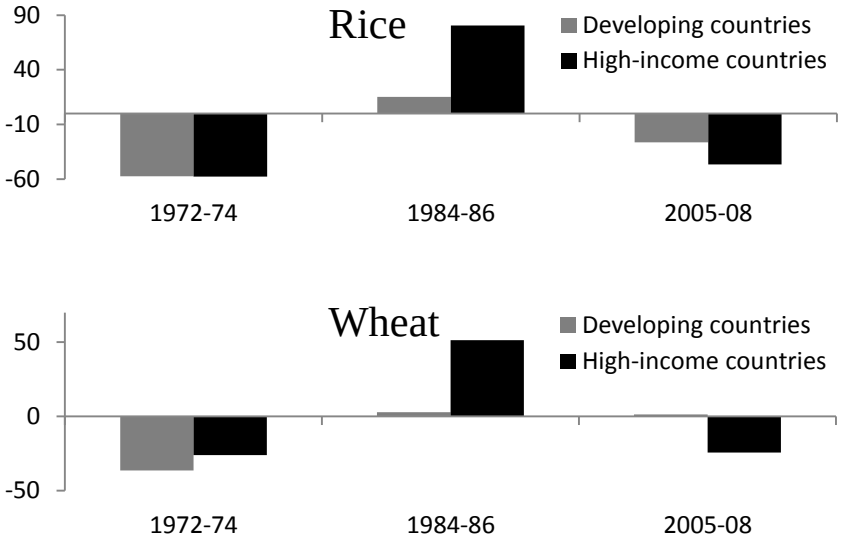
Source: Authors' calculations based on updated NRA estimates from Anderson and Nelgen (2012b).

Such comparisons of period averages are blunt, however, because the averages hide a lot of year-to-year variation. A more-precise picture of the annual changes in the first half of the price spike periods can be seen in Table 5. It shows that the decline in NACs was more gradual in the recent price surge period than it was in the 1970s when all the change was in 1973 for wheat and in 1973 and 1974 for rice (whose harvest dates are less concentrated around the end of the year than are those for wheat). Because of that faster price change in the 1970s, the magnitude of the annual NAC changes was greater then, than in the recent period to 2008.

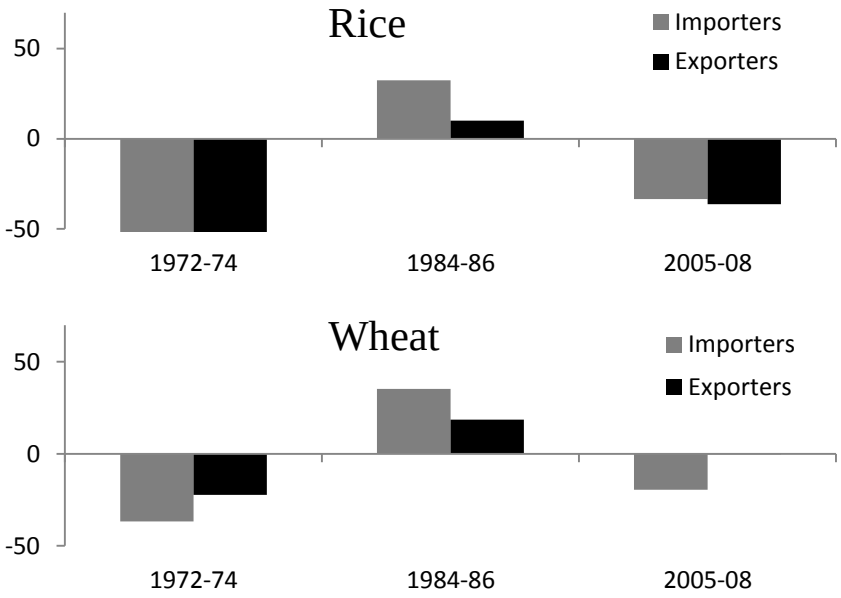
The rice NACs over the 1972-74 period fell by more than two-fifths for both high-income and developing countries. The NAC falls for wheat were not as severe as for rice, but were still substantial at more than one-quarter for high-income countries and nearly one-third for developing countries. The extent of annual decline in the NACs in the most recent price spike is slightly less than in the 1970s except for high-income wheat, and not quite as rapid: between 2005 and 2008 the NAC for rice fell 22 percent for high-income countries and 20 percent for developing countries, and for wheat it fell around 15 percent for both high-income and developing countries (calculated from Table 5). That slightly smaller and slower decline also is consistent with the fact that there were smaller and slower proportionate rises in the international prices of those cereals in 2005-08 than in the early 1970s.

Figure 4: Changes in NACs for rice and wheat,[a] high-income and developing countries, and world exporters and world importers, 1972-74, 1984-86, and 2005-08 (percentage changes in weighted averages of national NACs)[a]

(a) High-income and developing countries



(b) World exporters and world importers



[a] Consumption weights are used in the first and third periods when international prices spiked upwards, and production weights in the mid-1980s period when prices spiked downwards.
Source: Authors' compilation from Anderson and Nelgen (2012b).

Turning to all covered farm products (bottom segment of Table 5), the NAC for developing countries fell by 13 percent in the first two years before rising by less than that amount in the subsequent two years of the 1970s' spike period. The fall for high-income countries was almost the same (9 percent) but it more than recovered in the subsequent two years. As for the mid-1980s price slump period, the NAC rise for all farm products was larger for high-income countries and smaller for developing countries in1984-86 than the fall in 1972-74, consistent with the findings discussed above from Table 4(b) and Figure 4(a).

(g) Do governments respond differently to upward versus downward price spikes?

Table 6 offers a comparison between the mid-1980s, and the two upward price spike periods, of annual price changes in NACs. For rice, for wheat, and for all farm products there appears to be little difference in the extent of change in NACs in the mid-1980s and their extents of change in the two upward price spike periods.

Table 6 also suggests there is little difference not only in the magnitude but also in the timing of the responses of food-importing and food-exporting countries. That is the case not only for rice and wheat but also for all products included in the World Bank's database, shown in part (c) of Table 6.

Table 6: Annual changes in NACs, by country group, 1972-74, 1984-86, and 2005-10
(percent)

(a) Rice

	1972/73	1973/74	1984/85	1985/86	2005/06	2006/07	2007/08	2008/09	2009/10
World exporters	-29	-10	18	20	-3	5	-3	-13	18
World importers	-24	-27	11	1	-10	-4	-13	1	21
High-income countries	-26	-19	16	29	-14	-10	-1	-7	5
Developing countries	-25	-23	10	-7	-2	-3	-15	-1	na

(a) Wheat

	1972/73	1973/74	1984/85	1985/86	2005/06	2006/07	2007/08	2008/09	2009/10
World exporters	-22	-6	2	43	2	-3	1	2	0
World importers	-33	4	14	21	-3	-20	-4	19	0
High-income countries	-28	1	17	29	-3	-10	-1	4	-1
Developing countries	-34	3	3	12	-2	-11	-3	16	na

(a) All farm products

	1972/73	1973/74	1984/85	1985/86	2005/06	2006/07	2007/08	2008/09	2009/10
World exporters	-12	-3	15	17	-2	1	-5	-1	0
World importers	-13	-6	9	9	-8	-4	-7	2	-7
High-income countries	-9	-6	8	15	-6	-3	-5	-1	-4
Developing countries	-13	-3	10	1	-4	-2	-4	3	na

[a] Unweighted averages of national NACs changes.

Source: Authors' calculations based on updated NRA estimates from Anderson and Nelgen (2012b).

(h) How much do the various trade measures contribute to NRA changes?

The NRAs have been decomposed in Table 7 into the various border measures plus domestic measures for developing and high-income countries, for all products covered by the World Bank's database, following the methodology in Croser and Anderson (2011). The annual estimates are shown for the upward spike period of 1972-76 and the downward spike period of 1984-88. Export restrictions were the dominant instrument for developing countries in both those periods, becoming more and then less important in the upward spike period of 1972-76 (when import tariffs were lowered and then raised), and conversely in the downward spike period of 1984-88.

In high-income countries there are virtually no taxes or other restrictions on exports, but the component of their NRAs due to export subsidies, as one would expect, have followed the same path as dominant import tariffs over those spike periods: U-shaped during the upward spike, inverted U-shaped in the downward spike.The bolded rows of Table 7 (showing the NRAs from border measures and the aggregate NRAs which include also domestic producer taxes and subsidies) reveal that border measures account for the vast majority (recently decreasing in high-income countries) of the distortions to producer prices in both subsets of countries.

In Table 8 the decomposition by instrument for those two previous spike periods is reported in terms of instrument welfare reduction and trade reduction indexes (ITRIs and IWRIs), again following the methodology in Croser and Anderson (2011).

Table 7: Contributions to Total Agricultural NRA[a] from Different Policy Instruments, by Region, 1972-76, 1984-88 and 2005-10, %

(a) Developing countries	**'72**	**'73**	**'74**	**'75**	**'76**	**'84**	**'85**	**'86**	**'87**	**'88**	**'05**	**'06**	**'07**	**'08**	**'09**	**'10**
Border measures																
Import tax equivalent	22	2	2	8	6	7	7	8	9	8	4	4	1	1	-1	na
Export subsidies	4	0	0	1	1	1	1	1	1	1	2	3	1	2	-2	na
Export tax equivalent	-26	-18	-24	-22	-9	-20	-10	-14	-19	-22	-3	-3	-4	-7	5	na
Import subsidy equivalent	-6	-5	-5	-2	-1	-1	-1	-1	-1	-2	0	-1	-1	-1	1	na
ALL BORDER MEASURES	**-22**	**-21**	**-28**	**-16**	**-4**	**-14**	**-3**	**-6**	**-10**	**-15**	**4**	**4**	**-1**	**-6**	**3**	**na**
TOTAL NRA(incl. domestic measures)	**3**	**-14**	**-29**	**-17**	**-2**	**-15**	**-2**	**-5**	**-9**	**-13**	**4**	**4**	**-1**	**-6**	**3**	**na**
(b) High-income countries	**'72**	**'73**	**'74**	**'75**	**'76**	**'84**	**'85**	**'86**	**'87**	**'88**	**'05**	**'06**	**'07**	**'08**	**'09**	**'10**
Border measures																
Import tax equivalent	24	17	14	20	29	33	34	51	50	43	13	11	8	0	0	0
Export subsidies	3	2	1	2	1	2	4	7	7	5	1	1	1	0	0	0
Export tax equivalent	0	-1	0	0	0	0	-1	0	0	0	0	0	0	0	0	0
Import subsidy equivalent	-1	-3	-3	-1	-1	0	0	0	0	0	0	0	0	0	0	0
ALL BORDER MEASURES	**26**	**15**	**11**	**21**	**29**	**35**	**37**	**57**	**57**	**47**	**15**	**12**	**9**	**1**	**0**	**0**
TOTAL NRA(incl. domestic measures)	**28**	**17**	**12**	**22**	**31**	**45**	**52**	**71**	**70**	**59**	**33**	**28**	**23**	**20**	**23**	**19**

[a] All entries have been generated by dividing the producer subsidy equivalent of all (including domestic price, non-product-specific and 'decoupled') measures by the total agricultural sector's gross production valued at undistorted prices.

Source: Anderson and Nelgen (2012b).

Table 8: Contributions to total agricultural welfare and trade reduction indexes (WRIs and TRIs) from different policy instruments, developing and high-income countries, 1965-2010

(percent)

(a) WRI

Developing countries	65-71	'72	'73	'74	'75	'76	77-83	'84	'85	'86	'87	'88	89-04	'05	'06	'07	'08	'09	'10
M tax eq	12	15	4	3	11	13	12	12	17	19	17	13	11	6	6	6	3	3	na
X tax eq	19	16	31	34	28	18	23	30	22	28	33	32	10	3	5	11	12	9	na
M subsidy eq	3	4	8	7	3	2	4	2	2	1	2	2	2	1	1	2	2	3	na
All (incl. domestic) measures	**38**	**41**	**47**	**55**	**53**	**38**	**51**	**60**	**46**	**53**	**59**	**51**	**29**	**13**	**17**	**24**	**23**	**21**	**na**

High-income countries	65-71	'72	'73	'74	'75	'76	77-83	'84	'85	'86	'87	'88	89-04	'05	'06	'07	'08	'09	'10
M tax eq	49	40	26	25	39	55	60	62	65	88	101	74	51	26	18	16	1	1	1
X subsidies	7	6	3	1	3	3	4	4	7	11	11	7	5	2	5	5	1	0	0
All (incl. domestic) measures	**58**	**48**	**35**	**32**	**42**	**62**	**67**	**69**	**78**	**111**	**118**	**84**	**60**	**35**	**24**	**21**	**9**	**4**	**4**

(b) TRI

Developing countries	65-71	'72	'73	'74	'75	'76	77-83	'84	'85	'86	'87	'88	89-04	'05	'06	'07	'08	'09	'10
M tax eq	9	13	3	2	10	11	9	10	13	14	16	11	9	4	5	5	2	2	na
X tax eq	19	15	29	32	26	17	22	28	20	26	32	30	9	3	5	11	12	9	na
M subsidy eq	-3	-3	-8	-7	-3	-2	-4	-2	-2	-1	-2	-2	-2	-1	-1	-2	-2	-3	na
All (incl. domestic) measures	**24**	**21**	**32**	**75**	**91**	**51**	**98**	**162**	**108**	**129**	**155**	**159**	**61**	**23**	**19**	**60**	**63**	**32**	**na**

High-income countries	65-71	'72	'73	'74	'75	'76	77-83	'84	'85	'86	'87	'88	89-04	'05	'06	'07	'08	'09	'10
M tax eq	36	30	21	17	25	36	38	41	42	62	61	52	36	17	13	10	0	1	1
X subsidies	-4	-4	-2	-1	-2	-2	-3	-3	-5	-8	-8	-6	-3	-1	-1	-1	0	0	0
All (incl. domestic) measures	**31**	**25**	**16**	**13**	**22**	**33**	**34**	**37**	**37**	**54**	**55**	**48**	**33**	**15**	**12**	**9**	**0**	**1**	**0**

Source: Authors' calculations based Anderson and Croser (2009) and Anderson and Nelgen (2012b).

The ITRI (IWRI) is defined as the ad valorem trade tax rate for a particular policy instrument which, if applied uniformly across all tradable agricultural commodities in a country, would generate the same reduction in trade volume (or same economic welfare loss) as the actual cross-product structure of NRAs and CTEs for that instrument in that country subset. Table 8 reveals that those indexes, after tracing a U-shape or inverted U-shape during a spike period, tend to return to the pre-spike period average within two years after the peak of the spike.

(i) How successfully do national governments stabilize their domestic markets?

How successfully has policy action reduced instability in domestic relative to international markets for farm products?

Three statistical indicators can help answer this question, following Schiff and Valdés (1992): the standard deviation around the sample mean of the domestic price relative to that for the border price, the coefficient of variation (the standard deviation divided by the sample mean) of the domestic price relative to that for the border price, and the Z-Statistic as a measure of the average deviation of the price from its value in the preceding period (annual price change). The Z-statistic is defined as the square root of the average squared deviation of the price from its value lagged one year (or of the first difference of the price):

$$Z = \left(\frac{\sum_{t=2}^{n} (P_t - P_{t-1})^2}{n-1} \right)^{1/2} \qquad (4)$$

The Z-statistic gives a better indication of the producer's concern. Farmers are more likely to be concerned with price deviations from previous year prices than with deviations from the sample mean. The SD and Z-statistic are directly comparable as one measures the deviation from the sample mean and the other from the value in the preceding period. The Z-statistic captures more accurately persistent annual price volatility that might be masked in a measure of the SD[10] and gives a better measure of relative stability.

A ratio of less than 100 percent means domestic prices are more stable than international prices in terms of each measure. It is expected for the domestic prices to be more stable than international prices across all products.

Table 9 provides the average of each of these three relative indicators for various developing country regions, for high-income countries, and for the full sample of 82 countries, for the periods 1955-1984 and 1985-2010 (that is, before and following the major economic policy reforms that began for many countries in the mid-1980s). Note that there is little difference between the two periods' indicators, at least for high-income countries and globally. Among the developing country regions the numbers are between two-thirds and four-fifths for Asia, quite close to one for Latin America, and close to or slightly above one for Africa. That is, while interventions in developing Asia were severe enough to provide some insulation, in Africa they were such (perhaps for reasons of poor policy timing) as to possibly even de-stabilize domestic markets. Taken together, the indicators for the world as a whole suggest that market interventions by governments appear to have had very

[10] Schiff and Valdés (1992) provide an example: assume p1=100 for ten periods and then rises to 200 for ten additional periods, whereas p2 varies annually from 100 to 200. Both series have the same mean of 150 and they have the same SD of 50. The p1 series has a much smaller Z-statistic however (Z=23 for p1t and Z=100 for p2t).

little impact in preventing domestic market prices from gyrating less than prices in international markets. As mentioned above, such an outcome is shown by Martin and Anderson (2011) to indeed be possible when food-exporting and food-importing countries both alter their trade restrictions in offsetting ways when prices move away from trend.

Table 9: Relative stability[a] of domestic producer and border prices of all covered agricultural products, 1955-84 and 1985-2010

		1955-1984	**1985-2010**
Africa	SDd/SDb	0.88	1.21
	CVd/CVb	1.06	1.18
	Zd/Zb	0.80	1.15
Developing Asia	SDd/SDb	0.67	0.98
	CVd/CVb	0.70	0.96
	Zd/Zb	0.75	0.85
Latin America	SDd/SDb	0.84	0.97
	CVd/CVb	0.96	1.01
	Zd/Zb	0.61	1.01
All developing countries	SDd/SDb	0.73	1.01
	CVd/CVb	0.80	0.97
	Zd/Zb	0.74	0.91
High-income countries	SDd/SDb	1.26	1.34
	CVd/CVb	0.94	0.95
	Zd/Zb	1.11	1.12
All focus countries	SDd/SDb	**1.02**	**1.14**
	CVd/CVb	**0.88**	**0.98**
	Zd/Zb	**0.97**	**1.01**

[a] SDd/SDb is the standard deviation of the domestic producer price relative to that for the border price, CVd/CVb is the coefficient of variation (the standard deviation divided by the sample mean) of the domestic producer price relative to that for the border price, and Zd/Zb is the Z-Statistic (defined in equation (10) of the text) of the domestic producer price relative to that for the border price.

Source: Authors' estimates based on prices compiled by Anderson and Nelgen (2012b).

(j) Summary of empirical evidence

The above empirical findings can be summarized as follows:

- Product NRAs are significantly negatively correlated with fluctuations around trend in the product's international price, with little more than half the movement in international food prices being transmitted to domestic markets within the first year;
- That insulation tendency appears to be no less in the two decades following the trade-related policy reforms that began in the mid-1980s than it was in the previous two decades;
- NACs were substantially lower in the two upward price spike periods, and higher for the downward price spike period around 1986, than in adjacent non-spike periods, with both export and import measures contributing to that finding;
- The extent and speed of NAC changes in each spike period are similar for food-exporting and food-importing countries, suggesting both types of countries actively insulate their domestic market from international food prices spikes;
- The extent and speed of the annual NAC changes during an upward price spike was greater in the early 1970s than in the recent period to 2008, consistent with the fact that international food prices rose proportionately less per year in the latter period;
- The percentage change in the NAC was less for developing countries and more for high-income countries in the mid-1980s' downward price-spike

period than in the two upward spike periods, suggesting that in developing countries consumers are more likely to be protected from an upward price spike than producers would be from a downward price spike, and conversely in high-income countries;

- Border measures account for the vast majority of the distortions to producer prices in both high-income and developing countries, and in both agricultural-exporting and agricultural-importing countries; and
- Governments appear to have had very little impact in preventing domestic market prices from gyrating less than prices in international markets for agricultural products.

The behavior of policy makers indicated by those estimates is so similar to that indicated by past responses to price spikes that tentative policy implications can now be drawn with reasonable confidence, pending the availability of a more-comprehensive update of distortion estimates and more-elaborate statistical analysis of them.

D. Policy implications

Trade policy interventions are varied in response to international food price spikes to achieve various stated or hidden objectives of governments. The most commonly stated one in developing countries in the case of upward price spikes is to ensure domestic food security for consumers, that is, to have adequate supplies at affordable prices for all domestic households. Related stated objectives are to reduce inflationary or balance of payments pressures from an upward price spike, but those

concerns could be better handled via monetary or exchange rate policies, respectively. As for downward price spikes, the commonly stated objective of altering a country's trade barriers is to protect poor farmers from income losses.

Corden (1997, pp. 72-76) suggests the pattern of intermittent border interventions, aimed at lowering the hurt to those adversely affected by an external shock even though it harms those helped by the shock and the overall economy, implies a conservative social welfare function. A more formal model of loss-averting reactions of governments, based on utility theory, has been developed by Freund and Özden (2008), building on the pioneering lobbying model of Grossman and Helpman (1994).[11] Helpful though this may be in explaining why governments intervene, more work is needed to explain why governments attempt to provide loss-averting assistance by varying their trade restrictions rather than via more-direct and thus more efficient domestic policy instruments.[12]

Traditional national government trade policy reactions to food price spikes are undesirable also because, collectively, they are not very effective in stabilizing domestic prices, and not least because they add to international price volatility by reducing the role that trade between nations can play in bringing stability to the world's food markets. That adverse aspect will become ever more important as climate change increases the frequency of extreme weather events. The larger the number of countries insulating their domestic markets, the more other countries perceive a need to do likewise, exacerbating the effect on world prices such that even greater changes in trade barriers are desired by each nation – both exporters and

[11] See also Thompson et al. (2004), Tovar (2009) and Martin and Anderson (2011).
[12] Even if the policy objective was explicitly to reduce food import dependence, Nettle, Britten-Jones and Anderson (1987) show that trade policy alone is second best to an import tariff plus a tariff-funded production subsidy.

importers. They also transfer welfare between food-surplus and food-deficit countries, and may even add to rather than reduce poverty.

The above suggests there is considerable scope for improvement in national policy responses to price spikes, and for new multilateral initiatives.

(a) Scope for improved national policy responses

An additional justification sometimes given for price-stabilizing intervention in poor countries is that credit markets are under-developed, or inefficient because of local monopoly lenders, so low-income consumers and producers have difficulty smoothing their consumption over time as prices fluctuate. If that is the case, the first-best policy response would be to improve the credit market. The same is true for markets for futures and options (Sarris, Conforti and Prakash 2010). More generally, where domestic markets are underdeveloped, there can be a high payoff from investing more in efficient institutional arrangements (for such things as contract enforcement and market information services) and in infrastructure (transport, communications), as well as ensuring a level playing field in terms of incentives (Byerlee, Jayne and Myers 2006). Holding national public grain stocks is more problematic, not only because it crowds out private stockholding but also because bureaucrats are typically less likely than private firms to buy and sell optimally.

A price spike is but one of many situations in which an economic change disadvantages some households. There is a strong case for developing better social safety net policies that can offset the adverse impacts of a wide range of different shocks on poor people – net sellers as well as net buyers of food – without imposing the costly by-product distortions that necessarily accompany n^{th}-best trade policy

instruments. A program of targeted income supplements to only the most vulnerable households, and only while the price spike lasts, is possibly the lowest-cost intervention. It is often claimed that such payments are unaffordable in poor countries, but recall that in half the cases considered above, governments *reduce* their trade taxes, so even that intervention is a drain on the finance ministry's budget. Moreover, the information and communication technology revolution has made it possible for conditional cash transfers to be provided as direct assistance to even remote and small households, and even to the most vulnerable members of those households (typically women and their young children – see, e.g., Fiszbein and Schady (2009), Adato and Hoddinott (2010) and Skoufias, Tiwari and Zaman (2010)).

(b) Scope for new multilateral initiatives

Clearly there is scope for governments to multilaterally agree to stop intermittently intervening in these ways. The World Trade Organization (WTO) is the most obvious place to seek restraints on variable trade restrictions. Indeed one of the original motivations for the Contracting Parties to sign the GATT (WTO's predecessor) was to bring stability and predictability to world trade. To date the membership has adopted rules to encourage the use of trade taxes in place of quantitative restrictions on trade (Article IX of the GATT), and has managed to obtain binding commitments on import tariffs and on production and export subsidies as part of the Uruguay Round Agreement on Agriculture. However, those bindings have been set well above applied rates by most countries, leaving great scope for varying them without dishonoring those legal commitments.

In the current Doha round of WTO negotiations there are proposals to phase out agricultural export subsidies as well as to bring down import tariff bindings, both of which would contribute to global economic welfare and more-stable international prices for farm products. At the same time, however, developing countries have added to the WTO's Doha agenda a proposal for a Special Safeguards Mechanism (SSM) that would allow those countries to raise their import barriers above their bindings for a significant proportion of agricultural products in the event of a sudden international price rise or an import surge. This is the opposite of what is needed by way of a global public good to reduce the frequency and amplitude of food price spikes (Hertel, Martin and Leister 2010).

Moreover, proposals to broaden the Doha agenda to also introduce disciplines on export restraints have struggled to date to gain traction.[13] This reflects the facts that traditionally the demandeurs in WTO negotiations have been dominated by interests seeking market access, and that upward price spikes are infrequent. Yet the above analysis reveals the need for symmetry of treatment of export and import disciplines.

Could greater supply assurances from food-surplus countries, in the form of stronger disciplines on export restrictions, provide a Doha breakthrough? Potentially it could reduce the need for an SSM, which has been one of the more contentious issues in the Doha talks and the one that triggered their suspension in mid-2008. But more than that, it could reduce the concerns food-deficit countries have over relying on food imports in general, thereby increasing the chances of lowering not only the

[13] A proposal by Japan in 2000, for example, involved disciplines similar to those on the import side, with export restrictions to be replaced by taxes and export taxes to be bound. A year later Jordan proposed even stronger rules: a ban on export restrictions and (as proposed for export subsidies) the binding of all export taxes at zero.

variance of but also the mean NRAs of those countries. Strong opposition to the inclusion of this item on the Doha Development Agenda has come from several food-exporting developing countries, led by Argentina (whose farm exports have been highly taxed since its large currency devaluation at the end of 2001).

References

Adato, M. and J. Hoddinott (eds.) (2010), *Conditional Cash Transfers in Latin America,* Baltimore MD: Johns Hopkins University Press for IFPRI.

Aksoy, M.A. and B. Hoekman (eds.) (2010), *Food Prices and Rural Poverty,* London: Centre for Economic Policy Research for the World Bank.

Anderson, K. (ed.) (2009), *Distortions to Agricultural Incentives: A Global Perspective, 1955-2007,* London: Palgrave Macmillan and Washington DC: World Bank.

Anderson, K. (ed.) (2010), *The Political Economy of Agricultural Price Distortions*, Cambridge and New York: Cambridge University Press.

Anderson, K., J. Cockburn and W. Martin (eds.) (2010), *Agricultural Price Distortions, Inequality and Poverty,* Washington DC: World Bank.

Anderson, K. and J.L. Croser (2009), *National and Global Agricultural Trade and Welfare Reduction Indexes, 1955 to 2007,* database at www.worldbank.org/agdistortions.

Anderson, K., M. Kurzweil, W. Martin, D. Sandri, and E. Valenzuela (2008), 'Measuring Distortions to Agricultural Incentives, Revisited', *World Trade Review* 7(4): 675–704.

Anderson, K. and E. Valenzuela (2008), *Global Estimates of Distortions to Agricultural Incentives, 1955 to 2007*, data spreadsheets at www.worldbank.org/agdistortions

Bevan, D., P. Collier and J.W. Gunning (1990), *Controlled Open Economies: A Neoclassical Approach to Structuralism,* Oxford: Clarendon Press.

Byerlee, D., T.S. Jayne and R.J. Myers (2006), 'Managing Food Price Risks and Instability in a Liberalizing Market Environment: Overview and Policy Options', *Food Policy* 31(4): 275-87, August.

Collier, P., G.W. Gunning and Associates (1999), *Trade Shocks in Developing Countries* (2 volumes), London: Oxford University Press.

Corden, W.M. (1997), *Trade Policy and Economic Welfare*, revised edition, Oxford: Clarendon Press.

Croser, J.L. and K. Anderson (2011), 'Changing Contributions of Different Agricultural Policy Instruments to Global Reductions in Trade and Welfare', *World Trade Review* 10(3): 297-323, July.

Deaton, A. and G. Laroque (1992), "On the Behavior of Commodity Prices", *Review of Economic Studies* 59(198): 1-23, January.

FAO et al. (2011), *Price Volatility in Food and Agricultural Market: Policy Responses*, Background Policy Report for the G20 Summit in Paris in November 2011, Rome: FAO in collaboration with IFAD, IFPRI, IMF, OECD, UNCTAD, WFP, World Bank and WTO, May.

Fiszbein, A. and N. Schady (with F. H.G. Ferreira, M. Grosh, N. Kelleher, P. Olinto and E. Skoufias) (2009), *Conditional Cash Transfers: Reducing Present and Future Poverty*, Policy Research Report, Washington DC: World Bank.

Freund, C. and C. Özden (2008), 'Trade Policy and Loss Aversion', *American Economic Review* 98(4): 1675-1691, September.

Grossman, G.M. and E. Helpman (1994), 'Protection for Sale', *American Economic Review* 84(4): 833–50, September.

Hertel, T., W. Martin and A. Leister, (2010), 'Potential Implications of a Special Safeguard Mechanism in the World Trade Organization: The Case of Wheat', *World Bank Economic Review* 24(2): 330–59.

Hertel, T.W. and L.A. Winters (eds.) (2006), *Poverty and the WTO: Impacts of the Doha Development Agenda*, London: Palgrave Macmillan and Washington DC: World Bank.

Krueger, A. O., M. Schiff and A. Valdés (1988), 'Agricultural Incentives in Developing Countries: Measuring the Effect of Sectoral and Economy-wide Policies', *World Bank Economic Review* 2(3): 255-72, September.

Martin, W. and K. Anderson (2012), 'Export Restrictions and Price Insulation During Commodity Price Booms', *American Journal of Agricultural Economics* 94(2):422-27, January.

Minot, N. (2011), 'Transmission of World Food Price Changes to Markets in Sub-Saharan Africa', Discussion Paper 1059, IFPRI, Washington DC, February.

Nerlove, M. (1972), 'Lags in Economic Behaviour', *Econometrica* 40(2): 221-52, March.

Nettle, R.S., M. Britten-Jones and K. Anderson (1987), 'Optimal Policy Intervention to Reduce Import Dependence', *International Economic Journal 1(4)*: 101-106, Winter.

OECD (2010), *Producer and Consumer Support Estimates, OECD Database 1986-2009*. http://www.oecd.org.

Sarris, A., P. Conforti and A. Prakash (2010), 'The Use of Organized Commodity Markets to Manage Food Import Price Instability and Risk', *Agricultural Economics* 42(1): 47-64, January.

Schiff, M. and A. Valdés (1992), 'The Effects of Intervention on Price Variability', Ch. 3 in M. Schiff and A. Valdés, *The Political Economy of Agricultural Pricing Policy, Volume 4: A Synthesis of the Economics in Developing Countries,* Baltimore: Johns Hopkins University Press for the World Bank.

Skoufias, E., S. Tiwari and H. Zaman (2010), 'Can We Rely on Cash Transfers to Protect Dietary Diversity During Food Crises? Estimates from Indonesia', Policy Research Working Paper 5548, World Bank, Washington DC, January.

Thompson, S.R., P.M. Schmitz, N. Iwai and B.K. Goodwin (2004), 'The Real Rate of Protection: The Income Insurance Effects of Agricultural Policy", *Applied Economics* 36: 1-8.

Tovar, P. (2009), 'The Effects of Loss Aversion on Trade Policy: Theory and Evidence', *Journal of International Economics* 78(1): 154-67, June.

Tyers, R. (1991), 'On the Neglect of Dynamics, Risk and Market Insulation in the Analysis of Uruguay Round Food Trade Reforms', *Australian Journal of Agricultural Economics* 35(3): 295-313, December.

Tyers, R. and K. Anderson (1992), *Disarray in World Food Markets: A Quantitative Assessment*, Cambridge and New York: Cambridge University Press.

Warr, P.G. (2005), 'Food Policy and Poverty in Indonesia: A General Equilibrium Analysis', *Australian Journal of Agricultural and Resource Economics* 49(3): 429-51.

World Bank (2010), *Global Commodity Markets: Review and Price Forecasts,* Washington DC: World Bank.

Chapter 3:

How much do trade restrictions responses contribute to international price spikes?

Signe Nelgen

(with Kym Anderson)

Revision of a paper forthcoming in a special issue of the *Oxford Review of Economic Policy*, on protectionism during the recent financial crisis

Abstract

Import barriers are often raised during turbulent times, as governments worry about immediate domestic concerns such as unemployment. The recent global financial crisis, however, was accompanied by an exogenous upward spike in the international price of food, which led some countries to raise *export* barriers, thereby exacerbating both the price spike and the international welfare transfer associated with that change in the terms of trade. As in previous price spike periods, that response by food-exporting countries was accompanied by a *lowering* of import restrictions by food-importing countries, further exacerbating the international price spike. This paper provides new evidence up to 2010 on the extent of the change in domestic relative to international prices in both groups of countries, compares it with responses during two previous food price spike periods, and concludes that there is a need for stronger WTO disciplines on export as well as import restrictions so as to limit the extent to which beggar-thy-neighbor government responses to international price spikes (up or down) exacerbate those shocks.

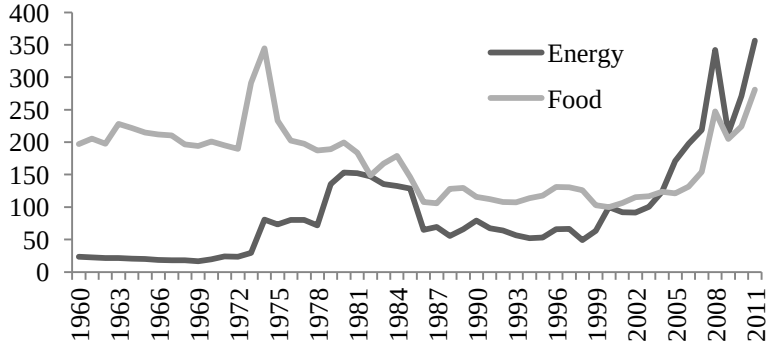
How much do trade restrictions contribute to international price spikes?

A. Introduction

Within a year of the onset of the global financial crisis (GFC) in 2008, and again since then, concerns have been expressed that protectionist forces were leading to beggar-thy-neighbor increases in trade restrictions (Evenett 2009, 2010). Such policy responses could exacerbate the crisis, not least through lowering the demand for and hence prices received by exporters of affected tradable goods. Yet at the same time as demand was shrinking for manufactures and services, international prices of food and fuel spiked upwards in 2008, having risen steadily in the previous three or four years. They fell back somewhat in 2009, but rose to near-record highs again in 2010-11 (Figure 1). Evidently there has been a different dynamic affecting these goods than that affecting the markets for non-primary products in recent years.

Figure 1: International prices for food and energy raw materials, 1960 to 2011

(current US dollars, 2011 to October only)



Source: World Bank (2011).

The upward spike in the international price of food led some countries to raise export barriers, thereby exacerbating both the price spike and the international welfare transfer associated with that change in the terms of trade. Those restrictions on food exports received much publicity in the mass media, and in international fora including the G20 (FAO et al. 2011). What has received relatively little publicity, though, was a lowering of restrictions on food imports: the response by food-exporting countries was accompanied by a reduction or suspension of import tariffs (and possibly some provision of import subsidies) by food-importing countries. That further exacerbated the spike in international food prices. Such beggar-thy-neighbor behavior of national governments is a concern for all trading nations, because it reduces the stability and predictability of trade opportunities and lowers the gains from trade (Jacks, O'Rourke and Williamson 2011). It may also slow economic growth of primary-exporting countries. In addition, typically it is not even in the best economic interests of the intervening countries to so insulate their domestic markets, as there are almost always more-efficient instruments than trade measures to avert losses for politically significant interest groups.

The key question this paper addresses is: How and to what extent have border restrictions on trade in farm products (a) altered during this recent period of rising food prices and (b) contributed to the price spikes?[14] In addressing that question, the paper summarizes political economy explanations for that policy behaviour before examining the domestic and international market and welfare effects we should

[14] Fluctuations are to be expected in commodity markets subject to periodic supply or demand shocks, especially if an adverse supply shock or a surge in demand occurs when global stocks are at low levels and even more so if there are unanticipated changes in government storage activity (Deaton and Laroque 1992; Gouel 2011; Wright 2011; Carter, Rausser and Smith 2011). An analysis of why fuel prices spiked over the same period can be found in Turner, Farrimond and Hill (2011) and the references cited therein.

expect if many countries so intervene. It then provides new evidence up to 2010 on the extent of the change in domestic relative to border prices in both grain-exporting and grain-importing countries, and compares it with evidence of responses during previous food price spike periods. Responses by both grain-importing and grain-exporting countries are shown to be substantial, ensuring that each group (a) reduced the effectiveness of the other's domestic market stabilizing intervention effort while (b) exacerbating the international price spike. Upper-bound estimates of the extent to which those policy responses contributed to the spike in international prices are then provided. The paper concludes by exploring more-effective national policy options than trade measures for reducing the harm to key groups that are at risk of being hurt by such prices spikes, and new initiatives that might be undertaken multilaterally.

B. Political economy causes of domestic market insulation

Why do countries act unilaterally to insulate their domestic market from international food price fluctuations? To address that question, it is possible to draw on and adapt recent political economy theory by Freund and Özden (2008), who in turn built on the pioneering work of Grossman and Helpman (1994). They show how the preference for policies that insulate domestic prices from year-to-year changes around a desired level that differs from world prices can be specified in a welfare function.

Corden (1997, pp. 72-76) suggests that pattern of intermittent border interventions implies a conservative social welfare function. An objective function that represents this type of preference has been suggested by Jean, Laborde and

Martin (2010) and is closely related to one developed by Freund and Özden (2008). That is, Jean et al.'s model predicts that the higher the international price of food in any year relative to its long-run trend value, the lower will be the rate of distortion of domestic food prices that year, ceteris paribus. More than that, the key coefficient in their model is one minus the coefficient of price insulation in the international-to-domestic price transmission equation estimated by Tyers and Anderson (1992). It suggests that such policy makers will adjust their rates of distortion to domestic food prices to partially offset deviations of international prices from their trend value.

Even in the absence of generic national social safety nets, governments may be able to directly assist consumers when international prices spike upwards (or assist farmers when prices slump) at lower economic cost and more effectively than via altering their restrictions on trade. But if only trade measures are considered by policy makers to be the only feasible political instrument available to them, this would mean that when international food prices rise above trend, agricultural export restrictions will rise in food-exporting countries, and food import restrictions will be eased (or import subsidies introduced or raised) in countries that are net importers of food – and conversely when international food prices fall below trend.

C. Economic effects of domestic market insulation

An export tax or its equivalent lowers the domestic price below the border price of a tradable product such as grain (as does an import subsidy), whereas an import tax or its equivalent raises its domestic price above the border price (as does an export subsidy). Hence it is not surprising that governments, in seeking to protect domestic

consumers from an upward spike in international food prices, consider a change in trade measures as an appropriate response, since that raises the consumer subsidy/lowers the consumer tax equivalent of any such measure.

However, such domestic market insulation using trade measures is inefficient, possibly inequitable (it may even *add to* poverty), and – most importantly from a global viewpoint – not very effective in reducing domestic price instability.

(a) Inefficient and possibly inequitable

An import tax (or export subsidy) is the equivalent of a consumer tax and a producer subsidy, hence lowering it also reduces the extent to which the measure assists producers of the product in question. Likewise, since an export tax (or import subsidy) is the equivalent of a consumer subsidy and a producer tax, raising it not only helps consumers but also harms farmers. If farming is discouraged, the demand for labour on farms falls, and with it the wages of unskilled workers not only in farm jobs but also in non-farm jobs – and more so the more agrarian is the economy. Thus while poor households may benefit on the expenditure side from a measure that reduces the extent to which the price of food would otherwise rise, they could be harmed on the earnings side if they are sellers of food or suppliers of unskilled labor. Such trade policy responses therefore could add to rather than reduce poverty.[15]

In the case of a small food-exporting country unable to influence its terms of trade, an increase in export restrictions is likely to reduce its national economic welfare, because such measures distort domestic production in addition to lowering

[15] Recent empirical studies provide numerous cases of where trade restrictions have added to or would add to poverty. See, for example, Warr (2005), Hertel and Winters (2006), Anderson, Cockburn and Martin (2010) and Aksoy and Hoekman (2010).

the consumer price of food.[16] Trade measures are wasteful too if it is only the poorest consumers who need to be helped, since a trade measure affects all food consumers in the country.

