The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.

Global Trade Analysis Project
https://www.gtap.agecon.purdue.edu/

This paper is from the
GTAP Annual Conference on Global Economic Analysis
https://www.gtap.agecon.purdue.edu/events/conferences/default.asp

Grain Price Spikes and Beggar-thy-neighbor Policy Responses:

A Global Economywide Analysis

Hans G Jensen

University of Copenhagen
hans@ifro.ku.dk

and

Kym Anderson

University of Adelaide and Australian National University
kym.anderson@adelaide.edu.au

July 2014

Without implicating them, the authors are grateful for funding support from the Australian Research Council, the Rural Industries Research and Development Corporation, the World Bank and the University of Copenhagen.

Abstract

When prices spike in international grain markets, national governments often reduce the extent to which that spike affects their domestic food markets. Those actions exacerbate the price spike and international welfare transfer associated with that terms of trade change. Several recent analyses have assessed the extent to which those policies contributed to the 2006-08 international price rise, but only by focusing on one commodity or using a back-of-the envelope (BOTE) method. This paper provides a more-comprehensive analysis using a global economy-wide model that is able to take account of the interactions between markets for farm products that are closely related in production and/or consumption, and able to estimate the impacts of those insulating policies on grain prices and on the grain trade and economic welfare of the world's various countries. Our results support the conclusion from earlier studies that there is a need for stronger WTO disciplines on export restrictions.

Keywords: Domestic market insulation, Distorted incentives, International price transmission, Commodity price stabilization

JEL codes: F14, Q17, Q18

Author contact:

Kym Anderson
School of Economics
University of Adelaide
Adelaide SA 5005 Australia
Phone +61 8 8303 4712
Fax +61 8 8223 1460
kym.anderson@adelaide.edu.au

Grain Price Spikes and Beggar-thy-neighbor Policy Responses: A Global Economywide Analysis

Upward spikes in the international price of food in recent years led some countries to raise export barriers, thereby exacerbating both the price spike and reducing the terms of trade for food-importing countries ('beggaring' their 'neighbors'). At the same time, and for similar political-economy reasons, numerous food-importing countries reduced or suspended their import tariffs, and some even provided food import subsidies -- which also exacerbated the international price spike, thus turning the terms of trade even further against food-importing countries. This issue became a major item on the agenda of various international policy fora, including the annual meetings of G20 countries in recent years. For that reason, recent studies have attempted to quantify the extent to which such policy actions contributed to the rise in international food prices.

Martin and Anderson (2012) and Anderson and Nelgen (2012), for example, use a back-of-the-envelope (BOTE) model to examine policy contributions to the rise in rice, wheat and maize prices in 2006-08. To keep their analysis as simple as possible, they assume each product is homogeneous, no supply responses were possible in that period, the own-price elasticity of demand is the same in all countries, and all cross-price elasticities of supply and demand are zero (so no interaction with livestock or other farm product markets, nor among the three grains, is entertained). They estimate that altered border restrictions on trade were responsible for about two-fifths of the rise in the international price for rice, about one-fifth for wheat, and one-tenth for maize.

A more-recent study examined this issue using the GTAP model of the world economy, but it focuses just on the wheat market (Rutten, Shutes and Meijerink 2013). That study considers only a small rise in the international price, assumed to be due to a drought in Australia, and it examines, as arch-typical examples of responses elsewhere, the impact of India imposing a tax on its wheat exports and Tanzania lowering its wheat import tariff.

The purpose of the present paper is to re-visit this important policy issue but to do so more comprehensively. Like Rutten, Shutes and Meijerink (2013), we use the standard GTAP multi-product, multi-country model of the global economy (Hertel 1997). Such a model makes it possible to estimate the extent to which changes in trade restrictions contributed to that 2006-08 spike in food prices without the restrictions on price elasticities that were necessary for the back-of-the-envelope studies, instead accepting the medium-term elasticities incorporated in the GTAP model's standard parameter set.

We go beyond Rutten, Shutes and Meijerink (2013) in several respects though. First, we focus on rice and coarse grains in addition to wheat. Second, we draw on the World Bank's *Distortions to Agricultural Incentives* (DAI) database to alter the GTAP version 8.1 protection database's estimates of national trade restrictions on those grains as of 2006.[1] Third, we use the DAI-estimated changes in actual national trade restrictions between 2006 and 2008 for each of those grains to simultaneously calibrate exogenous supply shocks and consequent policy adjustments for each country. And fourth, we simulate the observed international grain price spikes of 2006-08 including the associated changes in government interventions around the world in that period, and estimate the contribution of the latter to the former.

The paper is structured as follows. In the next section we summarize the basic theory behind the effects of policy responses to an exogenous shock to the world's food market. We then describe the modifications we make to the GTAP model's database to set up the pertinent scenario for present purposes. The modeling results that emerge are then presented in some detail. These GTAP results are compared with the BOTE results presented in Anderson and Nelgen (2012) in the

[1] The latest version of those data are provided by Anderson and Nelgen (2013). For present purposes we used exactly the same earlier version of those data as Martin and Anderson (2012) and Anderson and Nelgen (2012), so as to be more comparable with the earlier BOTE analyses.

penultimate section. The paper concludes by drawing out implications for both national policymakers and multilateral trade negotiators.

Theory

The tendency for each country to transmit less than fully any fluctuations in international food prices away from their trend has been widespread and systematic. This has been revealed by recent estimates of nominal rates of assistance and consumer tax equivalents (NRAs and CTEs) of government interventions in national grain markets. For example, the correlation coefficient between the international price of rice and its national NRA, averaged over the 82 countries in the annual dataset for the past five decades compiled by Anderson and Nelgen (2013), is almost -0.8, and that for wheat is not much lower. Furthermore, the NRA and CTE estimates tend to be very highly correlated if not identical, suggesting it is largely alterations to trade restrictions at national borders that provide this insulation of domestic markets.

When some governments alter the restrictiveness of their food trade measures to partially insulate their domestic markets from international price fluctuations, the volatility faced by other countries is amplified. That reaction therefore prompts more countries to follow suit, particularly in severe international price spike periods. The irony is, however, that when both food-exporting and food-importing countries so respond, each country group undermines the other's attempt to stabilize its domestic markets. That is, what seems like a solution to each country's concern if it were acting alone turns out to be less effective the more other countries respond in a similar way.

To see this, consider a world of two country groups, food importers and food exporters, and suppose a severe weather shock at a time of low global stocks causes the international food price to suddenly rise. Those national governments wishing to avert losses for domestic food consumers may alter their food trade restriction so that only a fraction of that price rise is transmitted to their domestic market.[2] For example, imposing or raising an export tax on food exports would ensure the domestic price in a food-surplus country rose less than the border price. Similarly, lowering/suspending any import tax on food would ensure the domestic price in a food-deficit country would rise less than the price of an imported substitute. Each of those responses raises the consumer subsidy equivalent/lowers the consumer tax equivalent of any such trade measure, and does the opposite to producer incentives (so the CTE and NRA fall).

However, if such domestic market insulation using both types of trade measures is practiced by large countries, or by a sufficiently large number of small countries, it turns out to be not very effective in keeping a domestic price spike below what it would be in the international marketplace if no government so responded. This can be seen with the help of Figure 1, which depicts the international market for food. In a normal year, the excess supply curve for the world's food-exporting countries is ES_o and the excess demand curve for the world's food-importing countries is ED_o. In the absence of any trade costs such as for transport, equilibrium in a normal year would be at E_o with Q_o units traded at international price P_o.

[Insert Figure 1 about here]

An adverse season in, say, some exporting countries, at a time when global stocks are low, would shift the excess supply curve leftwards to ES_1.[3] If there were no policy responses, the equilibrium would shift from E_o to E_1, and 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 international price prompts governments to alter their trade restrictiveness, there will be additional effects.

---

[2] For a political economy explanation of why governments seek in this way to avert real income losses to significant interest groups when prices spike, see Dissanayake (2014).

[3] The same shift would occur if in some exporting countries there was a sudden new demand for grains, such as for use in generating more biofuels when the price of fossil fuels spiked or when new or higher biofuel subsidies and mandates are introduced (as occurred in the United States and European Union around 2006).

Suppose some of the food-exporting countries choose to impose or raise a food export tax (or, in the extreme, impose an export ban). That would move the excess supply curve in Figure 1 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, their combined actions reduce aggregate exports to Q_2 and cause the international terms of trade to turn 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.

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'. That response would provide partial insulation in those food-importing countries from the initial exogenous shock to the international market: their domestic price would be only MN instead of ME' above the pre-shock price of P_o in Figure 1. However, such combined actions by the importing countries would cause the international terms of trade to turn further against them.

What if both country groups intervene, each seeking to at least offset the effect on their domestic price of the initial exogenous shock and the other country group's policy response? In practice, the more one group seeks to insulate its domestic market, the more the other group is likely to respond. The example of such actions shown in Figure 1 involves the curves shifting simultaneously 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 illustrated case the domestic price (and the quantity traded internationally, Q_1) is 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, than if only one of the groups altered their trade barriers. Aggregate global welfare would be the same as it would be if neither country group so altered their trade restrictions, but there would be an economic welfare transfer from food-importing to food-exporting countries, via the terms of trade change, equal to areas $P_1E_1E_3P_3$.

Figure 1 depicts just one product, but in practice the international prices of various foods do not move identically of course. Also, some products are close substitutes in farm production and/or in consumption by final consumers; and feed grains are major inputs into many countries' livestock industries and so affect the latter's product prices to varying extents too. Since overall agricultural trade and national economic welfare effects of a spike in one grain's price depend on those interactions, it is more desirable to use a multi-commodity rather than single-commodity model to capture the full effects of government responses to a price spike. This is especially so when several food prices rise simultaneously but to different extents. And given that policy responses differ also from country to country, a multi-country model such as the GTAP Model is needed. With such a model that includes some supply response over the three-year period under consideration, differing demand elasticities across countries, and non-zero cross-price elasticities and demand and supply among farm and food products, the estimated contributions of policy actions to the grain price spikes in 2006-08 are likely to be less than the back-of-the-envelope estimates by Martin and Anderson (2012) and Anderson and Nelgen (2012).

Model and Data

The model used in the present study is the well-known global computable general equilibrium model known as GTAP (Hertel 1997). We make no alterations to the model, and we use its standard closure and medium-term behavioral parameters. The price responsiveness of producers and consumers may be a little higher in this model than is appropriate for a short-run shock of the type being focused on in this study, in which case the impact on international prices of the policy responses to the exogenous shocks will be underestimated (in contrast to the results from the recent BOTE studies which are likely to be over-estimated because of its assumed zero price elasticities).

The GTAP Model's database (Narayanan, Aguiar and McDougall, 2012) is a framework of multi-sector economy-wide input/output tables linked at the sectoral level through trade flows between commodities used both for final consumption and intermediate use in production. The latest GTAP version 8.1 database divides the global economy into 134 countries/regions with 57 sectors/product groups specifies in the database. Among these commodities rice, wheat and coarse grains (of which all by one-tenth is maize) are specified separately, providing a snapshot of the world's grain production, consumption and trade among different countries as of 2007. The initial GTAP database has domestic policies embedded in the form of price wedges representing applied ad valorem import tariffs rates, export taxes, as well as domestic support in the form of input, output and land, labor and capital subsidies by each country, in that year.