Conversely, in the case of opposite changes to trade measures aimed at protecting farmers from a spike *downwards* in international prices, it is consumers who are inadvertently harmed by such trade policy responses, and all producers rather than just the poorest are helped – and in proportion to their output, thereby adding to farm income inequality.

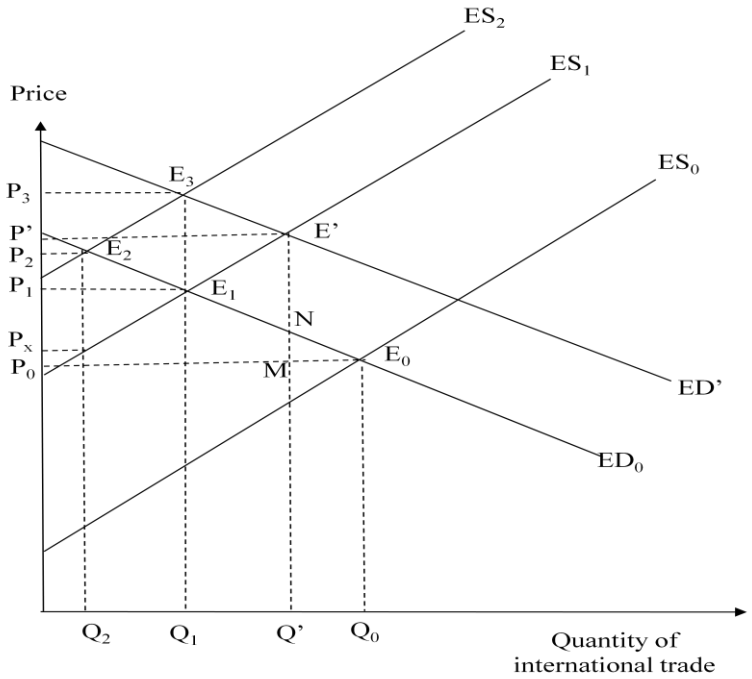
(b) Moreover, not very effective

Trade measures are not only *inefficient* at protecting a needy group from being harmed by a temporary shock to international food markets, they are also *ineffective* if many countries respond similarly. The ineffectiveness comes about because trade barriers of *both* food-exporting *and* food-importing countries often are altered in an effort to prevent the transmission of the international price shock. To see why this leads to ineffective outcomes, it is helpful to refer to Figure 2, which depicts the international market of food which involves, in a normal year, the excess supply curve (ES_o) for the world's food-exporting countries and the excess demand curve for the world's food-importing countries (ED_o). In the absence of any trade costs

[16] Variable trade restrictions can also affect long-term investments and hence economic growth rates. Williamson (2008) found evidence for this during the 19th century. Drawing on a broad range of developing country case studies, Bevan Collier and Gunning (1990) and Collier, Gunning and Associates (1999) suggest that faster economic growth would result from allowing producers access to high prices in those rare occasions when they spike, rather than taxing it away. According to the evidence in their case studies, this is because governments have been more prone than farm households to squander the windfall either in poor investments or in extra consumption.

such as for transport, equilibrium would be at E_o with Q_o units traded at international price P_o.

Figure 2: Effects of offsetting export barrier increases and import barrier reductions in the international market for food



Source: Authors' depiction.

Suppose there is an adverse season in some exporting countries at a time when global stocks are low, which shifts the excess supply curve leftwards to ES_1. If there were no policy responses, the equilibrium would shift from E_o to E_1 the international price and quantity traded across national borders would change from P_o and Q_o to P_1 and Q_1. However, if the higher price prompts governments to alter their trade restrictiveness, there will be additional effects. Consider three possible policy reactions.

First, suppose some of the food-exporting countries choose to impose an export tax. That would move the excess supply curve further to the left, say to ES_2. This would move the equilibrium to E_2 and raise the international price further, to P_2, but the domestic price in those export-restricting countries would be P_x which is below P_1. Such a reaction thus provides partial insulation in those exporting countries from the initial exogenous shock to the international market. Furthermore, even if each of those countries is so small as to be unable to influence the international market, their combined actions reduce aggregate exports to Q_2 and cause the international terms of trade to turn even further in their favor, because of the additional reduction in available supplies on the international market. That means, however, that food-importing countries face an even higher international price, at P_2 instead of P_1. Whether economic welfare falls or rises in food-exporting countries depends on whether the national benefit from imposing (or increasing) their export restrictions more or less than offsets the gain from the terms of trade change when many exporting countries so act.[17]

Alternatively, suppose some protective food-importing countries were to reduce their barriers to food imports in response to the international price rising from P_0 to P_1. That would shift the excess demand curve to the right, say to ED'. In that case the new equilibrium would be at E', involving Q' units traded at international price P', but it would provide partial insulation in those food-importing countries from the initial exogenous shock to the international market: their domestic price would rise by only MN instead of by ME' in Figure 2. However, the combined actions of those importing countries cause the international terms of trade to turn

[17] For a country with an export subsidy in place prior to the exogenous shock abroad, lowering that subsidy would improve that country's welfare.

even further against them, to the benefit of food-exporting countries' farmers but also to the detriment of consumers in those exporting countries who would have to pay P' for food. Whether economic welfare rises or falls in food-importing countries depends on whether the national benefit from reducing their import restrictions more or less than offsets the loss from the terms of trade change when many importing countries so act.

The third and more-realistic possibility is that both country groups intervene, each seeking to at least offset the effect on their domestic price of the other country group's policy response. In that case, the more one group seeks to insulate its domestic market, the more the other group is likely to respond. One example of such actions is shown in Figure 2 involving the curves shifting to ES_2 and ED', in which case the international price is pushed even higher to P_3 while the domestic price in each country group would be lower by E_3E_1. That is, in that particular case the domestic price (and the quantity traded internationally, Q_1) would be exactly the same as if neither country group's governments had altered their trade restrictions. The terms of trade would now be even better for the food-exporting country group, and even worse for food-importing countries. Aggregate global welfare would be the same as when neither country group so intervenes, but there would be a transfer from food-importing to food-exporting countries, via the terms of trade change, equal to areas $P_1E_1E_3P_3$.

Conversely, if the exogenous weather shock was of the opposite sort (a bumper harvest) which even after purchases by stockholders depressed the international price, and if governments sought in that case to protect their farmers

from the full force of the price fall, the international price fall would be accentuated to the benefit of food-importing countries.

Clearly, such attempted price insulation exacerbates international price volatility while doing little or possibly nothing to assist those most harmed by the initial exogenous weather shock.

(c) How to estimate how much policy responses exacerbate international price spikes

With the help of some simplifying assumptions, it is possible to estimate the extent to which government reactions contribute to any international food price spike. Martin and Anderson (2012) point out that this can be done by assuming a homogenous product whose global market equilibrium condition, assuming perfect competition and zero trade costs, is:

(1) $\Sigma_i (S_i(p_i)+v_i) - \Sigma_i D_i(p_i) = 0$

where S_i is the supply in country i; p_i is the country's domestic price; v_i is a random weather-related exogenous production shift variable for that country; and D_i is demand in country i (assumed to be not subject to shocks from year to year). Assume further that border measures are the only price-distorting policy intervention to be used, in which case we can define a single variable for the power of the trade tax equivalent, $T_i = (1+t_i)$ where t_i is country i's rate of tax on trade.

Totally differentiating equation (1), rearranging it, and expressing the results in percentage change form yields the following expression for the impact of a set of

changes in trade distortions on the international price p^*, assuming the policy changes are independent of the exogenous supply shocks:

$$(2) \qquad \hat{p}^* = \frac{\sum_i H_i \hat{v}_i + \sum_i (H_i \gamma_i - G_i \eta_i) \hat{T}_i}{\sum_i (G_i \eta_i - H_i \gamma_i)}$$

where $\hat{p}^*$ is the proportional change in the international price; $\hat{v}_i$ is an exogenous stochastic shock to output such as might result from above or below average weather; η_i is the price elasticity of demand; γ_i is the price elasticity of supply; G_i is the share, at the international price, of country i in global demand; and H_i is the share of country i in global production. That is, the impact on the international price of a change in trade distortions by country i depends on the importance of that country in global demand and supply (G_i and H_i), as well as the responsiveness of its production and consumption to price changes in the country (as represented by γ_i and η_i).

If it is assumed that output cannot respond in the short run, and that inventory levels are low enough that stock adjustments have limited effect (as is typically the case in a price spike period – see Wright 2011), then γ_i=0. If one further assumes that the national elasticities of final demand for the product (η_i) are the same across countries, then equation (2) reduces to:

$$(3) \qquad -\sum_i G_i \hat{T}_i = \hat{T}$$

which is simply the negative of the consumption-weighted global average of the $\hat{T}_i$'s, which we call $\hat{T}$.

However, if the changes in trade restrictiveness are not independent of the exogenous supply (or any other) shocks, then

$$(4) \qquad \hat{p}^* = \hat{T} + R + (\hat{T} * R),$$

from which it follows that R = $(\hat{p}^* - \hat{T})/(1 + \hat{T})$, where R refers to the rest of the influences on p*. In that case, and if the interaction term is distributed proportionately, the contribution of the changes in trade restrictiveness to the international price change, in proportional terms, is $\frac{\hat{T}}{\hat{T} + R}$.

With these equations in hand, we now examine national estimates of annual NRAs, then price transmission elasticities over the entire time period, and then changes in restrictions when international prices spike severely.

D. Evidence of food market insulation from world price fluctuations

To provide systematic evidence of insulating behaviour by governments requires time series of estimates of annual changes in domestic and international prices for a representative set of commodities and countries.

(a) Price data and indicators of price distortions

Fortuitously, an ideal database has recently been compiled for the period just prior to the current global financial crisis. It provides, in a single source, a set of indicators of the extent to which price-distorting policies have altered annual average domestic producer and consumer prices of farm products away from their international price levels over the past half century (Anderson and Valenzuela 2008, with summary estimates in Anderson 2009). The original sample includes 20 high-income countries and 55 developing and transition countries that together account for all but one-tenth

of global agriculture, and the 75 most important products so as to cover around 70 percent of the gross value of agricultural output in each focus country.

Those Anderson and Valenzuela estimates go up to only 2004 for most developing countries and 2007 for high-income and European transition countries. We have therefore updated the estimates so as to be able to also assess recent changes in trade restrictions. These newest estimates are based, for high-income countries (including those that recently acceded to the European Union), on the market price support component of the producer support estimates (PSEs) for each product to 2010 that are reported in OECD (2011), making sure they are comparable with the estimates to 2007 in Anderson and Valenzuela (2008). We have also added five more small high-income countries for the period 1986 to 2010, again based on OECD estimates. PSE estimates for several large developing countries are included in OECD (2011), in Appendix A to this thesis. For other developing countries, we updated the Anderson and Valenzuela estimates by making use of FAO and World Bank data sources for producer and border prices.[18]

The key indicator used for present purposes is the national nominal rate of assistance to agricultural producers (NRA). The NRA is the percentage by which the domestic producer price exceeds the border price of like products at the same point

[18] Two more developing countries are added to the original Anderson and Valenzuela database, namely Israel (from OECD 2011) and Morocco (compiled by Ernesto Valenzuela from estimates in Tyner (2010) and updated by the present authors). The updated estimates for developing countries not included in OECD (2011) are available only to 2009 because that is the latest year on the FAO's producer price series; they are not as reliable as those based on the OECD's PSEs or the earlier estimates for developing countries in Anderson and Valenzuela (2008), for several reasons. One is that, to do the update promptly, producer prices reported to FAO had to be used for focus developing countries rather than more-nuanced prices available only in national statistical agencies. To minimize the errors this might introduce, the FAO producer prices in US current dollars were converted into an index set at 100 for the latest year available in Anderson and Valenzuela (2008) and the following years were updated using the changes in that index for each country through to 2009. Likewise, to overcome delays in obtaining export and import volumes and values, we create indexes set at 100 for the latest available year in Anderson and Valenzuela (2008) so as to be able to update the border prices using the changes in each of those indexes through to 2009.

in the value chain (that is, appropriately adjusted to include internal trade and processing costs).[19] Hence the NRA is negative if producers receive less than the price would be for a like product in the absence of government intervention. Over the past half-century the NRA has been very highly correlated with the consumer tax equivalent (CTE),[20] suggesting that most price-distorting interventions in national agricultural markets occur at the border, rather than in the form of domestic consumer or producer subsidies or taxes. Since part of our interest is in examining proportional changes in the NRA (and CTE), that can best be done by converting the NRA to a nominal assistance coefficient, where NAC = 1+NRA/100. This is especially so when some NRAs/CTEs are negative, in which case the NAC is between zero and one.

A change in NRA may not require any policy action on the part of the government, but rather be part of the original policy design. For example, the use of specific rather than ad valorem rates of trade taxation or trade subsidization automatically ensures some insulation of the domestic market from international price changes, as does the use of quantitative restrictions on trade such as fixed import or export quotas or bans. Explicit formulae for varying the import or export duty according to international price movements also may be part of the policy regime. And in some cases explicit provisions for restricting or relaxing trade barriers in price spike periods also are part of some policy packages – even though they may lay dormant in all but extreme periods. In what follows such provisions

[19] This assumes other wedges such as trade costs enter multiplicatively rather than additively. It also assumes those wedges are not correlated with food prices, and are not subject to variable monopolistic markups. If they were, then the NRA would be an upper-bound estimate of the intervention policy's effect.

[20] The coefficient of correlation between the NRA and CTE for the original 75 countries and 75 products over the five decades covered by Anderson and Valenzuela (2008) is 0.93. For details of the methodology for estimating the NRAs and CTEs, see Anderson et al. (2008).

will be treated no differently than any formal change of policy: both show up as a change in the NRA.

Needless to say, governments do not limit their interventions in markets for farm products to periods of extreme prices. In the past developing countries have tended to set NRAs below zero, especially if they are food-surplus countries, while high-income countries have tended to assist their farmers (NRAs above zero), especially if they are food-deficit. That is, NRAs tend to be higher the higher a country's income per capita and the weaker the country's agricultural comparative advantage. That pattern is shown to be statistically significant for the panel data in the Anderson and Valenzuela (2008) database, suggesting that agricultural NRAs tend to rise over time as a country's per capita income rises, and more so the more that growth is accompanied by a decline in agricultural comparative advantage (Anderson 2010, Ch. 2).

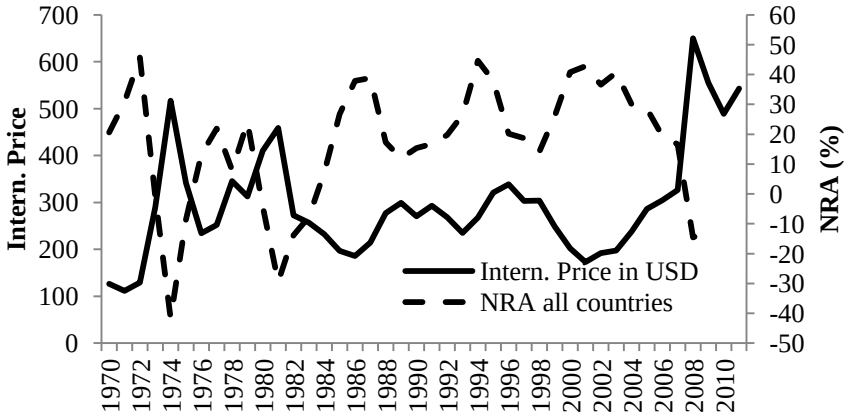
(b) NRA estimates

Pertinent to the present paper is the fact that around the long-run trends in NRAs for each country there is much fluctuation from year to year in individual product NRAs. NRAs are negatively correlated with deviations from trend in the international price of the product in question (Anderson 2010, Table 2.14). Perhaps the most notable cases are grains, for which the coefficients of correlation between their international price and national NRAs for the full sample of countries from 1970 to 2010 are -0.74 for rice, -0.40 for wheat and -0.55 for maize (Figure 3).

Figure 3: Grain NRAs and their international price, 82 countries,[a] 1970 to 2010

(left axis is int'l price in current US$, right axis is weighted average NRA in percent)

(a) Rice



(b) Wheat

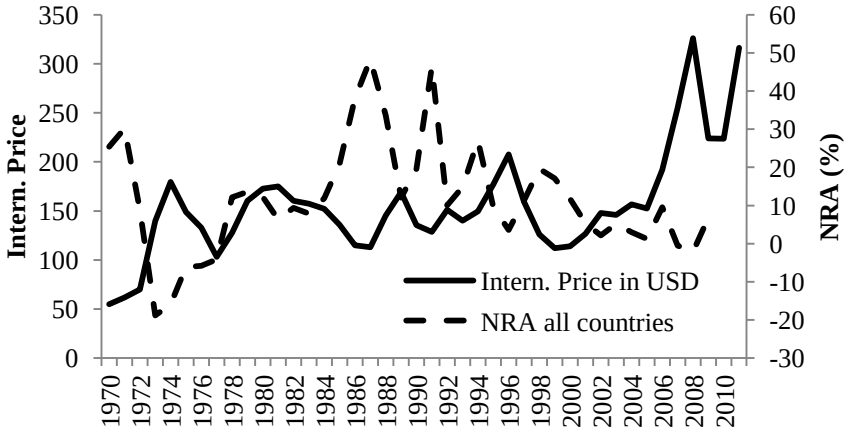
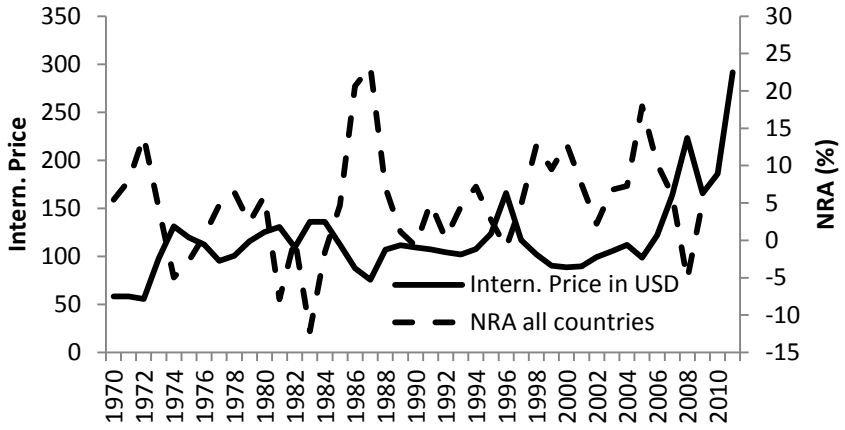


Figure 3 (continued): Grain NRAs and their international price,[a] 82 countries, 1970 to 2010

(left axis is int'l price in current US$, right axis is weighted average NRA in percent)

(c) Maize



[a] The NRA is a weighted average of the nominal rate of assistance to producers in each country, using production valued at undistorted prices as weights. The international prices are from World Bank (2011). Coefficients of correlation between the price and NRA are -0.74 for rice, -0.40 for wheat and -0.55 for maize.

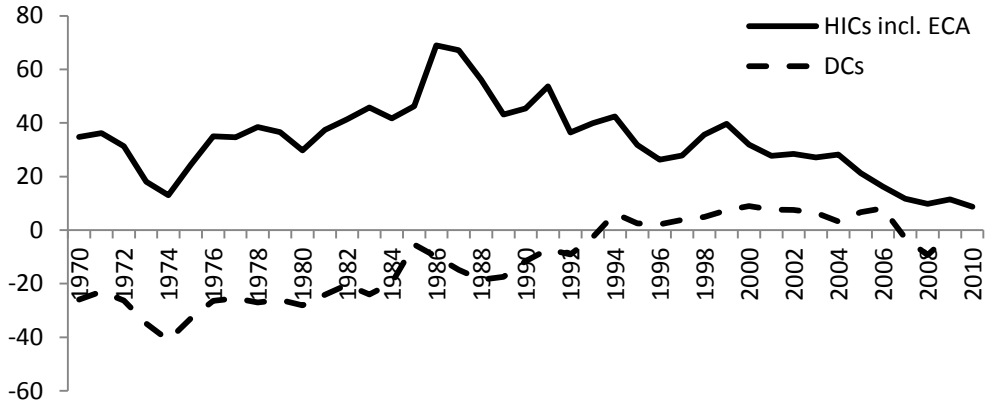
Source: Authors' compilation using NAC estimates from Anderson and Nelgen (2012b).

It is clear from Figure 1 that the largest upward spikes in the international food price index over the past half-century are in 1973-74 and 2006-08 (with a further spike in late 2010 and 2011); and the sharpest downward price spike was in 1985-86. Those three spikes are also evident for each of the three grains shown in Figure 3, when their NRAs also spiked in the opposite direction. One would expect that strong negative correlation between the international price and the estimated NRA to become weaker the more products are in the sample. Yet even when the NRAs for the full sample of 82 agricultural products are aggregated, the weighted

average NRA (using the gross value of production at undistorted prices as weights) still spikes during those three price-spike periods (Figure 4).

Figure 4: NRA, all products,[a] high-income and developing countries,[b] 1970 to 2010

(percent)



[a] Weighted average of the nominal rate of assistance to producers in each country, using production valued at undistorted prices as weights.
[b] The high-income countries include all European transition economies in the sample (ECA, those now members of EU-27 plus Russia and Ukraine). See Appendix for full list of countries.

Source: Authors' compilation using NAC estimates from Anderson and Nelgen (2012b).

(c) Price transmission estimates

It is also evident from Figures 3 and 4 that NRAs fluctuate around trend not only in extreme price spike periods. To examine what proportion of any international price fluctuation is transmitted to domestic markets within twelve months, we estimate a short-run elasticity of transmission of the international product price to the domestic market for the three key grains. Following Nerlove (1972) and Tyers and Anderson (1992, pp. 65-75), we use a partial-adjustment geometric distributed lag formulation

to estimate elasticities for each key product for all focus countries for the period 1985 to 2010 (see Chapter 2 for detailed methodology).

Table 1 summarizes the estimates. The average of estimates for the short-run transmission elasticity over the 25 years to 2010 range from nearly two-thirds for maize down to just one-half for rice. The unweighted average across these plus seven other key farm products is 0.58, suggesting that within one year, barely half the movement in international prices of farm products is been transmitted domestically on average.[21]

Table 1: Global average short-run price transmission elasticities,[a] key grains, 1985 to 2010

(weighted average across all of the 82 countries for which NRAs are available, using value of national production at undistorted prices as weights)

Rice	0.51
Wheat	0.58
Maize	0.63

[a] The proportion of a change in the international price that is transmitted to the domestic market of a country within a year, estimated using equation (3) in Chapter 2.

Source: Authors' calculations using price data compiled by Anderson and Nelgen (2012b).

[21] In a recent study of 11 Sub-Saharan African countries and using a somewhat different methodology, Minot (2011) estimated short-run price transmission elasticities for key staple foods which averaged 0.63. Earlier multicountry studies are by Comforti (2004) and Mundlak and Larson (1992), as well as Tyers and Anderson (1992, Appendix 2) who generally got short-run estimates below 0.5.

(d) Proportional NAC changes when prices spike

We move now to a closer examination of periods of extreme spikes in international grain prices. The most-extreme periods prior to the 2008 spike since 1960 are those around 1974 (an upward price spike) and around 1986 (a downward price spike). In Table 2 we focus on the annual average nominal assistance coefficient (NAC = 1 + NRA/100)[22] in the spike year plus the two years each side of it, relative to the longer period either side of each spike period. For the latest spike we have yet to have a post-spike period, but at least we can compare it with the immediately prior long period of relatively stable food prices (1988 to 2006 – see Figure 1).[23]

The expectation is that the NAC would be lower in the upward spike periods than in the average of the two adjoining longer non-spike periods, and conversely for the downward spike period around 1986. That is indeed what is evident in Table 2, where the spike periods are shown in bold italics. The percentage changes in the average NACs from the prior non-spike period to the shorter price spike period are shown in Table 3. Notice that the signs of the NAC changes in the two upward price spikes are negative in all but one minor case, while those in the downward spike period are all positive. That is true for both high-income and developing countries. More importantly from the viewpoint of this paper, it is also true for both grain-exporting and grain-importing country groups.

[22] The national NACs are averaged across countries without using weights, so that each polity is treated as an equally interesting case. The aggregate estimates therefore differ from those reported for country groups in Anderson (2009 and 2010), where production weights are used to calculate NRA averages (and consumption weights for CTE averages).

[23] Some of the figures in this sub-section are revisions of ones presented in Anderson and Nelgen (2012a), based on a fuller sample of countries than was available at the time of completing that earlier study.

Table 2: Average annual NACs[a], key crops, developing and high-income countries, 1965 to 2010

(1 + NRA/100)

	Developing countries						High-income countries					
	1965-1972	***1972-1976***	1976-1984	***1984-1988***	1988-2006	***2006-2009***	1965-1972	***1972-1976***	1976-1984	***1984-1988***	1988-2006	***2006-2010***
Rice	0.97	***0.91***	1.02	***1.27***	1.29	***1.14***	1.23	***1.07***	1.37	***2.37***	2.19	***1.71***
Importers	1.06	***0.99***	1.09	***1.35***	1.34	***1.20***	1.85	***1.70***	2.28	***4.20***	4.84	***2.42***
Exporters	0.76	***0.65***	0.78	***1.02***	1.13	***0.87***	0.99	***0.81***	1.01	***1.92***	1.50	***1.03***
Wheat	1.10	***0.90***	1.10	***1.18***	1.19	***1.05***	1.37	***0.91***	1.38	***1.95***	1.43	***1.06***
Importers	1.12	***0.89***	1.09	***1.18***	1.23	***1.07***	1.41	***0.90***	1.46	***2.09***	1.71	***1.38***
Exporters	1.01	***0.94***	1.24	***1.36***	0.91	***0.97***	1.20	***0.97***	1.08	***1.46***	1.18	***0.99***
Maize	1.09	***0.99***	1.03	***1.18***	1.07	***1.08***	1.39	***1.22***	1.36	***1.60***	1.34	***1.07***
Importers	1.20	***1.14***	1.15	***1.29***	1.12	***1.11***	1.42	***1.24***	1.41	***1.70***	1.42	***0.09***
Exporters	0.95	***0.78***	0.85	***0.87***	1.00	***1.05***	1.03	***1.02***	1.04	***1.18***	1.07	***1.01***

[a] Unweighted average of national NACs each year, averaged over the number of years in each period.

Source: Authors' calculations using NAC estimates from Anderson and Nelgen (2012b).

Table 3: Percentage changes in NACs from previous non-spike period,[a] key crops, developing and high-income countries, 1965 to 2010

	Developing countries			High-income countries		
	1972-1976	**1984-1988**	**2006-2009**	**1972-1976**	**1984-1988**	**2006-2010**
Rice importers	-6	24	-11	-8	84	-65
Rice exporters	-14	31	-22	-18	90	-32
Wheat importers	-21	9	-11	-37	44	-19
Wheat exporters	-6	9	-31	-20	36	-16
Maize importers	-6	12	-1	-13	21	-23
Maize exporters	-17	2	5	-1	14	-5

[a] Calculated from unweighted-average NACs in Table 2.

Source: Authors' calculations using NAC estimates from Anderson and Nelgen (2012b).

If we focus on just the sub-periods of rising prices, Figure 5 again reveals for the three grains the uniformity of this pattern. In particular, by this proportional measure importing countries responded during the latest spike more than exporting countries in the case of wheat and almost as much as exporters in the cases of rice and maize. They thus tend to offset each other's efforts to avoid transmitting the international price shock to their home markets. Both groups' responses were somewhat less than the proportional responses in the early 1970s, however. Comparisons of period averages are somewhat blunt because the averages hide a lot of year-to-year variation. These changes can be seen on an annual basis in the first pair of rows in Table 4 for rice, wheat and maize.

Figure 5: Changes in nominal assistance coefficients for grains, 1972-74, 1984-86, and 2005-08

(percentage changes in weighted averages of national NACs)[a]

(a) world exporters and world importers

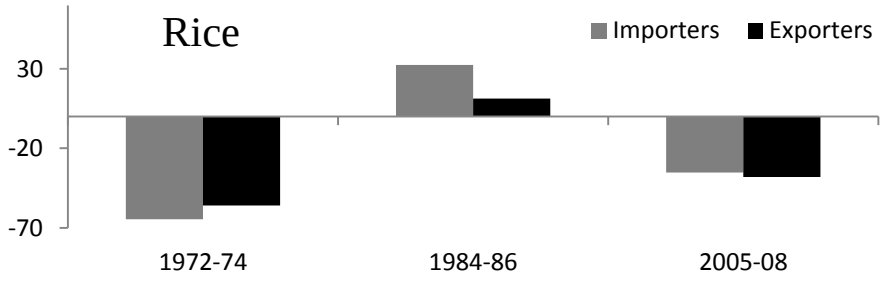
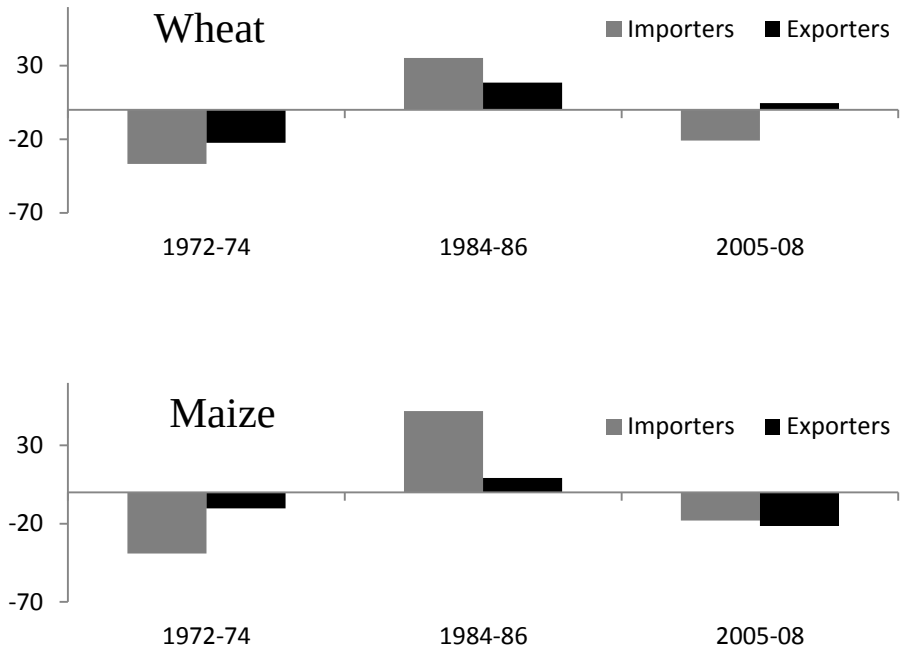


Figure 5 (continued): Changes in nominal assistance coefficients for grains, 1972-74, 1984-86, and 2005-08

(percentage changes in weighted averages of national NACs)[a]

(a) world exporters and world importers



(b) developing countries and high-income countries

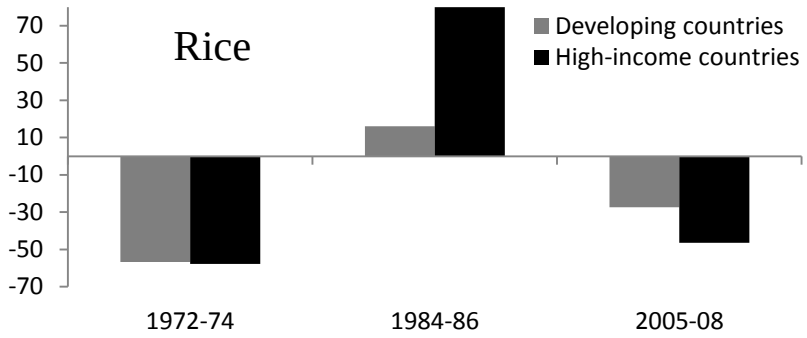
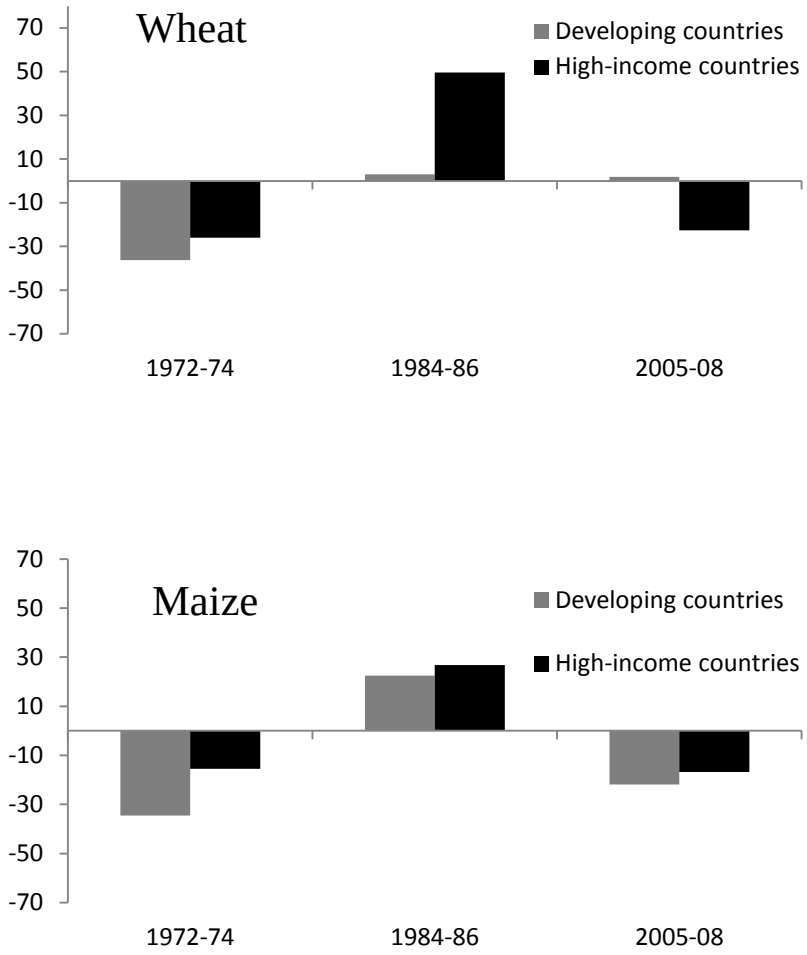


Figure 5 (continued): Changes in nominal assistance coefficients for grains, 1972-74, 1984-86, and 2005-08

(percentage changes in weighted averages of national NACs)[a]

(a) developing countries and high-income countries



[a] Consumption weights are used in the first and third periods when international prices spiked upwards, and production weights in the mid-1980s period when prices spiked downwards.

Source: Authors' calculations using NAC estimates from Anderson and Nelgen (2012b).

Table 4: Annual NACs (1 + NRA/100) for rice, wheat and maize, by country group,[a] 1972 to 2010

(a) Rice

	1972	1973	1974	1975	1976	1984	1985	1986	1987	1988	2005	2006	2007	2008	2009	2010
World exporters	0.87	0.62	0.56	0.73	0.88	1.11	1.31	1.58	1.79	1.66	1.01	0.97	1.03	0.99	0.86	1.01
World importers	1.37	1.03	0.75	1.07	1.17	1.45	1.61	1.62	1.64	1.49	1.57	1.41	1.36	1.19	1.20	1.45
High-income countries	1.29	0.95	0.77	1.07	1.26	1.70	1.97	2.53	2.84	2.82	1.60	1.38	1.24	1.26	1.17	1.23
Developing countries	1.11	0.83	0.64	0.91	1.03	1.24	1.37	1.28	1.29	1.15	1.29	1.26	1.22	1.04	1.03	na
Asia	1.15	0.84	0.58	0.89	1.02	1.26	1.42	1.35	1.46	1.25	1.23	1.20	1.05	0.81	0.90	Na
Africa	1.10	0.84	0.66	0.99	1.06	1.21	1.17	1.16	1.29	1.12	1.12	1.16	1.25	1.05	0.91	na
Latin America	1.05	0.81	0.75	0.82	0.96	1.27	1.65	1.34	0.90	0.96	1.57	1.45	1.47	1.40	1.36	na

(b) Wheat

	1972	1973	1974	1975	1976	1984	1985	1986	1987	1988	2005	2006	2007	2008	2009	2010
World exporters	1.14	0.88	0.83	0.97	0.98	1.17	1.19	1.71	1.70	1.41	0.98	1.00	0.97	0.98	1.00	1.00
World importers	1.09	0.73	0.76	0.96	0.93	1.28	1.46	1.77	2.07	1.80	1.40	1.37	1.09	1.05	1.25	1.25
High-income countries	1.10	0.79	0.80	0.92	0.94	1.42	1.65	2.13	2.46	2.10	1.17	1.14	1.03	1.02	1.07	1.06
Developing countries	1.10	0.72	0.74	1.01	0.95	1.06	1.09	1.22	1.33	1.20	1.14	1.11	1.00	0.96	1.11	na
Asia	1.35	0.80	0.89	1.21	1.01	1.20	1.20	1.28	1.42	1.46	1.03	1.13	0.99	0.79	1.14	na
Africa	0.99	0.77	0.64	0.87	0.84	0.92	0.91	1.20	1.38	1.11	1.27	1.18	1.06	1.12	1.16	na
Latin America	1.02	0.63	0.72	0.96	1.07	1.14	1.27	1.20	1.16	1.09	1.04	1.03	0.93	0.91	1.03	na

(c) Maize

	1972	1973	1974	1975	1976	1984	1985	1986	1987	1988	2005	2006	2007	2008	2009	2010
World exporters	0.95	0.89	0.75	0.75	0.71	0.83	0.86	1.01	1.14	0.87	1.07	1.11	1.22	0.95	0.97	0.97
World importers	1.51	1.14	0.95	1.12	1.20	1.06	1.15	1.62	1.98	1.54	1.22	1.13	1.17	0.99	1.13	1.04
High-income countries	1.54	1.14	0.98	1.17	1.26	1.16	1.26	1.78	2.16	1.67	1.18	1.15	1.18	0.99	1.01	1.02
Developing countries	1.23	1.02	0.87	0.91	0.95	0.90	0.97	1.22	1.41	1.13	1.15	1.07	1.17	0.96	1.12	na
Asia	1.30	0.99	0.91	0.87	0.98	0.95	1.05	1.10	1.31	1.22	1.08	1.10	1.18	0.82	1.30	Na
Africa	1.24	1.01	0.86	0.95	0.95	0.86	0.93	1.34	1.56	1.15	1.24	1.09	1.35	1.04	0.99	na
Latin America	1.12	1.06	0.83	0.85	0.90	0.93	0.98	1.03	1.16	1.00	1.07	1.03	0.96	0.97	1.12	na

[a] Unweighted averages of national NACs.

Source: Authors' calculations using NAC estimates from Anderson and Nelgen (2012b).

Table 5: Annual changes in NACs and international reference prices, by country group,[a] 1972-74, 1984-86, and 2005-10

(percent)

(a) Rice

	1972/73	1973/74	1984/85	1985/86	2005/06	2006/07	2007/08	2008/09	2009/10
World exporters	-29	-10	18	20	-3	5	-3	-13	18
World importers	-24	-27	11	1	-10	-4	-13	1	21
High-income countries	-26	-19	16	29	-14	-10	-1	-7	5
Developing countries	-25	-23	10	-7	-2	-3	-15	-1	na
*****Reference price***	***124***	***79***	***-15***	***-5***	***6***	***7***	***99***	***-15***	***-12***

(b) Wheat

	1972/73	1973/74	1984/85	1985/86	2005/06	2006/07	2007/08	2008/09	2009/10
World exporters	-22	-6	2	43	2	-3	-1	2	0
World importers	-33	4	14	21	-3	-20	-4	19	0
High-income countries	-28	1	17	29	-3	-10	-1	4	-1
Developing countries	-34	3	3	12	-2	-11	-3	16	na
*****Reference price***	***100***	***29***	***-11***	***-15***	***26***	***33***	***28***	***-31***	***0***

(c) Maize

	1972/73	1973/74	1984/85	1985/86	2005/06	2006/07	2007/08	2008/09	2009/10
World exporters	-6	-16	4	16	3	10	-23	3	0
World importers	-25	-17	9	40	-8	4	-16	15	-8
High-income countries	-26	-14	9	41	-2	3	-16	3	1
Developing countries	-17	-15	8	26	-7	9	-19	17	na
*****Reference price***	***75***	***34***	***-17***	***-22***	***23***	***34***	***36***	***-26***	***12***

[a] Unweighted averages of national NACs changes.