Since our analysis focuses on the contribution of domestic and trade policy changes to the price spike experienced in the period 2006 to 2008, we need to recalibrate the GTAP database to reflect the domestic policies in the initial pre-price spike year of 2006. We do that to the initial GTAP database using the World Bank's DAI database's key indicator, the national nominal rate of assistance (NRA) which, as mentioned above, is very similar to the consumer tax equivalent (CTE) in most countries and so is assumed to also represent the CTE. The DAI database is the most appropriate available because: (i) it covers the years 2006 to 2008 in a consistent manner, (ii) it links its NRA estimate to the world market border prices in each year, (iii) it contains NRA estimates for rice, wheat and coarse grains, (iv) it covers 82 developing and developed countries including all the large ones and thus around 90% of global production, consumption and trade of each of those three grains, and (v) it captures a wide range of market price-distorting policy instruments.

The incorporated NRA estimates are based on actual price comparisons rather than applied tariff rates. In principle, careful domestic to border price comparisons can capture nontariff import barriers as well as production or export taxes or other export restrictions. Those NRA estimates of the 2006 actual price wedges at national borders and domestic subsidies/taxes are inserted in the GTAP database, in place of its standard estimates, using an ALTERTAX program (Malcolm 1998) and GEMPACK software (Harrison et al. 2014). In order to get a concordance between the DAI and GTAP databases, a new program (DAItoGTAP) was written so as to transfer the NRA estimates in a consistent manner for the two years 2006 and 2008.[4] This program is then used to calculate shocks to move the 2006 NRA-updated GTAP database to 2008 NRA levels of support in a scenario described below. To make reporting of model results easier, we aggregate GTAP's 134 countries/regions 57 sector/product groups to 34 regions and 11 sectors, keeping the major grain countries as separate economies, before running the simulation.

Global Price Spike Scenario

The observed increases during 2006-08 in international prices for rice, wheat, and maize in current US dollars were 113%, 70% and 83%, respectively (World Bank 2011). We assume the domestic producer and consumer prices in each country would have altered by the same amount had there

[4] See Jensen and Anderson (2014). This is a revision and update of the effort by Valenzuela and Anderson (2008), who made a similar adjustment to the Version 7 GTAP protection database for 2004. Specifically, the DAItoGTAP program has four steps. *Firstly*, it aggregates the World Bank's NRA data, consisting of border market support (NRA_{bms}), domestic price support (NRA_{dms}) and intermediate input support (NRA_I), to GTAP's product groups. *Secondly,* the NRA_{bms} are allocated as price wedges at national borders, as either import or export taxes depending on each country's trade status as a net importer or exporter. *Thirdly*, GTAP output and intermediate input subsidies are brought into line with the NRA_{dms} and NRA_I estimates so that the GTAP database mirrors the DAI database in which $NRA = NRA\_{bms} + NRA\_{dms} + NRA\_I$. *Fourthly*, the DAItoGTAP program generates a shock file used in the ALTERTAX program to incorporate the DAI price wedge estimates into our aggregation of the GTAP database.

been (i) no change in the country's nominal rates of government assistance to producers and taxation of consumers of each of these grains, and (ii) no exogenous shocks domestically over that period. That two-part assumption allows us to use the information in the DAI database on changes in national grain price distortions to estimate, as a residual, the extent to which there have been exogenous shocks that stimulated the policy adjustments. The exogenous shocks in 2006-08 were a combination of weather-related supply shortfalls and a surge in demand for farm products for biofuel production (Wright 2011), but for simplicity we assume they are the result of just the former, causing a drop in each country's grain productivity. The NRA estimates together with the international price changes then allow us to estimate the extent of that supply shortfall in each country.

To illustrate this methodology, consider rice in Thailand and Malaysia as examples. The NRA is the percentage by which the domestic producer price exceeds the border price of like products at the same point in the value chain. Hence the NRA is negative if producers receive less than what the price would be in the absence of government intervention. In 2006 the NRA was -20.3% in Thailand and and 44.5% in Malaysia. Assuming the world market price is equal to 1.0 in 2006, the NRA is telling us that the farm gate price to farmers in Thailand and Malaysia would be 0.797 and 1.445, respectively. Thailand, a net exporter of rice, is effectively taxing exports to reduce the domestic farm gate price below the world market price. Meanwhile Malaysia, a net importer of rice, is imposing an import tax to support its rice farmers. In 2008 the NRA changed in these two countries to -39.8% and -14.0%, respectively: Thailand increased its export tax and Malaysia switched from taxing to subsidizing rice imports. During the 2006-08 period the world market price of rice increased by 113%, raising it from our assumed price of 1.0 in 2006 to 2.13 in 2008. Given that the NRA is measured relative to the world market price each year, we then assume that the farm gate price has changed during this period from 0.797 to (60.2% of 2.13 =) 1.282 in Thailand

and from 1.445 to (86% of 2.13 =) 1.832 in Malaysia. This is equivalent to the farm gate price increasing in the domestic market of these two countries by only 61% and 27%, respectively, as compared with 113% in the international market for rice.

Initially to shock the farm gate price in the GTAP model, we change the closure of the model so that the farm gate price is exogenous while the value-added augmenting technical change variable is endogenous. That is, we estimate a change in the productivity of employed factors of production in the three commodities (rice, wheat and coarse grains)[5] individually in each country/region. We then swap back to the standard closure of the model with the farm gate price endogenous, and shock two variables: the value-added augmenting technical change variable, using the results of our first initial scenario, and the NRAs, to shift them from their 2006 levels to their 2008 levels. In this scenario we thus capture both the movement of international grain prices as a consequence of the exogenous shocks and the policy responses in the period 2006-08.

In order to quantify the contribution of changing NRAs to the international price spikes, we decompose the simulation results so as to separate out the contribution of the exogenous supply shocks. We do that by making use of the Subtotal statement (Harrison, Horridge and Pearson 2000) found in the GEMPACK software (Harrison et al. 2014) used to run the GTAP model.

GTAP Model Results

The NRA adjustments in the various countries during 2006-08 together had an estimated non-trivial impact on international grain prices (Table 1). This is especially so for rice, where just under one-third of the rise in that period (34 of 113%) is attributed to NRA changes. For coarse grains nearly one-ninth of its rise of 83% is attributed to NRA changes. Only in the case of wheat is the

[5] We assume the same level of border protection to both paddy and processed rice, bearing in mind that it is processed rice that is mostly traded; and to simplify the presentation we report results for processed rice. Also, we assume the international price of all other coarse grains change to the same extent as that for maize, which represents about 90% of the global coarse grain market.

contribution of NRA changes estimated to be of minor importance (one-fifteenth of the 70% rise in its international price).

[Insert Table 1 about here]

The right-hand side of Table 1(a) shows changes in export measures were responsible for most of the impact on the price in the case of both rice andcoarse grains, whereas for wheat more than one-fifth of the impact came from a loosening of import restrictions.

The NRA changes also made a contribution to the rise in the international prices of other crop and livestock products. However, that contribution is estimated to be minor, amounting to less than one-thirtieth in each of those cases and insignificantly in the case of the 'Other processed foods' aggregate (lower part of Table 1(a)). Hence the omission of this effect by earlier analysts using simpler methods appears to be of little consequence.

Almost all of the contribution of changing NRAs to the rice price rise comes from developing countries. This result is unsurprising, since that is where most of the world's rice production and consumption takes place. By contrast, in the case of wheat the NRA changes of high-income countries contribute as much as the NRA changes in developing countries. The coarse grain case is in between, with the NRA changes of developing countries contributing nearly twice as much as those of high-income countries (Table 1(b)).

The aggregate quantity of grain traded internationally rose 3% during 2006-08 as a consequence of changes in NRAs. The negative impact on that quantity traded from the tightening of grain export restrictions was slightly more than offset by the positive impact of the lowering of both import restrictions (tariff suspensions and the like) and domestic price supports.

[Insert Table 2 about here]

Naïve theory suggests that had the global trade contribution of NRA changes been close to zero or negative, so too would have been the global welfare effect of the NRA changes. However, since importers reduced their distortions to trade more than exporters increased theirs, the resulting positive net change in overall grain trade raised global welfare. The aggregate gain in global economic welfare from the NRA changes was $1.0 billion per year in 2007 US dollars. Gains mostly accrued in high-income countries, and mostly because of reductions in their import protection and domestic support; that improved the efficiency of their resource allocation, although they also gained from improved terms of trade (Table 3). The terms of trade change boosted welfare in some Asian and Latin American food-exporting economies too. However, since the majority of developing countries are net importers of grain, their welfare fell because of the terms of trade change that favored exporters and hurt importers. Among the high-income countries the biggest gainer is Japan. That is because during this period, and coincidentally, Japan moved away from price-distorting measures for such products as wheat.

[Insert Table 3 about here]

The economic welfare changes for individual countries and regions are detailed in Appendix Table 3.[6] In addition to the Japan result, that table reveals how much the terms of trade changes cause losses in net grain-importing regions such as Africa, the Middle East, Bangladesh and the Philippines and gains for grain-exporting countries such as Argentina, India, Thailand, Vietnam and the United States. It also reveals losses in resource allocation efficiency for countries that tighten export restrictions (Pakistan) or raise import subsidies (Bangladesh, Egypt). The final column of Appendix Table 3 reports the contribution to the global welfare change that altered trade restrictions by each country or region make.

[6] The GTAP model has only one representative household in each country/region and so has nothing to say about the income distributional or poverty effects within countries. However, see Anderson, Ivanic and Martin (2014) for estimates of the national and global poverty effects of the BOTE results in Martin and Anderson (2012).

Table 4 provides a breakdown of the welfare effects of changes in the NRAs by commodity, thereby showing the extent to which the global welfare gain provided by the trade-expanding change in wheat NRAs more than offsets the global loss generated by the trade-reducing NRA changes for rice. It also shows the extent of the economic welfare transfer from importing to exporting countries via the terms of trade changes resulting from ad valorem changes in trade restrictions. Rice-exporting countries gained $2.3 billion, wheat exporters $1.0 billion and coarse grain exporters $2.5 billion, whereas rice-importing countries lost $5.3 billion, coarse grain importers lost $2.6 billion while wheat importers gained $3.2 billion. This total gain for wheat importers includes the welfare gain from the decoupling of domestic support in Japan that coincided with the price spike. Disregarding this reallocation of domestic support in Japan, then wheat importers lost $1.3 billion.

[Insert Table 4 about here]

The exogenous shock plus the changes in trade restrictions reduces the global quantity of grain produced and consumed, but by less than 5% for each grain.[7] In the case of rice one-eighth of that is due to changed trade restrictions, while the policy contribution in the case of the other grains is very minor (Table 5).

[Insert Table 5 about here]

Comparison of GTAP and BOTE Model Estimates

The back-of-the-envelope (BOTE) studies by Martin and Anderson (2012) and Anderson and Nelgen (2012) both use the same NRA estimates of distortions as used here, and their results do not

[7] In the GTAP model there is no allowance for stock changes, so global production equals global consumption in each period.

differ very much, but those in Anderson and Nelgen (2012) are far more detailed and so are the ones we compare here with our GTAP model results.

In terms of the aggregate contribution of altered NRAs to the grain price rises internationally, the coarse grain estimates from the earlier BOTE analysis are remarkably close to those from the GTAP model, the former one being only one-tenth higher than the former; and for rice the GTAP ones are just one-quarter lower than the BOTE one. In the case of wheat, however, the GTAP estimate is only one-third of the BOTE one.