Source: Authors' calculations using NAC estimates from Anderson and Nelgen (2012b) and, for international reference prices, World Bank (2011).

A more-discernable picture of the annual changes in the first half of the price spike periods is provided in Table 5. It shows that the decline in NACs was more gradual in the recent price surge period to 2008 than it was in the 1970s surge when most of the change was in 1973 for wheat and in 1973 and 1974 for rice (whose harvest dates are less concentrated around the end of the year than are those for wheat). Because of that faster price change in the 1970s than in recent years (see the bold italics rows in Table 5), the magnitude of the annual NAC changes was greater then than in the period to 2008.

The rice NACs over the 1972-74 period fell by more than two-fifths for both high-income and developing countries. The NAC falls for wheat were not quite as severe as for rice, but were still substantial at more than one-quarter for high-income countries and nearly one-third for developing countries. The extent of annual decline in the NACs in the most recent price spike is slightly less than in the 1970s, and not quite as rapid. That slightly smaller and slower decline also is consistent with the fact that there were smaller and slower proportionate rises in the international prices of those grains during 2005-08 than in the early 1970s.

E. How much do NRA changes contribute to upward price spikes?

Martin and Anderson (2012) point out that insulating policies generate a classic collective-action problem akin to when a crowd stands up in a stadium to get a better view: no one gets a better view by standing, but those that remain seated get a worse view and so are induced to stand as well. This collective action not only is ineffective

from a national viewpoint, but also it generates an international public 'bad' by amplifying the volatility in international food prices, and hence also the volatility of the income transfers associated with terms-of-trade changes. It also involves a transfer between food-importing and food-exporting countries, akin to tall people benefitting at the expense of short people when all stand up in the stadium.

We show above that with some simplifying assumptions, it follows from equation (2) that the proportional contribution to international price changes resulting from changes in national trade restrictions is $\frac{\hat{T}}{\hat{T}+R}$, where $\hat{T}$ is the negative of the global consumption-weighted average proportional change in the NAC for each product and R is 'other' influences, calculated as R = $(\hat{p}^* - \hat{T})/(1 + \hat{T})$. Estimates of those indicators are summarized for the key grains in Table 6.

For rice the cumulative proportional decline in the NAC shown in the first row of Table 6 is 0.32 between 2005 and 2008. The comparable numbers for wheat and maize are 0.11 and 0.20, respectively. According to World Bank (2011) data, the international price of rice increased by 127 percent between 2005 and 2008, and the prices of wheat and maize by 114 and 126 percent, respectively (middle part of Table 6). Thus these estimates suggest that altered trade restrictions during the 2005-08 period caused international prices to be higher by 0.31 for rice, 0.12 for wheat, and 0.18 for maize (bottom third of Table 6). The unweighted average of these three, at 0.20, is almost the same as the 0.23 for 1972-74 (first column of Table 6), although the price spikes were somewhat larger then.

Table 6: Contributions of policy-induced trade barrier changes to changes in the international prices of key agricultural products, 1972-74 and 2005-08

	1972-74	2005-08
Consumption-weighted proportional decline in NAC, that is,- $\hat{T}$ [a]		
Rice	0.56	0.32
Wheat	0.30	0.11
Maize	0.21	0.20
Proportional international price rise, $\hat{p}^*$		
Rice	3.00	1.27
Wheat	1.57	1.14
Maize	1.35	1.26
Proportional contribution of changed trade restrictions to the international price change [b]		
Rice	0.27	0.31
Wheat	0.23	0.12
Maize	0.18	0.18

[a] $\hat{T}$ is the negative of the weighted average of proportional changes in national NACs over the period, using national shares of global consumption valued at undistorted prices (G_i's) as weights.

[b] The proportional contribution of altered trade restrictions is $\frac{\hat{T}}{\hat{T}+R}$, where R is 'other' influences and is derived from the equation $\hat{p}^* = \hat{T} + R + (\hat{T} * R)$, from which it follows that $R = (\hat{p}^* - \hat{T})/(1 + \hat{T})$.

Source: Authors' calculations based on the NAC estimates in Anderson and Nelgen (2012b).

It is possible to apportion those policy contributions between country groups. In Table 7 we report the contributions of high-income versus developing countries, and also of exporting versus importing countries. During 2005-08, developing

countries were responsible for the majority of the policy contribution to all three grains' price spikes, whereas in 1972-74 the opposite was the case except for rice. As for exporters versus importers, it appears exporters' policies had the majority of the influence other than for wheat in the 1970s, but importers made a very sizeable contribution as well. This is an important finding, since it has been mostly exporting countries who have been blamed for exacerbating the recent food price spike.

Table 7: Contributions[a] of high-income and developing countries, and of importing and exporting countries, to the proportion of the international price change that is due to policy-induced trade barrier changes, 1972-74 and 2005-08

	TOTAL PROPORTIONAL CONTRIBUTION	High-income countries' contribution	Developing countries' contribution	Importing countries' contribution	Exporting countries' contribution
1972-74					
Rice	0.27	0.04	0.23	0.10	0.17
Wheat	0.23	0.15	0.08	0.18	0.05
Maize	0.18	0.14	0.04	0.06	0.12
2005-08					
Rice	0.31	0.02	0.29	0.16	0.15
Wheat	0.12	0.06	0.06	0.04	0.08
Maize	0.18	0.08	0.10	0.05	0.13

[a] Expressed such that the two numbers in each subsequent pair of columns add to the total proportion shown in column 1 of each row.

Source: Authors' calculations based on NACs in Anderson and Nelgen (2012b).

F. How much did domestic grain prices rise relative to international prices?

With changes in trade restrictions contributing to the spike in international food prices, the question arises as to how effective those interventions are in limiting the rise in domestic prices? The proportional rise in the international price *net of* the contribution of changed trade restrictions is R/($\widehat{T}$ + R). That fraction, when multiplied by the international price rise shown in the middle part of Table 6, is reported in the second column of Table 8, where it is compared with the proportional rises in the domestic price in our sample of countries. The numbers for 2005-08 suggest that, on average for all countries in the sample, domestic prices rose slightly more than the adjusted international price change for wheat, and only slightly less for wheat and just one-third less for rice. The extent of insulation was greater in developing countries, especially for wheat and maize, which is consistent with the finding from the middle columns of Table 7 that their policymakers contributed more to the price spike than governments of high-income countries. Even so, in the case of rice the extent of insulation was only a little more than for high-income countries. This recent experience contrasts with the early 1970s, when high-income countries were much more insulated than recently, and also compared with developing countries in the 1970s. These results suggests that the combined responses by governments of all countries have been sufficiently offsetting as to do very little to insulate domestic markets from this recent international food price spike.

Table 8: Comparison of the domestic price rise with the rise in international grain prices net of the contribution of changed trade restrictions, rice, wheat and maize, 1972-74 and 2005-08

(percent, unweighted averages)

	International price rise		**Domestic price rise**		
	Including contribution of changed trade restrictions	Net of contribution of changed trade restrictions	All countries	Developing countries	High-income countries
1972-74					
Rice	300	220	59	72	27
Wheat	157	121	64	77	55
Maize	135	111	49	48	52
2005-08					
Rice	127	88	58	55	66
Wheat	114	88	98	60	114
Maize	126	103	99	67	126

Source: Authors' calculations based on the NAC estimates in Anderson and Nelgen (2012b).

These results suggests that the combined responses by governments of all countries have been sufficiently offsetting as to do very little to insulate domestic markets from this recent international food price spike. Thus even if one of the motivations for a country to alter its trade restrictions during an international price spike period was to avoid an increase in domestic food prices for fear it would

worsen poverty,[24] its success in achieving that objective would appear to be very limited. It is limited by the extent that other countries try to do the same, since that affects the extent to which each country avoids transmitting to their domestic market all of the rise from P_0 to P_1 in Figure 2.

G. Summary of results and implications for policy

The above empirical findings can be summarized as follows:

- Farm product NRAs are significantly negatively correlated with fluctuations around trend in each product's international price, with less than half the movement in international food prices being transmitted to domestic markets within the first year;
- NACs were substantially lower in the two upward price spike periods (and higher for the downward price spike period around 1986) than in adjacent non-spike periods, with changes in both export and import restrictions contributing to that finding;
- The extent and speed of NAC changes in each spike period are similar for grain-exporting and grain-importing countries, suggesting both types of countries actively insulate their domestic market from international food prices spikes;

- Consistent with the fact that international food prices rises were greater in the earlier period, the extent and speed of the annual NAC changes during an

[24] For an updated analysis of the determinants of the effects of trade and other policy instruments on poverty, see Martin (2011).

upward price spike was less in the recent period to 2008 than in the early 1970s, but they were nonetheless substantial;

- The changes in restrictions on global grain trade during 2005-08 are responsible for estimated increases in the international prices of rice, maize and wheat of around one-third, one-sixth and one-eighth, respectively;
- In the absence of those changes in trade restrictions, domestic prices of wheat and maize would have risen *less* on average across all countries' and
- Those altered trade restrictions caused rice price rises in both high-income and developing countries to be only one-quarter less than what they otherwise would have been.

It is possible, given the listed assumptions that had to be made to get the bottom-line results reported in Tables 6 and 7, that these numbers overstate the extent of governmental variations in trade restrictions. Even so, the numbers are sufficiently large as to be of concern, especially since in a many-country world the actions of individual countries are being offset by those of other countries and so the interventions are rather ineffective in achieving their stated aim. The most commonly stated objectives of governments in developing countries in the case of upward price spikes is to ensure domestic food security for consumers, that is, to have adequate supplies at affordable prices for all domestic households. Related stated objectives are to reduce inflationary or balance of payments pressures from an upward price spike. Yet most governments could respond much more efficiently with more-direct domestic measures rather than by varying their trade restrictions. For example, monetary policy could deal with inflationary concerns, and balance of payments

pressures could be better handled via more exchange rate flexibility, while food-affordability concerns of the poor can best be dealt with using generic social safety net policies that can offset the adverse impacts of a wide range of different shocks on poor people – net sellers as well as net buyers of food – without imposing the costly by-product distortions that necessarily accompany the use of n^{th}-best trade policy instruments.

A program of targeted income supplements to only the most vulnerable households, and only while the price spike lasts, is possibly the lowest-cost intervention. It is often claimed that such payments are unaffordable in poor countries, but recall that in half the cases considered above, governments *reduce* their trade taxes, so even that intervention is a drain on the finance ministry's budget in food-importing countries. Moreover, the information and communication technology revolution has made it possible for conditional cash transfers to be provided electronically as direct assistance to even remote and small households, and even to the most vulnerable members of those households (typically women and their young children – see, e.g., Fiszbein and Schady (2009), Adato and Hoddinott (2010) and Skoufias, Tiwari and Zaman (2010)).

Traditional national government trade policy reactions to food price spikes are undesirable also because, collectively, they are not very effective in stabilizing domestic prices, and not least because they add to international price volatility by reducing the role that trade between nations can play in bringing stability to the world's food markets. That adverse aspect will become ever more important as climate change increases the frequency and severity of extreme weather events – and if current biofuel policy responses to it continue to strengthen the link between food

and volatile fossil fuel markets (Hertel and Beckman 2011). The larger the number of countries insulating their domestic markets, the more other countries perceive a need to do likewise (the standing-up-in-the-stadium problem). This exacerbates the effect on international prices such that even greater changes in trade barriers are desired by each nation, both exporters and importers. These policy variations also transfer welfare between food-surplus and food-deficit countries, and may even add to rather than reduce poverty (Ivanic and Martin 2008). They do not necessarily lead to lower volumes of farm trade though, as that depends on whether the greater export restrictions are more or less than offset by the lowering of barriers to imports of farm products.

The above suggests there is considerable scope for governments to multilaterally agree to stop intermittently intervening in these ways. The World Trade Organization (WTO) is the most obvious place for them to seek restraints on variable trade restrictions. Indeed one of the original motivations for the Contracting Parties to sign the General Agreement on Tariffs and Trade (GATT, WTO's predecessor) was to bring stability and predictability to world trade. To date the membership has adopted rules to encourage the use of trade taxes in place of quantitative restrictions on trade (Article IX of the GATT), and has managed to obtain binding commitments on import tariffs and on production and export subsidies as part of the Uruguay Round Agreement on Agriculture. However, those bindings continue to be set well above applied rates by most countries, leaving plenty of scope for varying import restrictions without dishonoring those legal commitments under WTO.

In the current Doha round of WTO negotiations there are proposals to phase out agricultural export subsidies as well as to bring down import tariff bindings, both of which would contribute to global economic welfare and more-stable international prices for farm products. At the same time, however, developing countries have added to the WTO's Doha agenda a proposal for a Special Safeguards Mechanism (SSM) that would allow those countries to raise their agricultural import barriers above their bindings for a significant proportion of agricultural products in the event of a sudden international price fall or an import surge. This is the exact opposite of what is needed by way of a global public good to reduce the frequency and amplitude of downward food price spikes (Hertel, Martin and Leister 2010). Moreover, the above evidence from the mid-1980s experience suggests that if food-importing countries were to exercise that proposed freedom, food-surplus countries would respond by lowering their export restrictions – thereby weakening the efforts of the food-importing countries to insulate their domestic markets from the international price fall, *and* further depressing that price.

Moreover, proposals to broaden the Doha agenda to also introduce disciplines on export restraints have struggled to date to gain traction. A proposal by Japan in 2000, for example, involved disciplines similar to those on the import side, with export restrictions to be replaced by taxes and export taxes to be bound. A year later Jordan proposed even stronger rules: a ban on export restrictions and (as proposed for export subsidies) the binding of all export taxes at zero. However, strong opposition to the inclusion of this item on the Doha Development Agenda has come from several food-exporting developing countries, led by Argentina (whose farm exports have been highly taxed since its large currency devaluation at the end of

2001). This reflects the facts that traditionally the demandeurs in WTO negotiations have been dominated by interests seeking market access, and that upward price spikes are infrequent. Yet the above analysis reveals the need for symmetry of treatment of export and import disciplines in the WTO.

References

Adato, M. and J. Hoddinott (eds.) (2010), *Conditional Cash Transfers in Latin America,* Baltimore MD: Johns Hopkins University Press for IFPRI.

Aksoy, M.A. and B. Hoekman (eds.) (2010), *Food Prices and Rural Poverty,* London: Centre for Economic Policy Research for the World Bank.

Anderson, K. (ed.) (2009), *Distortions to Agricultural Incentives: A Global Perspective, 1955-2007,* London: Palgrave Macmillan and Washington DC: World Bank.

Anderson, K. (ed.) (2010), *The Political Economy of Agricultural Price Distortions*, Cambridge and New York: Cambridge University Press.

Anderson, K., J. Cockburn and W. Martin (eds.) (2010), *Agricultural Price Distortions, Inequality and Poverty,* Washington DC: World Bank.

Anderson, K., M. Kurzweil, W. Martin, D. Sandri, and E. Valenzuela (2008), 'Measuring Distortions to Agricultural Incentives, Revisited', *World Trade Review* 7(4): 675–704.

Anderson, K. and S. Nelgen (2012a), 'Trade Barrier Volatility and Agricultural Price Stabilization', *World Development* 40(1): 36-48, January.

Anderson, K. and S. Nelgen (2012b), *Updated National and Global Estimates of Distortions to Agricultural Incentives, 1955 to 2010,* Database uploaded in March 2012 at www.worldbank.org/agdistortions.

Anderson, K. and E. Valenzuela (2008), *Global Estimates of Distortions to Agricultural Incentives, 1955 to 2007,* data spreadsheets at www.worldbank.org/agdistortions

Bevan, D., P. Collier and J.W. Gunning (1990), *Controlled Open Economies: A Neoclassical Approach to Structuralism*, Oxford: Clarendon Press.

Carter, C.A., G.C. Rausser and A. Smith (2011), 'Commodity Booms and Busts', *Annual Review of Resource Economics* 3: 87-118.

Collier, P., G.W. Gunning and Associates (1999), *Trade Shocks in Developing Countries* (2 volumes), London: Oxford University Press.

Conforti, P. (2004), *Price Transmission in Selected Agricultural Markets*, Commodity and Trade Policy Research Working Paper 7, Food and Agriculture Organisation, Rome, March.

Corden, W.M. (1997), *Trade Policy and Economic Welfare*, revised edition, Oxford: Clarendon Press.

Deaton, A. and G. Laroque (1992), 'On the Behavior of Commodity Prices', *Review of Economic Studies* 59(198): 1-23, January.

Evenett, S.J. (ed.) (2009), The Unrelenting Pressure of Protectionism: The 3rd GTA Report, London: Centre for Economic Policy Research, for Global Trade Alert, December. www.globaltradealert.org/gta-analysis/unrelenting-pressure-protectionism-3rd-gta-report

Evenett, S.J. (ed.) (2011), Resolve Falters As Global Prospects Worsen: The 9th GTA Report, London: Centre for Economic Policy Research, for Global Trade Alert, July. www.globaltradealert.org/9th_GTA_Report

FAO et al. (2011), *Price Volatility in Food and Agricultural Market: Policy Responses*, Background Policy Report for the G20 Summit in Paris in November 2011, Rome: FAO in collaboration with IFAD, IFPRI, IMF, OECD, UNCTAD, WFP, World Bank and WTO, May.

Fiszbein, A. and N. Schady (with F.H.G. Ferreira, M. Grosh, N. Kelleher, P. Olinto and E. Skoufias) (2009), *Conditional Cash Transfers: Reducing Present and Future Poverty*, Policy Research Report, Washington DC: World Bank.

Freund, C. and C. Özden (2008), 'Trade Policy and Loss Aversion', *American Economic Review* 98(4): 1675-1691, September.

Goule, C. (2011), 'Agricultural Price Instability: A Survey of Competing Explanations and Remedies', *Journal of Economic Surveys* 25 (forthcoming).

Grossman, G.M. and E. Helpman (1994), 'Protection for Sale', *American Economic Review* 84(4): 833–50, September.

Hertel, T. W. and J. Beckman (2011), 'Commodity Price Volatility in the Biofuel Era: An Examination of the Linkage Between Energy and Agricultural Markets', Ch. 6 (pp. 189-221) in *The Intended and Unintended Effects of U.S. Agricultural and Biotechnology Policies*, edited by J. Graff Zivin and J. Perloff, Chicago: University of Chicago Press for NBER.

Hertel, T., W. Martin and A. Leister (2010), 'Potential Implications of a Special Safeguard Mechanism in the World Trade Organization: The Case of Wheat', *World Bank Economic Review* 24(2): 330–59.

Ivanic, M. and W. Martin (2008), 'Implications of Higher Global Food Prices for Poverty in Low-Income Countries', *Agricultural Economics* 39: 405-16.

Jacks, D.S., K.H. O'Rourke and J.G. Williamson (2011), 'Commodity Price Volatility and World Market Integration Since 1700', *Review of Economics and Statistics* 93(3): 800-13, January.

Jean, S., D. Laborde and W. Martin (2010), 'Formulas and Flexibility in Trade Negotiations: Sensitive Agricultural Products in the WTO's Doha Agenda', *World Bank Economic Review* 24 (3): 500-19.

Martin, W. and K. Anderson (2012), 'Export Restrictions and Price Insulation During Commodity Price Booms', *American Journal of Agricultural Economics* 94(2): 422-27, January.

Minot, N. (2011), 'Transmission of World Food Price Changes to Markets in Sub-Saharan Africa', Discussion Paper 1059, IFPRI, Washington DC, February.

Mundlak, Y. and D. Larson (1992), **'**On the Transmission of World Agricultural Prices', *World Bank Economic Review* 6: 399-422.

Nerlove, M. (1972), 'Lags in Economic Behaviour', *Econometrica* 40(2): 221-52, March.

OECD (2011), *Producer and Consumer Support Estimates, OECD Database 1986-2010,* http://www.oecd.org, accessed 26 September.

Skoufias, E., S. Tiwari and H. Zaman (2010), 'Can We Rely on Cash Transfers to Protect Dietary Diversity During Food Crises? Estimates from Indonesia', Policy Research Working Paper 5548, World Bank, Washington DC, January.

Turner, A., J. Farrimond and J. Hill (2011), 'The Oil Trading Markets, 2003-10: Analysis of Market Behaviour and Possible Policy Responses', *Oxford Review of Economic Policy* 27(1): 33-67, Spring.

Tyers, R. and K. Anderson (1992), *Disarray in World Food Markets: A Quantitative Assessment*, Cambridge and New York: Cambridge University Press.

Tyner, W. (with H. Serghini and I. Ouraich) (2010), 'Moroccan Agricultural Policy: Recent Historical Context and Moving Forward via the *Maroc Plan Vert'*, mimeo for the World Bank, Purdue University, West Lafayette IN, January.

Warr, P.G. (2005), 'Food Policy and Poverty in Indonesia: A General Equilibrium Analysis', *Australian Journal of Agricultural and Resource Economics* 49(3): 429-51.

Williamson, J.G. (2008), 'Globalization and the Great Divergence: Terms of Trade Booms and Volatility in the Poor Periphery 1782-1913', *European Review of Economic History* 12(3): 355-91, December.

Wright, B.D. (2011), 'The Economics of Grain Price Volatility', *Applied Economic Perspectives and Policy* 33(1): 32-58, Spring.

World Bank (2012), *Pink Sheets,* http://econ.worldbank.org, accessed 29 January.

Chapter 4:

Trade Policy for Loss Aversion:

Evidence from Agriculture

Signe Nelgen

(with Kym Anderson)

Abstract

It is not uncommon for governments to respond to alter their trade barriers in order to stabilize the domestic market for politically sensitive products. When international food prices spike upwards, not only do some food-exporting countries restrict exports but also some food-importing countries lower their import barriers, and the opposite when international food prices slump. This paper draws on and adapts recent political economy theory by Freund and Özden (2008) to develop hypotheses to explain this phenomenon, and tests them empirically using a comprehensive database on the extent of government intervention in agricultural markets in 82 countries from 1955 to 2010. Specifically, we examine whether developing countries' policy reactions to food price spikes differ from those of high-income countries, and whether there are differences as between food-surplus and food-deficit countries. The paper concludes by drawing out some policy implications and areas for further research.

Trade Policy for Loss Aversion: Evidence from Agriculture

A. Introduction

Food export restrictions received much publicity when prices in international food markets spiked in mid-2008. The rapid price rise (see Figure 1, Chapter 2) was fueled in part by news of some developing countries suspending their grain exports so as to slow the rise in domestic food prices. Commodity prices came down somewhat in the final few months of 2008, but grain prices rose again from the second half of 2010, triggered by Russia's announcement, in the wake of its drought and wildfires, to suspend grain exports initially until end-2010 and then to mid-2011 (http://www.globaltradealert.org/measure/russia-temporal-ban-certain-agricultural-exports). Ukraine, Belarus, Uzbekistan and Kazakhstan restricted or banned their grain exports in the latter half of 2010 too. The World Bank's food price index in January 2011 was 29 percent above its level a year earlier, and only 3 percent below its 2008 peak (World Bank 2011).

It is not uncommon for governments to respond to changing market circumstances by altering their trade barriers in order to stabilize the domestic market for politically sensitive products, but such responses are especially common in the case of staple foods.[25] When international food prices spike upwards, not only do some food-exporting countries restrict exports but also some food-importing countries lower their import barriers or even subsidize imports. And the opposite tends to occur when international food prices spike downwards: some export-

[25] And volatility in international prices is not uncommon, for reasons reviewed in Wright (2011).

restricting food-surplus countries lower their export barriers or subsidize exports while some food-importing countries raise their import barriers (Anderson and Nelgen 2012a).

When both sets of countries so respond, they each *accentuate* the extent of the price spike and the associated transfer of welfare from one set to the other associated with that terms of trade change. Martin and Anderson (2012b) estimate that 46 percent of the spike in the international rice price to 2008 was due to such trade policy responses from 2006 by both exporting and importing countries, and a somewhat less but still sizable share of 28 percent for wheat. However, as Martin and Anderson (2012a) point out, the actions of each of those two groups of countries *offsets* the attempt by the other group to stabilize its domestic food prices – and would do so fully if each country endeavoured to transmit none of the price hike caused by the other country group. In this sense those actions collectively generate an international public 'bad' (greater international price volatility) while contributing little or nothing to each country's national public good of a more-stable domestic food market. It suggests scope to agree multilaterally (presumably via the World Trade Organization) to desist. Yet the WTO membership has done very little toward that end: export measures are undisciplined (as are temporary cuts in import tariffs when prices soar), and agricultural import tariff bindings in many cases are well above applied tariff rates and thus allow plenty of scope for raising tariffs when international prices fall.[26]

Why do countries act unilaterally in this way rather than agree multilaterally to desist? And why do they not use more-direct and thus more-efficient domestic

[26] That is not to say WTO bindings are ineffective. As Francois and Martin (2004), even a high bound rate can prevent the worst protection increases in periods of very low international prices.

policy instruments rather than trade policy instruments for achieving their desired national political objectives (such as to reducing the risk of large welfare losses for politically significant groups)? Even in the absence of generic national social safety nets, governments may be able to directly assist consumers when international prices spike upwards (or farmers when prices slump) at lower cost and more effectively than via altering their trade measures.

To begin to address those questions, this paper draws on and adapts recent political economy theory by Freund and Özden (2008) – who build on the pioneering work of Grossman and Helpman (1994) – to develop hypotheses. It then tests them empirically using a comprehensive database on the extent of government intervention in agricultural markets (Anderson and Nelgen 2012b). That database provides annual estimates of agricultural distortion for 82 countries up to 2010, and has been recently updated to 2009 for developing countries and 2010 for high-income countries. The sample of countries in that database is sufficiently comprehensive to allow us to examine whether developing countries' policy reactions to food price spikes differ from those of high-income countries, and whether there are differences as between food-surplus and food-deficit countries.

In the rest of the paper, the theory is laid out in the next section, the dataset is described in section C, the expectations derived from the theory are tested empirically in section D and the final section of the paper draws out some policy implications and areas for further research.

B. Political economy theory

There is much evidence to suggest that policy makers prefer different trend rates of taxation or protection of farmers over time, reflecting both the evolution of relative political-economy strengths of different interest groups and a desire to smooth intertemporal variations in domestic commodity prices and quantities that openness to international markets otherwise would involve (Anderson et al. 2010). This preference for policies that insulate domestic prices from year-to-year changes around a desired level that differs from world prices can be specified in a welfare function. Corden (1997, pp. 72-76) suggests that pattern of intermittent border interventions implies a conservative social welfare function.[27] An objective function that represents this type of preference has been suggested by Jean, Laborde and Martin (2010) and is closely related to one developed by Freund and Özden (2008). Suppose that policy makers in a single, small country seek to minimize the following money-metric political-economy welfare loss function:

$$W=(p-\bar{p})'\alpha(p-\bar{p})-h'p+e(p,u)-g(p,v)-z_p(p-p^*) \quad (1)$$

where higher values of W indicate greater costs to policy makers of deviating from their preferred long-run political equilibrium in which domestic prices are aligned to the strength of different interest groups; p is the domestic price vector; α is a matrix representing the political-economy costs of deviations from the vector of desired domestic prices under the intervention regime, $\bar{p}$; h is a vector of weights that represents the preference for higher or lower average long-run domestic prices for individual commodities; e is the country's gross expenditure function; g is the GDP

[27] There is a literature also on the broader aversion of society to income inequality. See, for example, Engelmann and Strobel (2004) and Bellemare, Kroger and Soest (2008), and its application in the context of US farm-support programs in Lusk and Briggeman (2011).

function representing the value of output in the country; $z = e - g$ is the net expenditure function and hence its derivative, z_p, is by duality the country's vector of net imports; and p^* is a vector of world prices. The $(p - p^*)$ term is a vector of border price interventions such as trade taxes and subsidies or quantitative trade restrictions. In this paper we assume that is the only set of policy measures available, leaving for further research the issue of also including domestic producer and consumer taxes and subsidies. Also implicit in equation (1) is the assumption that only domestic interest groups matter to this small country's policy makers.

The last three terms of equation (1) are a standard balance-of-trade function (Anderson and Neary 2005). If policy makers seek to minimize this function alone, the optimal tariff, $p - p^*$, will be zero and the balance-of-trade function can be used to measure the cost of deviations from zero tariffs. Inclusion of the $h'p$ term makes the political-economy function consistent with non-zero interventions. The h function captures in reduced form a wide range of political-economy incentives for intervention such as the relative ability of particular sectors to lobby for assistance (similar to the policy preference for sector-specific profits in Freund and Özden 2008). It allows factors such as countervailing lobbying by downstream users, and the differential impact of protection on returns to factors emphasized by Anderson (1995), to be taken into account. The first term in equation (1) represents the cost of deviations from desired trend levels of domestic prices. The diagonal elements of this matrix are expected to be positive, because deviations from average domestic prices raise costs to some groups and hence incur some political pain. The off-diagonal elements might be positive or negative, depending on whether changes in other prices alleviate or exacerbate the political pain.

Equation (1) differs from the welfare function in equation (5) of Freund and Özden (2008) in three ways. First, equation (1) is based on deviations from the expected domestic price, rather than a reference price. A second difference is that deviations in either direction from the expected price, not just a downturn, show up as losses in equation (1). The third difference is that the cost of deviations enters in a quadratic way rather than linearly, reflecting the fact that costs of being away from the average price increase with the size of the deviation. These differences in formulation are needed to reflect the particular nature of agricultural markets, especially in developing countries. The expected price can be viewed as a rational expectations counterpart of the reference price in Freund and Özden (2008). With agricultural commodities in poor countries, deviations in either direction from the expected price involve social costs, because staple foods make up a large share of the incomes of poor consumers with limited access to credit as well as being important for the income of many poor farm households. Hence while interventions in markets for manufactures are included just as import restrictions, in the case of farm products they also include export subsidies, export restrictions, and even import subsidies.

Differentiating equation (1) with respect to prices yields:

(2) $$\partial W / dp = 2\alpha(p - \bar{p}) - h - z_{pp}'(p - p^*) = 0$$

and hence

(3) $$(p - p^*) = z_{pp}^{-1}(2\alpha(p - \bar{p}) - h)$$

The expected value of $(p - p^*)$ is therefore given by:

(4) $$E(p - p^*) = (\bar{p} - \overline{p^*}) = -z_{pp}^{-1}h$$

Rearranging (3) and substituting for $\bar{p}$ from (4) gives:

(5) $$z_{pp}(p - p^*) = 2\alpha(p + z_{pp}^{-1}h - \overline{p^*}) - h$$

which can be rearranged to give:

(6) $$z_{pp}(p - p^*) = 2\alpha(p - p^* + p^* - \overline{p^*}) + 2\alpha z_{pp}^{-1}h - h$$

and

(7) $$(z_{pp} - 2\alpha)(p - p^*) = 2\alpha(p^* - \overline{p^*}) + (2\alpha - z_{pp})z_{pp}^{-1}h$$

and finally:

(8) $$(p - p^*) = -(2\alpha - z_{pp})^{-1}2\alpha(p^* - \overline{p^*}) - z_{pp}^{-1}h$$

Equation (8) is difficult to interpret as is. However, policymakers are unlikely to have a clear idea of either the full matrix of slopes of the import demand function, z_{pp}, or penalties, α, for deviations from the average domestic price. Thus applied analysts typically focus only on the diagonal elements of the relevant matrices (Feenstra 1995). Doing this with equation (8) provides the following relationship between the price distortion rate and deviations from the average world price of a particular commodity:

(9) $$(p_i - p_i^*) = -\frac{2\alpha_i}{(2\alpha_i - z_{ii})}(p_i^* - \overline{p_i^*}) + (\overline{p_i} - \overline{p_i^*})$$

Since α_i is positive and z_{ii} is negative, the coefficient on $(p_i^* - \overline{p_i^*})$ in equation (9) lies between zero and one, implying that the higher the world price in any year relative to its long-run trend value, the lower will be the rate of distortion that year, ceteris paribus.[28] That is, equation (9) suggests that policy makers minimizing an objective function such as equation (1) will adjust their rates of distortion to agricultural prices to partially offset deviations of world prices from

[28] This coefficient is one minus the coefficient of price insulation used by Tyers and Anderson (1992).

their trend value. In the present case where it is assumed only trade measures are available to policy makers, this implies that: When international prices fall below (rise above) trend, agricultural protection (taxation) rates will rise in countries where farm households have stronger (weaker) political clout than net buyers of food.

For the reasons outlined in Anderson (1995), farm households are expected to be dominated by non-farm households in the polity of poor countries and conversely for high-income countries; and, within the farm sector, the export sub-sector is expected to have less political clout than the import-competing sub-sector, because trade measures to support the import-competing sub-sector raise government revenue whereas treasury funds need to be drawn on if trade measures are to support the export sub-sector. The latter is most likely to be the case in developing countries, as they have fewer low-cost ways of raising government revenue than do high-income countries. This suggests the following two testable hypotheses:

(i) developing (high-income) countries alter their food trade barriers more than high-income (developing) countries when international prices spike up (down); and

(ii) food-surplus countries alter their food trade barriers more (less) than food-deficit countries when international prices spike up (down).

C. The agricultural price distortions dataset

The above hypotheses are not inconsistent with numerous reports in the Global Trade Alert database available at www.globaltradealert.org of trade policy actions by governments surrounding both the 2007-08 and 2010-11 food price spikes. They are

consistent also with the compilation reported by Abbott (2012) and summarized in Table 1. To provide more-systematic evidence, however, requires time series of estimates of annual changes in domestic and international prices for a representative set of commodities and countries.

Table 1: Countries who imposed agricultural export restrictions during 2007-08

NOTE:
This table is included on page 151 of the print copy of the thesis held in the University of Adelaide Library.

Source: Abbott (2012).

Fortuitously, such a database has recently been compiled. It provides, in a single source, a set of indicators of the extent to which price-distorting policies have altered annual average domestic producer and consumer prices of farm products away from their international price levels over more than the past half century (Anderson and Nelgen (2012b)). The sample includes 26 high-income countries and 56 developing and transition countries that together account for all but one-tenth of global agriculture, and the 82 most important products so as to cover around 70 percent of the gross value of agricultural output in each focus country. Those estimates go up to 2009 for most developing countries and 2010 for high-income and transition countries, and therefore covering the 2008 price spike.

The key indicator used for present purposes is the national nominal rate of assistance to agricultural producers (NRA), or the nominal assistance coefficient where NAC = 1 + NRA/100. The NRA is the percentage by which the domestic producer price exceeds the border price, and hence is negative (or NAC<1) if farmers receive less than the price at the country's border for a similar product. Over the past half-century the NRA has been very highly correlated with the consumer tax equivalent (CTE),[29] suggesting that most interventions in national agricultural markets occur at the border, rather than in the form of domestic consumer or producer subsidies or taxes.

A change in NRA may not require any policy action on the part of the government, but rather be part of the original policy design. For example, the use of specific rather than ad valorem rates of trade taxation or trade subsidization automatically ensures some insulation of the domestic market from international

[29] The coefficient of correlation between the NRA and CTE for the 75 countries and 70+ products over the five decades covered by Anderson and Valenzuela (2008) is 0.93.

price changes, as does the use of quantitative restrictions on trade such as fixed import or export quotas or bans. Explicit formulae for varying the import or export duty according to international price movements also may be part of the policy regime. And in some cases explicit provisions for restricting or relaxing trade barriers in price spike periods also are part of a policy package – even though they may lay dormant in all but extreme periods. In what follows such provisions will be treated no differently than any formal change of policy: both show up as a change in the NRA.

D. Empirical evidence for agriculture

Following to exploring the NRA/NAC estimates cited in Section C in various informal ways, formal econometric testing of the hypotheses suggested in Section B will be applied. One quick way to get a sense of the extent to which NRAs move with international prices is simply to plot both of them over time. This is done in Figure 2 in Chapter 2 for perhaps the most notable agricultural case, which is rice in Asia. For the period 1970 to 2009, the coefficient of correlation between the NRA and international price for rice globally is well above 0.7, and is as high as 0.52 for South Asia. It is also above 0.5 for such products as cotton, maize, pork and sugar, and is 0.41 for wheat globally (Anderson et al. 2010, Table 2.7).

A slightly more formal way of gauging the extent of insulation is to estimate the short-run (one year) elasticity of transmission of the international product price to the domestic market for key farm products.

Table 2: Global average short-run price transmission elasticities, key agricultural products, 82 focus countries, 1985 to 2010

(weighted average, using value of production at undistorted prices as weights)

Rice	0.51
Wheat	0.58
Maize	0.63
Soybean	0.73
Sugar	0.43
Cotton	0.57
Milk	0.51
Beef	0.66
Pig meat	0.51
Poultry	0.68
Unweighted average, 10 products	**0.58**

Source: Authors' estimates based on NRAs from Anderson and Nelgen (2012b).

Anderson and Nelgen (2012a) do that using a geometric distributed lag formulation proposed by Nerlove (1972) and adopted by Tyers and Anderson (1992, pp. 65-75) – thereby making the estimates consistent with equation (9) in Section 1 above. They estimate elasticities for each key product for all focus countries for the period 1985 to 2010. As reported in Table 2, the estimates range from a low of 0.4 for sugar to around 0.5 for rice, milk and pig meat, not quite 0.6 for cotton and wheat, just over 0.6 for maize, and around 0.7 for beef, poultry and soybean. The unweighted average across all of those key products is 0.58, suggesting that, on average over the past quarter-century, little more than half the movement in

international prices of those farm products has been transmitted domestically within one year.

Table 3: Deviation of national NRA around its trend value,[a] key farm products,[b] developing and high-income countries, 1965–84 and 1985–2010

	Deviation of national NRAs around trend[a]				Weighted average of NRAs (%)			
	Developing countries		High-income countries		Developing countries		High-income countries	
	1965–84	1985–09	1965–84	1985–10	1965–84	1985–09	1965–84	1985–10
Rice	32	59	66	186	-20.1	0.9	136.8	351.8
Wheat	33	43	52	76	5.5	9.1	12.2	20.5
Maize	36	33	40	48	-3.4	2.3	6.9	11.9
Soybean	46	120	75	54	2.7	-2.1	0.1	5.2
Sugar	53	64	168	152	17.2	18.0	107.6	108.1
Cotton	38	32	42	30	-16.0	-2.7	21.3	10.4
Coconut	22	34	na	na	-11.5	1.2	na	na
Coffee	41	29	na	na	-37.3	-11.6	na	na
Beef	45	56	84	109	-12.4	2.6	22.7	37.9
Pork	81	58	73	69	23.6	-4.6	37.1	15.0
Poultry	109	69	91	175	26.3	11.8	24.5	25.4

[a]Deviation, measured in NRA percentage points, is computed as the absolute value of (residual – trend NRA) where national trend NRA in each of the two sub-periods is obtained by ordinary least squares linear regression of the national NRA on time. Estimates shown are an unweighted average of national NRA deviations each year, averaged over the number of years in each period.

Source: Authors' compilation based on NRAs from Anderson and Nelgen (2012b).

A third way to look at these price data is to examine the NRAs' annual average deviation from their long-run trend. Table 3 shows those deviations for the two decades before and after 1985. The average deviation from trend NRA is more than one-tenth higher in the latter two decades than in the earlier two decades in just as many cases as it is more than one-tenth lower. This suggests the tendency for each country to alter its individual product NRAs from year to year around their long-run

trend has not diminished, despite the trade-related policy reforms that began in many countries in the 1980s. Nor is there much difference in that pattern as between developing and high-income countries. Notice too that the deviations are non-trivial: except for rice in high-income countries, the average deviation is well above each product's mean NRA (reported in the right-hand half of Table 3).