To understand the sources of these differences, Table 6 reveals which countries' NRA changes contributed most to the international price increases (and Appendix Table 1 shows the trade status of each region in 2007 for each of the three grains). Our GTAP results suggest that for rice, the main contributors via lowered import restrictions are Indonesia and the Philippines, and the main contributors via higher export barriers are (in order) India, Pakistan, Thailand and China. In the case of wheat, Japan and India contributed most on the import side while the main contributors on the export side are Argentina, Pakistan and China. China, Argentina, Central Asia and India are the dominant contributors, as exporters, to the rise in the international price of coarse grains, which Western Europe is the main contributor among the importers.

Those country rankings of price spike contributors based on the GTAP results are very different from the BOTE-based ones (also shown in Table 6). The key reason for the difference is that the GTAP model's estimates depend on the change in the net trade of each country whereas the BOTE estimates depend on the country contribution to global consumption (based on the simplifying assumption of no supply responsiveness over this period). It is thus unsurprising that the estimates by these two methods of the net policy contributions are not identical.

[Insert Table 6 about here]

It is therefore also unsurprising that the relative contributions of high-income and developing country governments to those price rises differ across the two studies. Both country groups' NRA changes are estimated to make almost equal contributions to the international price changes for wheat and coarse grains in the BOTE analysis; but developing countries play a much larger role in the GTAP results (as they do for rice in both studies). The price impacts of exporting countries' NRA changes dominate those of grain-importing countries in all three cases in both studies, but the extent of that domination is much greater in the present study for rice (Table 7).

[Insert Table 7 about here]

How much did the NRA changes lessen the rise in the domestic prices of grains? Table 8 first compares the actual rise in the international prices (column 1) with the estimates of what those rises would have been had NRAs not changed (column 2, as would have been the case if, for example, all domestic and border price-distorting policy instruments were set at fixed ad valorem rates). The latter are lower than the former to the extent of the estimated contribution of altered NRAs reported in column 1 of Table 7. They are thus dissimilar for the two studies except for coarse grains, where the present study suggests a smaller contribution from altered trade restrictions.

[Insert Table 8 about here]

The right-hand half of Table 8 shows how much domestic prices actually rose during 2006-08 for their respective groups of countries. (The GTAP results involve all countries whereas the BOTE ones involve only a sub-set of countries.) On average in the GTAP results, domestic prices rose nearly one-quarter less than the adjusted international price change for rice, but only slightly less for wheat and coarse grains. The extent of insulation was greater in developing countries, 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. These results, like those reproduced in the lower half of Table 8 from the BOTE analysis, suggest that the combined responses by governments of all countries have been sufficiently offsetting as to do very little to insulate domestic markets from the 2006-08 international food price spike.

Caveats

In the above analysis we assumed all countries' domestic grain prices would have risen by the same proportions as the international grain prices during 2006-08 had governments not altered their grain NRAs. That is, we ignored the Armington elasticities in the GTAP model that differentiate somewhat the domestically produced grains from imported grains.[8] This approach allowed us to derive a supply shock in each region that, together with the supply shocks in all other regions, was sufficient along with the changed NRAs to generate the international price increases shown in column 1 of Table 1. An alternative way of approaching the task would be to impose arbitrary supply or demand shocks to a subset of regions, as in the GTAP analysis by Rutten, Shutes and Meijerink (2013). Those shocks would have to be sufficient, together with the changed national NRAs, to generate the observed international price increases. However, in the absence of information on the size of those exogenous shocks to supply or demand, we felt that approach would be less reliable than the approach taken in this paper.

Conclusion and Implications

The above empirical findings can be summarized as follows:

- The changes in restrictions on global grain trade during 2006-08 are responsible for around one-third, one-ninth, and one-fifteenth of the observed increases in the international prices of rice, coarse grains and wheat, respectively;

[8] Also, using the increases in international grain prices during 2006-08 as a benchmark for all countries' export price increases simplifies the analysis undertaken in this paper, but it should be kept in mind that this ignores any contractual arrangements that delay adjustments in the price of different types of traded grains.

- Those altered trade restrictions caused domestic price increases to be only one-quarter less than what they otherwise would have been on average across all countries for rice, and only one-eleventh less in the case of wheat and coarse grains; and
- The changes in trade restrictions enlarged the transfers in economic welfare from food-importing to food-exporting countries because of the respective changes in their international terms of trade.

These results surprised us. We suspected the BOTE results reported in Martin and Anderson (2012) and Anderson and Nelgen (2012) may have greatly exaggerated the extent to which governmental variations in trade restrictions contributed to the grain price spikes of 2006-08, because of their numerous zero price elasticity assumptions and their treatment of each grain independently. Yet even with an economywide model that includes livestock and all other agricultural industries, and that treats the price changes of the three grains simultaneously and has non-zero price elasticities, the aggregate results from this study are only a little smaller than those of the BOTE analyses.

This study thus underscores the key conclusion from those earlier studies, which is that, in a many-country world, the actions of grain-exporting countries are being offset by those of import-competing countries such that market-insulating interventions are rather ineffective in achieving their stated aim of avoiding large domestic price rises when international food prices spike.

Moreover, traditional national government trade policy reactions to food price spikes are undesirable not only because, collectively, they are not very effective in stabilizing domestic prices, but also 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 following an exogenous (e.g. weather-related) shock. 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. The larger the number of countries insulating their domestic food markets, the more other countries perceive a need to do likewise (the standing-up-in-the-stadium-to see-better problem).

This suggests 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 for them to seek restraints on variable trade restrictions. It could be achieved by bringing discipline to export restrictions to match those currently applying to import restrictions. Such disciplines would be even more effective if bindings on both types of trade restrictions were required to be ad valorem taxes rather than allow volumetric (specific) tariffs, since specific taxes automatically provide some insulation of domestic markets when international prices spike up or down.