All of the above evidence for those key products suggests a considerable degree of insulation of domestic markets from international markets fluctuations. How successfully has that policy action reduced instability in domestic relative to international markets? We choose three statistical indicators to address this question, following Schiff and Valdés (1992): the standard deviation around the sample mean of the domestic price relative to that for the border price, the coefficient of variation (the standard deviation divided by the sample mean) of the domestic price relative to that for the border price, and the Z-Statistic of the domestic price relative to that for the border price. The Z-Statistic is a measure of the average deviation of the price from its value in the preceding period (annual price change). It is defined as the square root of the average squared deviation of the price from its value lagged one year (or of the first difference of the price):

$$Z = \left(\frac{\sum_{t=2}^{n} (P_t - P_{t-1})^2}{n-1} \right)^{1/2} \qquad (10)$$

Table 4: Relative stability[a] of domestic producer and border prices of all covered agricultural products, 1955-84 and 1985-2010

		1955-1984	1985-2010
Africa	SDd/SDb	0.88	1.21
	CVd/CVb	1.06	1.18
	Zd/Zb	0.80	1.15
Developing Asia	SDd/SDb	0.67	0.98
	CVd/CVb	0.70	0.96
	Zd/Zb	0.75	0.85
Latin America	SDd/SDb	0.84	0.97
	CVd/CVb	0.96	1.01
	Zd/Zb	0.61	1.01
All developing countries	SDd/SDb	0.73	1.01
	CVd/CVb	0.80	0.97
	Zd/Zb	0.74	0.91
High-income countries	SDd/SDb	1.26	1.34
	CVd/CVb	0.94	0.95
	Zd/Zb	1.11	1.12
All focus countries	SDd/SDb	**1.02**	**1.14**
	CVd/CVb	**0.88**	**0.98**
	Zd/Zb	**0.97**	**1.01**

[a] SDd/SDb is the standard deviation of the domestic producer price relative to that for the border price, CVd/CVb is the coefficient of variation (the standard deviation divided by the sample mean) of the domestic producer price relative to that for the border price, and Zd/Zb is the Z-Statistic (defined in equation (10) of the text) of the domestic producer price relative to that for the border price.

Source: Authors' calculations based Anderson and Nelgen (2012b).

Table 4 provides the average of each of these three relative indicators for developing country regions, for high-income countries, and for the full sample of 82 countries, for the periods 1955-1984 and 1985-2010. These numbers reveal at least three things. First, there is remarkably little difference between indicators for the two periods (before and following the initiation of major trade policy reforms in the mid-1980s) for high-income countries and globally. Second, among the developing country regions the numbers are between two-thirds and four-fifths for Asia, quite close to one for Latin America, and close to or above one for Africa.

Table 5: Average annual NACs[a] and percentage changes in them, key crops, developing and high-income countries, 1965 to 2010 (1 + NRA/100)

(a) Average annual NACs (1 + NRA/100)

	Developing countries						High-income countries					
	1965-1972	***1972-1976***	1976-1984	***1984-1988***	1988-2006	***2006-2009***	1965-1972	***1972-1976***	1976-1984	***1984-1988***	1988-2006	***2006-2010***
Rice	0.97	***0.91***	1.02	***1.27***	1.29	***1.14***	1.23	***1.07***	1.37	***2.37***	2.19	***1.25***
Importers	1.06	***0.99***	1.09	***1.35***	1.34	***1.20***	1.85	***1.70***	2.28	***4.20***	4.84	***1.71***
Exporters	0.76	***0.65***	0.78	***1.02***	1.13	***0.87***	0.99	***0.81***	1.01	***1.92***	1.50	***1.03***
Wheat	1.10	***0.90***	1.10	***1.18***	1.19	***1.05***	1.37	***0.91***	1.38	***1.95***	1.43	***1.06***
Importers	1.12	***0.89***	1.09	***1.18***	1.23	***1.07***	1.41	***0.90***	1.46	***2.09***	1.71	***1.38***
Exporters	1.01	***0.94***	1.24	***1.36***	0.91	***0.97***	1.20	***0.97***	1.08	***1.46***	1.18	***0.99***
Maize	1.09	***0.99***	1.03	***1.13***	1.07	***1.08***	1.39	***1.22***	1.36	***1.60***	1.34	***1.07***
Soybean	1.20	***0.99***	1.19	***1.27***	1.45	***1.45***	0.97	***1.00***	1.45	***1.93***	1.22	***1.03***
Sugar	1.39	***0.78***	1.10	***1.49***	1.37	***1.42***	2.96	***1.17***	2.21	***3.25***	2.29	***1.55***
							1.23	***1.07***	1.37	***2.37***	2.19	***1.25***

(b) Percentage change in NAC from previous non-spike period

	1972-1976	**1984-1988**	**2006-2009**	**1972-1976**	**1984-1988**	**2006-2010**
Rice importers	-6	24	-10	-8	84	-65
Rice exporters	-14	31	-23	-18	90	-32
Wheat importers	-21	9	-13	-37	44	-19
Wheat exporters	-6	9	6	-20	36	-16
Maize	-9	10	1	-12	18	-20
Soybean	-18	7	0	4	33	-15
Sugar	-44	35	3	-60	47	-32

[a] Unweighted average of national NACs each year, averaged over the number of years in each period.

Source: Authors' calculations based Anderson and Nelgen (2012b).

Table 6: Annual NACs (1 + NRA/100) for rice, wheat and maize, by country group,[a] 1972 to 2010

(a) Rice

	1972	1973	1974	1975	1976	1984	1985	1986	1987	1988	2005	2006	2007	2008	2009	2010
World exporters	0.87	0.62	0.56	0.73	0.88	1.11	1.31	1.58	1.79	1.66	1.01	0.97	1.03	0.99	0.86	1.01
World importers	1.37	1.03	0.75	1.07	1.17	1.45	1.61	1.62	1.64	1.49	1.57	1.41	1.36	1.19	1.20	1.45
High-income countries	1.29	0.95	0.77	1.07	1.26	1.70	1.97	2.53	2.84	2.82	1.60	1.38	1.24	1.26	1.17	1.23
Developing countries	1.11	0.83	0.64	0.91	1.03	1.24	1.37	1.28	1.29	1.15	1.29	1.26	1.22	1.04	1.03	na
Asia	1.15	0.84	0.58	0.89	1.02	1.26	1.42	1.35	1.46	1.25	1.23	1.20	1.05	0.81	0.90	Na
Africa	1.10	0.84	0.66	0.99	1.06	1.21	1.17	1.16	1.29	1.12	1.12	1.16	1.25	1.05	0.91	na
Latin America	1.05	0.81	0.75	0.82	0.96	1.27	1.65	1.34	0.90	0.96	1.57	1.45	1.47	1.40	1.36	na

(b) Wheat

	1972	1973	1974	1975	1976	1984	1985	1986	1987	1988	2005	2006	2007	2008	2009	2010
World exporters	1.14	0.88	0.83	0.97	0.98	1.17	1.19	1.71	1.70	1.41	0.98	1.00	0.97	0.98	1.00	1.00
World importers	1.09	0.73	0.76	0.96	0.93	1.28	1.46	1.77	2.07	1.80	1.40	1.37	1.09	1.05	1.25	1.25
High-income countries	1.10	0.79	0.80	0.92	0.94	1.42	1.65	2.13	2.46	2.10	1.17	1.14	1.03	1.02	1.07	1.06
Developing countries	1.10	0.72	0.74	1.01	0.95	1.06	1.09	1.22	1.33	1.20	1.14	1.11	1.00	0.96	1.11	na
Asia	1.35	0.80	0.89	1.21	1.01	1.20	1.20	1.28	1.42	1.46	1.03	1.13	0.99	0.79	1.14	na
Africa	0.99	0.77	0.64	0.87	0.84	0.92	0.91	1.20	1.38	1.11	1.27	1.18	1.06	1.12	1.16	na
Latin America	1.02	0.63	0.72	0.96	1.07	1.14	1.27	1.20	1.16	1.09	1.04	1.03	0.93	0.91	1.03	na

(c) Maize

	1972	1973	1974	1975	1976	1984	1985	1986	1987	1988	2005	2006	2007	2008	2009	2010
World exporters	0.95	0.89	0.75	0.75	0.71	0.83	0.86	1.01	1.14	0.87	1.07	1.11	1.22	0.95	0.97	0.97
World importers	1.51	1.14	0.95	1.12	1.20	1.06	1.15	1.62	1.98	1.54	1.22	1.13	1.17	0.99	1.13	1.04
High-income countries	1.54	1.14	0.98	1.17	1.26	1.16	1.26	1.78	2.16	1.67	1.18	1.15	1.18	0.99	1.01	1.02
Developing countries	1.23	1.02	0.87	0.91	0.95	0.90	0.97	1.22	1.41	1.13	1.15	1.07	1.17	0.96	1.12	na
Asia	1.30	0.99	0.91	0.87	0.98	0.95	1.05	1.10	1.31	1.22	1.08	1.10	1.18	0.82	1.30	Na
Africa	1.24	1.01	0.86	0.95	0.95	0.86	0.93	1.34	1.56	1.15	1.24	1.09	1.35	1.04	0.99	na
Latin America	1.12	1.06	0.83	0.85	0.90	0.93	0.98	1.03	1.16	1.00	1.07	1.03	0.96	0.97	1.12	na

[a] Unweighted average of national NACs.

Source: Authors' calculations based Anderson and Nelgen (2012b).

That is, while interventions in developing Asia are severe enough to provide some insulation, in Africa they are such (perhaps for reasons of poor policy timing) as to possibly even de-stabilize domestic markets. And third, the indicators for the world as a whole suggest that market interventions by governments appear to have had very little impact in preventing domestic market prices from gyrating less than prices in international markets. As mentioned in Section 1, such an outcome is shown by Martin and Anderson (2011) to indeed be possible *if* food-exporting and food-importing countries both alter their trade restrictions in offsetting ways when prices move away from trend.

Evidence on whether food-exporting and food-importing countries both alter their trade restrictions in offsetting ways will be easiest to see in periods of extreme price spikes. NACs before and during the three price spike periods in our dataset are shown in Table 5. Part (b) of that table reveals that for both rice and wheat, exporting and importing countries do indeed alter their NACs in the same direction (reducing them when prices spike up, raising them when international prices slump) and thus tend to offset each other's efforts to avoid transmitting the international price shock to their home markets. These changes can be seen on an annual basis in the first pair of rows in Table 6 not only for rice and wheat but also for all covered agricultural products.

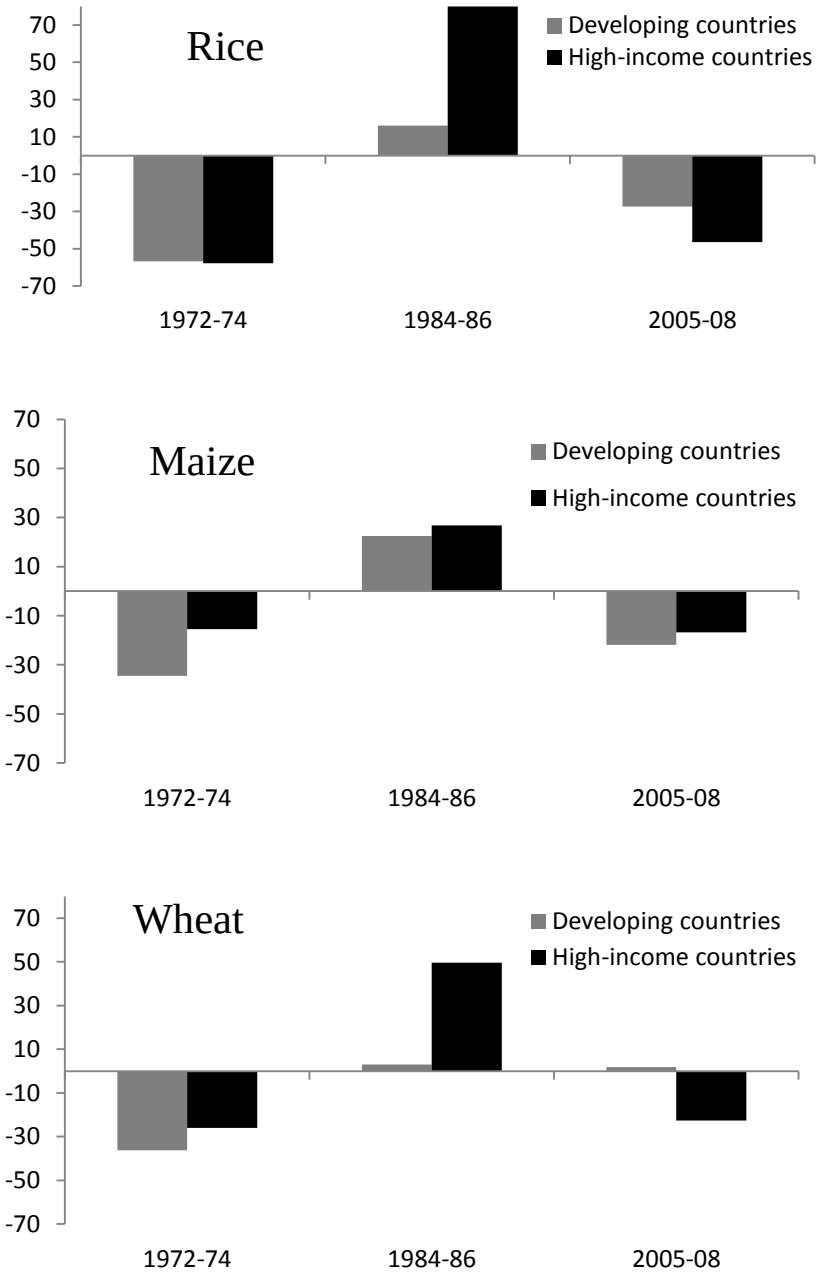
With that as background, we turn to evidence relating to the two hypotheses summarized at the end of Section B. The first is that developing (high-income) countries alter their food trade barriers more than high-income (developing) countries when international prices spike up (down). For rice, maize and wheat, that hypothesis is supported in six of the nine cases shown in Figure 1. It is also

supported for the aggregate of all covered farm products (though not for the upturn in the recent spike period): the NAC in 1972-74 fell by 16 percent for developing countries as compared with 14 percent for high-income countries, whereas in the downward price spike of 1984-86 the NAC rose just 11 percent for developing countries as compared with 24 percent for high-income countries (derived from Table 5, Chapter 2). This suggests that in developing countries consumers are more likely to be protected from an upward price spike than producers would be from a downward price spike, and conversely in high-income countries.

The second of the hypotheses from Section B is that food-surplus countries alter their food trade barriers more (less) than food-deficit countries when international prices spike up (down). In the cases of rice and wheat, this is true two-thirds of the times shown in Table 5 for developing countries, and half the times for high-income countries. In the case of all farm products, there is little difference between the world's exporters and importers in the 1970s' spike, while in the slump of the 1980s the NAC changes were larger for exporters than for importers, contrary to expectations. It needs to be kept in mind, however, that the fall in international food prices in the mid-1980s was partly induced by changes in export policies, most notably the export subsidy war between the European Union and North America (Anderson 2009). More-sophisticated testing of that hypothesis therefore will require econometrics, drawing on the empirical approaches of others including Imai, Katayama and Krishna (2009).

Figure 1: Changes in nominal assistance coefficients for rice, maize and wheat, high-income and developing countries, 1972-74, 1984-86, and 2005-08

(cumulative percentage changes in NAC over the 2 or 3 years shown)



Source: Authors' compilation from Anderson and Nelgen (2012b).

Utilizing the panel dataset by Anderson and Nelgen (2012b), regression analysis is used to formally test the hypotheses described in Section B, using equation (9), which is derived from the policy maker's welfare function (equation 1). The statements of hypotheses (1) and (2) are, firstly, that developing countries alter their trade restrictions more than high-income countries in upward spikes and the opposite is the case in downward spikes, and secondly, that countries alter their export restrictions more than their import restrictions in upward spikes and vice versa for downwards spikes.

The requirements to test equation (9) are border and domestic price information on commodity level for each country, which are provided by Anderson and Nelgen (2012b) for 82 developing and developed countries over a time period of more than five decades. The database also classifies products into exportables and import-competing, and countries into high-income countries and developing countries. In total, eight different regression scenarios have been used to test the hypotheses, subdividing the dataset into upward and downward spikes, by country group and by trade status.

The linear trend for the border and the domestic price is calculated for the whole time period and for the sub-period from 1985 to 2010, to take the reforms in the mid-1980s into account. Once these trends have been calculated, the independent variables can be computed, as the deviation from the border price from its trend and the difference between the domestic and border price trend. The dependent variable is the difference between the domestic and the border price, which is comparable to the NRA measure except that it is a difference, rather than a proportion measure.

The first regression coefficient in Table 7 can be interpreted as a reaction coefficient to a deviation of the international prices from its trend. For both time frames analysed, hypotheses (1) and (2) get confirmed in three of the four scenarios. In times of high international prices, the reaction coefficient for developing countries is -0.56 (0.54 for the period after 1985), which is higher than for high-income countries with 0.31 (0.13 for period after 1985), and it is also higher for exportable than for import-competing sub-sectors during times when the international price exceeds its trend. Import-competing sub-sectors also react more than exporters during times of downward spikes. However, the results do not confirm that high-income countries react more than developing countries in downward spikes.

In the case of high international prices, the coefficients for the time period starting in 1985 are overall lower than for the whole period, suggesting that the intervention has decreased in that period compared to the earlier period. However, the differences are minor in some of the cases and diminish even further when looking at the coefficients resulting from the regressions of the low international price periods.

The coefficient of the second independent variable from equation (9), the difference between the domestic and international price trend, is restricted to be one. Table 1 shows the averages of this coefficient, which ranges from 0.86 to 1.10, with values close to one in most cases. The standard deviation ranges from as low as 0.12 to a maximum of 0.28 over the number of countries and observations listed in Table 1. The t-test shows that this restricted coefficient is significant, that is, that the coefficient is significantly close to one and applying the t-test further confirms this result.

Table 7: Regression results of equation (9), developing and high-income countries and for food exporting and import-competing countries, 1985-2010 and 1955-2010

(a) Border price of individual product exceeds domestic price

	1955-2010 Coeff1	1985-2010 Coeff1	1955-2010 Mean coeff 2	1955-2010 St dev Coeff 2	Nb of countries	Av nb. of obs per country	Av adj R-sq
Developing countries	-0.56	-0.54	1.10	0.24	42	154	0.74
High-income countries	-0.31	-0.13	1.04	0.12	36	213	0.78
Exportables	-0.52	-0.50	0.98	0.28	76	67	0.76
Import-competing	-0.40	-0.23	1.10	0.22	70	111	0.74

(b) Domestic price of individual product exceeds border price

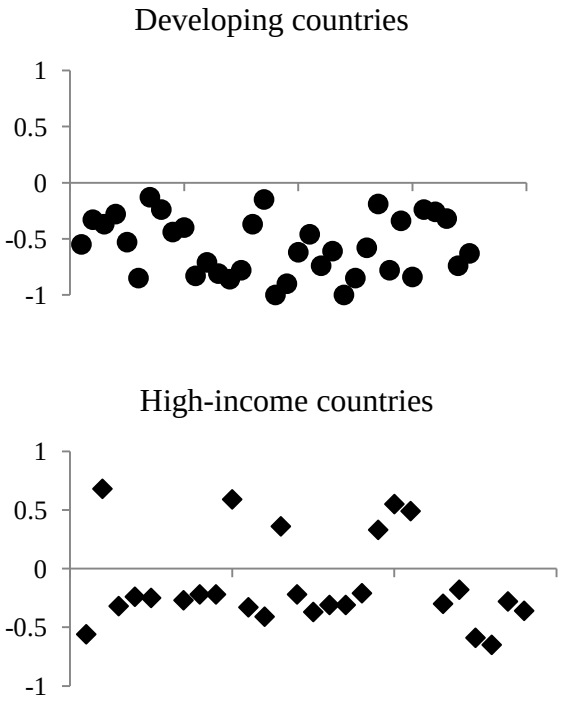
	1955-2010 Coeff1	1985-2010 Coeff2	Mean coeff x2	St dev Coeff x2	Nb of countries	Average nb. of obs per country	Ave adj R-sq
Developing countries	-0.27	-0.29	0.86	0.21	42	200	0.64
High-income countries	-0.11	-0.09	0.97	0.15	36	278	0.77
Exportables	-0.30	-0.31	0.89	0.24	76	88	0.60
Import-competing	-0.39	-0.37	1.08	0.17	70	111	0.72

Source: Authors' compilation from Anderson and Nelgen (2012b).

Figure 2 shows a scatter plot for the reaction coefficients of the regressions where the international price is above its trend. The plot indicates that overall, the coefficient values are lower for developing countries compared to high-income countries. The analysis is less clear for the difference in reactions between exporting and import-competing countries.[30]

Figure 2: Reaction coefficient of developing countries vs. high-income countries and exporters and importers during times when the international price exceeds its trend.

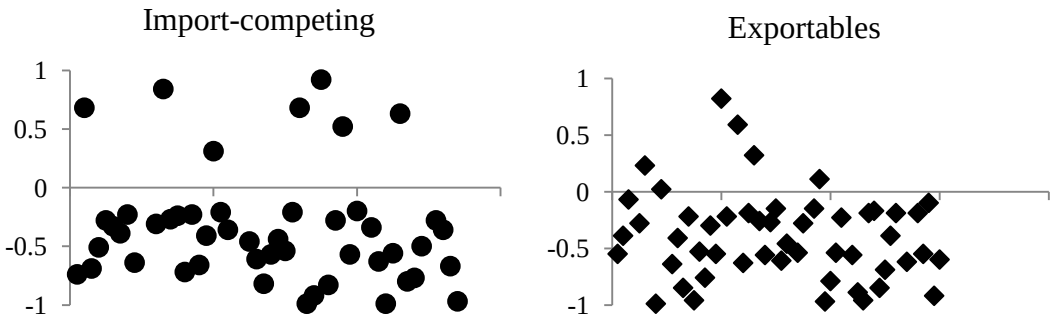
(a) Developing countries vs. high-income countries



[30] Results from the t-test reveal that the reaction coefficients between high-income countries and developing countries are significally different during high international price periods. The differences between the coefficients for the other scenarios were not statistically significant at the 10 percent level.

Figure 2 (continued): Reaction coefficient of developing countries vs. high-income countries and exporters and importers during times when the international price exceeds its trend.

(b) Exportables vs. import-competing products



Source: Authors' compilation from Anderson and Nelgen (2012b).

Overall, the reaction coefficients show the expected sign, indicating that countries react to deviations in the international price from its trend in either direction. Furthermore, results suggest that consumers seem to have stronger political influence in developing countries during times of higher international prices than in high-income countries because of the higher reaction coefficient. This gives evidence for the first part of hypothesis (1). However, the results do not confirm the second part of hypothesis (1), which is that strong farm lobbying causes higher reactions in high-income countries compared to developing countries during times of low international prices.

Results indicate that exporters of agricultural commodities react more than import-competing countries during times of high prices and vice versa. However, the

extent of the difference between the reaction coefficients is questionable, as Figure 7 suggests that the overall distribution of the data lies within a close area. Altogether, the results provide empirical support for the loss aversion theory.

E. Lessons and policy implications

The evidence summarized above is supportive of at least the first hypothesis, namely, that developing (high-income) countries alter their food trade barriers more than high-income (developing) countries when international prices spike up (down). As well, the evidence shows in several ways the considerable extent to which trade measures are used to try to insulate domestic food markets from international price fluctuations. On average over the past quarter-century, little more than half the movement in international prices of farm products has been transmitted domestically within one year. Yet because both food-exporting and food-importing countries tend to intervene simultaneously, their efforts have been largely offsetting and so domestic price instability is hardly any less than international price instability except in developing Asia.

Such national government trade policy reactions to food price spikes are undesirable also because they add to international price instability: they reduce the role that trade between nations can play in bringing stability to the world's food markets. That adverse aspect will become ever more important as climate change increases the frequency of extreme weather events. The larger the number of countries insulating their domestic markets, the more other countries perceive a need to do likewise, exacerbating the effect on world prices such that even greater changes

in trade barriers are desired by each nation – both exporters and importers. Those interventions also transfer welfare between food-surplus and food-deficit countries, and may even add to rather than reduce poverty.

Clearly there is scope for governments to multilaterally agree to stop intermittently intervening in these ways. The World Trade Organization (WTO) is the most obvious place to seek restraints on variable trade restrictions. Indeed one of the original motivations for the Contracting Parties to sign the GATT (WTO's predecessor) was to bring stability and predictability to world trade. To date the membership has adopted rules to encourage the use of trade taxes in place of quantitative restrictions on trade (Article IX of the GATT), and has managed to obtain binding commitments on import tariffs and on production and export subsidies as part of the Uruguay Round Agreement on Agriculture. However, those bindings have been set well above applied rates by most countries, leaving great scope for varying them without dishonoring those legal commitments. In the current Doha round of WTO negotiations there are proposals to phase out agricultural export subsidies as well as to bring down import tariff bindings, both of which would contribute to global economic welfare and more-stable international prices for farm products. At the same time, however, developing countries have added to the WTO's Doha agenda a proposal for a Special Safeguards Mechanism (SSM) that would allow those countries to raise their import barriers above their bindings for a significant proportion of agricultural products in the event of a sudden international price rise or an import surge. This is exactly the opposite of what is needed by way of a global public good to reduce the frequency and amplitude of food price spikes (Hertel, Martin and Leister 2010).

Moreover, proposals to broaden the Doha agenda to also introduce disciplines on export restraints have struggled to date to gain traction. This reflects the facts that traditionally the demandeurs in WTO negotiations have been dominated by interests seeking market access, and that upward price spikes are infrequent. Yet the above analysis reveals the need for symmetry of treatment of export and import disciplines.

As for further research, there is scope for country case studies. The Global Trade Alert initiative is well placed to identify appropriate countries on which to focus such studies, especially as the products whose prices are spiking in 2010-11 are different from those that spiked in 2008.

More work is needed also to explain why governments attempt to provide loss-averting assistance by varying their trade restrictions rather than via more-direct and thus more efficient domestic policy instruments such as income supplements targeted to only the most vulnerable households and only while the price spike lasts. In the past the administrative cost of making such payments to poor households (whether net buyers or sellers of food) were prohibitively expensive, but thanks to the information technology revolution it is now possible for developing country governments to provide conditional cash transfers (CCTs) electronically at relatively little cost (see, for example, Adato and Hoddinott 2010). That still leaves the problem of raising government revenue in the first place, and trade taxes are one important source for some low-income countries. However, what the above analysis reveals is that half the time such countries are intervening in the hope of reducing domestic market instability, they are cutting rather then raising their trade taxes. Might the new affordability of CCTs alter not only the economics but also the

political economy of actions aimed at averting losses for significant groups from market disruptions?

References

Abbott, P. (2012), 'Export Restrictions as Stabilization Reponses to Food Crisis', *American Journal of Agricultural Economics* 94(1), January.

Adato, M. and J. Hoddinott (eds.) (2010), *Conditional Cash Transfers in Latin America,* Baltimore MD: Johns Hopkins University Press for IFPRI.

Anderson, J.E. and J.P. Neary (2005), *Measuring the Restrictiveness of International Trade Policy*, Cambridge MA: MIT Press.

Anderson, K. (1995), 'Lobbying Incentives and the Pattern of Protection in Rich and Poor Countries', *Economic Development and Cultural Change* 43(2): 401-23, January.

Anderson, K. (ed.) (2009), *Distortions to Agricultural Incentives: A Global Perspective, 1955–2007,* London: Palgrave Macmillan and Washington DC: World Bank.

Anderson, K., J.L. Croser, D. Sandri and E. Valenzuela (2010), 'Agricultural Distortion Patterns Since the 1950s: What Needs Explaining', Ch. 2 in K. Anderson (ed.), *The Political Economy of Agricultural Price Distortions*, Cambridge and New York: Cambridge University Press.

Anderson, K. and S. Nelgen (2012), 'Trade Barrier Volatility and Agricultural Price Stabilization', *World Development* 40(1): 36-48, January.

Anderson, K. and E. Valenzuela (2008), *Global Estimates of Distortions to Agricultural Incentives, 1955 to 2007*, data spreadsheets at www.worldbank.org/agdistortions

Bellemare, C., S. Kroger and A. van Soest (2008), 'Measuring Inequality Aversion in a Heterogeneous Population Using Experimental Decisions and Subjective Probabilities', *Econometrica* 76(4): 815-39, July.

Bouët, A. and D. Laborde (2010), 'The Economics of Export Taxation in a Context of Food Crisis: A Theoretical and CGE-Approach Contribution', Discussion Paper 00994, IFPRI, Washington DC, June.

Corden, W.M. (1997), *Trade Policy and Economic Welfare*, revised edition, Oxford: Clarendon Press.

Engelmann, D. and M. Strobel (2004), 'Inequality Aversion, Efficiency, and Maximin Preferences in Simple Distribution Experiments', *American Economic Review* 94(4): 857-69, September.

Feenstra, R. (1995), 'Estimating the Effects of Trade Policy', in G. Grossman and K. Rogoff (eds.), *Handbook of International Economics*, vol. 3, Amsterdam: Elsevier

Francois, J.F. and W. Martin (2004), 'Commercial Policy, Bindings and Market Access', *European Economic Review* 48: 665-79, June.

Freund, C. and C. Özden (2008), 'Trade Policy and Loss Aversion', *American Economic Review* 98(4): 1675-91, September.

Grossman, G.M. and E. Helpman (1994), 'Protection for Sale', *American Economic Review* 84(4): 833–50, September.

Hertel, T., W. Martin and A. Leister (2010), 'Potential Implications of a Special Safeguard Mechanism in the World Trade Organization: The Case of Wheat', *World Bank Economic Review* 24(2): 330–59.

Imai, S., H. Katayama and K. Krishna (2009), 'Protection for Sale or Surge protection?', *European Economic Review* 53: 675-88.

Jean, S., D. Laborde and W. Martin (2010), 'Formulas and Flexibility in Trade Negotiations: Sensitive Agricultural Products in the WTO's Doha Agenda', *World Bank Economic Review* 24 (3): 500-519.

Lusk, J.L. and B.C. Briggeman (2011), 'Selfishness, Altruism, and Inequality Aversion Toward Consumers and Farmers', *Agricultural Economics* 42(2): 121-39, March.

Martin, W. and K. Anderson (2012a), 'Trade Distortions and Food Price Surges', in *Commodity Price Volatility and Inclusive Growth in Low-income Countries*, edited by R. Arezki and M. Zhu, Washington DC: International Monetary Fund (forthcoming).

Martin, W. and K. Anderson (2012b), 'Export Restrictions and Price Insulation During Commodity Price Booms', *American Journal of Agricultural Economics* 94(2): 422-27, January.

OECD (2010), *Producer and Consumer Support Estimates, OECD Database 1986-2009*. http://www.oecd.org.

Schiff, M. and A. Valdés (1992), 'The Effects of Intervention on Price Variability', Ch. 3 in M. Schiff and A. Valdés, *The Political Economy of Agricultural Pricing Policy, Volume 4: A Synthesis of the Economics in Developing Countries*, Baltimore: Johns Hopkins University Press for the World Bank.

Tyers, R. and K. Anderson (1992), *Disarray in World Food Markets: A Quantitative Assessment*, Cambridge and New York: Cambridge University Press.

World Bank (2010), *Global Commodity Markets: Review and Price Forecasts,* Washington DC: World Bank.

World Bank (2011), *Food Price Watch,* Washington DC: World Bank. Accessed 26 February at http://www.worldbank.org/foodcrisis/food_price_watch_report_feb2011.html

Wright, B.D. (2011), 'The Economics of Grain Price Volatility', *Applied Economic Perspectives and Policy* 33(1): 32-58, Spring.

Chapter 5:

What's the Appropriate Agricultural Protection Counterfactual for Trade Analysis?

Signe Nelgen

(with Kym Anderson)

Revision of a paper published as chapter 13 (pp.325-54) in

Unfinished Business? The WTO's Doha Agenda,

edited by Will Martin and Aaditya Mattoo (2011), London:

CEPR and the World Bank.

NOTE:
This publication is included on pages 178-219 in the print copy of the thesis held in the University of Adelaide Library.

Future directions

The thesis aims to contribute to the understanding of the reactions and the underlying political economy causes of a policy maker's decision to distort agricultural markets. The thesis topic of agricultural market distortions and the underlying updated data from Anderson and Nelgen (2012b) can be further explored in many additional ways.

There is considerable scope for future research now that the current study has provided an updated, expanded and revised version of the agricultural distortion database initially compiled by Anderson and Valenzuela (2008). This latest dataset gives researchers the tools to explore the reactions of individual countries each year in more detail, which could contribute to the understanding of agricultural distortions on a more disaggregated level than this thesis has had room for. Political economy causes of agricultural distortions can differ to a great extent between countries, and the aggregated level of distortion measures does not expose the specific political economy of an individual country. More research at the country level can help to refine generalized facts established in this thesis, by focusing on differences in countries' backgrounds more deeply.

There is also the opportunity for future econometric research to focus more deeply on different distortions, price variability and transmission, as well as trade and welfare indexes, both at the cross-sectional level and through time series analysis. Most of the indicators are available at the product and country levels (see Appendix A), allowing detailed analysis at both levels.

An additional area for more research is the empirical analysis of the political economy reason for agricultural trade policy decisions of countries. Chapter 4

attempts to give empirical evidence for the loss aversion theory. More work can be done to refine the theory, and to test it econometrically.

Last but not least, there will be the opportunity to update the database in the near future once data for the second part of the most recent price spike (2010-11) are available. This will give further insight to national government reactions to price spikes in agricultural goods and additional scope to test the robustness of the findings of this thesis.

Appendices

Appendix A: Distortions Revision, Expansion and Update to 2010

This thesis updates the Distortions to Agricultural Incentives (DAI) database compiled by Anderson and Valenzuela (2008) to analyse the political economy reasons underlying price stabilization in agricultural markets, including the most recent international price spike period. The original dataset covers half of the last century up to the year 2004 for developing countries and up to 2007 for high-income countries, and provides distortion indicators in agricultural markets for 75 high-income and developing countries and for a total of 75 agricultural products. That coverage amounts to two-thirds of the value of global agricultural production and consumption.

The update provides these indicators for the more-recent period up to 2009 for developing countries and to 2010 for high-income countries. It also adds six additional countries, which expands the dataset to 82 countries. With the most recent price spike included, the updated and expanded database now covers the 1973/74 upward spike, the downward spike in 1986 and the most recent upward spike in international food prices in 2008.

This Appendix provides the information on how the distortion indicators have been updated for different country groups. Section (a) explains the methodology applied for countries where OECD PSE spreadsheets are available. In Section (b), the update for the remaining developing countries is explained. For this part, data from FAO and the World Bank's pink sheets are used. Section (c), (d) and (e) contain tables summarizing the list of countries covered, the coverage of products in

each country, the countries by product, and a concordance table for the products used to update the DAI database from FAO for trade, prices and production.

(a) Update for OECD countries

This part of Appendix A explains in detail the methodology applied to update the countries for which the OECD provides producer and consumer support estimates (PSEs and CSEs) up to 2010. The data cover all OECD countries (with EU 27 treated as a single entity), and a few large developing countries, namely Brazil, Chile, China, Russia, South Africa, and the Ukraine. Additionally, this update also extends the coverage of countries, namely to Belgium, Cyprus, Greece, Israel, Luxembourg and Malta as additions to the original set of 75 countries. Similar to the NRAs, the PSE estimates aim to capture the transfer that is made by government policies to the agricultural sector.

The aggregation of the EU 27 countries in the OECD files requires additional information to be downloaded from FAO to split the estimates for those countries into individual country and product estimates for the agricultural distortions database. FAO provides the production volumes for all of those countries at the product level, which is used together with information from OECD to provide estimates of national average NRAs and CTEs using the value of production and consumption at the country and product levels.

OECD provides a distortion measure entitled the producer nominal protection coefficient (PNPC), which is derived from the PSEs. The PNPC is the ratio between the domestic producer price received by farmers (including output transfers) and the border price, measured at the farm gate. It is therefore comparable to the NRA,

which is calculated by comparing the domestic producer price plus the per unit transfer received for payments based on output and the border price:

$$PNPC_i=((PP_i+(PO_i/QP_i))/RP_i \quad (1)$$

where PP_i is the producer price of product i, PO_i is the output based transfer to product i (sub-category of A in the table 1), QP_i is the production volume of the product and RP_i is the reference price of product i. The output-based support is added in the numerator to account for direct supplements to the producer price on top of the market price support measures. To derive the NRAs from this measure, one simply needs to subtract unity from the ratio between the market price differential (producer price minus border price) and the border price, which is defined as the NRA. The NRA is based around zero, with negative values for negative support and positive values otherwise.

The NRAs aggregated by country can be refined using the aggregates section of the OECD data set. It is necessary to be particularly careful here, as the changes in methodology have been applied by the OECD to this section of its database and the numbering of the different parts of the NRA equivalents has changed over time.

To update to 2010 the equivalent of the decoupled payments in the agricultural distortions data base by Anderson and Valenzuela (2008), three sets of payments are added up: payments based on current and non-current A/An/R/I1 where production is required, payments based on non-current A/An/R/I where production is not required, and payments based on non-commodity criteria (sections C, D, E, F in the last column of table 1). These are multiplied by the PSE and converted to US

dollars. With this dollar value of decoupled payments, the NRA can be calculated by dividing the result by the value of production at undistorted prices. Since the decoupled part of support in agriculture is steadily increasing in high-income countries, it is of particular importance to integrate this part of support, even though it is less market- and resource-distorting than other distortion measures. The different sub-categories of the PSEs have changed over time since they have first been published, as table 1 demonstrates.

Non-product-specific distortions are accounted for by payments based on input use and miscellaneous payments (section B and G in table 1), where the first part (accounted for by section B) is the non-product specific input share of the NRA. The same methodology as for the decoupled payments is used here to obtain the additional distortion that can be added to the aggregated NRA measure at the country level. These different subdivisions of the OECD data allow deriving the different aggregated country level NRA measures that are provided in the DAI database by Anderson and Valenzuela (2008), dependent on the instruments used. There is the version that excludes non-product specific assistance and decoupled payments, the variable that include both, and one where non-product-specific assistance is included but decoupled payments are not. Since decoupled payments do not contribute to inefficiencies in the economy to the same extent as some other distortive measures and are mainly applied in high-income countries, for comparison purposes it is useful to be able to choose the measure that fits the purpose of the analysis (see table 2).

The aggregated OECD PSEs expressed in percent are similar to the NRAs at the aggregate country level. Both measures include support to input products that are linked to agricultural input prices (e.g. import tariffs on inputs). The market price

support component in the numerator of the percentage PSE is based on the market price differential between domestic and border prices. However, the base used to calculate the percentage level of support for PSEs and NRAs is different, as the NRA measure uses producer receipts valued at undistorted (border) prices whereas the PSE uses producer receipts valued at distorted domestic prices as its basis.

Table 1: Development of decoupled and non-product specific PSE categories over time, 1979 to 2010.

	1979-85	1986-2004	2005-10
Decoupled Payments	• C. Direct Payments • E. General Services • F. Sub-national Payments • G. Other Payments	• C. Payments based on area planted/animals numbers • D. Payments based on historical entitlements • F. Payments based on input constraints • G. Payments based on overall farming income	• C. Payments based on current A/An/R/I, production required • D. Payments based on non-current A/An/R/I production required • E. Payments based on non-current A/An/R/I, production not required • F. Payments based on no-commodity criteria
NPS	• D. Reduction of Input Costs	• E. Payments based on input use • H. Miscellaneous payments	• B. Payments based on input use • G. Miscellaneous payments
NPS input	na	• E. Payments based on input use	• B. Payments based on input use

Source: Author's compilation based on OECD (2011).

Table 2: Aggregate NRA variables derived from OECD files.

nra_totp	NRA aggregate, excl. NPS
nra_tott	NRA aggregate, incl. NPS
nra_totd	NRA aggregate, incl. NPS and decoupled payments
decpay	Decoupled payments as a share of VOP
rra	RRA
nra_agtrad	NRA, agricultural tradables, incl. NPS
rra_decpay	RRA using a version of nra_agtrad that includes decoupled payments
nps	NPS, $US
nps_input	NPS to inputs, $US

Source: Author's compilation.

The self-sufficiency ratios (SSRs) need to be calculated to define the trade status of each product. They can be calculated from OECD production and consumption volumes. A product will be defined as an exportable if the SSR as the ratio of production to consumption is greater than one, and as an importable if it is smaller than one. If the SSR equals one, the product is defined as non-traded and the NRA will be set to zero in the absence of domestic producer and consumer taxes and subsidies.

(b) Update for remaining developing countries

This part of appendix A explains the details of the methodology used to update the NRA as an indicator of distortions to agricultural markets for the developing countries where no OECD estimates were available, based on data from the FAO (2010) and the World Bank (2011).[41]

[41] If both data sources are not able to provide (parts of) the data that are necessary for the update of a certain country and/or commodity and where national agency provide those data, the gaps are filled with the latter values. Taiwan is such an example.

For the update of national commodity level NRAs, the domestic producer price for each country's individual list of products, and the product-specific border price are collected (see table 3 for concordance of FAO and DAI products). The FAO recently made price, production and trade data available up to the year 2009 (2010 for production). Since border prices are not provided as such in the data set, they are calculated from trade values and volumes. This requires as a first step to define a product as an exportable product or an import-competing product. To do so, the self-sufficiency ratios (SSRs) of each country's list of products are assessed, using FAO's food balance sheets.[42]

However, in specific cases, the border prices computed with the trade data did not provide sensible results, often because small volumes of trade caused unrepresentative unit values. After identifying those cases, the border prices of the affected country and product combinations were replaced with a reference price from the World Bank's Pink Sheets. The World Bank's Pink Sheet data also allowed filling some gaps by providing international price data where country specific trade data are missing but production volume and prices were available.

FAO producer prices used for the purpose of the update are not as accurate as the more refined price data from national statistical agencies that were previously used in the data set of Anderson and Valenzuela (2008). An index methodology was applied for the update to smoothe the breaks that could occur in the time series if the absolute values from FAO were to be used. The FAO domestic producer price in current US dollars for each country and product is converted into an index, and set at

[42] Since the food balance sheets only provide consumption and production data up to 2007, the SSRs are updated to 2009 in the following way: apparent consumption is calculated using production and trade data from FAO (2010) and SSRs are computed using the values of this calculation. To avoid breaks in the series, an index of those SSRs is used to update the SSRs of the remaining two years up to 2009 and to define the trade status from those.

100 for the last year for which there were domestic producer prices covered in the Anderson and Valenzuela (2008) database. The changes in this index are applied to the most recently available producer price to update each country's domestic price up to 2009 at the commodity level.

After the border prices are assigned to each country's products according to their trade status for each product, the same index methodology as used for the domestic price is applied to the border price.

Since the NRA can be simply defined as:

$$NRA = (Pd\_us/Bp)-1 \qquad (1)$$

with pd_us being the domestic producer price in current US dollars, and Bp being the border price in current US dollars, the data needed for the computation of commodity level NRAs by country are available.

As a next step, production volume data at the country and commodity levels need to be incorporated into the database to update the value of production at undistorted prices through multiplication of the border price and production volume. The value of consumption at undistorted prices can be added by using the formula:

$$voc\_prod = vop\_prod*(1+NRA)/(SSR*(1+CTE)) \qquad (2)$$

where vop_prod is the volume of production at undistorted prices.

Since the coefficient of correlation between the CTEs and the NRAs has been 0.9 over the whole of the Anderson and Valenzuela (2008) database, and with this value being identical to the correlation coefficient of the OECD's equivalent of CTEs

and NRAs for the countries and years where the update is taken from the OECD spreadsheets,[43] it is not unreasonable to assume the CTEs to be identically to the NRAs for the developing countries' update, where more-detailed information is missing. This assumption seems reasonable when the OECD for the updated years are split into developing countries and high-income countries: the correlation coefficient for the first set of countries is 0.98 and for the high-income countries it is 0.86.

Furthermore, the FAO's value of production data are used to calculate each country's coverage in terms of agricultural production for the updated years. This is needed to get an estimate for the non-covered part of each country's agricultural sctor. For the computation of the total value of production by country at undistorted prices, the covered value of production and the non-covered part are added up. In the case of developing countries that are updated using FAO and World Bank Pink Sheet data, the total value of production at undistorted prices can be replaced by using the formula:

$$vop\_tot = vop\_covt/(percentcov/100) \qquad (3)$$

where vop_covt is the covered part of the value of production and percentcov is the coverage ratio in percent, calculated from the value of production in current US dollars as an approximate measure for the coverage achieved in the updated years.

To get an estimate of the non-covered NRAs for this update, the assumption is made for NRAs of those products to be the same share of the covered NRAs as the

[43] The years after 2004 are used for developing countries of the OECD countries subset and after 2007 for the remaining countries to ensure getting a significant reflection of the correlation for both country sets. Japan has been excluded from those calculations as an extreme outlier.

2000-04 average and the same methodology applies where the non-covered part of the production value at undistorted prices is missing.

The non-product-specific part of the NRAs is assumed to be zero in the updated years for the developing country group included in this update (since it is small in the earlier period covered by Anderson and Valenzuela (2008)).

Another important indicator to measure distortions in agriculture is provided by comparing the support to agricultural tradables and non-agricultural tradables. The indicator is called relative rate of assistance (RRA) and is defined as:

$$RRA = (1+nra\_agtrad)/(1+nra\_nonagtrad)-1 \qquad (4)$$

where nra_agtrad is the NRA for agricultural tradables and nra_nonagtrad the NRA for non-agricultural tradables. To calculate this measure, non-agricultural tradables support is assumed to be unchanged since the last available year in the database.[44]

The high correlation between NRAs and CTEs indicates that most of the distortions in agricultural markets happen at a country's border. If there are no domestic distortions, the NRA is equal to the CTE. Because of the lack of more-detailed information by FAO, the NRAs for domestic support are assumed to be zero and the border measures for tradables are assumed to be equal to the product-specific NRAs in the updated years for developing countries. in those cases where the trade status is defined as non-tradable, the NRA is set to zero. The distinction between

[44] An attempt was made to incorporate WTO manufacturing tariff rates in hte update, but these were not sufficiently representative of the previous data series. There is thus scope for future work to find a more appropriate and comparable measure for the support to non-agricultural tradables for the updated years.

support to exportables or import-competing products is made according to the product's trade status.

To generate the country level aggregates, the value of production at undistorted prices for each product is used as a weight for all NRA measures and the value of consumption at undistorted prices is used for all CTE measures.

Appendix Table A.1: List of 82 countries in the updated agricultural distortions database

Sub-Saharan African developing
Benin
Burkina Faso
Cameroon
Chad
Côte d'Ivoire
Ethiopia
Ghana
Kenya
Madagascar
Mali
Mozambique
Nigeria
Senegal
South Africa
Sudan
Tanzania
Togo
Uganda
Zambia
Zimbabwe

Asian developing
Bangladesh
China
India
Indonesia
Korea, Rep. of
Malaysia
Pakistan
Philippines
Sri Lanka
Taiwan, China
Thailand
Vietnam

Latin American developing
Argentina
Brazil
Chile
Colombia
Dominican Republic
Ecuador
Mexico
Nicaragua

European transition & Mediterranean
Bulgaria
Czech Republic
Egypt, Arab Rep. of
Estonia
Hungary
Israel
Kazakhstan
Latvia
Lithuania
Morocco
Poland
Romania
Russian Federation
Slovak Republic
Slovenia
Turkey
Ukraine

Other high-income countries
Australia
Austria
Belgium
Canada
Cyprus
Denmark
Finland
France
Germany
Greece
Iceland
Ireland
Italy
Japan
Luxembourg
Malta
Netherlands
New Zealand
Norway
Portugal
Spain
Sweden
Switzerland
United Kingdom
United States

Appendix Table A.2: Focus countries and covered products

Argentina	**Bangladesh**	**Burkina Faso**	**Colombia**	**Denmark**	**Ethiopia**
beef	jute	cassava	beef	barley	chat
maize	potato	cotton	coffee	beef	coffee
milk	rice	millet	cotton	egg	hides&skins
soybean	sugar	sorghum	maize	milk	maize
sunflower	tea	yam	milk	oat	oilseed
wheat	wheat	**Cameroon**	palmoil	pigmeat	pulse
Australia	**Belgium**	banana	rice	potato	teff
apple	barley	cassava	sorghum	poultry	wheat
banana	beef	cocoa	soybean	rapeseed	**Finland**
barley	egg	coffee	sugar	sheepmeat	barley
beef	maize	cotton	wheat	sugar	beef
cotton	milk	maize	**Cote d'Ivoire**	tomato	egg
egg	oat	millet	cassava	wheat	milk
grape	pigmeat	otherroots&tubers	cocoa	**Dom Rep**	oat
maize	potato	plantain	coffee	banana	pigmeat
milk	poultry	sorghum	cotton	bean	potato
oat	rapeseed	**Canada**	plantain	cassava	poultry
oilseeds	sheepmeat	barley	rice	coffee	sheepmeat
olive	sugar	beef	yam	garlic	sugar
orange	tomato	egg	**Cyprus**	onion	wheat
pigmeat	wheat	maize	barley	poultry	**France**
potato	wine	milk	beef	rice	barley
poultry	**Benin**	peas	egg	sugar	beef
rapeseed	cassava	pigmeat	milk	tomato	egg
rice	cotton	potato	oat	**Ecuador**	maize
sheepmeat	millet	poultry	pigmeat	banana	milk
sorghum	sorghum	rapeseed	potato	beef	oat
soybean	yam	soybean	poultry	cocoa	pigmeat
sugar	**Brazil**	sugar	sheepmeat	coffee	potato
sunflower	beef	wheat	tomato	maize	poultry
tobacco	coffee	**Chad**	wheat	milk	rapeseed
wheat	cotton	cassava	wine	pigmeat	rice
wool	maize	cotton	**Czech Rep**	poultry	sheepmeat
Austria	pigmeat	millet		rice	soybean
barley	poultry	sorghum	barley	soybean	sugar
beef	rice	yam	beef	sugar	sunflower
egg	soybean	**Chile**	egg	**Egypt**	tomato
maize	sugar	apple	maize	beef	wheat
milk	wheat	beef	milk	cotton	wine
oat	**Bulgaria**	grape	oat	maize	**Germany**
pigmeat	barley	maize	pigmeat	milk	barley
potato	beef	milk	potato	rice	beef
poultry	egg	sugar	poultry	sugar	egg
rapeseed	maize	wheat	rapeseed	wheat	maize
sheepmeat	milk	**China**	sheepmeat	**Estonia**	milk
sugar	oat	cotton	soybean	barley	oat
sunflower	pigmeat	fruits	sugar	beef	pigmeat
wheat	potato	maize	sunflower	egg	potato
wine	poultry	milk	tomato	milk	poultry
	rapeseed	pigmeat	wheat	oat	rapeseed
	rice	poultry		oilseed	sheepmeat
	sheepmeat	rice		pigmeat	soybean
	soybean	soybean		potato	sugar
	sugar	sugar		poultry	Sunflower
	sunflower	vegetables		rye	tomato
	tomato	wheat		sheepmeat	wheat
	wheat			tomato	wine
	wine			wheat	

Appendix Table A.2 (continued): Focus countries and covered products

Ghana	**India**	**Italy**	**Korea**	**Mali**	**Morocco**	**NZ**
cassava	chickpea	barley	barley	cassava	apple	barley
cocoa	cotton	beef	beef	cotton	banana	beef
groundnut	fruit&veg	egg	cabbage	millet	barley	coarsegrains
maize	groundnut	maize	egg	sorghum	beef	egg
plantain	maize	milk	garlic	yam	clementine	fruit&veg
rice	milk	oat	milk	**Malta**	egg	grape
yam	rapeseed	pigmeat	pepper	barley	maize	maize
Greece	rice	potato	pigmeat	beef	melon	milk
barley	sorghum	poultry	poultry	egg	milk	oat
beef	soybean	rapeseed	rice	milk	olive	othercrops
egg	sugar	rice	soybean	pigmeat	orange	pigmeat
maize	sunflower	sheepmeat	wheat	potato	potato	poultry
milk	wheat	soybean	**Latvia**	poultry	poultry	sheepmeat
oat	**Indonesia**	sugar	barley	sheepmeat	rice	wheat
pigmeat	coconut	sunflower	beef	tomato	sheepmeat	wool
potato	coffee	tomato	egg	wheat	soybean	**Nicaragua**
poultry	maize	wheat	milk	wine	strawberry	bean
rapeseed	palmoil	wine	oat	**Madagascar**	sugar	beef
rice	poultry	**Japan**	oilseed	cassava	tomato	coffee
sheepmeat	rice	apple	pigmeat	clove	wheat	groundnut
soybean	rubber	barley	potato	cocoa	**Mozambique**	maize
sugar	soybean	beef	poultry	coffee	bean	milk
sunflower	sugar	cabbage	rye	maize	cashew	poultry
tomato	tea	cucumber	sheepmeat	pepper	cassava	rice
wheat	**Ireland**	egg	sugar	rice	cotton	sesame
wine	barley	grape	tomato	sugar	groundnut	sorghum
Hungary	beef	mandarin	wheat	sweetpotato	maize	soybean
barley	egg	milk	**Lithuania**	vanilla	millet	sugar
beef	milk	onion	barley	**Malaysia**	potato	**Nigeria**
egg	oat	pear	beef	cocoa	rice	cassava
maize	pigmeat	pigmeat	egg	palmoil	sorghum	cocoa
milk	potato	poultry	maize	rice	sugar	cotton
oat	poultry	rice	milk	rubber	sweetpotato	groundnut
pigmeat	rapeseed	soybean	oat	**Mexico**	tobacco	maize
potato	sheepmeat	spinach	oilseed	barley	**Netherlands**	millet
poultry	sugar	strawberry	pigmeat	bean	barley	palmoil
rapeseed	tomato	sugar	potato	beef	beef	rice
rice	wheat	wheat	poultry	coffee	egg	sorghum
sheepmeat	**Israel**	**Kazakhstan**	rye	egg	maize	yam
soybean	apple	beef	sheepmeat	maize	milk	**Norway**
sugar	avocado	milk	sugar	milk	oat	barley
sunflower	banana	pigmeat	tomato	pigmeat	pigmeat	beef
tomato	beef	potato	wheat	poultry	potato	egg
wheat	cotton	sugar	**Luxembourg**	rice	poultry	milk
wine	egg	wheat	barley	sorghum	rapeseed	oat
Iceland	grape	**Kenya**	beef	soybean	sheepmeat	pigmeat
beef	grapefruit	coffee	egg	sugar	sugar	poultry
egg	groundnut	fruit&veg	maize	tomato	tomato	sheepmeat
milk	milk	maize	milk	wheat	wheat	wheat
pigmeat	orange	sugar	oat			wool
poultry	pepper	tea	pigmeat			
sheepmeat	potato	wheat	potato			
wool	poultry		poultry			
	sheepmeat		rapeseed			
	tomato		sheepmeat			
	wheat		sugar			
			tomato			
			wheat			
			wine			

Appendix Table A.2 (continued): Focus countries and covered products

Pakistan	**Romania**	**Slovakia**	**Sri Lanka**	**Taiwan**	**Turkey**	**Ukraine**
cotton	barley	barley	chillies	beef	apple	barley
maize	beef	beef	coconut	egg	barley	beef
milk	egg	egg	onion	milk	beef	egg
rice	maize	maize	potato	pigmeat	cotton	maize
sugar	milk	milk	rice	poultry	egg	milk
wheat	oat	oat	rubber	rice	grape	oat
Philippines	pigmeat	pigmeat	tea	wheat	hazelnut	pigmeat
banana	potato	potato	**Sudan**	**Tanzania**	maize	potato
beef	poultry	poultry	beef	bean	milk	poultry
coconut	rapeseed	rapeseed	camel	cashew	potato	rye
maize	rice	rye	cotton	cassava	poultry	sugar
pigmeat	sheepmeat	sheepmeat	groundnut	coffee	rice	sunflower
poultry	soybean	soybean	gumarabic	cotton	sheepmeat	wheat
rice	sugar	sugar	milk	maize	sugar	**USA**
sugar	sunflower	sunflower	millet	millet	sunflower	barley
Poland	tomato	tomato	sesame	plantain	tobacco	beef
barley	wheat	wheat	sheepmeat	potato	tomato	cotton
beef	wine	wine	sorghum	pyrethrum	wheat	egg
	South					
egg	**Africa**	**Slovenia**	sugar	rice	**Uganda**	maize
maize	apple	barley	wheat	sisal	bean	milk
milk	beef	beef	**Sweden**	sorghum	cassava	pigmeat
oat	grape	egg	barley	sugar	coffee	potato
oilseed	maize	maize	beef	sweetpotato	cotton	poultry
othergrains	orange	milk	egg	tea	groundnut	rice
pigmeat	poultry	pigmeat	milk	tobacco	maize	sheepmeat
potato	sheepmeat	poultry	oat	wheat	millet	sorghum
poultry	sugar	sheepmeat	pigmeat	**Thailand**	plantain	soybean
sheepmeat	sunflower	sugar	potato	cassava	rice	sugar
soybean	wheat	wheat	poultry	maize	sorghum	wheat
sugar	**Russia**	**Spain**	rapeseed	palmoil	sugar	wool
sunflower	barley	barley	sheepmeat	pigmeat	sweetpotato	**Vietnam**
tomato	beef	beef	sugar	poultry	tea	coffee
wheat	egg	egg	wheat	rice	**UK**	pigmeat
Portugal	maize	maize	**Switzerland**	rubber	barley	poultry
barley	milk	milk	barley	soybean	beef	rice
beef	oat	oat	beef	sugar	egg	rubber
egg	pigmeat	pigmeat	egg	**Togo**	milk	sugar
maize	poultry	potato	maize	cassava	oat	**Zambia**
milk	rye	poultry	milk	cotton	pigmeat	cotton
oat	sugar	rapeseed	oat	millet	potato	groundnut
pigmeat	sunflower	rice	oilseed	sorghum	poultry	maize
potato	wheat	sheepmeat	pigmeat	yam	rapeseed	millet
poultry	**Senegal**	soybean	poultry		sheepmeat	rice
rice	cotton	sugar	sheepmeat		sugar	sorghum
sheepmeat	groundnut	sunflower	sugar		tomato	soybean
sugar	millet	tomato	wheat		wheat	sunflower
sunflower	rice	wheat				tobacco
tomato		wine				wheat
wheat						**Zimbabwe**
wine						cotton
						groundnut
						maize
						sorghum
						soybean
						sunflower
						tobacco
						wheat

Appendix Table A.3: Covered products and focus countries

Apple	**Barley**	**Beef**	**Cabbage**	**Coffee**	**Egg**	**Fruit&veg**
australia	australia	argentina	japan	brazil	australia	india
chile	austria	australia	korea	cameroon	austria	kenya
israel	belgium	austria	**Camel**	colombia	belgium	newzealand
japan	bulgaria	belgium	sudan	coted'ivoire	bulgaria	**Fruits**
morocco	canada	brazil	**Cashew**	dominicanrep	canada	china
rsa	cyprus	bulgaria	mozambique	ecuador	cyprus	**Garlic**
turkey	czechrep	canada	tanzania	ethiopia	czechrep	dominicanrep
Banana	denmark	chile	**Cassava**	indonesia	denmark	korea
australia	estonia	colombia	benin	kenya	estonia	**Grape**
cameroon	finland	cyprus	burkinafaso	madagascar	finland	australia
dominicanrep	france	czechrep	cameroon	mexico	france	chile
ecuador	germany	denmark	chad	nicaragua	greece	israel
israel	greece	ecuador	coted'ivoire	tanzania	germany	japan
morocco	hungary	egypt	dominicanrep	uganda	hungary	newzealand
philippines	ireland	estonia	ghana	vietnam	iceland	rsa
Bean	italy	finland	madagascar	**Cotton**	ireland	turkey
dominicanrep	japan	france	mali	australia	israel	**Ground nut**
mexico	korea	greece	mozambique	benin	italy	ghana
mozambique	latvia	hungary	nigeria	brazil	japan	india
nicaragua	lithuania	iceland	tanzania	burkinafaso	korea	israel
tanzania	luxembourg	ireland	thailand	cameroon	latvia	mozambique
uganda	malta	israel	togo	chad	lithuania	nicaragua
	mexico	italy	uganda	china	luxembourg	nigeria
	morocco	japan	**Chat**	colombia	malta	senegal
	netherlands	kazakhstan	germany	coted'ivoire	mexico	sudan
	newzealand	korea	**Chick pea**	ethiopia	morocco	uganda
	norway	latvia	india	egypt	netherlands	zambia
	poland	lithuania	**Chilies**	india	newzealand	zimbabwe
	portugal	luxembourg	srilanka	israel	norway	**Gum arabic**
	romania	malta	**Clove**	mali	poland	sudan
	russia	mexico	madagascar	mozambique	portugal	**Hazelnut**
	slovakia	morocco	**Coarse grains**	nigeria	romania	turkey
	slovenia	netherlands	newzealand	pakistan	russia	**Hides&skins**
	spain	newzealand	**Cocoa**	senegal	slovakia	ethiopia
	sweden	nicaragua	cameroon	sudan	slovenia	**Jute**
	switzerland	norway	coted'ivoire	tanzania	spain	bangladesh
	turkey	philippines	ecuador	togo	sweden	
	uk	poland	ghana	turkey	switzerland	
	ukraine	portugal	madagascar	uganda	taiwan	
	us	romania	malaysia	us	turkey	
		rsa	nigeria	zambia	uk	
		russia	**Coconut**	zimbabwe	ukraine	
		slovakia	indonesia	**Cucumber**	us	
		slovenia	philippines	japan		
		spain	srilanka			
		sudan				
		sweden				
		switzerland				
		taiwan				
		turkey				
		uk				
		ukraine				
		us				

Appendix Table A.3 (continued): Covered products and focus countries

Maize	**Mandarin**	**Millet**	**Oil seeds**	**Pig meat**	**Plantain**
argentina	japan	benin	australia	australia	cameroon
australia	**Milk**	burkinafaso	**Olive**	austria	coted'ivoire
austria	argentina	cameroon	australia	belgium	ghana
belgium	australia	chad	morocco	brazil	tanzania
brazil	austria	mali	**Onion**	bulgaria	uganda
bulgaria	belgium	mozambique	dominicanrepublic	canada	**Potato**
cameroon	bulgaria	nigeria	japan	china	australia
canada	canada	senegal	srilanka	cyprus	austria
chile	chile	sudan	**Orange**	czechrep	bangladesh
china	china	tanzania	australia	denmark	belgium
colombia	colombia	togo	israel	ecuador	bulgaria
czechrep	cyprus	uganda	morocco	estonia	canada
ecuador	czechrep	zambia	rsa	finland	cyprus
egypt	denmark	**Oat**	**Other crops**	france	czechrep
ethiopia	ecuador	australia	newzealand	greece	denmark
france	egypt	austria	**Other grains**	germany	estonia
greece	estonia	belgium	poland	hungary	finland
germany	finland	bulgaria	**Other roots&tubers**	iceland	france
ghana	france	cyprus	cameroon	ireland	greece
hungary	greece	czechrep	**Palm oil**	italy	germany
india	germany	denmark	colombia	japan	hungary
indonesia	hungary	estonia	indonesia	kazakhstan	ireland
italy	iceland	finland	malaysia	korea	israel
kenya	india	france	nigeria	latvia	italy
lithuania	ireland	greece	thailand	lithuania	kazakhstan
luxembourg	israel	germany	**Pear**	luxembourg	latvia
madagascar	italy	hungary	japan	malta	lithuania
mexico	japan	ireland	**Peas**	mexico	luxembourg
morocco	kazakhstan	italy	canada	netherlands	malta
mozambique	korea	latvia	**Pepper**	newzealand	morocco
netherlands	latvia	lithuania	israel	norway	mozambique
newzealand	lithuania	luxembourg	korea	philippines	netherlands
nicaragua	luxembourg	netherlands	madagascar	poland	poland
nigeria	malta	newzealand		portugal	portugal
pakistan	mexico	norway		romania	romania
philippines	morocco	poland		russia	slovakia
poland	netherlands	portugal		slovakia	spain
portugal	newzealand	romania		slovenia	srilanka
romania	nicaragua	russia		spain	sweden
rsa	norway	slovakia		sweden	tanzania
russia	pakistan	spain		switzerland	turkey
slovakia	poland	sweden		taiwan	uk
slovenia	portugal	switzerland		thailand	ukraine
spain	romania	uk		uk	us
switzerland	russia	ukraine		ukraine	
tanzania	slovakia	**Oil seed**		us	
thailand	slovenia	estonia		vietnam	
turkey	spain	ethiopia			
uganda	sudan	latvia			
ukraine	sweden	lithuania			
us	switzerland	poland			
zambia	taiwan	switzerland			
zimbabwe	turkey				
	uk				
	ukraine				
	us				

Appendix Table A.3 (continued): Covered products and focus countries

Poultry	**Pulse**	**Rice**	**Sesame**	**Sorghum**	**Sugar**	**Sunflower**
australia	ethiopia	australia	nicaragua	australia	australia	argentina
austria	**Pyrethrum**	bangladesh	sudan	benin	austria	australia
belgium	tanzania	brazil	**Sheep meat**	burkinafaso	bangladesh	austria
brazil	**Rapeseed**	bulgaria	australia	cameroon	belgium	bulgaria
bulgaria	australia	china	austria	chad	brazil	czechrep
canada	austria	colombia	belgium	colombia	bulgaria	france
china	belgium	coted'ivoire	bulgaria	india	canada	greece
cyprus	bulgaria	dominicanrep	cyprus	mali	chile	germany
czechrep	canada	ecuador	czechrep	mexico	china	hungary
denmark	czechrep	egypt	denmark	mozambique	colombia	india
dominicanrep	denmark	france	estonia	nicaragua	czechrep	italy
ecuador	france	ghana	finland	nigeria	denmark	poland
estonia	germany	greece	france	sudan	dominicanrep	portugal
finland	greece	hungary	greece	tanzania	ecuador	romania
france	hungary	india	germany	togo	egypt	rsa
greece	india	indonesia	hungary	uganda	finland	russia
germany	ireland	italy	iceland	us	france	slovakia
hungary	italy	japan	ireland	zambia	greece	spain
iceland	luxembourg	korea	israel	zimbabwe	germany	turkey
indonesia	netherlands	madagascar	italy	**Soybean**	hungary	ukraine
ireland	romania	malaysia	latvia	argentina	india	zambia
israel	slovakia	mexico	lithuania	australia	indonesia	zimbabwe
italy	spain	morocco	luxembourg	brazil	ireland	**Sweet potato**
japan	sweden	mozambique	malta	bulgaria	italy	madagascar
korea	uk	nicaragua	morocco	canada	japan	mozambique
latvia		nigeria	netherlands	china	kazakhstan	tanzania
lithuania		pakistan	newzealand	colombia	kenya	uganda
luxembourg		philippines	norway	czechrep	latvia	**Tea**
malta		portugal	poland	ecuador	lithuania	bangladesh
mexico		romania	portugal	france	luxembourg	indonesia
morocco		senegal	romania	greece	madagascar	kenya
netherlands		spain	rsa	germany	mexico	srilanka
newzealand		srilanka	slovakia	hungary	morocco	tanzania
nicaragua		taiwan	slovenia	india	mozambique	uganda
norway		tanzania	spain	indonesia	netherlands	**Teff**
philippines		thailand	sudan	italy	nicaragua	ethiopia
poland		turkey	sweden	japan	pakistan	**Tobacco**
portugal		uganda	switzerland	korea	philippines	australia
romania		us	turkey	mexico	poland	mozambique
rsa		vietnam	uk	morocco	portugal	tanzania
russia		zambia	us	nicaragua	romania	turkey
slovakia		**Rubber**	**Sisal**	poland	rsa	zambia
slovenia		indonesia	tanzania	romania	russia	zimbabwe
spain		malaysia		slovakia	slovakia	
sweden		srilanka		spain	slovenia	
switzerland		thailand		thailand	spain	
taiwan		vietnam		us	sudan	
thailand		**Rye**		zambia	sweden	
turkey		estonia		zimbabwe	switzerland	
uk		latvia		**Spinach**	tanzania	
ukraine		lithuania		japan	thailand	
us		russia		**Strawberry**	turkey	
vietnam		slovakia		japan	uganda	
		ukraine		morocco	uk	
					ukraine	
					us	
					vietnam	

Appendix Table A.3 (continued): Covered products and focus countries

Sunflower	**Tomato**	**Wheat**	**Wine**
argentina	belgium	argentina	austria
australia	bulgaria	australia	belgium
austria	cyprus	austria	bulgaria
bulgaria	czechrep	bangladesh	cyprus
czechrep	denmark	belgium	france
	dominicanrep		
france	ublic	brazil	greece
greece	estonia	bulgaria	germany
germany	france	canada	hungary
hungary	greece	chile	italy
india	germany	china	luxembourg
italy	hungary	colombia	malta
poland	ireland	cyprus	portugal
portugal	israel	czechrep	romania
romania	italy	denmark	slovakia
rsa	latvia	egypt	spain
russia	lithuania	estonia	**Wool**
slovakia	luxembourg	ethiopia	australia
spain	malta	finland	iceland
turkey	mexico	france	newzealand
ukraine	morocco	greece	norway
zambia	netherlands	germany	us
zimbabwe	poland	hungary	**Yam**
Sweet potato	portugal	india	benin
madagascar	romania	ireland	burkinafaso
mozambique	slovakia	israel	chad
tanzania	spain	italy	coted'ivoire
uganda	turkey	japan	ghana
Tea	uk	kazakhstan	mali
bangladesh	**Vanilla**	kenya	nigeria
indonesia	madagascar	korea	togo
kenya	**Vegetables**	latvia	
srilanka	china	lithuania	
tanzania		luxembourg	
uganda		malta	
Teff		mexico	
ethiopia		morocco	
Tobacco		netherlands	
australia		newzealand	
mozambique		norway	
tanzania		pakistan	
turkey		poland	
zambia		portugal	
zimbabwe		romania	
		rsa	
		russia	
		slovakia	
		slovenia	
		spain	
		sudan	
		sweden	
		switzerland	
		taiwan	
		tanzania	
		turkey	
		uk	
		ukraine	
		us	
		zambia	
		zimbabwe	

Appendix Table A.4: FAOSTAT concordance table for trade and production

Ag distortion	FAO Production + Prices	FAO Trade Names	FAO Trade Codes
apple	Apples	Apples	515
banana	Bananas	Bananas	486
barley	Barley	Barley	44
bean	Beans, dry	Beans, dry	176
	Beans, green	Beans, green	414
beef	Cattle meat	Bovine Meat >	2071
	Buffalo meat		
cabbage	Cabbages and other brassicas	Cabbages and other brassicas	358
camel	Camel meat	Camel meat	1127
cashew		Cashew nuts, with shell	217
cassava	Cassava	Cassava	125
chat			
chickpea	Chick peas	Chick peas	191
chillies	Chillies and peppers, dry	Chillies and peppers, dry	689
	Chillies and peppers, green	Chillies and peppers, green	401
clove		Cloves	698
coarsegrains			
cocoa	Cocoa beans	Cocoa beans	661
	Coconuts	Coconuts	249
coconut		Coconuts, Desiccated	250
coffee	Coffee, green	Coffee, green	656
cotton	Seed cotton	Cotton lint	767
		Cottonseed	329
cucumber	Cucumbers and gherkins	Cucumbers and gherkins	397
egg	Hen eggs, in shell	Hen eggs, in shell	1062
fruit&veg			
fruits			
garlic		Garlic	406
grape	Grapes	Grapes	560
groundnut	Groundnuts, with shell	Groundnuts, with shell	242
gumarabic		Gums Natural	839
hazelnut	Hazelnuts, with shell	Hazelnuts, with shell	225
hides&skins		Hides + Skins -21 >	1898
jute		Jute	780
maize	Maize	Maize	56
mandarin	Tangerines, mandarins, clem.	Tangerines, mandarins, clem.	495
milk	Cow milk, whole, fresh	Cow milk, whole, fresh	882
	Sheep milk, whole, fresh	Sheep milk, whole, fresh	982
	Buffolo milk, whole, fresh		
	Camel milk, whole, fresh		
	Goat milk, whole, fresh		
millet	Millet	Millet	79
oat	Oats	Oats	75
oilseed		Oilseeds -22 >	1899
olive	Olives	Olive Oil, Total >	1999

Appendix Table A.4 (continued): FAOSTAT concordance table for trade and production

Ag distortion	FAO Production + Prices	FAO Trade Names	FAO Trade Codes
onion	Onions, dry	Onions, dry	403
		Onions, green	492
orange	Oranges	Oranges	490
othercrops			
othergrains			
otherroots&tubers		Roots and Tubers, nes	149
palmoil	Oil palm fruit	Palm oil	257
pear		Pears	521
peas	Cow peas, dry	Cow peas, dry	195
	Peas, dry	Peas, dry	187
	Peas, green	Peas, green	417
pepper	Pepper (Piper spp.)	Pepper (Piper spp.)	687
pigmeat	Pig meat	Pig meat	1035
plantain	Plantains	Plantains	489
potato	Potatoes	Potatoes	116
poultry	Chicken meat	Poultry Meat >	2074
	Turkey meat		
pulse	Pulses, nes	Pulses, nes	211
pyrethrum		Pyrethrum Extr	755
rapeseed	Rapeseed	Rapeseed	270
rice	Rice, paddy	Rice >	1946
rubber	Natural rubber	Rubber Nat Dry	837
rye	Rye	Rye	71
sesame		Sesame seed	289
sheepmeat	Sheep meat	Sheep meat	977
	Goat meat	Goat meat	1017
sisal		Sisal	789
sorghum	Sorghum	Sorghum	83
soybean	Soybeans	Soybeans	236
spinach		Spinach	373
strawberry	Strawberries	Strawberries	544
sugar	Sugar beet	Sugar, Total (Raw Equiv.) >	1955
	Sugar cane		
sunflower	Sunflower seed	Sunflower seed	267
sweetpotato	Sweet potatoes	Sweet potatoes	122
tea	Tea	Tea	667
teff			
tobacco	Tobacco, unmanufactured	Tobacco, unmanufactured	826
tomato	Tomatoes	Tomatoes	388
vanilla		Vanilla	692
vegetables			
wheat	Wheat	Wheat	15
wine		Wine	564
wool	Wool, greasy	Wool, greasy	987
yam	Yams	Yams	137
	Taro (cocoyam)	Taro (cocoyam)	136
	Yautia (cocoyam)	Yautia (cocoyam)	135

Appendix B: Price Transmission Elasticities

Appendix Table B.1: Global averages, selected covered products, all focus countries, 1985 to 2010

Product	SR-elasticity (=Π_1 x mean price ratio)	LR-elasticity	Coefficient of Adjustment (= 1 - Π_2)	Mean Lag (=Π_2 /(1 - Π_2)
Rice	0.51	0.79	0.51	1.39
Wheat	0.58	0.84	0.65	0.88
Maize	0.63	0.83	0.68	1.17
Soybean	0.73	0.89	0.79	0.33
Sugar	0.43	0.62	0.64	0.90
Cotton	0.57	0.73	0.68	0.82
Milk	0.51	0.55	0.82	0.63
Beef	0.66	0.82	0.76	0.68
Pigmeat	0.51	0.83	0.57	1.59
Poultry	0.68	0.89	0.69	0.65

Appendix Table B.2: Global averages, selected covered products, all focus countries, 1965 to 1985

Product	SR-elasticity (=Π_1 x mean price ratio)	LR-elasticity	Coefficient of Adjustment (= 1 - Π_2)	Mean Lag (=Π_2 /(1 - Π_2)
Rice	0.57	0.63	0.89	0.18
Wheat	0.51	0.69	0.72	0.71
Maize	0.87	0.90	0.97	0.08
Soybean	0.96	0.97	0.98	0.03
Sugar	0.48	0.58	0.84	0.24
Cotton	0.56	0.59	0.80	0.52
Milk	0.60	0.73	0.61	1.26
Beef	0.64	0.89	0.65	1.75
Pigmeat	0.71	0.82	0.79	0.36
Poultry	0.82	0.86	0.91	0.12

Appendix Table B.3: Global averages, selected covered products, developing countries, 1985 to 2010

Product	SR-elasticity (=Π_1 x mean price ratio)	LR-elasticity	Coefficient of Adjustment (= 1 - Π_2)	Mean Lag (=Π_2 /(1 - Π_2)
Rice	0.54	0.83	0.51	1.31
Wheat	0.60	0.93	0.59	1.06
Maize	0.54	0.88	0.49	2.02
Soybean	0.70	0.95	0.68	0.53
Sugar	0.42	0.59	0.63	0.92
Cotton	0.61	0.64	0.74	0.70
Milk	0.69	0.74	0.89	0.64
Beef	0.51	0.88	0.57	1.34
Pigmeat	0.36	0.92	0.30	2.69
Poultry	0.63	0.88	0.58	0.95

Appendix Table B.4: Global averages, selected covered products, high-income countries, 1985 to 2010

Product	SR-elasticity (=Π_1 x mean price ratio)	LR-elasticity	Coefficient of Adjustment (= 1 - Π_2)	Mean Lag (=Π_2 /(1 - Π_2)
Rice	0.18	0.24	0.45	2.34
Wheat	0.55	0.75	0.71	0.70
Maize	0.72	0.79	0.88	0.29
Soybean	0.76	0.82	0.93	0.09
Sugar	0.45	0.70	0.66	0.83
Cotton	0.53	0.82	0.61	0.95
Milk	0.42	0.47	0.79	0.62
Beef	0.73	0.79	0.84	0.38
Pigmeat	0.69	0.72	0.91	0.20
Poultry	0.73	0.89	0.79	0.38

Appendix Table B.5: Global averages, selected covered products, developing countries, 1965 to 1985

Product	SR-elasticity (=Π_1 x mean price ratio)	LR-elasticity	Coefficient of Adjustment (= 1 - Π_2)	Mean Lag (=Π_2 /(1 - Π_2)
Rice	0.54	0.58	0.91	0.15
Wheat	0.38	0.46	0.81	0.26
Maize	0.66	0.75	0.88	0.29
Soybean	0.79	0.84	0.91	0.12
Sugar	0.49	0.60	0.85	0.25
Cotton	0.32	0.37	0.58	1.15
Milk	0.17	0.17	0.28	4.09
Beef	0.76	0.98	0.70	1.52
Pigmeat	0.51	0.77	0.69	0.63
Poultry	0.66	0.69	0.85	0.19

Appendix Table B.6: Global averages, selected covered products, high-income countries, 1965 to 1985

Product	SR-elasticity (=Π_1 x mean price ratio)	LR-elasticity	Coefficient of Adjustment (= 1 - Π_2)	Mean Lag (=Π_2 /(1 - Π_2)
Rice	0.75	0.96	0.73	0.41
Wheat	0.56	0.77	0.69	0.87
Maize	0.95	0.95	1.00	0.00
Soybean	1.00	1.00	1.00	0.00
Sugar	0.44	0.52	0.83	0.22
Cotton	0.76	0.76	0.97	0.03
Milk	0.70	0.86	0.69	0.57
Beef	0.62	0.87	0.64	1.80
Pigmeat	0.72	0.83	0.79	0.34
Poultry	0.84	0.89	0.92	0.11

Appendix Table B.7: Price Transmission Elasticities, rice, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$)
Global					**0.51**	**0.79**	**0.51**	**1.39**
Australia	0.17	0.99	-0.02	0.99	0.98	0.96	1.02	-0.02
Bangladesh	5.64	0.42	0.39	1.01	0.42	0.69	0.61	0.64
Brazil	1.67	0.76	0.38	0.97	0.74	1.00	0.62	0.61
China	34.63	0.54	0.65	1.04	0.56	1.00	0.35	1.86
Colombia	0.37	0.43	0.57	0.92	0.40	0.92	0.43	1.33
Cote d'Ivoire	0.19	0.34	0.75	0.98	0.33	1.00	0.25	3.00
Dominican Republic	0.13	0.16	0.64	0.91	0.15	0.41	0.36	1.78
Ecuador	0.21	0.17	0.49	0.96	0.16	0.32	0.51	0.96
Egypt	1.51	0.21	0.49	1.03	0.22	0.42	0.51	0.96
France	0.04	0.01	0.75	0.93	0.01	0.04	0.25	3.00
Ghana	0.07	0.52	0.34	0.95	0.50	0.75	0.66	0.52
Greece	0.33	0.49	-0.06	0.92	0.45	0.43	1.06	-0.06
India	16.53	0.58	0.54	1.01	0.59	1.00	0.46	1.17
Indonesia	14.17	0.58	0.29	1.00	0.58	0.82	0.71	0.41
Italy	0.45	0.01	0.74	0.93	0.01	0.04	0.26	2.85
Japan	3.48	0.01	0.80	0.77	0.01	0.04	0.20	4.00
Korea	2.30	-0.48	0.81	0.84	-0.41	-2.13	0.19	4.26
Madagascar	0.63	1.17	0.04	0.99	1.00	1.00	0.96	0.04
Malaysia	0.35	0.07	0.68	0.89	0.06	0.20	0.32	2.13
Mexico	0.05	0.27	0.24	0.98	0.27	0.35	0.76	0.32
Mozambique	0.01	0.78	0.59	1.10	0.86	1.00	0.41	1.44
Nicaragua	0.10	0.32	0.04	0.96	0.31	0.32	0.96	0.04
Nigeria	0.57	0.19	0.40	0.99	0.19	0.31	0.60	0.67
Pakistan	1.32	0.19	0.79	1.05	0.20	0.95	0.21	3.76