One of the original motivations for the Contracting Parties to sign in 1947 the General Agreement on Tariffs and Trade (GATT, now part of the WTO) 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 1994 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. If bindings were to be applied to export restraints, they would only be effective if that 'binding-overhang' problem was avoided by setting bound rates at their currently applied rates.

Proposals to broaden the Doha agenda to also introduce disciplines on export restraints have struggled to date to gain traction, however. 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. Nor is it surprising that non-distorting grain-exporting countries are not pushing for WTO disciplines on export restraints, since they benefit from improved terms of trade when other countries tax exports – as revealed in Appendix Table 3.

One final point. Tighter disciplines to discourage the use of trade measures to deal with price spikes would not leave countries devoid of policy instruments. Generic social safety net policies can offset the adverse impacts of a wide range of different shocks on poor people 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 in food-importing countries *reduce* their trade taxes (or provide food import subsidies), 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 electronically as direct assistance to even remote and small households, and even to the most vulnerable members of those households (World Bank 2014).

References

Anderson, K., M. Ivanic, and W. Martin. 2014. Food Price Spikes, Price Insulation, and Poverty, Ch. 8 in *The Economics of Food Price Volatility***,** edited by J.-P. Chavas, D. Hummels and B. Wright, Chicago and London: University of Chicago Press for NBER (forthcoming).

Anderson, K. and S. Nelgen. 2012. Agricultural Trade Distortions During the Global Financial Crisis, *Oxford Review of Economic Policy* 28(2): 235-60, Summer.

Anderson, K. and S. Nelgen. 2013. *Updated National and Global Estimates of Distortions to Agricultural Incentives, 1955 to 2011*, Database uploaded in June at www.worldbank.org/agdistortions.

Dissanayake, D.M.J.R. 2014. Political Economy of Altering Trade Restrictiveness: Theory and Evidence, Ch. 3 in *Three Essays on International Food Prices*, unpublished PhD thesis, Australian National University, Canberra (forthcoming).

Harrison, W.J., J.M. Horridge and K.R. Pearson. 2000. Decomposing Simulation Results with Respect to Exogenous Shocks, *Computational Economics* 15: 227-249.

Harrison, W.J., J.M. Horridge, M. Jerie and K.R. Pearson. 2014. *GEMPACK Manual*, Release 11, Melbourne: GEMPACK Software, April. http://www.copsmodels.com/gpmanual.htm

Hertel, T.W. ed. 1997. *Global Trade Analysis: Modeling and Applications*, Cambridge and New York: Cambridge University Press.

Jensen, H.G. and K. Anderson. 2014. Alternative Agricultural Price Distortions for CGE Analysis, 2007 and 2011. *Research Memorandum* No. 27, West Lafayette IN: Center for Global Trade Analysis, Purdue University, March. https://www.gtap.agecon.purdue.edu/resources/download/6720.pdf

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.

Malcolm, G. 1998. Adjusting Tax Rates in the GTAP Data Base. *GTAP Technical Paper*, No. 12, Purdue University, September.

Narayanan, B.G., A. Aguiar and R.A. McDougall, eds. 2012. *Global Trade, Assistance, and Production: The GTAP 8 Data Base*, West Lafayette: Center for Global Trade Analysis, Purdue University. www.gtap.agecon.purdue.edu/databases/v8/v8_doco.asp

Rutten, M., L. Shutes and G. Meijerink. 2013. Sit Down in the Ball Game: How Trade Barriers Make the World Less Food Secure, *Food Policy* 38(1): 1-10, February.

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. www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=2925

World Bank. 2011. *Pink Sheets,* http://econ.worldbank.org, accessed 18 November.

World Bank. 2014. *The State of Social Safety Nets 2014,* Washington DC: World Bank.