Appendix Table B.7 (continued): Price Transmission Elasticities, rice, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$)
Philippines	3.80	0.33	0.66	0.96	0.32	0.93	0.34	1.94
Portugal	0.05	-0.06	0.62	0.93	-0.06	-0.15	0.38	1.63
Senegal	0.05	-0.04	0.79	0.93	-0.04	-0.18	0.21	3.76
Spain	0.28	-0.02	0.71	0.93	-0.02	-0.06	0.29	2.45
Sri Lanka	0.49	0.29	0.62	1.00	0.29	0.77	0.38	1.63
Taiwan	0.57	0.32	0.66	0.87	0.28	0.82	0.34	1.94
Tanzania	0.13	0.33	0.75	1.02	0.34	1.00	0.25	3.00
Thailand	3.84	1.01	-0.14	1.03	1.00	0.88	1.14	-0.12
Turkey	0.09	0.04	0.64	0.89	0.04	0.10	0.36	1.78
Uganda	0.07	0.55	0.22	0.97	0.53	0.68	0.78	0.28
US	1.17	0.63	0.03	0.96	0.61	0.63	0.97	0.03
Vietnam	4.55	0.57	0.03	1.01	0.57	0.59	0.97	0.03
Zambia	0.00	0.82	0.58	1.09	0.90	1.00	0.42	1.38

Appendix Table B.8: Price Transmission Elasticities, wheat, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity (=Π_1 x mean price ratio)	LR-elasticity	Coefficient of Adjustment (= 1 - Π_2)	Mean Lag (=Π_2 /(1 - Π_2)
Global					**0.58**	**0.84**	**0.65**	**0.88**
Argentina	2.67	0.87	0.07	1.05	0.91	0.98	0.93	0.08
Australia	4.79	0.95	0.01	1.00	0.95	0.96	0.99	0.01
Austria	0.26	0.29	0.77	0.94	0.27	1.00	0.23	3.35
Bangladesh	0.40	0.26	0.49	1.00	0.26	0.51	0.51	0.96
Bel-Lux	0.31	0.49	0.16	0.95	0.47	0.55	0.84	0.19
Brazil	0.66	1.01	0.19	1.00	1.00	1.00	0.81	0.23
Bulgaria	0.58	1.05	0.14	1.03	1.00	1.00	0.86	0.16
Canada	2.93	0.95	0.02	0.99	0.95	0.96	0.98	0.02
Chile	0.42	0.53	0.28	0.97	0.52	0.72	0.72	0.39
China	18.91	0.57	0.52	0.97	0.55	1.00	0.48	1.08
Colombia	0.01	0.32	0.82	0.96	0.31	1.00	0.18	4.56
Cyprus	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Czech Republic	0.54	0.86	0.13	1.01	0.87	1.00	0.87	0.15
Denmark	0.84	0.28	0.60	0.95	0.27	0.67	0.40	1.50
Egypt	1.47	0.32	0.48	0.94	0.30	0.58	0.52	0.92
Estonia	0.02	0.87	0.02	0.99	0.86	0.88	0.98	0.02
Ethiopia	3.98	1.04	0.04	1.01	1.00	1.00	0.96	0.04
Finland	0.11	0.28	0.86	0.91	0.25	1.00	0.14	6.14
France	6.49	0.27	0.61	0.95	0.26	0.66	0.39	1.56
Germany	4.03	0.27	0.61	0.95	0.26	0.66	0.39	1.56
Greece	0.35	0.48	0.13	0.95	0.46	0.52	0.87	0.15
Hungary	0.55	0.91	0.06	1.00	0.91	0.97	0.94	0.06
India	10.25	0.44	0.47	0.98	0.43	0.81	0.53	0.89
Ireland	0.15	0.28	0.60	0.95	0.27	0.67	0.40	1.50

Appendix Table B.8 (continued): Price Transmission Elasticities, wheat, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$)
Israel	0.03	0.47	0.28	0.97	0.46	0.64	0.72	0.39
Italy	1.34	0.29	0.59	0.98	0.28	0.69	0.41	1.44
Japan	0.18	0.49	0.21	0.84	0.41	0.52	0.79	0.27
Kazakhstan	1.57	0.78	-0.01	1.01	0.79	0.78	1.01	-0.01
Kenya	0.08	0.44	0.61	0.96	0.42	1.00	0.39	1.56
Korea	0.00	-0.22	0.75	0.85	-0.19	-0.75	0.25	3.00
Latvia	0.07	0.86	0.18	1.00	0.86	1.00	0.82	0.22
Lithuania	0.17	0.82	0.24	1.00	0.82	1.00	0.76	0.32
Malta	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Mexico	0.75	0.61	0.36	0.95	0.58	0.90	0.64	0.56
Morocco	1.01	0.58	-0.23	0.94	0.54	0.44	1.23	-0.19
Netherlands	0.20	0.27	0.60	0.95	0.26	0.64	0.40	1.50
New Zealand	0.08	0.96	0.01	1.00	0.96	0.97	0.99	0.01
Norway	0.06	0.15	0.70	0.84	0.13	0.42	0.30	2.33
Pakistan	5.22	0.28	0.80	1.05	0.29	1.00	0.20	4.00
Poland	1.37	0.84	0.06	0.98	0.82	0.88	0.94	0.06
Portugal	0.05	0.28	0.61	0.95	0.27	0.68	0.39	1.56
Romania	0.83	0.74	-0.04	0.96	0.71	0.69	1.04	-0.04
RSA	0.52	0.31	0.33	0.97	0.30	0.45	0.67	0.49
Russia	5.21	1.06	0.10	1.04	1.00	1.00	0.90	0.11
Slovakia	0.22	0.80	0.13	1.00	0.80	0.92	0.87	0.15
Slovenia	0.02	0.50	-0.03	0.93	0.46	0.45	1.03	-0.03
Spain	1.19	0.28	0.62	0.95	0.27	0.70	0.38	1.63
Sudan	0.09	0.49	0.34	1.00	0.49	0.74	0.66	0.52

Appendix Table B.8 (continued): Price Transmission Elasticities, wheat, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$)
Sweden	0.42	0.35	0.54	0.95	0.33	0.72	0.46	1.17
Switzerland	0.18	-0.07	0.84	0.86	-0.06	-0.38	0.16	5.25
Tanzania	0.01	0.25	0.90	0.97	0.24	1.00	0.10	9.00
Turkey	3.74	0.55	0.36	0.94	0.52	0.81	0.64	0.56
UK	2.70	0.28	0.60	0.95	0.27	0.67	0.40	1.50
Ukraine	2.22	0.35	0.23	1.05	0.37	0.48	0.77	0.30
US	9.66	0.73	0.04	0.98	0.71	0.74	0.96	0.04
Zambia	0.04	-0.43	0.76	1.11	-0.48	-1.99	0.24	3.17
Zimbabwe	0.06	0.49	0.60	1.16	0.57	1.00	0.40	1.50

Appendix Table B.9: Price Transmission Elasticities, maize, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$)
Global					**0.63**	**0.83**	**0.68**	**1.17**
Argentina	1.86	0.54	0.26	1.05	0.57	0.77	0.74	0.35
Australia	0.08	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Austria	0.28	0.51	0.51	0.95	0.48	0.98	0.49	1.04
Bel-Lux	0.08	0.46	0.17	0.93	0.43	0.51	0.83	0.20
Brazil	5.66	0.74	0.32	1.03	0.76	1.00	0.68	0.47
Bulgaria	0.24	1.09	-0.04	1.01	1.00	0.96	1.04	-0.04
Cameroon	0.22	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Canada	1.37	0.84	0.03	0.99	0.83	0.86	0.97	0.03
Chile	0.22	0.83	0.11	1.01	0.83	0.94	0.89	0.12
China	21.10	0.47	0.80	1.01	0.47	1.00	0.20	4.00
Colombia	0.33	0.29	0.65	0.98	0.28	0.81	0.35	1.86
Ecuador	0.08	0.67	0.56	0.94	0.63	1.00	0.44	1.27
Egypt	1.27	-0.06	0.71	0.93	-0.06	-0.19	0.29	2.45
Ethiopia	4.76	1.01	0.03	1.01	1.00	1.00	0.97	0.03
France	3.03	0.28	0.56	0.93	0.26	0.59	0.44	1.27
Germany	0.72	0.26	0.58	0.93	0.24	0.58	0.42	1.38
Ghana	0.20	0.54	0.29	0.93	0.50	0.71	0.71	0.41
Greece	0.31	0.52	0.02	0.93	0.48	0.49	0.98	0.02
Hungary	0.91	1.12	-0.02	1.01	1.00	0.98	1.02	-0.02
India	2.16	0.54	0.19	0.98	0.53	0.66	0.81	0.23
Indonesia	2.01	0.73	0.34	0.97	0.71	1.00	0.66	0.52
Italy	2.03	0.27	0.57	0.93	0.25	0.59	0.43	1.33
Kenya	0.68	0.12	0.83	1.02	0.12	0.72	0.17	4.88

Appendix Table B.9 (continued): Price Transmission Elasticities, maize, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$)
Madagascar	0.11	0.22	0.49	1.06	0.23	0.46	0.51	0.96
Mexico	5.29	0.44	0.46	0.99	0.43	0.81	0.54	0.85
Mozambique	0.14	0.58	0.65	1.06	0.61	1.00	0.35	1.86
Netherlands	0.05	0.26	0.58	0.93	0.24	0.58	0.42	1.38
New Zealand	0.04	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Nicaragua	0.12	0.53	-0.04	0.99	0.52	0.50	1.04	-0.04
Nigeria	0.69	0.04	0.58	0.88	0.04	0.08	0.42	1.38
Pakistan	0.34	0.12	0.30	1.03	0.12	0.18	0.70	0.43
Philippines	0.93	0.24	0.62	0.91	0.22	0.57	0.38	1.63
Poland	0.22	0.99	0.06	0.98	0.97	1.00	0.94	0.06
Portugal	0.16	0.26	0.60	0.93	0.24	0.61	0.40	1.50
Romania	1.63	0.77	-0.03	0.96	0.74	0.72	1.03	-0.03
RSA	1.25	0.15	0.26	0.97	0.15	0.20	0.74	0.35
Russia	0.39	0.64	-0.15	1.01	0.64	0.56	1.15	-0.13
Slovakia	0.10	1.00	0.08	0.99	0.99	1.00	0.92	0.09
Slovenia	0.04	0.89	0.06	0.97	0.87	0.92	0.94	0.06
Spain	0.89	0.26	0.59	0.93	0.24	0.59	0.41	1.44
Switzerland	0.05	-0.02	0.84	0.87	-0.02	-0.11	0.16	5.25
Tanzania	0.62	0.22	0.51	1.03	0.23	0.46	0.49	1.04
Thailand	0.72	0.78	0.08	1.02	0.79	0.86	0.92	0.09
Turkey	0.47	0.72	0.45	0.94	0.67	1.00	0.55	0.82
Uganda	0.30	0.85	0.15	1.01	0.86	1.00	0.85	0.18

Appendix Table B.9 (continued): Price Transmission Elasticities, maize, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$)
Ukraine	0.91	1.19	-0.08	1.01	1.00	0.93	1.08	-0.07
US	33.66	0.84	0.03	0.99	0.83	0.86	0.97	0.03
Zambia	0.37	1.04	0.50	1.15	1.00	1.00	0.50	1.00
Zimbabwe	0.87	-0.02	0.36	1.18	-0.02	-0.04	0.64	0.56

Appendix Table B.10: Price Transmission Elasticities, soybean, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$)
Global					**0.73**	**0.89**	**0.79**	**0.33**
Argentina	16.72	0.62	0.25	1.05	0.65	0.86	0.75	0.33
Australia	0.04	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Brazil	22.24	0.70	0.39	1.02	0.71	1.00	0.61	0.64
Canada	1.51	0.97	0.01	1.00	0.97	0.98	0.99	0.01
China	10.48	0.67	0.44	0.98	0.66	1.00	0.56	0.79
Colombia	0.05	0.24	0.64	0.99	0.24	0.66	0.36	1.78
Ecuador	0.07	0.31	0.41	1.02	0.32	0.54	0.59	0.69
France	0.14	0.25	0.67	0.96	0.24	0.73	0.33	2.03
Germany	0.00	0.66	0.51	0.98	0.64	1.00	0.49	1.04
Greece	0.04	0.30	0.47	0.97	0.29	0.55	0.53	0.89
India	4.40	1.07	-0.06	0.99	1.00	0.94	1.06	-0.06
Indonesia	0.60	0.57	0.40	0.97	0.55	0.92	0.60	0.67
Italy	0.45	0.24	0.68	0.96	0.23	0.72	0.32	2.13
Japan	0.56	0.56	0.10	0.93	0.52	0.58	0.90	0.11
Korea	0.09	0.08	0.77	0.75	0.06	0.26	0.23	3.35
Mexico	0.06	0.63	0.32	0.98	0.62	0.91	0.68	0.47
Nicaragua	0.01	-0.10	0.66	1.05	-0.11	-0.31	0.34	1.94
Romania	0.10	0.79	0.16	0.99	0.78	0.93	0.84	0.19
Spain	0.00	0.26	0.70	0.96	0.25	0.83	0.30	2.33
Thailand	0.15	0.14	0.69	0.98	0.14	0.44	0.31	2.23
US	42.18	0.77	0.06	0.99	0.77	0.81	0.94	0.06
Zambia	0.04	-0.07	0.75	1.14	-0.08	-0.32	0.25	3.00
Zimbabwe	0.07	-0.02	0.58	1.18	-0.02	-0.06	0.42	1.38

Appendix Table B.11: Price Transmission Elasticities, sugar, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$)
Global					**0.43**	**0.62**	**0.64**	**0.90**
Australia	3.03	0.97	0.00	0.99	0.96	0.96	1.00	0.00
Austria	0.26	0.43	0.66	0.75	0.32	0.95	0.34	1.94
Bangladesh	0.42	0.06	0.72	0.72	0.04	0.15	0.28	2.57
Bel-Lux	0.20	0.49	0.01	0.71	0.35	0.35	0.99	0.01
Brazil	12.91	0.51	0.67	1.13	0.57	1.00	0.33	2.03
Bulgaria	0.00	-0.61	-0.15	0.95	-0.58	-0.50	1.15	-0.13
Canada	0.00	0.49	0.03	0.89	0.44	0.45	0.97	0.03
Chile	0.52	0.41	0.39	0.94	0.39	0.63	0.61	0.64
China	8.98	0.88	-0.04	0.94	0.83	0.80	1.04	-0.04
Colombia	1.28	0.25	0.67	0.87	0.22	0.66	0.33	2.03
Czech Republic	0.39	0.41	0.05	0.90	0.37	0.39	0.95	0.05
Denmark	0.29	0.43	0.63	0.77	0.33	0.89	0.37	1.70
Dominican Republic	0.50	0.37	0.81	1.14	0.42	1.00	0.19	4.26
Ecuador	0.43	0.39	0.56	1.02	0.40	0.90	0.44	1.27
Egypt	1.59	0.03	0.63	1.01	0.03	0.08	0.37	1.70
Finland	0.10	0.54	0.45	0.77	0.41	0.75	0.55	0.82
France	2.78	0.41	0.64	0.77	0.31	0.87	0.36	1.78
Germany	2.40	0.41	0.64	0.77	0.31	0.87	0.36	1.78
Greece	0.11	0.48	-0.03	0.71	0.34	0.33	1.03	-0.03
Hungary	0.13	0.36	0.00	0.80	0.29	0.29	1.00	0.00
India	19.66	0.09	0.48	0.92	0.08	0.16	0.52	0.92
Indonesia	10.31	0.47	0.10	0.98	0.46	0.51	0.90	0.11
Ireland	0.15	0.58	0.45	0.75	0.43	0.79	0.55	0.82

Appendix Table B.11 (continued): Price Transmission Elasticities, sugar, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$)
Italy	0.95	0.41	0.64	0.77	0.31	0.87	0.36	1.78
Japan	1.75	0.55	0.26	0.81	0.45	0.60	0.74	0.35
Kenya	0.42	0.14	0.72	0.95	0.13	0.48	0.28	2.57
Latvia	0.33	0.88	0.10	0.87	0.77	0.85	0.90	0.11
Lithuania	0.56	0.83	0.25	0.86	0.72	0.95	0.75	0.33
Madagascar	0.18	0.95	0.14	1.01	0.96	1.00	0.86	0.16
Mexico	4.01	0.89	0.13	0.90	0.80	0.92	0.87	0.15
Morocco	0.45	0.85	-0.03	0.94	0.80	0.77	1.03	-0.03
Mozambique	0.12	0.14	0.69	0.96	0.13	0.43	0.31	2.23
Netherlands	0.58	0.41	0.64	0.77	0.31	0.87	0.36	1.78
Nicaragua	0.17	0.43	-0.14	0.86	0.37	0.33	1.14	-0.12
Pakistan	2.45	0.17	0.41	0.81	0.14	0.23	0.59	0.69
Philippines	2.36	0.31	0.47	0.82	0.25	0.48	0.53	0.89
Poland	0.55	0.67	0.00	0.86	0.58	0.58	1.00	0.00
Portugal	0.05	0.39	0.57	0.76	0.30	0.69	0.43	1.33
Romania	0.03	0.86	0.32	0.84	0.72	1.00	0.68	0.47
RSA	1.64	0.23	0.66	0.89	0.20	0.60	0.34	1.94
Russia	1.59	1.08	-0.06	0.91	0.98	0.92	1.06	-0.06
Slovakia	0.11	0.39	0.06	0.87	0.34	0.36	0.94	0.06
Slovenia	0.01	0.71	0.03	0.77	0.55	0.57	0.97	0.03
Spain	0.67	0.41	0.63	0.77	0.31	0.85	0.37	1.70
Sudan	0.96	0.13	0.83	0.99	0.13	0.76	0.17	4.88
Sweden	0.23	0.44	0.30	0.78	0.34	0.49	0.70	0.43
Switzerland	0.16	0.91	0.44	0.80	0.73	1.00	0.56	0.79

Appendix Table B.11 (continued): Price Transmission Elasticities, sugar, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$)
Tanzania	0.07	0.37	0.84	0.89	0.33	1.00	0.16	5.25
Thailand	3.85	0.82	0.25	0.91	0.75	1.00	0.75	0.33
Turkey	1.88	0.70	0.36	0.91	0.64	1.00	0.64	0.56
Uganda	0.47	0.78	-0.11	0.94	0.74	0.66	1.11	-0.10
UK	0.83	0.42	0.63	0.77	0.32	0.87	0.37	1.70
Ukraine	1.42	0.22	-0.17	0.96	0.21	0.18	1.17	-0.15
US	3.99	0.31	0.39	0.82	0.25	0.42	0.61	0.64
Vietnam	0.73	0.36	-0.08	0.78	0.28	0.26	1.08	-0.07

Appendix Table B.12: Price Transmission Elasticities, cotton, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity (=Π_1 x mean price ratio)	LR-elasticity	Coefficient of Adjustment (= 1 - Π_2)	Mean Lag (=Π_2 /(1 - Π_2)
Global					**0.57**	**0.73**	**0.68**	**0.82**
Australia	4.76	1.00	-0.05	1.00	1.00	0.95	1.05	-0.05
Benin	0.38	0.04	0.82	1.03	0.04	0.23	0.18	4.56
Brazil	5.95	0.29	0.44	1.00	0.29	0.52	0.56	0.79
Burkina Faso	0.43	-0.07	0.85	1.03	-0.07	-0.48	0.15	5.67
Cameroon	0.23	0.15	0.76	1.01	0.15	0.63	0.24	3.17
Chad	0.14	0.03	0.81	1.03	0.03	0.16	0.19	4.26
China	16.20	0.86	0.04	1.00	0.86	0.90	0.96	0.04
Colombia	0.40	0.52	0.35	0.99	0.51	0.79	0.65	0.54
Cote d'Ivoire	0.87	0.31	0.62	1.07	0.33	0.87	0.38	1.63
Egypt	4.89	0.26	0.71	1.05	0.27	0.94	0.29	2.45
India	14.50	0.92	0.10	0.98	0.90	1.00	0.90	0.11
Israel	0.23	0.31	0.23	0.99	0.31	0.40	0.77	0.30
Mali	0.46	-0.03	0.84	1.04	-0.03	-0.20	0.16	5.25
Mozambique	0.09	0.58	0.75	1.07	0.62	1.00	0.25	3.00
Nigeria	3.90	-0.31	0.74	1.29	-0.40	-1.54	0.26	2.85
Pakistan	4.70	0.48	0.37	1.01	0.48	0.77	0.63	0.59
Senegal	0.04	0.01	0.87	1.03	0.01	0.08	0.13	6.69
Sudan	0.58	1.25	0.43	1.00	1.00	1.00	0.57	0.75
Tanzania	0.71	0.07	0.62	1.31	0.09	0.24	0.38	1.63
Togo	0.16	0.14	0.83	1.05	0.15	0.86	0.17	4.88
Turkey	17.01	0.23	0.62	1.07	0.25	0.65	0.38	1.63

Appendix Table B.12 (continued): Price Transmission Elasticities, cotton, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity (=Π_1 x mean price ratio)	LR-elasticity	Coefficient of Adjustment (= 1 - Π_2)	Mean Lag (=Π_2 /(1 - Π_2)
Uganda	0.11	0.25	0.86	1.05	0.26	1.00	0.14	6.14
US	21.89	0.73	0.23	0.96	0.70	0.91	0.77	0.30
Zambia	0.22	0.31	0.71	1.16	0.36	1.00	0.29	2.45
Zimbabwe	1.15	0.18	0.57	1.15	0.21	0.48	0.43	1.33

Appendix Table B.13: Price Transmission Elasticities, milk, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity (=Π_1 x mean price ratio)	LR-elasticity	Coefficient of Adjustment (= 1 - Π_2)	Mean Lag (=Π_2 /(1 - Π_2)
Global					**0.51**	**0.55**	**0.82**	**0.63**
Argentina	1.46	0.78	0.08	1.00	0.78	0.85	0.92	0.09
Australia	2.03	0.57	0.26	0.97	0.56	0.75	0.74	0.35
Austria	0.74	0.19	0.39	0.91	0.17	0.28	0.61	0.64
Bel-Lux	0.52	0.57	-0.03	0.88	0.50	0.49	1.03	-0.03
Bulgaria	0.31	0.79	0.09	1.00	0.79	0.87	0.91	0.10
Canada	1.63	0.09	0.9	0.85	0.08	0.76	0.10	9.00
Chile	0.41	0.64	0.06	0.97	0.62	0.66	0.94	0.06
China	2.95	0.41	0.76	0.97	0.40	1.00	0.24	3.17
Colombia	0.80	0.12	0.78	0.93	0.11	0.51	0.22	3.55
Czech Republic	0.46	0.51	0.17	0.94	0.48	0.58	0.83	0.20
Denmark	1.05	0.19	0.17	0.89	0.17	0.20	0.83	0.20
Ecuador	0.75	0.31	0.42	0.99	0.31	0.53	0.58	0.72
Egypt	0.92	0.17	0.55	1.02	0.17	0.38	0.45	1.22
Estonia	0.11	1.04	-0.13	0.98	1.00	0.88	1.13	-0.12
Finland	0.57	0.03	0.34	0.89	0.03	0.04	0.66	0.52
France	5.63	0.19	0.18	0.89	0.17	0.21	0.82	0.22
Germany	6.40	0.18	0.19	0.89	0.16	0.20	0.81	0.23
Greece	0.28	0.57	-0.03	0.88	0.50	0.49	1.03	-0.03
Hungary	0.34	0.39	0.21	0.93	0.36	0.46	0.79	0.27
Iceland	0.02	0.08	0.7	0.76	0.06	0.20	0.30	2.33
India	19.49	0.99	-0.2	0.93	0.92	0.77	1.20	-0.17
Ireland	1.21	0.18	0.19	0.89	0.16	0.20	0.81	0.23

Appendix Table B.13 (continued): Price Transmission Elasticities, milk, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity (=Π_1 x mean price ratio)	LR-elasticity	Coefficient of Adjustment (= 1 - Π_2)	Mean Lag (=Π_2 /(1 - Π_2)
Israel	0.22	0.28	0.43	0.92	0.26	0.45	0.57	0.75
Italy	2.54	0.17	0.27	0.89	0.15	0.21	0.73	0.37
Japan	3.56	-0.12	0.76	0.83	-0.10	-0.42	0.24	3.17
Korea	0.46	0.25	0.52	0.85	0.21	0.44	0.48	1.08
Latvia	0.13	1.32	-0.22	1.01	1.00	0.82	1.22	-0.18
Lithuania	0.32	0.82	0.38	1.04	0.85	1.00	0.62	0.61
Mexico	1.60	0.24	0.48	0.90	0.22	0.41	0.52	0.92
Morocco	0.27	0.37	0.03	0.93	0.34	0.36	0.97	0.03
Netherlands	2.49	0.19	0.17	0.89	0.17	0.20	0.83	0.20
New Zealand	2.86	0.97	-0.06	0.99	0.96	0.91	1.06	-0.06
Nicaragua	0.14	0.4	0.29	0.99	0.39	0.56	0.71	0.41
Norway	0.34	-0.01	0.38	0.82	-0.01	-0.01	0.62	0.61
Pakistan	2.08	0.1	0.61	0.96	0.10	0.25	0.39	1.56
Poland	1.85	0.73	0.09	0.96	0.70	0.77	0.91	0.10
Portugal	0.45	0.21	0.1	0.90	0.19	0.21	0.90	0.11
Romania	0.87	0.45	0.23	0.92	0.42	0.54	0.77	0.30
Russia	4.97	1.27	0.09	0.96	1.00	1.00	0.91	0.10
Slovakia	0.17	0.52	0.16	0.94	0.49	0.58	0.84	0.19
Slovenia	0.09	0.35	0.12	0.91	0.32	0.36	0.88	0.14
Spain	1.69	0.19	0.17	0.90	0.17	0.21	0.83	0.20
Sudan	2.47	0.39	0.71	0.99	0.38	1.00	0.29	2.45
Sweden	0.74	0.05	0.43	0.89	0.04	0.08	0.57	0.75

Appendix Table B.13 (continued): Price Transmission Elasticities, milk, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity (=Π_1 x mean price ratio)	LR-elasticity	Coefficient of Adjustment (= 1 - Π_2)	Mean Lag (=Π_2 /(1 - Π_2)
Switzerland	0.79	-0.13	0.68	0.81	-0.11	-0.33	0.32	2.13
Turkey	1.60	0.48	0.42	0.90	0.43	0.74	0.58	0.72
UK	3.34	0.18	0.19	0.89	0.16	0.20	0.81	0.23
Ukraine	2.53	0.68	0.48	1.04	0.71	1.00	0.52	0.92
US	13.37	0.77	0.01	0.92	0.71	0.71	0.99	0.01

Appendix Table B.14: Price Transmission Elasticities, beef, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$)
Global					**0.66**	**0.82**	**0.76**	**0.68**
Argentina	2.96	0.52	0.09	1.02	0.53	0.58	0.91	0.10
Australia	5.72	1	0.01	1.00	1.00	1.00	0.99	0.01
Austria	0.35	0.45	0.43	0.92	0.41	0.73	0.57	0.75
Bel-Lux	0.23	0.63	0.02	0.91	0.57	0.58	0.98	0.02
Brazil	8.31	0.8	0.21	1.01	0.81	1.00	0.79	0.27
Bulgaria	0.07	0.33	0.63	1.01	0.33	0.90	0.37	1.70
Canada	4.98	0.95	0.01	1.00	0.95	0.96	0.99	0.01
Chile	0.48	0.41	0.39	0.98	0.40	0.66	0.61	0.64
Colombia	2.23	0.33	0.45	1.01	0.33	0.60	0.55	0.82
Czech Republic	0.25	0.54	0.17	0.96	0.52	0.63	0.83	0.20
Denmark	0.26	0.39	0.22	0.91	0.36	0.46	0.78	0.28
Ecuador	0.66	0.4	0.35	1.00	0.40	0.62	0.65	0.54
Egypt	2.90	0.1	0.74	0.98	0.10	0.38	0.26	2.85
Estonia	0.03	0.3	0.55	1.00	0.30	0.67	0.45	1.22
Finland	0.16	0.67	0.33	0.91	0.61	0.91	0.67	0.49
France	2.68	0.41	0.21	0.91	0.37	0.47	0.79	0.27
Germany	2.18	0.38	0.25	0.91	0.35	0.46	0.75	0.33
Greece	0.05	0.61	0.03	0.91	0.56	0.57	0.97	0.03
Hungary	0.13	0.42	0.61	0.97	0.41	1.00	0.39	1.56
Iceland	0.01	0.09	0.61	0.92	0.08	0.21	0.39	1.56
Ireland	0.96	0.4	0.22	0.91	0.37	0.47	0.78	0.28
Israel	0.12	1.05	-0.18	0.93	0.97	0.83	1.18	-0.15

Appendix Table B.14 (continued): Price Transmission Elasticities, beef, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$
Italy	1.93	0.39	0.25	0.91	0.36	0.48	0.75	0.33
Japan	4.01	-0.15	0.6	0.91	-0.14	-0.34	0.40	1.50
Korea	0.78	0.48	0.39	0.90	0.43	0.71	0.61	0.64
Latvia	0.03	0.28	0.67	1.01	0.28	0.85	0.33	2.03
Lithuania	0.08	0.4	0.59	0.99	0.40	0.97	0.41	1.44
Mexico	7.12	0.47	0.51	0.99	0.47	0.95	0.49	1.04
Morocco	0.55	0.18	0.57	0.91	0.16	0.38	0.43	1.33
Netherlands	0.67	0.4	0.23	0.91	0.37	0.47	0.77	0.30
New Zealand	1.38	0.91	0.02	1.00	0.91	0.93	0.98	0.02
Nicaragua	0.78	0.4	0.85	1.03	0.41	1.00	0.15	5.67
Norway	0.15	0.06	0.71	0.85	0.05	0.18	0.29	2.45
Philippines	0.81	0.78	0.28	0.98	0.76	1.00	0.72	0.39
Poland	0.58	0.56	0.62	0.98	0.55	1.00	0.38	1.63
Portugal	0.18	0.43	0.04	0.92	0.39	0.41	0.96	0.04
Romania	0.37	0.3	0.55	0.98	0.29	0.65	0.45	1.22
RSA	1.44	0.62	0.42	1.01	0.62	1.00	0.58	0.72
Russia	2.98	0.53	0.54	1.00	0.53	1.00	0.46	1.17
Slovakia	0.09	0.58	0.45	0.97	0.56	1.00	0.55	0.82
Slovenia	0.06	0.49	0.2	0.93	0.46	0.57	0.80	0.25
Spain	1.15	0.41	0.19	0.92	0.38	0.46	0.81	0.23
Sudan	4.89	0.15	0.82	1.17	0.18	0.98	0.18	4.56
Sweden	0.24	0.44	0.4	0.92	0.40	0.67	0.60	0.67

Appendix Table B.14 (continued): Price Transmission Elasticities, beef, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$)
Switzerland	0.26	0.24	0.61	0.88	0.21	0.54	0.39	1.56
Taiwan	0.03	0.31	0.49	0.93	0.29	0.56	0.51	0.96
Turkey	1.08	0.36	0.6	0.93	0.33	0.84	0.40	1.50
UK	1.18	0.4	0.25	0.91	0.37	0.49	0.75	0.33
Ukraine	1.23	0.81	0.18	1.00	0.81	0.99	0.82	0.22
US	30.25	1.00	-0.01	1.00	1.00	0.99	1.01	-0.01

Appendix Table B.15: Price Transmission Elasticities, pigmeat, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2 /(1 - \Pi_2$)
Global					**0.51**	**0.83**	**0.57**	**1.59**
Australia	0.54	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Austria	0.68	0.62	0.07	0.97	0.60	0.65	0.93	0.08
Bel-Lux	0.91	0.72	0.02	0.98	0.70	0.72	0.98	0.02
Brazil	1.08	0.73	0.25	1.00	0.73	0.98	0.75	0.33
Bulgaria	0.13	0.73	0.33	1.00	0.73	1.00	0.67	0.49
Canada	2.37	0.90	0.00	1.00	0.90	0.90	1.00	0.00
China	47.09	0.37	0.75	1.02	0.38	1.00	0.25	3.00
Czech Republic	0.44	0.59	0.11	0.98	0.58	0.65	0.89	0.12
Denmark	1.85	0.68	-0.04	0.98	0.66	0.64	1.04	-0.04
Ecuador	0.19	0.37	0.58	1.00	0.37	0.88	0.42	1.38
Estonia	0.04	0.48	0.51	0.99	0.48	0.97	0.49	1.04
Finland	0.20	0.79	0.41	0.96	0.76	1.00	0.59	0.69
France	2.47	0.68	-0.04	0.98	0.66	0.64	1.04	-0.04
Germany	4.43	0.68	-0.04	0.98	0.66	0.64	1.04	-0.04
Greece	0.10	0.73	0.00	0.98	0.71	0.71	1.00	0.00
Hungary	0.58	0.6	0.05	0.97	0.58	0.61	0.95	0.05
Iceland	0.01	-0.03	0.87	0.88	-0.03	-0.20	0.13	6.69
Ireland	0.24	0.68	-0.04	0.98	0.66	0.64	1.04	-0.04
Italy	1.64	0.68	-0.03	0.98	0.66	0.64	1.03	-0.03
Japan	4.53	0.02	0.42	0.97	0.02	0.03	0.58	0.72
Korea	0.96	0.55	0.12	0.89	0.49	0.56	0.88	0.14
Latvia	0.03	0.6	0.38	0.97	0.58	0.94	0.62	0.61
Lithuania	0.08	0.38	0.49	0.97	0.37	0.72	0.51	0.96

Appendix Table B.15 (continued): Price Transmission Elasticities, pigmeat, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2 /(1 - \Pi_2$)
Mexico	1.70	0.34	0.54	1.01	0.34	0.74	0.46	1.17
Netherlands	1.48	0.68	-0.05	0.98	0.66	0.63	1.05	-0.05
New Zealand	0.09	1.03	-0.04	1.00	1.00	0.96	1.04	-0.04
Norway	0.11	0.25	0.62	0.88	0.22	0.58	0.38	1.63
Philippines	1.99	0.21	0.65	0.98	0.21	0.59	0.35	1.86
Poland	2.27	0.78	0.26	1.00	0.78	1.00	0.74	0.35
Portugal	0.34	0.68	-0.02	0.98	0.66	0.65	1.02	-0.02
Romania	0.59	0.61	0.18	0.97	0.59	0.72	0.82	0.22
Russia	1.72	1.15	0.41	0.96	1.00	1.00	0.59	0.69
Slovakia	0.16	0.44	0.13	0.97	0.43	0.49	0.87	0.15
Slovenia	0.07	0.55	-0.02	0.97	0.53	0.52	1.02	-0.02
Spain	3.28	0.68	-0.04	0.97	0.66	0.64	1.04	-0.04
Sweden	0.30	0.62	0.27	0.97	0.60	0.82	0.73	0.37
Switzerland	0.26	0.31	0.23	0.88	0.27	0.35	0.77	0.30
Taiwan	0.90	0.02	0.58	0.90	0.02	0.04	0.42	1.38
Thailand	0.80	0.37	0.4	0.99	0.37	0.61	0.60	0.67
UK	0.81	0.67	-0.02	0.98	0.65	0.64	1.02	-0.02
Ukraine	0.79	0.26	0.8	0.99	0.26	1.00	0.20	4.00
US	10.65	0.98	0.00	1.00	0.98	0.98	1.00	0.00
Vietnam	1.09	-0.37	0.45	1.05	-0.39	-0.70	0.55	0.82

Appendix Table B.16: Price Transmission Elasticities, poultry, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$
Global					**0.68**	**0.89**	**0.69**	**0.65**
Australia	0.99	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Austria	0.13	0.5	0.42	0.93	0.47	0.80	0.58	0.72
Bel-Lux	0.32	0.55	0.19	0.92	0.50	0.62	0.81	0.23
Brazil	6.05	1.11	-0.06	1.01	1.00	0.94	1.06	-0.06
Bulgaria	0.11	0.23	0.35	0.96	0.22	0.34	0.65	0.54
Canada	2.22	0.82	0.66	0.98	0.81	1.00	0.34	1.94
China	27.43	0.67	0.50	1.01	0.68	1.00	0.50	1.00
Czech Republic	0.26	0.55	0.01	0.94	0.52	0.52	0.99	0.01
Denmark	0.24	0.67	0.40	0.92	0.62	1.00	0.60	0.67
Dominican Republic	0.22	0.35	0.54	1.02	0.36	0.78	0.46	1.17
Ecuador	0.69	0.03	0.51	1.00	0.03	0.06	0.49	1.04
Estonia	0.01	0.69	0.03	0.95	0.65	0.67	0.97	0.03
Finland	0.09	0.59	0.33	0.94	0.55	0.83	0.67	0.49
France	2.45	0.69	0.38	0.92	0.63	1.00	0.62	0.61
Germany	1.07	0.64	0.47	0.92	0.59	1.00	0.53	0.89
Greece	0.10	0.58	0.08	0.92	0.53	0.58	0.92	0.09
Hungary	0.70	0.63	-0.08	0.94	0.59	0.55	1.08	-0.07
Iceland	0.00	0.10	0.63	0.78	0.08	0.21	0.37	1.70
Indonesia	1.42	0.35	0.53	0.91	0.32	0.67	0.47	1.13
Ireland	0.15	0.74	0.35	0.92	0.68	1.00	0.65	0.54
Israel	0.73	0.51	0.69	0.99	0.51	1.00	0.31	2.23
Italy	1.24	0.64	0.40	0.92	0.59	0.98	0.60	0.67

Appendix Table B.16 (continued): Price Transmission Elasticities, poultry, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$
Japan	3.69	0.71	0.50	0.97	0.69	1.00	0.50	1.00
Korea	0.53	0.07	0.64	0.90	0.06	0.17	0.36	1.78
Latvia	0.01	0.88	0.02	0.93	0.82	0.84	0.98	0.02
Lithuania	0.04	0.83	0.16	0.93	0.77	0.92	0.84	0.19
Mexico	3.69	0.21	0.49	0.94	0.20	0.39	0.51	0.96
Morocco	0.76	0.29	-0.09	0.97	0.28	0.26	1.09	-0.08
Netherlands	0.82	0.69	0.44	0.92	0.63	1.00	0.56	0.79
New Zealand	0.25	1.12	0.11	0.95	1.00	1.00	0.89	0.12
Nicaragua	0.12	0.00	0.01	0.96	0.00	0.00	0.99	0.01
Norway	0.02	0.53	0.21	0.81	0.43	0.54	0.79	0.27
Philippines	0.25	0.37	0.69	0.94	0.35	1.00	0.31	2.23
Poland	0.94	0.64	0.20	0.95	0.61	0.76	0.80	0.25
Portugal	0.29	0.7	0.33	0.92	0.64	0.96	0.67	0.49
Romania	0.37	0.42	0.45	0.93	0.39	0.71	0.55	0.82
RSA	2.47	0.77	0.27	1.00	0.77	1.00	0.73	0.37
Russia	1.51	1.5	-0.08	0.95	1.00	0.93	1.08	-0.07
Slovakia	0.11	0.72	0.03	0.93	0.67	0.69	0.97	0.03
Slovenia	0.06	0.77	0.36	0.92	0.71	1.00	0.64	0.56
Spain	1.34	0.77	0.28	0.92	0.71	0.98	0.72	0.39
Sweden	0.11	0.67	0.11	0.94	0.63	0.71	0.89	0.12
Switzerland	0.03	0.68	0.17	0.77	0.52	0.63	0.83	0.20
Taiwan	0.81	0.07	0.75	0.88	0.06	0.25	0.25	3.00
Thailand	1.91	0.37	0.77	0.99	0.37	1.00	0.23	3.35

Appendix Table B.16 (continued): Price Transmission Elasticities, poultry, all focus countries, 1985 to 2010

	Country share of value of production	Estimated coefficient of Pb (Π_1)	Estimated coefficient of Pd lagged (Π_2)	Mean price ratio ([mean Pd/mean Pb])	SR-elasticity ($=\Pi_1$ x mean price ratio)	LR-elasticity	Coefficient of Adjustment ($= 1 - \Pi_2$)	Mean Lag ($=\Pi_2/(1 - \Pi_2)$
Turkey	1.19	0.88	0.13	0.94	0.83	0.95	0.87	0.15
UK	1.81	0.66	0.39	0.92	0.61	0.99	0.61	0.64
Ukraine	0.42	0.64	-0.09	0.95	0.61	0.56	1.09	-0.08
US	29.25	0.76	0.11	1.00	0.76	0.85	0.89	0.12
Vietnam	0.58	0.86	0.13	1.00	0.86	0.99	0.87	0.15

Appendix C: Stability measures of domestic producer and border prices

Appendix Table C.1: Relative stability[a] of domestic producer and border prices of all covered agricultural products, by country, 1955-84 and 1985-2010

	SDd/SDb	SDd/SDb	CVd/CVb	CVd/CVb	Zd/Zb	Zd/Zb
	1955-1984	1985-2010	1955-1984	1985-2010	1955-1984	1985-2010
Africa	**0.88**	**1.21**	**1.06**	**1.18**	**0.80**	**1.15**
Asia (excl. Japan)	**0.67**	**0.98**	**0.70**	**0.96**	**0.75**	**0.85**
Latin America	**0.84**	**0.97**	**0.96**	**1.01**	**0.61**	**1.01**
DCs	**0.73**	**1.01**	**0.80**	**0.99**	**0.74**	**0.91**
ECA	**0.76**	**1.18**	**0.90**	**1.05**	**0.56**	**1.16**
HIC	**1.26**	**1.34**	**0.94**	**0.95**	**1.11**	**1.12**
World	**1.02**	**1.14**	**0.88**	**0.98**	**0.97**	**1.01**
Argentina	0.74	0.78	0.99	0.94	0.70	0.80
Australia	0.94	1.01	0.89	0.99	0.98	1.00
Austria	0.94	1.48	0.71	1.02	0.62	1.00
Bangladesh	1.30	1.14	1.34	1.17	1.88	0.73
Bel-Lux	1.27	0.93	0.67	0.74	1.13	1.03
Benin	0.98	0.96	0.98	0.97	0.97	0.96
Brazil	0.59	0.98	0.74	1.05	0.47	0.98
Bulgaria	na	1.12	na	1.19	na	1.18
Burkina Faso	0.96	0.93	0.98	0.94	0.95	0.93
Cameroon	0.75	1.02	0.84	1.04	0.75	0.95
Canada	1.11	1.07	0.98	0.97	1.07	0.95
Chad	0.87	0.97	0.93	0.98	0.84	0.96
Chile	0.70	1.15	0.71	1.05	0.81	0.91
China	0.20	0.85	0.44	0.94	na	0.72
Colombia	0.92	0.78	0.97	0.72	0.79	0.91
Cote d'Ivoire	0.53	0.77	0.76	1.08	0.49	0.67
Cyprus	na	0.98	na	0.90	na	na
Czech Rep	na	0.86	na	0.78	na	0.98
Denmark	1.70	1.16	1.03	0.86	1.38	0.93
Dominican Rep	0.75	0.84	0.78	0.91	0.52	0.92
Ecuador	0.66	0.80	0.75	0.86	0.68	1.12
Egypt	0.90	2.38	1.37	1.91	0.56	2.02
Estonia	na	1.01	na	0.93	na	0.95
Ethiopia	1.13	0.88	1.27	0.97	na	0.87

Appendix Table C.1 (continued): Relative stability[a] of domestic producer and border prices of all covered agricultural products, by country, 1955-84 and 1985-2010

	SDd/SDb	SDd/SDb	CVd/CVb	CVd/CVb	Zd/Zb	Zd/Zb
	1955-1984	1985-2010	1955-1984	1985-2010	1955-1984	1985-2010
Finland	2.06	3.14	1.11	1.65	1.15	1.79
France	1.46	1.34	0.89	0.97	1.33	0.97
Germany	1.42	1.24	0.81	0.89	1.42	0.96
Ghana	1.03	0.99	1.52	1.01	0.95	1.13
Greece	na	0.91	na	0.78	na	0.92
Hungary	na	0.96	na	0.89	na	1.13
Iceland	2.99	3.84	0.86	1.42	na	2.39
India	0.79	1.11	0.70	0.99	0.62	0.95
Indonesia	0.92	0.99	0.86	0.98	0.79	0.96
Ireland	2.51	1.17	1.20	0.72	1.58	0.96
Israel	na	1.03	na	0.91		1.20
Italy	1.33	1.20	0.99	0.94	1.27	0.99
Japan	2.04	3.70	0.96	1.29	1.02	2.61
Kenya	0.74	0.86	0.82	0.96	0.62	0.77
Korea	1.94	3.63	1.33	1.29	1.07	3.02
Latvia	na	1.18	na	1.08	na	1.07
Lithuania	na	1.27	na	1.17	na	1.17
Madagascar	0.51	1.01	0.78	1.15	0.53	0.94
Malaysia	0.73	0.88	0.83	0.98	0.68	0.82
Mali	0.92	0.92	0.97	0.94	0.91	0.92
Malta	na	1.06	na	0.99	na	
Mexico	1.52	1.13	1.52	1.05	na	1.20
Morocco	na	1.16	na	0.85	na	1.11
Mozambique	0.72	0.99	1.33	1.01	0.19	0.94
Netherlands	1.88	1.10	0.95	0.79	1.68	0.98
Newzealand	1.04	1.02	0.95	0.97	1.14	1.11
Nicaragua	na	1.27	na	1.38	na	0.80
Nigeria	1.15	1.18	1.03	1.10	1.20	1.32
Norway	1.86	2.67	0.49	0.94	na	1.73
Pakistan	1.01	0.71	1.06	0.72	0.78	0.55
Philippines	0.64	1.05	0.67	0.88	0.62	0.77
Poland	na	1.04	na	0.92	na	1.12
Portugal	1.34	1.11	1.12	0.90	1.43	1.18
Romania	na	1.11	na	0.92	na	1.40
Russia	na	1.53	na	1.33	na	1.32
Senegal	0.46	1.53	0.61	1.50	0.48	0.68

Appendix Table C.1 (continued): Relative stability[a] of domestic producer and border prices of all covered agricultural products, by country, 1955-84 and 1985-2010

	SDd/SDb	SDd/SDb	CVd/CVb	CVd/CVb	Zd/Zb	Zd/Zb
	1955-1984	1985-2010	1955-1984	1985-2010	1955-1984	1985-2010
Slovakia	na	0.89	na	0.79	na	0.93
Slovenia	na	1.10	na	0.75	na	1.09
South Africa	0.77	1.02	0.72	0.97	0.79	1.15
Spain	0.65	1.20	0.63	0.93	0.65	0.89
Sri Lanka	1.09	1.08	1.33	1.11	0.81	0.94
Sudan	0.90	1.30	1.31	1.44	0.80	0.97
Sweden	1.56	1.66	0.66	1.08	1.02	1.20
Switzerland	3.04	3.45	0.91	1.14	na	1.97
Taiwan	1.01	1.47	0.95	0.68	1.08	1.96
Tanzania	0.48	0.71	1.22	0.98	na	0.58
Thailand	0.53	0.97	0.64	0.98	0.52	0.94
Togo	0.99	0.96	1.00	0.97	0.98	0.95
Turkey	0.76	1.16	0.90	0.93	0.56	1.09
Uganda	0.85	0.98	0.92	1.00	0.84	0.98
United Kingdom	1.77	1.31	1.28	0.89	1.64	1.00
Ukraine	na	0.95	na	1.04	na	0.96
United States	1.00	0.98	0.95	0.91	0.95	0.96
Vietnam	na	0.83	na	0.90	na	1.07
Zambia	0.52	1.09	0.87	1.83	0.32	0.76
Zimbabwe	0.60	0.69	0.94	1.34	0.49	0.66

[a] SDd/SDb is the standard deviation of the domestic producer price relative to that for the border price, CVd/CVb is the coefficient of variation (the standard deviation divided by the sample mean) of the domestic producer price relative to that for the border price, and Zd/Zb is the Z-Statistic (defined in equation (4), Chapter 2) of the domestic producer price relative to that for the border price.

Source: Authors' estimates based on prices compiled by Anderson and Nelgen (2012b).

Appendix Table C.2: Relative stability[a] of domestic producer and border prices of all covered agricultural products, by product, developing countries, 1955-84 and 1985-2010

	SDd/SDb	SDd/SDb	CVd/CVb	CVd/CVb	Zd/Zb	Zd/Zb
	1955-1984	1985-2010	1955-1984	1985-2010	1955-1984	1985-2010
Apple	1.19	1.23	1.16	1.03	1.17	1.32
Banana	0.76	0.99	0.96	1.08	0.83	1.00
Barley	2.11	1.21	1.15	0.78	2.67	1.14
Bean	0.75	0.71	0.98	0.83	1.09	0.77
Beef	1.08	1.33	1.24	1.27	0.83	1.34
Cabbage	na	1.20	na	0.96	na	1.13
Camel	1.44	0.06	1.81	0.29	0.99	0.08
Cashew	0.14	0.66	0.95	1.13	0.09	0.34
Cassava	1.00	1.01	1.00	1.03	1.01	1.03
Chat	na	0.52	na	0.91	na	0.51
Chickpea	1.10	1.10	1.01	1.05	1.29	1.26
Chillies	na	0.98	na	0.67	na	0.88
Clementine	na	1.08	na	0.95	na	1.15
Clove	0.22	0.74	0.87	1.83	0.21	0.43
Cocoa	0.56	0.75	1.09	1.13	0.44	0.75
Coconut	0.96	1.86	1.04	1.82	0.89	1.00
Coffee	0.55	0.84	0.88	0.94	0.49	0.75
Cotton	0.84	1.18	0.98	1.16	0.75	1.47
Egg	1.78	0.99	1.81	0.95	0.85	1.24
Fruit&Veg	0.91	0.96	0.99	1.00	0.95	0.92
Fruits	na	0.89	na	0.93	na	1.14
Garlic	1.74	3.15	0.79	1.16	2.16	1.75
Grape	0.87	1.04	0.91	1.02	0.75	0.98
Groundnut	0.81	1.49	0.89	1.44	1.05	0.86
Gumarabic	0.31	0.41	0.63	1.10	0.34	0.44
Hides&Skins	na	0.45	na	0.90	na	0.50
Jute	0.56	0.68	0.86	0.99	0.55	0.95
Maize	0.84	1.17	0.87	1.13	0.93	0.87
Melon	na	1.00	na	1.01	na	1.00
Milk	1.58	1.11	1.02	0.87	0.80	1.03
Millet	1.13	1.07	1.34	1.07	1.03	1.12
Oilseed	na	0.43	na	0.89	na	0.42
Olive	na	0.94	na	0.75	na	0.82
Onion	0.99	0.62	0.71	0.40	1.72	0.73
Orange	0.57	0.94	0.68	0.96	0.74	1.01
Otherroots&Tubers	1.00	1.00	1.00	1.00	1.00	1.00

Appendix Table C.2 (continued): Relative stability[a] of domestic producer and border prices of all covered agricultural products, by product, developing countries, 1955-84 and 1985-2010

	SDd/SDb	CVd/CVb	SDd/SDb	CVd/CVb	Zd/Zb	Zd/Zb
	1955-1984	1955-1984	1985-2010	1985-2010	1955-1984	1985-2010
Palmoil	0.76	0.90	0.90	1.01	0.64	0.81
Pepper	1.01	2.60	1.43	0.94	1.01	2.06
Pigmeat	0.44	0.98	0.83	1.07	1.46	0.55
Plantain	1.00	1.00	1.00	1.00	1.00	1.00
Potato	0.98	0.93	0.96	0.88	1.00	0.88
Poultry	1.23	1.08	0.91	1.05	1.64	1.81
Pulse	na	0.49	na	0.91	na	0.66
Pyrethrum	na	0.70	na	1.56	na	0.76
Rapeseed	0.89	2.17	0.66	1.31	1.12	2.00
Rice	0.53	1.00	0.61	0.96	0.50	0.81
Rubber	0.73	1.11	0.88	1.05	0.72	0.83
Sesame	0.39	1.04	0.96	1.52	0.40	0.92
Sheepmeat	0.90	1.14	1.20	1.36	0.94	1.06
Sisal	na	1.24	na	1.35	na	0.85
Sorghum	1.47	1.41	1.12	1.17	1.46	1.63
Soybean	0.76	0.99	0.77	1.04	0.71	0.91
Strawberry	na	1.22	na	1.36	na	1.22
Sugar	0.39	1.03	0.42	0.94	0.35	0.85
Sunflower	0.81	0.76	0.96	0.81	0.91	0.75
Sweet potato	1.00	1.00	1.00	1.00	1.00	1.00
Tea	0.97	1.03	1.35	1.20	1.05	1.10
Teff	na	0.86	na	0.92	na	0.81
Tobacco	0.69	1.12	1.27	2.05	0.76	1.15
Tomato	0.34	0.74	0.48	1.01	1.64	0.62
Vanilla	0.37	0.90	0.95	2.17	0.94	0.59
Vegetables	na	0.30	na	0.42	na	0.62
Wheat	1.04	1.19	0.99	1.06	0.93	0.92
Yam	1.02	1.00	1.01	1.01	1.01	1.01

[a] SDd/SDb is the standard deviation of the domestic producer price relative to that for the border price, CVd/CVb is the coefficient of variation (the standard deviation divided by the sample mean) of the domestic producer price relative to that for the border price, and Zd/Zb is the Z-Statistic (defined in equation (10) of the text) of the domestic producer price relative to that for the border price.

Source: Authors' estimates based on prices compiled by Anderson and Nelgen (2012b).

Appendix D: Global and national WRI and TRI estimates

Appendix Table D.1: Global TRI by commodity, 1965-2010

(percent)

(a) TRI

	65-71	'72	'73	'74	'75	'76	77-83	'84	'85	'86	'87	'88	89-04	'05	'06	'07	'08	'09	'10
Grains	**26**	**20**	**14**	**12**	**19**	**25**	**21**	**18**	**21**	**41**	**48**	**40**	**22**	**13**	**4**	**6**	**11**	**6**	**0**
Rice	51	93	49	32	43	39	44	41	52	66	74	58	42	30	21	19	27	23	21
Wheat	14	1	-24	-15	-7	-6	6	9	13	32	39	31	11	8	-7	3	-3	-10	-7
Maize	7	6	2	3	7	9	2	-3	-6	9	15	16	5	-4	-5	0	4	-3	-7
Cassava	17	32	39	8	0	-1	4	20	28	-1	20	19	11	na	na	na	na	na	na
Barley	25	-4	5	0	-9	15	-13	5	-3	68	93	43	18	5	3	6	8	4	-3
Sorghum	62	68	64	65	26	97	21	17	18	30	50	18	10	87	6	-4	27	21	0
Millet	60	49	18	8	19	8	-5	9	9	53	-62	-87	-46	na	na	na	na	na	na
Oat	5	-13	-14	-7	-10	-21	-4	-6	-8	9	22	-2	8	2	4	1	1	3	3
Oilseeds	**8**	**6**	**4**	**4**	**12**	**8**	**7**	**9**	**12**	**19**	**24**	**17**	**9**	**12**	**11**	**24**	**24**	**18**	**8**
Soybean	0	0	2	0	4	5	6	10	14	6	9	8	6	8	9	8	5	10	7
Groundnut	31	18	59	53	38	26	24	23	32	59	79	12	-6	-33	-40	-77	-31	-3	0
Palmoil	28	12	-18	-1	15	-3	-7	-6	-11	-13	4	22	7	19	13	51	48	32	na
Rapeseed	19	21	-1	0	-1	-1	10	3	0	52	76	62	20	13	23	13	0	0	0
Sunflower	-5	-1	-14	-19	4	-3	-9	-5	9	59	62	36	21	14	15	-4	13	2	21
Sesame	63	61	62	70	64	60	61	62	24	61	54	34	42	-45	-10	-39	-45	-110	na

Appendix Table D.1 (continued): Global TRI by commodity, 1965-2010

(percent)

(a) TRI

	65-71	'72	'73	'74	'75	'76	77-83	'84	'85	'86	'87	'88	89-04	'05	'06	'07	'08	'09	'10
Tropicalcrops	**38**	**27**	**9**	**20**	**37**	**23**	**28**	**40**	**41**	**38**	**40**	**31**	**26**	**2**	**4**	**-1**	**-11**	**-1**	**23**
Sugar	103	36	4	21	49	38	41	81	79	67	63	47	45	9	21	7	8	15	9
Cotton	5	19	15	16	15	6	9	-3	7	15	24	13	5	4	4	5	-12	17	50
Coconut	19	1	4	13	9	-5	6	25	22	6	17	21	22	-47	-106	-64	-90	-138	na
Coffee	31	34	29	32	28	49	43	51	36	29	35	44	9	8	9	9	6	-12	0
Rubber	10	2	2	14	8	9	21	14	10	15	21	16	3	-13	-11	-23	-32	-55	na
Tea	30	31	28	28	23	36	25	16	16	20	22	32	20	-4	-6	-2	-1	7	na
Cocoa	48	37	44	50	34	54	53	54	49	46	34	25	28	21	17	27	29	33	na
Livestock	**37**	**36**	**31**	**29**	**39**	**49**	**51**	**61**	**52**	**54**	**55**	**49**	**28**	**11**	**11**	**8**	**7**	**12**	**5**
Pigmeat	34	26	29	17	19	33	36	54	20	28	26	31	11	6	7	6	0	17	-2
Milk	88	87	71	80	99	126	141	138	150	143	163	101	56	18	15	7	10	10	8
Beef	19	23	17	5	17	20	21	52	52	53	48	43	32	18	15	14	11	11	7
Poultry	22	32	27	24	22	26	25	21	19	27	34	33	21	10	10	8	10	10	7
Egg	-10	-15	-14	19	11	-2	11	0	5	20	7	14	10	6	5	2	2	2	2
Sheepmeat	72	67	114	123	144	163	95	66	38	60	81	87	34	21	25	18	14	15	8
Wool	-4	-2	-2	-3	-3	-4	-6	-6	-3	-4	-3	-3	-2	0	0	0	0	0	0
29comm	**31**	**27**	**20**	**18**	**28**	**33**	**33**	**37**	**36**	**45**	**49**	**42**	**24**	**11**	**8**	**9**	**9**	**10**	**5**

Appendix Table D.2: Global WRI by commodity, 1965-2010

(percent)

(b) WRI

	65-71	‘72	‘73	‘74	‘75	‘76	77-83	‘84	‘85	‘86	‘87	‘88	89-04	‘05	‘06	‘07	‘08	‘09	‘10
Grains	**49**	**50**	**42**	**35**	**37**	**47**	**54**	**49**	**62**	**106**	**125**	**100**	**71**	**60**	**41**	**29**	**30**	**32**	**29**
Rice	70	138	70	53	56	63	79	85	113	172	193	149	135	103	70	58	51	46	65
Wheat	37	20	34	28	20	16	30	27	37	64	83	62	33	34	29	15	23	23	22
Maize	27	33	15	15	19	27	31	20	24	53	70	53	25	27	22	21	14	21	16
Cassava	17	32	39	8	1	1	11	20	28	1	20	19	12	na	na	na	na	na	na
Barley	53	43	13	8	23	21	42	36	48	136	180	93	58	45	25	16	15	31	23
Sorghum	91	115	84	75	58	133	57	51	53	50	104	43	43	173	66	48	56	39	0
Millet	61	50	23	18	24	18	28	19	18	54	69	93	68	na	na	na	na	na	na
Oat	75	64	48	43	79	71	78	37	42	111	91	44	50	29	15	5	5	18	19
Oilseeds	**17**	**16**	**12**	**11**	**17**	**16**	**24**	**26**	**28**	**42**	**46**	**36**	**30**	**28**	**28**	**38**	**32**	**28**	**21**
Soybean	8	9	9	5	11	13	22	27	32	29	30	30	28	29	29	20	17	21	23
Groundnut	38	28	59	55	41	33	43	33	38	74	97	19	45	52	52	83	33	64	0
Palmoil	31	21	32	35	17	14	22	29	21	24	20	31	29	26	22	54	52	42	na
Rapeseed	34	38	3	2	3	3	19	7	7	86	104	82	35	37	49	30	0	0	0
Sunflower	11	5	19	30	6	4	37	32	21	82	90	57	32	20	27	33	32	16	29
Sesame	63	61	62	70	65	60	61	62	25	61	55	35	45	52	22	39	45	110	na

Appendix Table D.2: Global WRI by commodity, 1965-2010

(percent)

(b) WRI

	65-71	'72	'73	'74	'75	'76	77-83	'84	'85	'86	'87	'88	89-04	'05	'06	'07	'08	'09	'10
Tropicalcrops	**76**	**47**	**40**	**46**	**49**	**42**	**46**	**65**	**68**	**64**	**69**	**57**	**52**	**62**	**58**	**59**	**52**	**68**	**38**
Sugar	161	52	46	60	61	56	68	122	132	110	116	87	78	78	47	56	60	63	22
Cotton	53	55	49	33	33	33	30	29	31	36	45	41	37	44	57	52	33	64	73
Coconut	20	10	7	14	12	11	17	26	24	15	20	22	26	57	142	90	100	164	na
Coffee	34	37	33	38	36	58	48	56	40	37	42	49	22	21	21	25	21	38	0
Rubber	18	17	16	22	19	22	24	19	13	19	25	19	20	86	88	99	77	95	na
Tea	36	35	30	32	31	49	40	35	33	39	32	40	32	25	9	4	3	7	na
Cocoa	52	39	49	51	40	60	59	57	54	51	38	29	36	45	48	48	45	45	na
Livestock	**77**	**77**	**60**	**52**	**66**	**86**	**86**	**90**	**85**	**94**	**97**	**80**	**57**	**34**	**34**	**29**	**30**	**34**	**27**
Pigmeat	77	64	63	45	44	71	64	66	36	45	47	48	29	23	27	23	39	38	33
Milk	160	158	120	123	147	197	213	182	188	226	280	157	92	41	43	29	24	36	31
Beef	39	48	33	20	38	41	50	104	110	109	88	82	71	49	41	37	25	27	19
Poultry	39	53	42	36	38	45	47	45	51	47	59	47	48	34	33	33	35	39	24
Egg	39	37	17	25	15	11	23	17	28	46	34	42	33	31	24	19	16	16	17
Sheepmeat	139	138	185	171	190	232	141	109	67	92	130	137	54	35	47	46	24	30	19
Wool	4	3	3	3	5	6	10	10	6	11	8	7	9	8	8	9	9	8	7
29comm	**62**	**60**	**48**	**41**	**49**	**60**	**64**	**66**	**70**	**92**	**100**	**82**	**59**	**44**	**38**	**33**	**32**	**35**	**28**

Source: Derived from estimates reported in Croser and Anderson 2009, updated from Anderson and Nelgen (2012b).

Appendix Table D.3: Global TRI by country, all covered farm products, 1965-2010
(percent)

(a) TRI

	65-71	'72	'73	'74	'75	'76	77-83	'84	'85	'86	'87	'88	89-04	'05	'06	'07	'08	'09	'10
Asia	**29**	**29**	**25**	**24**	**36**	**25**	**30**	**40**	**34**	**44**	**51**	**42**	**17**	**5**	**3**	**11**	**8**	**10**	**-3**
Banglasdesh	na	na	na	-13	91	-5	-9	16	38	22	45	12	1	16	-5	-10	-25	-15	na
China	na	na	na	na	na	na	43	46	31	44	53	50	10	1	-3	3	6	13	-5
India	35	37	53	51	56	41	41	39	80	95	113	36	22	1	-6	-6	-31	-24	na
Indonesia	11	-5	-15	1	13	14	9	23	19	10	3	-1	6	13	13	33	16	-3	na
Korea	30	88	20	-22	11	54	108	118	136	145	153	170	180	115	135	101	63	75	55
Malaysia	6	11	4	2	2	26	18	22	21	23	29	16	8	11	17	47	52	47	na
Pakistan	44	46	-37	-6	7	-1	4	7	13	14	10	20	0	4	6	6	-24	7	na
Philippines	4	21	-14	-25	-5	8	1	4	25	20	16	8	27	1	11	19	-18	4	na
Sri Lanka	18	24	37	3	9	9	19	12	18	14	-7	-9	15	-12	-40	-22	-4	13	na
Taiwan	-8	-28	-12	2	-12	-16	-12	-23	-32	-37	-46	-51	61	na	na	na	na	na	na
Thailand	23	21	16	44	28	12	16	8	10	10	9	11	6	0	6	-20	6	-8	na
Vietnam	na	na	na	na	na	na	na	na	na	10	27	3	8	-4	na	na	na	na	na
Latin America	**14**	**21**	**25**	**33**	**33**	**16**	**17**	**19**	**22**	**9**	**17**	**16**	**10**	**-6**	**6**	**2**	**6**	**6**	**1**
Argentina	24	30	35	38	41	32	20	22	22	19	13	10	9	21	27	30	39	33	na
Brazil	14	29	33	43	37	16	18	12	18	7	16	19	4	-1	0	-1	0	2	1
Chile	-7	-24	-21	-22	-13	-7	8	19	32	40	29	13	13	5	3	-4	1	-1	1
Colombia	7	14	6	2	8	4	14	21	16	8	8	10	2	-10	-3	-12	-6	4	na
DominicanRepublic	25	17	7	30	39	10	32	49	60	43	15	23	41	44	26	27	-2	-2	na
Ecuador	15	9	4	18	31	39	41	40	53	40	14	18	6	-13	-19	-38	-21	-11	na
Mexico	na	na	na	na	na	na	14	24	26	1	21	15	16	-24	8	-2	3	4	1
Nicaragua	na	na	na	na	na	na	na	na	na	na	na	na	18	13	13	17	0	30	na

Appendix Table D.3 (continued): Global TRI by country, all covered farm products, 1965-2010

(percent)

(a) TRI

	65-71	'72	'73	'74	'75	'76	77-83	'84	'85	'86	'87	'88	89-04	'05	'06	'07	'08	'09	'10
Africa	**22**	**19**	**18**	**23**	**25**	**31**	**19**	**32**	**31**	**52**	**66**	**54**	**18**	**42**	**15**	**-7**	**16**	**7**	**-1**
Cameroon	34	32	42	46	33	54	41	46	31	22	0	-9	6	-10	-11	-10	-1	7	na
Cote d'ivoire	23	42	51	12	32	73	38	40	44	47	44	16	30	35	46	54	42	56	na
Egypt	0	-9	-4	18	14	8	8	36	17	89	136	120	18	9	10	-3	7	-4	na
Ethiopia	na	na	na	na	na	na	42	40	56	49	51	61	48	4	8	4	3	-7	na
Ghana	22	37	12	2	18	45	53	107	50	54	102	68	25	23	15	-12	29	15	na
Kenya	-17	-1	-7	-2	-17	-13	-2	-2	20	25	35	32	4	5	5	36	13	-34	na
Madagascar	13	1	-39	-39	-21	8	2	26	38	16	12	65	8	7	-4	34	-20	-13	na
Mozambique	na	na	na	na	81	28	12	-60	-45	-42	-9	-1	14	9	-9	-38	-19	-3	na
Nigeria	103	127	82	49	69	104	50	51	77	103	155	35	12	93	-23	-67	1	-15	na
RSA	4	0	6	25	25	11	-2	6	-19	-19	-29	4	-4	0	5	-2	-3	0	-1
Senegal	19	39	44	45	41	40	39	46	52	49	30	21	21	-16	na	na	na	na	na
Sudan	30	20	29	28	20	30	24	42	58	51	58	59	31	87	60	12	61	58	na
Tanzania	na	na	na	na	na	36	20	29	61	48	40	37	30	na	na	na	na	na	na
Uganda	17	37	36	74	81	87	75	39	59	73	67	64	10	na	na	na	na	na	na
Zambia	-6	-20	37	40	55	29	8	-20	-41	-35	-47	-63	-4	-6	na	na	na	na	na
Zimbabwe	39	45	43	43	50	60	39	20	36	37	34	38	16	19	na	na	na	na	na

Appendix Table D.3 (continued): Global TRI by country, all covered farm products, 1965-2010
(percent)

(a) TRI

	65-71	'72	'73	'74	'75	'76	77-83	'84	'85	'86	'87	'88	89-04	'05	'06	'07	'08	'09	'10
Europe's transition econs.	**9**	**22**	**-15**	**0**	**7**	**31**	**16**	**-1**	**6**	**12**	**13**	**20**	**12**	**14**	**9**	**5**	**15**	**8**	**12**
Bulgaria	na	na	na	na	na	na	na	na	na	na	na	na	9	17	15	5	-1	-1	-1
Czech Republic	na	na	na	na	na	na	na	na	na	na	na	na	0	0	1	2	-2	-2	-1
Estonia	na	na	na	na	na	na	na	na	na	na	na	na	8	7	7	6	-1	0	0
Hungary	na	na	na	na	na	na	na	na	na	na	na	na	-13	-15	-11	-8	-2	-3	-2
Latvia	na	na	na	na	na	na	na	na	na	na	na	na	20	15	10	5	-2	-1	0
Lithuania	na	na	na	na	na	na	na	na	na	na	na	na	16	-1	-1	2	-2	-1	0
Poland	na	na	na	na	na	na	na	na	na	na	na	na	3	-21	-18	-12	-4	-3	-1
Romania	na	na	na	na	na	na	na	na	na	na	na	na	26	45	44	8	-1	-1	0
Russia	na	na	na	na	na	na	na	na	na	na	na	na	7	20	11	8	36	30	33
Slovakia	na	na	na	na	na	na	na	na	na	na	na	na	4	-2	-1	5	-2	-2	-1
Slovenia	na	na	na	na	na	na	na	na	na	na	na	na	-17	-20	-18	-3	-1	1	-2
Turkey	na	22	-15	0	7	31	16	-1	6	12	13	20	18	21	14	4	8	-12	-1
Ukraine	na	na	na	na	na	na	na	na	na	na	na	na	14	4	1	13	26	14	12

Appendix Table D.3 (continued): Global TRI by country, all covered farm products, 1965-2010
(percent)

(a) TRI

	65-71	'72	'73	'74	'75	'76	77-83	'84	'85	'86	'87	'88	89-04	'05	'06	'07	'08	'09	'10
High-income countries[b]	**32**	**27**	**18**	**13**	**24**	**36**	**37**	**41**	**42**	**53**	**52**	**47**	**34**	**19**	**14**	**11**	**9**	**11**	**9**
Australia	-12	-4	-1	0	-2	-4	-3	-5	-5	-10	-8	-3	-4	-1	0	0	0	0	0
Austria	59	26	-3	-13	8	6	29	20	37	-43	-25	-34	19	21	18	11	7	7	3
Canada	6	6	3	6	6	14	21	23	26	23	30	25	16	13	18	11	10	20	19
Denmark	-34	-30	48	32	47	85	65	68	61	101	97	73	40	16	13	7	6	4	3
Finland	9	-11	-5	3	-11	-10	7	13	-20	-190	-175	-7	-28	22	18	7	6	6	3
France	75	59	29	19	38	58	62	73	71	98	99	71	40	15	13	11	5	6	2
Germany	105	73	43	27	47	88	73	81	71	98	87	68	42	17	14	11	6	6	3
Iceland	na	na	na	na	na	na	142	176	217	-258	2	-170	29	68	51	17	41	22	36
Ireland	-15	-41	75	47	70	123	105	139	138	169	168	103	66	37	28	11	11	13	4
Italy	53	48	21	13	26	41	48	59	61	65	63	49	29	10	8	7	3	4	1
Japan	77	95	71	27	57	83	108	125	136	157	153	149	130	127	106	84	91	90	93
Netherlands	117	102	61	44	72	121	104	107	94	108	96	76	48	22	19	9	8	8	5
New Zealand	2	2	2	2	-18	-7	-9	-13	-10	-5	4	2	2	4	-1	-1	1	-1	-1
Norway	na	na	na	na	na	na	-44	92	-27	246	236	168	162	101	110	51	58	87	88
Portugal	15	20	4	10	33	30	25	16	13	48	48	46	26	14	12	9	4	4	2
Spain	16	3	-10	-17	3	1	-2	16	29	60	59	50	27	13	11	9	5	5	2
Sweden	38	57	50	42	44	53	50	55	53	-122	-113	-93	4	25	20	9	6	7	3
Switzerland	na	na	na	na	na	na	167	199	212	53	61	36	26	29	48	34	59	73	52
UK	45	31	49	34	52	83	73	85	82	117	112	83	49	26	24	15	9	11	5
US	2	0	-1	4	4	2	6	6	6	7	5	5	5	2	1	2	0	2	1

Source: Derived from estimates reported in Croser and Anderson 2009, updated from Anderson and Nelgen (2012b).

Appendix Table D.4: Global TRI by country, all covered farm products, 1965-2010
(percent)

(a) WRI

	65-71	'72	'73	'74	'75	'76	77-83	'84	'85	'86	'87	'88	89-04	'05	'06	'07	'08	'09	'10
Asia	**44**	**47**	**48**	**46**	**50**	**41**	**47**	**54**	**46**	**54**	**60**	**50**	**27**	**22**	**32**	**31**	**34**	**42**	**29**
Banglasdesh	na	na	na	30	98	11	30	34	73	68	61	17	30	31	26	25	38	32	na
China	na	na	na	na	na	na	56	53	36	48	57	53	17	14	20	17	23	35	28
India	44	49	59	56	63	60	55	69	112	121	126	45	27	32	40	31	35	26	na
Indonesia	18	13	26	18	20	25	26	36	27	21	17	20	26	47	69	68	58	72	na
Korea	55	101	38	40	37	68	121	127	149	162	176	187	211	137	155	120	84	99	82
Malaysia	10	12	7	17	14	31	24	35	41	39	47	24	17	25	33	47	57	47	na
Pakistan	74	94	63	61	42	26	39	44	48	47	47	48	29	21	25	20	53	26	na
Philippines	34	26	34	41	27	14	27	47	70	45	52	35	41	25	32	51	37	42	na
Sri Lanka	28	32	38	34	29	35	34	21	22	28	25	43	36	45	58	46	24	41	na
Taiwan	47	60	60	41	57	33	36	52	56	67	85	95	149	na	na	na	na	na	na
Thailand	26	26	24	46	35	18	24	16	19	16	15	19	16	18	18	30	20	32	na
Vietnam	na	na	na	na	na	na	na	na	na	23	41	12	29	26	na	na	na	na	na
Latin America	**25**	**38**	**41**	**52**	**49**	**27**	**38**	**44**	**46**	**35**	**35**	**34**	**27**	**31**	**18**	**20**	**17**	**16**	**5**
Argentina	26	30	35	42	42	36	22	22	22	22	14	12	12	23	29	31	40	35	na
Brazil	20	50	49	61	54	24	38	45	39	37	37	45	18	15	11	10	7	9	4
Chile	25	33	34	28	35	17	20	30	49	46	35	23	18	14	7	10	2	4	1
Colombia	22	17	22	37	37	23	33	45	42	28	22	23	37	47	44	49	47	41	na
DominicanRepublic	43	36	41	44	53	27	47	61	65	57	48	46	65	75	55	60	45	50	na
Ecuador	39	53	46	55	54	57	68	59	73	48	37	37	25	32	39	47	46	42	na
Mexico	na	na	na	na	na	na	46	51	62	39	44	31	38	49	14	20	8	7	8
Nicaragua	na	na	na	na	na	na	na	na	na	na	na	na	30	38	41	36	31	43	na

Appendix Table D.4 (continued): Global WRI by country, all covered farm products, 1965-2010

(percent)

(b) WRI

	65-71	'72	'73	'74	'75	'76	77-83	'84	'85	'86	'87	'88	89-04	'05	'06	'07	'08	'09	'10
Africa	**51**	**55**	**52**	**53**	**48**	**50**	**50**	**53**	**52**	**81**	**106**	**83**	**45**	**76**	**48**	**43**	**48**	**48**	**2**
Cameroon	37	36	47	50	37	59	45	50	41	33	9	15	16	16	16	15	8	13	na
Cote d'ivoire	47	45	51	36	34	75	52	48	49	48	44	33	37	44	48	54	49	57	na
Egypt	53	49	58	59	49	29	41	56	37	122	182	168	36	23	30	24	46	51	na
Ethiopia	na	na	na	na	na	na	45	43	57	53	53	63	52	4	8	4	3	7	na
Ghana	43	40	46	52	43	61	77	117	56	57	114	72	32	78	33	86	44	40	na
Kenya	38	18	28	31	28	18	25	13	54	41	47	35	30	18	29	56	25	66	na
Madagascar	23	7	48	62	33	52	53	62	48	35	48	70	24	32	39	63	47	46	na
Mozambique	na	na	na	na	81	82	63	93	91	92	74	61	38	61	77	68	65	62	na
Nigeria	126	170	112	80	93	142	100	89	112	170	206	89	74	183	67	79	63	50	na
RSA	18	36	18	32	39	35	42	37	29	47	77	27	24	17	13	15	10	2	2
Senegal	22	39	51	63	43	40	43	47	54	78	93	45	32	16	na	na	na	na	na
Sudan	43	46	54	55	40	37	40	48	66	57	66	64	56	119	72	34	85	75	na
Tanzania	na	na	na	na	na	73	71	77	74	69	67	68	56	na	na	na	na	na	na
Uganda	20	38	56	74	81	87	76	42	60	73	68	65	13	na	na	na	na	na	na
Zambia	43	51	50	50	63	41	43	44	55	55	82	85	49	9	na	na	na	na	na
Zimbabwe	47	46	47	50	54	64	49	49	40	41	39	41	53	19	na	na	na	na	na

Appendix Table D.4 (continued): Global TRI by country, all covered farm products, 1965-2010
(percent)

(b) WRI

	65-71	'72	'73	'74	'75	'76	77-83	'84	'85	'86	'87	'88	89-04	'05	'06	'07	'08	'09	'10
Europe's transition econs.	**35**	**39**	**46**	**25**	**37**	**62**	**39**	**29**	**29**	**36**	**41**	**39**	**43**	**46**	**40**	**36**	**35**	**33**	**30**
Bulgaria	na	na	na	na	na	na	na	na	na	na	na	na	26	38	26	24	9	12	8
Czech Republic	na	na	na	na	na	na	na	na	na	na	na	na	35	33	27	24	13	14	8
Estonia	na	na	na	na	na	na	na	na	na	na	na	na	28	31	28	20	10	12	7
Hungary	na	na	na	na	na	na	na	na	na	na	na	na	41	28	21	22	10	12	9
Latvia	na	na	na	na	na	na	na	na	na	na	na	na	52	37	29	19	10	12	7
Lithuania	na	na	na	na	na	na	na	na	na	na	na	na	58	37	31	25	12	14	8
Poland	na	na	na	na	na	na	na	na	na	na	na	na	31	36	29	27	14	16	10
Romania	na	na	na	na	na	na	na	na	na	na	na	na	50	68	60	24	11	13	8
Russia	na	na	na	na	na	na	na	na	na	na	na	na	36	37	33	40	52	42	42
Slovakia	na	na	na	na	na	na	na	na	na	na	na	na	33	33	24	20	11	12	8
Slovenia	na	na	na	na	na	na	na	na	na	na	na	na	69	44	36	27	17	21	12
Turkey	35	39	46	25	37	62	39	29	29	36	41	39	52	64	63	51	46	51	49
Ukraine	na	na	na	na	na	na	na	na	na	na	na	na	31	28	21	28	45	33	24

Appendix Table D.4 (continued): Global TRI by country, all covered farm products, 1965-2010

(percent)

(b) WRI

	65-71	'72	'73	'74	'75	'76	77-83	'84	'85	'86	'87	'88	89-04	'05	'06	'07	'08	'09	'10
High-income countries[b]	**65**	**59**	**44**	**41**	**51**	**72**	**78**	**81**	**88**	**107**	**119**	**86**	**66**	**40**	**31**	**26**	**18**	**20**	**18**
Australia	31	27	27	28	31	20	14	17	16	28	27	9	12	4	0	0	0	0	0
Austria	82	41	18	24	16	24	46	46	59	100	101	80	74	39	30	24	15	16	7
Canada	15	16	11	16	14	39	72	87	98	93	143	66	45	32	49	25	22	46	50
Denmark	87	85	87	80	103	145	152	130	126	148	178	96	58	30	23	17	11	11	6
Finland	137	108	83	79	110	102	102	62	107	246	245	213	113	38	27	20	13	15	8
France	121	112	76	69	86	123	128	133	126	146	169	96	61	35	29	26	14	15	8
Germany	142	117	83	73	89	150	137	140	131	148	164	92	61	35	25	24	13	14	7
Iceland	na	na	na	na	na	na	185	229	381	352	481	326	215	219	190	130	90	80	69
Ireland	97	93	123	104	126	191	187	197	193	210	248	123	78	56	38	27	18	23	8
Italy	93	90	60	54	62	95	99	112	111	114	128	79	54	27	21	19	13	14	8
Japan	101	136	103	49	82	131	159	182	211	272	286	256	220	209	154	123	129	122	131
Netherlands	158	144	100	92	116	182	172	166	151	164	187	102	65	39	27	22	16	17	11
New Zealand	13	15	14	14	30	17	21	27	24	27	50	26	12	20	3	2	4	3	4
Norway	na	na	na	na	na	na	220	184	259	324	305	211	188	124	137	92	83	100	95
Portugal	29	31	26	40	54	59	43	24	25	95	116	79	49	30	26	24	15	15	10
Spain	47	25	25	30	26	36	41	42	53	104	122	79	49	28	24	22	14	14	9
Sweden	175	168	130	116	145	180	193	155	152	169	152	118	83	41	30	23	14	15	7
Switzerland	na	na	na	na	na	na	188	226	249	401	434	436	218	142	115	66	81	89	77
UK	140	117	102	87	104	150	139	142	138	156	177	105	67	43	38	32	17	21	12
US	19	11	6	9	11	10	20	28	36	29	28	21	24	15	15	17	5	6	5

Source: Derived from estimates reported in Croser and Anderson 2009, updated from Anderson and Nelgen (2012b).