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

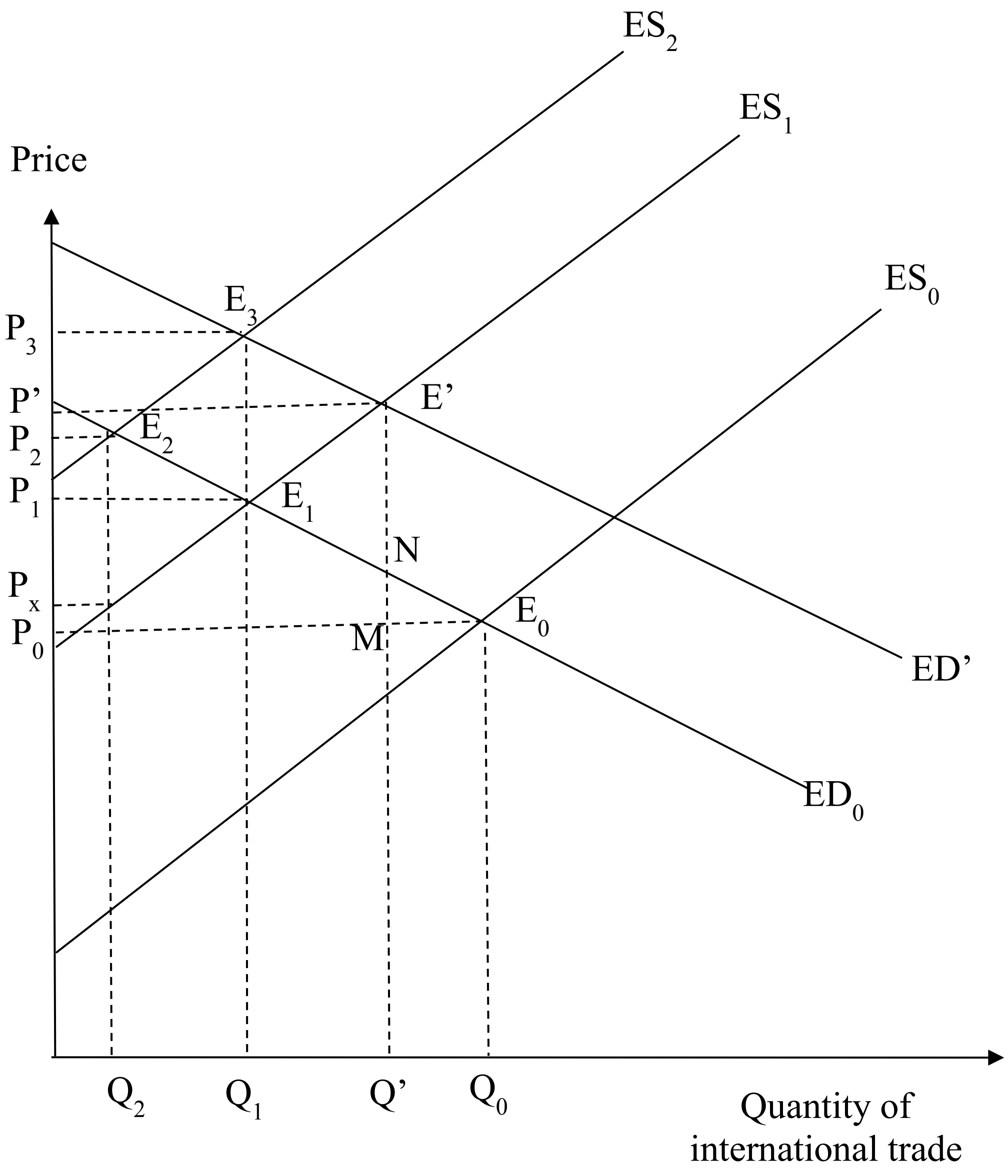

Figure 1: Effects of offsetting export barrier increases and import barrier reductions in the international market for food in response to an exogenous supply shock from ES_0 to ES_1

Table 1. International Price, % Change, Grains and Other Farm Products, 2006-08

(a) Impacts of different policy instruments

	Total actual change	Change due to ΔNRA	Policy measures contributing to ΔNRA's contrib'n:		
			ΔImport tax	ΔExport tax	ΔDomestic tax
Rice	113	34.2	3.7	30.8	-0.4
Wheat	70	4.6	1.0	2.9	0.7
Coarse grains	83	9.4	0.4	8.8	0.2
Other crops	8	0.2	0.0	0.2	0.1
Livestock	14	0.4	0.0	0.3	0.1
Meat & dairy products	5	0.1	0.0	0.1	0.0
Other processed foods	4	0.0	0.0	0.1	0.0

(b) Impacts of different country groups

	Total actual change	Change due to ΔNRA	Countries contributing to ΔNRA's contrib'n:	
			ΔDeveloping countries' trade restrictions	ΔHigh-income countries' trade restrictions
Rice	113	34.2	34.0	0.1
Wheat	70	4.6	4.4	0.1
Coarse grains	83	9.4	5.6	3.8

Source: Authors' GTAP model results

Table 2. International Grain Trade Quantity, % Change, 2006-08

	Total actual change	Change due to ΔNRA	Policy measures contributing to ΔNRA's contrib'n:		
			ΔImport tax	ΔExport tax	ΔDomestic tax
Rice	10.1	3.4	26.5	-23.5	0.4
Wheat	5.0	7.1	7.2	-2.1	1.9
Coarse grains	-2.7	-0.7	2.5	-3.6	0.4
Total grains	**3.0**	**3.3**	**9.2**	**-6.9**	**1.0**

Source: Authors' GTAP model results

Table 3. Global Welfare Change due to ΔNRA, by Country Group, 2006-08 (2007 US$ million)

	Change in welfare due to ΔNRA		Policy measures contributing to ΔNRA's contrib'n:			Contribution from change in:		
	$m	%	ΔImport tax	ΔExport tax	ΔDomestic tax	Allocative efficiency	Terms of trade	Investment and saving
High income	7329	0.02	2371	526	4432	5236	2116	-24
Developing	-6299	-0.05	-835	-4886	-578	-4206	-2118	24
SSAfrica	-2351	-0.30	-1099	-1230	-23	-921	-1455	24
ME_NAfrica	-2060	-0.09	-114	-1858	-88	151	-2206	-4
Asia	-1539	-0.02	291	-1454	-376	-2969	1487	-57
Latin America	-349	-0.01	86	-345	-91	-466	56	61
Total world	**1030**	**0.002**	**1536**	**-4360**	**3854**	**1030**	**0**	**0**

Source: Authors' GTAP model results

Table 4. Global Welfare Change due to ΔNRA, by Product and Country Group, 2006-08 (2007 US$ million)

	Welfare change due to ΔNRA	Contribution from change in:		
		Allocative efficiency	Terms of trade	Investment and saving
Rice				
Exporting countries	2278	-2328	4585	22
Importing countries	-5282	-676	-4585	-22
All countries	***-3004***	***-3004***	***0***	***0***
Wheat				
Exporting countries	983	-722	1827	-122
Importing countries	3219	4920	-1827	122
All countries	***4202***	***4198***	***0***	***0***
Coarse Grains				
Exporting countries	2456	-70	2555	-24
Importing countries	-2625	-94	-2555	24
All countries	***-169***	***-164***	***0***	***0***
All Grains				
Exporting countries	5717	-3120	8967	-124
Importing countries	-4688	4150	-8967	124
All countries	***1030***	***1030***	***0***	***0***

Source: Authors' GTAP model results

Table 5. Global Quantity Produced/Consumed, % Change, 2006-08

	Total change	Change due to ΔNRA	Policy measures contributing to ΔNRA:		
			ΔImport tax	ΔExport tax	ΔDomestic tax
Rice	-4.6	-0.6	-0.3	-0.3	0.0
Wheat	-3.5	0.2	0.1	0.2	0.0
Coarse grains	-4.7	-0.2	0.0	-0.2	0.0
Total grains	**-4.4**	**-0.3**	**-0.1**	**-0.2**	**0.0**