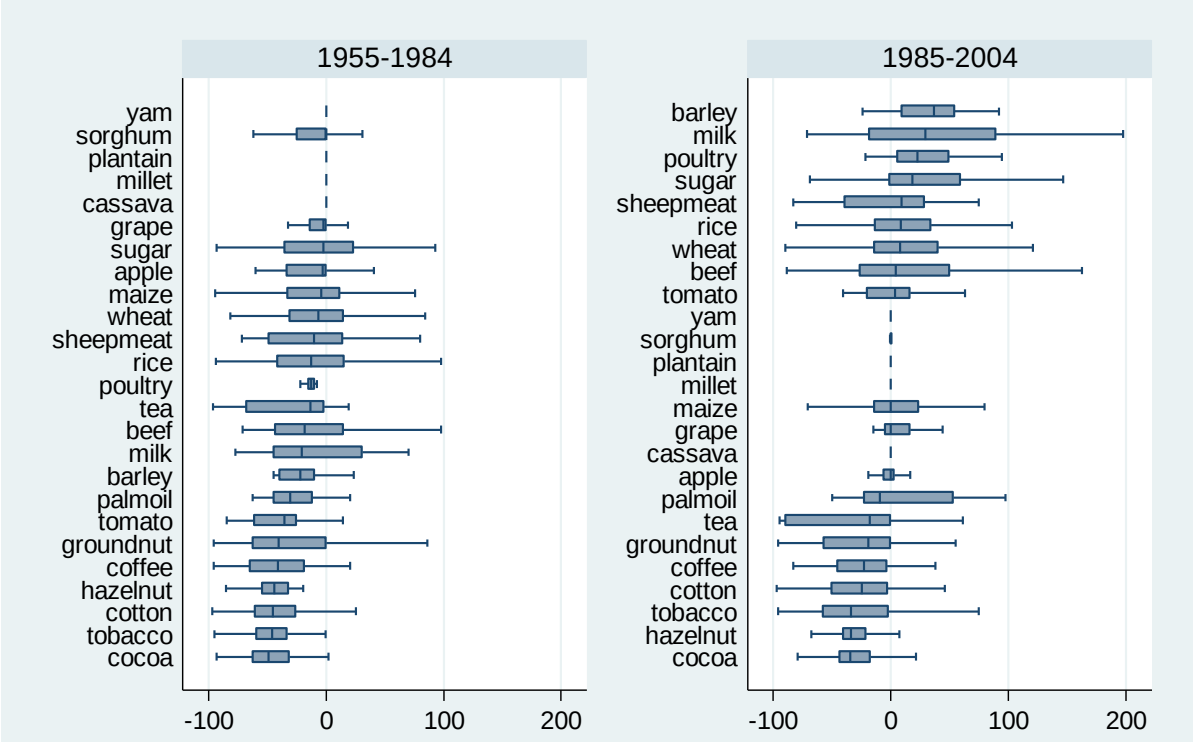
Appendix Table D.5: Global WRI and TRI, 29 main commodities, 82 countries, 1970-2010

	Aggregate WRI	Import-competing WRI	Exportables WRI	Aggregate TRI	Import-competing TRI	Exportables TRI
1970	59.1	73.9	24.2	28.8	44.0	4.9
1971	63.7	78.3	25.9	29.6	47.5	-3.0
1972	60.0	73.8	24.3	27.4	43.6	-0.1
1973	47.5	59.2	25.9	19.7	23.5	14.5
1974	41.1	45.0	33.2	18.3	12.3	25.2
1975	48.6	58.7	31.5	28.1	34.2	19.6
1976	59.6	78.6	22.1	33.1	48.5	9.8
1977	65.8	86.9	27.0	32.7	48.2	11.0
1978	68.7	90.2	25.9	31.6	47.0	8.9
1979	64.6	84.8	24.9	29.7	45.3	6.7
1980	55.4	72.4	24.9	26.3	36.2	12.7
1981	59.4	76.5	35.9	32.8	38.7	26.2
1982	63.5	79.9	40.7	38.1	48.7	26.9
1983	69.7	89.6	39.8	38.8	51.2	25.8
1984	66.3	88.5	33.4	37.4	53.0	22.8
1985	69.9	95.0	27.8	35.6	60.3	8.0
1986	91.8	119.4	38.6	45.4	76.1	9.5
1987	99.7	128.2	43.8	48.7	78.2	13.6
1988	81.8	101.5	40.5	41.5	61.6	18.7
1989	67.3	82.9	33.6	31.9	48.1	12.9
1990	68.4	81.0	35.2	30.7	46.3	9.7
1991	74.8	94.0	33.9	36.2	58.0	9.1
1992	68.8	83.5	34.4	29.3	42.6	12.3
1993	68.6	83.8	30.5	26.6	43.0	5.9
1994	72.0	89.5	26.5	26.1	47.9	0.1
1995	60.6	75.9	20.4	23.4	38.8	5.6
1996	49.3	64.6	18.2	19.9	34.8	4.8
1997	47.6	66.4	16.5	19.5	38.7	2.1
1998	50.4	69.6	19.1	19.4	41.6	-1.1
1999	62.3	86.5	19.7	23.9	51.1	-2.2
2000	57.6	77.7	18.7	20.5	43.6	-2.6
2001	49.5	66.1	18.6	19.8	38.9	0.0
2002	52.8	74.7	17.3	21.9	43.4	0.9
2003	49.7	72.0	14.5	20.4	40.8	0.7
2004	47.5	66.6	15.9	17.6	36.9	-0.2
2005	43.8	50.9	23.6	11.1	23.5	-3.9
2006	37.9	44.7	26.6	8.2	19.7	-5.5
2007	32.7	36.4	25.5	8.9	15.9	2.6
2008	31.7	37.6	24.5	9.5	12.9	7.0
2009	35.2	42.1	25.8	9.7	17.0	3.0
2010	27.5	35.2	13.2	4.6	18.6	-5.7

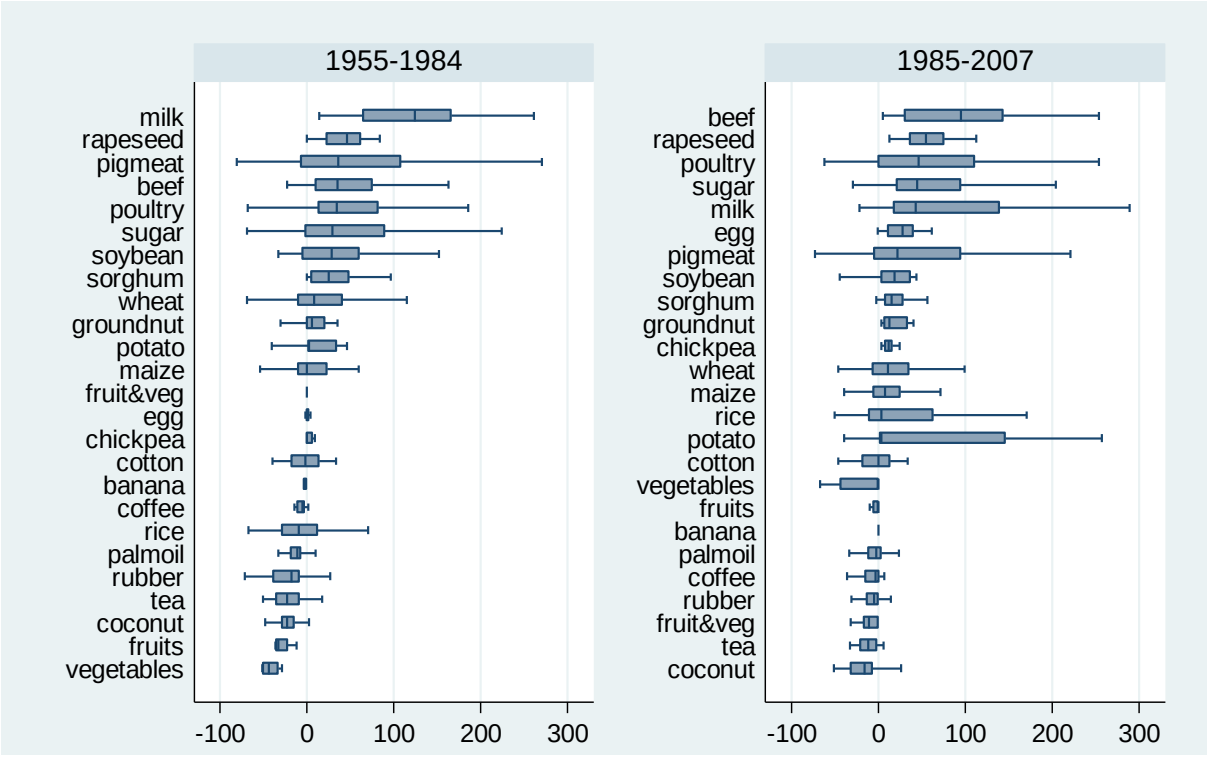
Appendix E: Box plot distributions of NRAs

The following graphs illustrate the box plot distributions of NRAs for 25 major agricultural products and various regions of the world for the period from 1955 to 2007. The long bar shows range within which 95 percent of the NRAs fall: 50 percent fall in the shaded area, and the vertical line within the shaded area is the median NRA for the sample period.

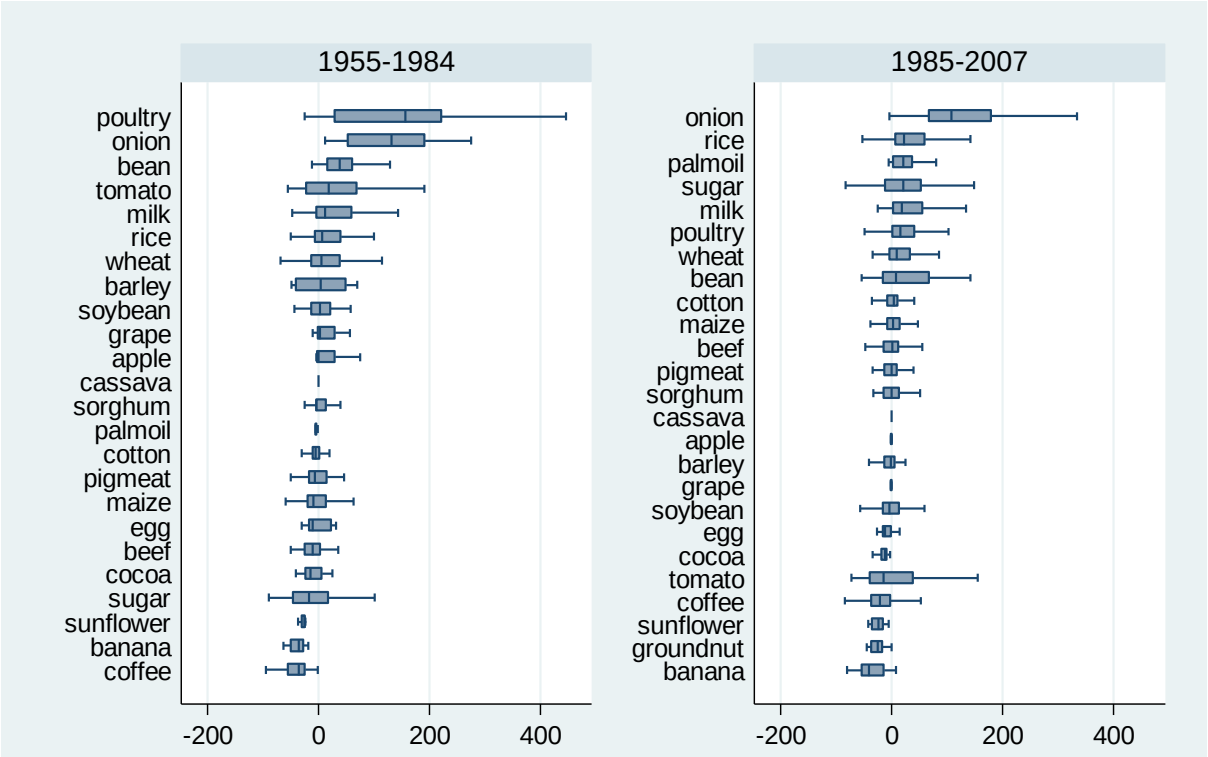
(a) All 21 focus African countries, plus Turkey (n = 7988)



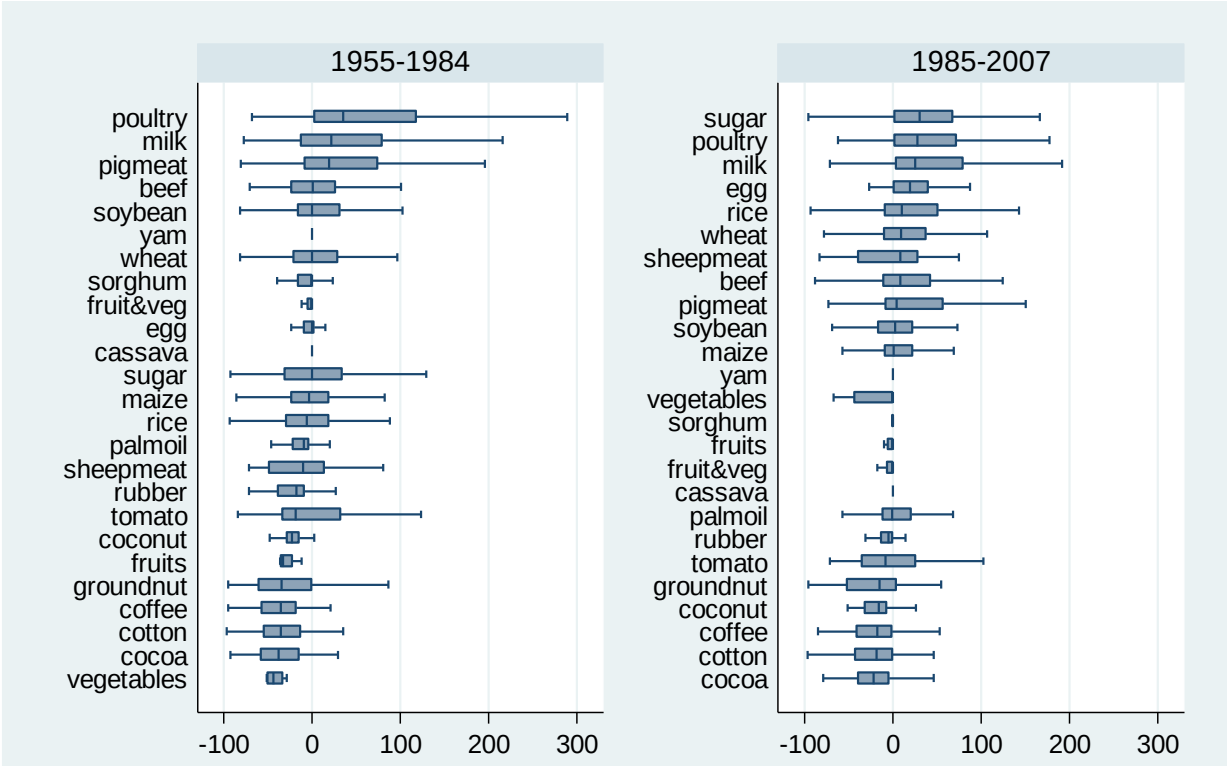
(b) All 12 focus Asian developing economies (excluding Japan) (n = 5410)



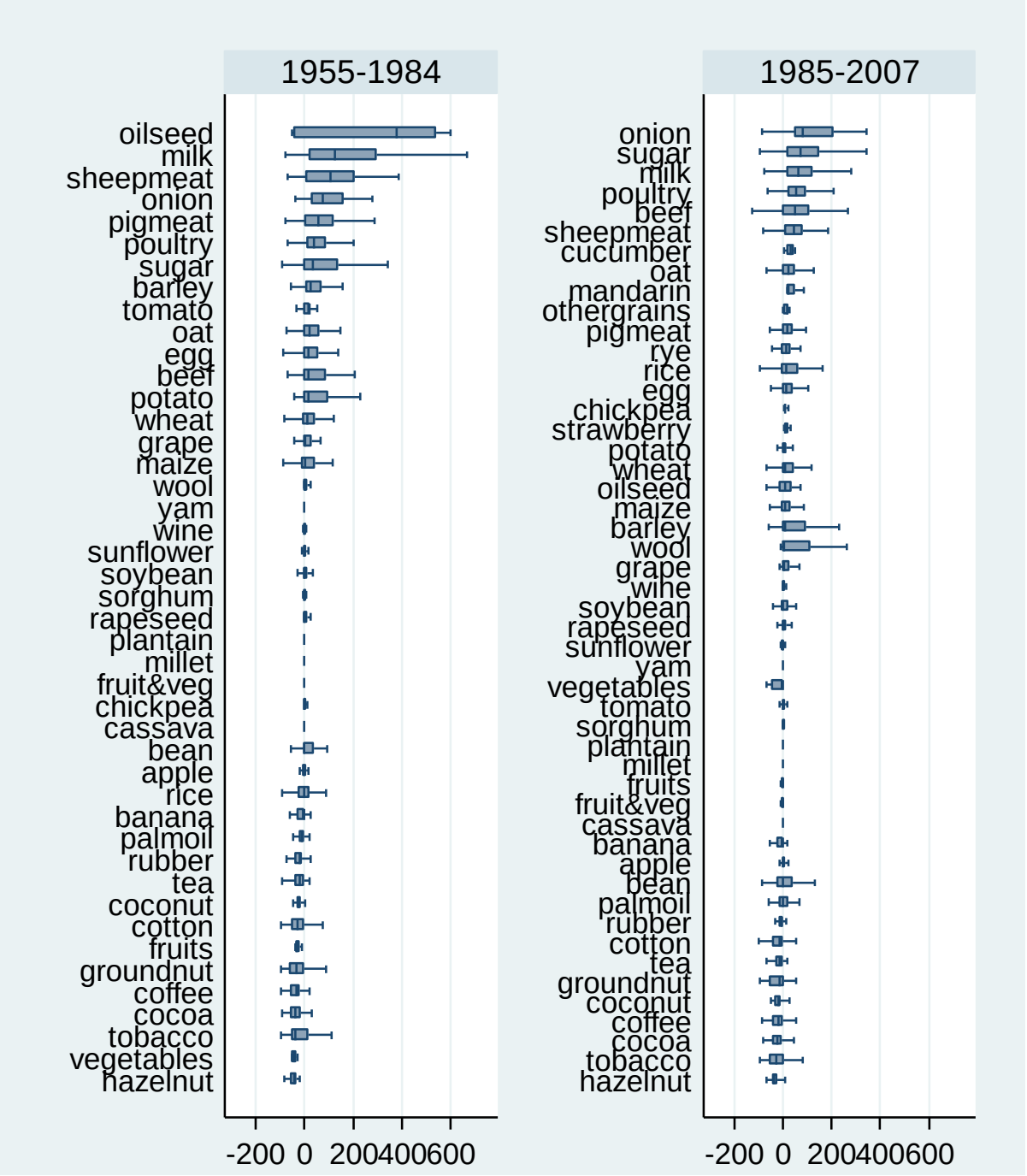
(c) All 8 focus Latin American countries (n = 4180)



(d) All 41 focus developing economies (including Turkey) (n = 14392)



(e) All 73 focus economies of the world including high-income and transition economies (n = 34833)



Source: Anderson (2010a, Appendix), drawn from estimates in Anderson and Valenzuela (2008).

All References Cited in Thesis

[Note: Each manuscript and appendix in the thesis has a self-contained reference list. This bibliography is a consolidated list of references to satisfy the University of Adelaide's thesis specification requirements.]

Abbott, P. (1979), Modeling International Grain Trade with Government Controlled Markets. *American Journal of Agricultural Economics* 61(1), 22-31.

Abbott, P. (2012), 'Export Restrictions as Stabilization Reponses to Food Crisis', *American Journal of Agricultural Economics* 94(1), January.

Adato, M. and J. Hoddinott (eds.) (2010), *Conditional Cash Transfers in Latin America,* Baltimore MD: Johns Hopkins University Press for IFPRI.

Aksoy, M.A. and B. Hoekman (eds.) (2010), *Food Prices and Rural Poverty*, London: Centre for Economic Policy Research for the World Bank.

Alston, J.M., M.C. Marra, P.G. Pardey and T.J. Wyatt (2000), *A Meta-Analysis of Rates of Return to Agricultural R&D: Ex Pede Herculem?* Washington DC: International Food Policy Research Institute.

Alston, J.M., B.A. Babcock and P.G. Pardey (eds.) (2010), *The Shifting Patterns of Agricultural Production and Productivity Worldwide,* Midwest Agribusiness Trade Research and Information Center, Iowa State University, Ames IA.

Anderson, J.E. and J.P. Neary (2005), *Measuring the Restrictiveness of International Trade Policy*, Cambridge MA: MIT Press.

Anderson, K. (1995), 'Lobbying Incentives and the Pattern of Protection in Rich and Poor Countries', *Economic Development and Cultural Change* 43(2): 401-23, January.

Anderson, K. (ed.) (2009), *Distortions to Agricultural Incentives: A Global Perspective, 1955–2007,* London: Palgrave Macmillan and Washington DC: World Bank.

Anderson, K. (ed.) (2010a), *The Political Economy of Agricultural Price Distortions*, Cambridge and New York: Cambridge University Press.

Anderson, K. (2010b), 'Krueger/Schiff/Valdés Revisited: Agricultural Price and Trade Policy Reform in Developing Countries Since 1960', *Applied Economic Perspectives and Policy* 32(2): 195-231, Summer.

Anderson, K., J. Cockburn and W. Martin (eds.) (2010), *Agricultural Price Distortions, Inequality and Poverty,* Washington DC: World Bank.

Anderson, K. and J.L. Croser (2009), *National and Global Agricultural Trade and Welfare Reduction Indexes, 1955 to 2007,* database at www.worldbank.org/agdistortions.

Anderson, K. and J.L. Croser (2011), 'Novel Indicators of the Trade and Welfare Effects of Agricultural Distortions in OECD Countries', *Review of World Economics* 147(2): 269–302, June.

Anderson, K., J.L. Croser, D. Sandri and E. Valenzuela (2010), 'Agricultural Distortion Patterns Since the 1950s: What Needs Explaining', Ch. 2 in K. Anderson (ed.), *The Political Economy of Agricultural Price Distortions*, Cambridge and New York: Cambridge University Press.

Anderson, K., Y. Hayami and Others (1986), *The Political Economy of Agricultural Protection: East Asia in International Perspective*, London: Allen and Unwin.

Anderson, K., M. Kurzweil, W. Martin, D. Sandri, and E. Valenzuela (2008), 'Measuring Distortions to Agricultural Incentives, Revisited', *World Trade Review* 7(4): 675–704.

Anderson, K., P.J. Lloyd and D. MacLaren (2007), 'Distortions to Agricultural Incentives in Australia Since World War II', *The Economic Record* 83(263): 461-82, December.

Anderson, K. and W. Martin (eds.) (2006), *Agricultural Trade Reform and the Doha Development Agenda***,** London: Palgrave Macmillan and Washington DC: World Bank.

Anderson, K. and W. Martin (eds.) (2009), *Distortions to Agricultural Incentives in Asia*, Washington DC: World Bank.

Anderson, K., W. Martin and D. van der Mensbrugghe (2012), 'Estimating Effects of Price-Distorting Policies Using Alternative Distortions Databases', Ch. in the *Handbook of Computable General Equilibrium Modeling***,** edited by P. Dixon and D. Jorgenson, Amsterdam: Elsevier (forthcoming).

Anderson, K. and S. Nelgen (2012a), 'Trade Barrier Volatility and Agricultural Price Stabilization', *World Development* 40(1): 36-48, January.

Anderson, K. and S. Nelgen (2012b), *Updated National and Global Estimates of Distortions to Agricultural Incentives, 1955 to 2010*, Database uploaded in March 2012 at www.worldbank.org/agdistortions.

Anderson, K. and S. Nelgen (2012c), 'Agricultural Trade Distortions During the Global Financial Crisis', *Oxford Review of Economic Policy* (forthcoming)**.**

Anderson, K. and E. Valenzuela (2008), *Global Estimates of Distortions to Agricultural Incentives, 1955 to 2007*, data spreadsheets at www.worldbank.org/agdistortions

Bates, R.H. (1981), *Markets and States in Tropical Africa: The Political Basis of Agricultural Policies*, Berkeley: University of California Press.

Bellemare, C., S. Kroger and A. van Soest (2008), 'Measuring Inequality Aversion in a Heterogeneous Population Using Experimental Decisions and Subjective Probabilities', *Econometrica* 76(4): 815-39, July.

Bevan, D., P. Collier and J.W. Gunning (1990), *Controlled Open Economies: A Neoclassical Approach to Structuralism,* Oxford: Clarendon Press.

Bouët, A. and D. Laborde (2010), 'Assessing the Potential Cost of a Failed Doha Round', *World Trade Review* 9(2): 319–351.

Byerlee, D., T.S. Jayne and R.J. Myers (2006), 'Managing Food Price Risks and Instability in a Liberalizing Market Environment: Overview and Policy Options', *Food Policy* 31(4): 275-87, August.

Carter, C.A., G.C. Rausser and A. Smith (2011), 'Commodity Booms and Busts', *Annual Review of Resource Economics* 3: 87-118.

Collier, P., G.W. Gunning and Associates (1999), *Trade Shocks in Developing Countries* (2 volumes), London: Oxford University Press.

Conforti, P. (2004), *Price Transmission in Selected Agricultural Markets*, Commodity and Trade Policy Research Working Paper 7, Food and Agriculture Organisation, Rome, March.

Corden, W.M. (1997), *Trade Policy and Economic Welfare,* revised edition, Oxford: Clarendon Press.

Croser, J.L. and K. Anderson (2011), 'Changing Contributions of Different Agricultural Policy Instruments to Global Reductions in Trade and Welfare', *World Trade Review* 10(3): 297-323, July.

Deaton, A. (1999), 'Commodity Prices and Growth in Africa', *Journal of Economic Perspectives* 13(3): 23-40, Summer.

Deaton, A. and G. Laroque (1992), 'On the Behavior of Commodity Prices', *Review of Economic Studies* 59(198): 1-23, January.

Engelmann, D. and M. Strobel (2004), 'Inequality Aversion, Efficiency, and Maximin Preferences in Simple Distribution Experiments', *American Economic Review* 94(4): 857-69, September.

Evenett, S.J. (ed.) (2009), The Unrelenting Pressure of Protectionism: The 3rd GTA Report, London: Centre for Economic Policy Research, for Global Trade Alert, December. www.globaltradealert.org/gta-analysis/unrelenting-pressure-protectionism-3rd-gta-report

Evenett, S.J. (ed.) (2011), Resolve Falters As Global Prospects Worsen: The 9th GTA Report, London: Centre for Economic Policy Research, for Global Trade Alert, July. www.globaltradealert.org/9th_GTA_Report

FAO et al. (2011), *Price Volatility in Food and Agricultural Market: Policy Responses,* Background Policy Report for the G20 Summit in Paris in November 2011, Rome: FAO in collaboration with IFAD, IFPRI, IMF, OECD, UNCTAD, WFP, World Bank and WTO, May.

FAO et al. (2011), *Price Volatility in Food and Agricultural Market: Policy Responses,* Background Policy Report for the G20 Summit in Paris in

November 2011, Rome: FAO in collaboration with IFAD, IFPRI, IMF, OECD, UNCTAD, WFP, World Bank and WTO, May.

Feenstra, R. (1995), 'Estimating the Effects of Trade Policy', in G. Grossman and K. Rogoff (eds.), *Handbook of International Economics*, vol. 3, Amsterdam: Elsevier

Fiszbein, A. and N. Schady (with F. H.G. Ferreira, M. Grosh, N. Kelleher, P. Olinto and E. Skoufias) (2009), *Conditional Cash Transfers: Reducing Present and Future Poverty*, Policy Research Report, Washington DC: World Bank.

Francois, J.F. and W. Martin (2004), 'Commercial Policy, Bindings and Market Access', *European Economic Review* 48: 665-79, June.

Freund, C. and C. Özden (2008), 'Trade Policy and Loss Aversion', *American Economic Review* 98(4): 1675-1691, September.

Goule, C. (2011), 'Agricultural Price Instability: A Survey of Competing Explanations and Remedies', *Journal of Economic Surveys* 25 (forthcoming).

Grossman, G.M. and E. Helpman (1994), 'Protection for Sale', *American Economic Review* 84(4): 833–50, September.

Haberler, G. (1958), *Trends in International Trade: A Report by a Panel of Experts*, Geneva: General Agreement on Tariffs and Trade, October.

Hertel, T.W. (ed.) (1997), *Global Trade Analysis: Modeling and Applications*, Cambridge and New York: Cambridge University Press.

Hertel, T.W. and J. Beckman (2011), 'Commodity Price Volatility in the Biofuel Era: An Examination of the Linkage Between Energy and Agricultural Markets', Ch. 6 (pp. 189-221) in *The Intended and Unintended Effects of U.S.*

Agricultural and Biotechnology Policies, edited by J. Graff Zivin and J. Perloff, Chicago: University of Chicago Press for NBER.

Hertel T.W. and N. Differbaugh (2011), 'Implications of Climate Volatility for Agricultural Commodity Markets in the Presence of Biofuel Mandates', Presented at the 14th Annual Conference on Global Economic Analysis, Venice, 16-18 June.

Hertel, T., W. Martin, and A. Leister, (2010), 'Potential Implications of a Special Safeguard Mechanism in the World Trade Organization: The Case of Wheat', *World Bank Economic Review* 24(2): 330–59.

Huang, J., S. Rozelle, W. Martin and Y. Liu (2008), 'Distortions to Agricultural Incentives in China', Ch. 3 in Anderson, K. and W. Martin (eds.), *Distortions to Agricultural Incentives in Asia,* Washington DC: World Bank.

Hertel, T.W. and L.A. Winters (eds.) (2006), *Poverty and the WTO: Impacts of the Doha Development Agenda*, London: Palgrave Macmillan and Washington DC: World Bank.

Imai, S., H. Katayama and K. Krishna (2009), 'Protection for Sale or Surge protection?', *European Economic Review* 53: 675-88.

Ivanic, M. and W. Martin (2008), 'Implications of Higher Global Food Prices for Poverty in Low-Income Countries', *Agricultural Economics* 39: 405-16.

Ivanic, M. and W. Martin (2010), 'Promoting Global Agricultural Growth and Poverty Reduction', mimeo, World Bank, Washington DC, October.

Jacks, D.S., K.H. O'Rourke and J.G. Williamson (2011), 'Commodity Price Volatility and World Market Integration Since 1700', *Review of Economics and Statistics* 93(3): 800-13, January.

Jean, S., D. Laborde and W. Martin (2010), 'Formulas and Flexibility in Trade Negotiations: Sensitive Agricultural Products in the WTO's Doha Agenda', *World Bank Economic Review* 24 (3): 500-19.

Johnson, D.G. (1973), *World Agriculture in Disarray*, London: St Martin's Press (revised in 1991).

Knudsen, O. and J. Nash (1990), 'Domestic Price Stabilization Schemes in Developing Countries', *Economic Development and Cultural Change* 38(3) 539–558, April.

Krueger, A.O., M. Schiff and A. Valdés (1988), 'Agricultural Incentives in Developing Countries: Measuring the Effect of Sectoral and Economy-wide Policies', *World Bank Economic Review* 2(3): 255–72, September.

Krueger, A.O., M. Schiff and A. Valdés (1991), *The Political Economy of Agricultural Pricing Policy, Volume 1: Latin America, Volume 2: Asia, and Volume 3: Africa and the Mediterranean*, Baltimore: Johns Hopkins University Press for the World Bank.

Lerner, A. (1936), 'The Symmetry Between Import and Export Taxes', *Economica* 3(11): 306–13, August.

Lloyd, P.J., J.L. Croser and K. Anderson (2010), 'Global Distortions to Agricultural Markets: New Indicators of Trade and Welfare Impacts, 1960 to 2007', *Review of Development Economics* 14(2): 141-60, May.

Lusk, J.L. and B.C. Briggeman (2011), 'Selfishness, Altruism, and Inequality Aversion Toward Consumers and Farmers', *Agricultural Economics* 42(2): 121-39, March.

Maddison, A. (2003), *The World Economy: Historical Statistics*, Paris: OECD Development Centre.

Martin, W. and K. Anderson (2012a), 'Trade Distortions and Food Price Surges', in *Commodity Price Volatility and Inclusive Growth in Low-income Countries*, edited by R. Arezki and M. Zhu, Washington DC: International Monetary Fund (forthcoming).

Martin, W. and K. Anderson (2012b), 'Export Restrictions and Price Insulation During Commodity Price Booms', *American Journal of Agricultural Economics* 94(2):422-27, January.

Martin, W. and D. Mitra (2001), 'Productivity Growth and Convergence in Agriculture and Manufacturing', *Economic Development and Cultural Change* 49(2): 403-22.

Minot, N. (2011), 'Transmission of World Food Price Changes to Markets in Sub-Saharan Africa', Discussion Paper 1059, IFPRI, Washington DC, February.

Mundlak, Y. and D. Larson (1992), 'On the Transmission of World Agricultural Prices', *World Bank Economic Review* 6: 399-422.

Narayanan, G.B. and T.L. Walmsley (eds.) (2008), *Global Trade, Assistance, and Production: The GTAP 7 Data Base*, West Lafayette IN: Center for Global Trade Analysis, Purdue University, downloadable at www.gtap.org.

Nerlove, M. (1972), 'Lags in Economic Behaviour', *Econometrica* 40(2): 221-52, March.

Nettle, R.S., M. Britten-Jones and K. Anderson (1987), 'Optimal Policy Intervention to Reduce Import Dependence', *International Economic Journal 1(4)*: 101-106, Winter.

Newbery, D. M. G. And J. E. Stiglitz (1981), *The Theory of Commodity Price Stabilization: A Study in the Economics of Risk*, London and New York: Oxford University Press.

OECD (2009), *Agricultural Policies in Emerging Economies: Monitoring and Evaluation 2009*, Paris: Organization for Economic Co-operation and Development, March.

OECD (2010), *Producer and Consumer Support Estimates, OECD Database 1986-2009*. http://www.oecd.org.

OECD (2011), *Producer and Consumer Support Estimates, OECD Database 1986-2010*, http://www.oecd.org, accessed 26 September.

Orden, D., F. Cheng, H. Nguyen, U. Grote, M. Thomas, K. Mullen and D. Sun (2007), *Agricultural Producer Support Estimates for Developing Countries: Measurement Issues and Evidence from India, Indonesia, China and Vietnam*, IFPRI Research Report 152, Washington DC: International Food Policy Research Institute.

Ramey, G. and V.A. Ramey (1995), 'Cross-Country Evidence on the Link between Volatility and Growth', *American Economic Review* 85(5): 1138-51, December.

Rausser, G.C., J. Swinnen and P. Zusman (2011), *Political Power and Economic Policy: Theory, Analysis and Empirical Applications*, Cambridge and New York: Cambridge University Press (forthcoming).

Sarris, A., P. Conforti and A. Prakash (2010), 'The Use of Organized Commodity Markets to Manage Food Import Price Instability and Risk', *Agricultural Economics* 42(1): 47-64, January.

Schiff, M. and A. Valdés (1992), 'The Effects of Intervention on Price Variability', Ch. 3 in M. Schiff and A. Valdés, *The Political Economy of Agricultural Pricing Policy, Volume 4: A Synthesis of the Economics in Developing Countries*, Baltimore: Johns Hopkins University Press for the World Bank.

Skoufias, E., S. Tiwari and H. Zaman (2010), 'Can We Rely on Cash Transfers to Protect Dietary Diversity During Food Crises? Estimates from Indonesia', Policy Research Working Paper 5548, World Bank, Washington DC, January.

Swinnen, J.F.M. (2008), *The Perfect Storm: The Political Economy of the Fischler Reforms of the Common Agricultural Policy*, Brussels: Centre for European Policy Studies.

Thompson, S.R., P.M. Schmitz, N. Iwai and B.K. Goodwin (2004), 'The Real Rate of Protection: The Income Insurance Effects of Agricultural Policy", *Applied Economics* 36: 1-8.

Tovar, P. (2009), 'The Effects of Loss Aversion on Trade Policy: Theory and Evidence', *Journal of International Economics* 78(1): 154-67, June.

Turner, A., J. Farrimond and J. Hill (2011), 'The Oil Trading Markets, 2003-10: Analysis of Market Behaviour and Possible Policy Responses', *Oxford Review of Economic Policy* 27(1): 33-67, Spring.

Tyers, R. (1991), 'On the Neglect of Dynamics, Risk and Market Insulation in the Analysis of Uruguay Round Food Trade Reforms', *Australian Journal of Agricultural Economics* 35(3): 295-313, December.

Tyers, R. and K. Anderson (1992), *Disarray in World Food Markets: A Quantitative Assessment*, Cambridge and New York: Cambridge University Press.

Tyner, W. (with H. Serghini and I. Ouraich) (2010), 'Moroccan Agricultural Policy: Recent Historical Context and Moving Forward via the *Maroc Plan Vert'*, mimeo for the World Bank, Purdue University, West Lafayette IN, January.

Valenzuela, E. and K. Anderson (2008), 'Alternative Agricultural Price Distortions for CGE Analysis of Developing Countries, 2004 and 1980-84', Research Memorandum No. 13, Center for Global Trade Analysis, Purdue University, West Lafayette, December, at www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=2925

van der Mensbrugghe, D. and R. Roson (2010), 'Climate, Trade and Development', Paper presented at the 13th Global Economic Analysis Conference, Penang, 9-11 June.

Vousden, N. (1990), *The Economics of Trade Protection*, Cambridge and New York: Cambridge University Press.

Warr, P.G. (2005), 'Food Policy and Poverty in Indonesia: A General Equilibrium Analysis', *Australian Journal of Agricultural and Resource Economics* 49(3): 429-51.

Williamson, J.G. (2008), 'Globalization and the Great Divergence: Terms of Trade Booms and Volatility in the Poor Periphery 1782-1913', *European Review of Economic History* 12(3): 355-91, December.

World Bank (2007), *World Development Report 2008: Agriculture for Development*, Washington DC: World Bank.

World Bank (2010), *Global Commodity Markets: Review and Price Forecasts*, Washington DC: World Bank.

World Bank (2011), *Food Price Watch,* Washington DC: World Bank. Accessed 26 February at http://www.worldbank.org/foodcrisis/food_price_watch_report_feb2011.html

World Bank (2012), *Pink Sheets*, http://econ.worldbank.org, accessed 29 January.

Wright, B.D. (2011), 'The Economics of Grain Price Volatility', *Applied Economic Perspectives and Policy* 33(1): 32-58, Spring.

WTO, ITC and UNCTAD (2007), *World Tariff Profiles 2006*, Geneva: World Trade Organization.