Source: Authors' GTAP model results

Table 6. Contributions of ∆NRA to Change in International Grain Prices, by Country,[a] 2006-08 (%)

Rice			Wheat			Coarse grains		
	GTAP	BOTE		GTAP	BOTE		GTAP	BOTE
India	9.1	5.7	Argentina	2.3	0.1	China	2.9	6.8
Pakistan	7.5	0.4	Japan	1.5	6.3	Argentina	2.4	0.1
Thailand	5.6	0.7	Pakistan	1.5	2.4	CentralAsia	2.2	-
China	2.4	12.8	China	1.3	4.5	WEurope	1.2	-
Indonesia	1.8	7.6	India	0.8	6.0	India	0.6	1.1
Egypt	1.6	0.3	Bangladesh	0.2	0.2	Russia	0.4	0.1
Philippines	0.7	1.6	Mexico	0.1	0.1	Australia	0.3	0.0
Malaysia	0.3	0.3	Egypt	-0.2	-0.4	Pakistan	0.3	0.2
Japan	0.2	3.8	Russia	-1.1	-0.3	South Africa	0.2	1.2
Brazil	0.2	0.7	Others	0.2	0.2	Thailand	0.1	0.1
Bangladesh	0.1	1.8	**Total**	**6.6**	**19.1**	Mexico	0.1	0.4
South Korea	0.1	3.0				Others	0.6	0.0
Others	0.5	1.5				**Total**	**11.3**	**10.0**
Total	**30.1**	**40.2**						

[a] Countries contributing less than 0.1 in the GTAP results are included in 'Others'

Source: Authors' GTAP model results

Table 7. Contributions[a] of High-Income and Developing Countries, and of Importing and Exporting Countries, to the Proportion of the International Grain Price Changes that are due ∆NRA, GTAP Versus BOTE Modeling, 2006-08

	TOTAL PROPORTIONAL CONTRIBUTION	High-income countries' contribution	Developing countries' contribution	Importing countries' contribution	Exporting countries' contribution
This GTAP study					
Rice	0.301	0.001	0.299	0.040	0.260
Wheat	0.066	0.002	0.064	0.027	0.039
Coarse grains	0.113	0.045	0.068	0.024	0.090
Anderson and Nelgen's (2012) BOTE study					
Rice	0.40	0.02	0.38	0.18	0.22
Wheat	0.19	0.09	0.10	0.07	0.12
Coarse grains	0.10	0.05	0.05	0.03	0.07

[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.

Sources: Authors' GTAP model results and Anderson and Nelgen (2012)

Table 8. Comparison of the Domestic Price Rises with the Rise in International Grain Prices Net of Policy-Induced Changes, GTAP Versus BOTE Modeling, 2006-08 (percent)

	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
<u>This GTAP study</u>					
Rice	113	79	57	53	93
Wheat	70	65	59	41	71
Coarse grains	83	74	68	61	73
<u>Anderson and Nelgen's (2012) BOTE study</u>					
Rice	113	68	56	48	74
Wheat	70	56	77	65	81
Coarse grains	83	75	73	62	82

Sources: Authors' GTAP model results and Anderson and Nelgen (2012)

Appendix Table 1. Grain self-sufficiency,[a] by country, 2007

	Rice	Wheat	Coarse grains
Western Europe	0.82	0.99	0.94
Rest EEurope	0.91	0.96	0.97
Russia	0.56	1.38	1.02
Central Asia	0.93	1.14	1.18
USA	1.13	2.75	1.22
Canada	0.31	8.50	1.18
Australia	1.06	1.29	1.12
New Zealand	0.20	0.79	1.02
Japan	0.92	0.28	0.08
China	1.01	1.05	1.03
Singapore	0.50	0.04	0.18
Indonesia	0.95	0.00	0.96
Malaysia	0.72	0.01	0.06
Philippines	0.79	0.00	0.96
Thailand	1.81	0.01	1.22
Vietnam	1.57	0.00	0.45
Rest of Asia	0.93	0.89	1.02
Pacific Islands	0.06	0.62	0.96
Hong Kong	0.02	0.65	0.34
South Korea	1.00	0.01	0.11
Taiwan	0.99	0.00	0.22
India	1.09	0.93	1.03
Pakistan	1.50	1.01	0.91
Sri Lanka	0.95	0.00	0.61
Bangladesh	0.96	0.33	0.33
Mexico	0.91	0.44	0.71
Argentina	1.70	3.00	2.17
Brazil	0.99	0.51	1.27
Rest Latin America	0.94	0.61	0.75
MEast_NAfrica	0.28	0.71	0.63
Egypt	1.15	0.48	0.67
South Africa	0.08	0.68	0.95
Rest of SSAfrica	0.36	0.41	1.00

[a] Domestic production divided by consumption; net exporters are shaded yellow.

Source: GTAP model database

Appendix Table 2. Grain nominal assistance coefficients,[a] % change between 2006 and 2008

	Rice	Wheat	Coarse grains
Western Europe	3	-1	-11
RestEEurope	0	0	0
Russia	0	7	-18
Central Asia	0	0	-23
USA	0	0	0
Canada	0	0	0
Australia	0	0	-18
New Zealand	0	0	0
Japan	-24	-62	0
China	-37	-23	-36
Singapore	0	0	0
Indonesia	-43	0	-12
Malaysia	-41	0	0
Philippines	-27	0	-22
Thailand	-24	0	-20
Vietnam	0	0	0
Rest of Asia	0	0	0
Pacific Islands	0	0	0
Hong Kong	0	0	0
South Korea	-42	0	0
Taiwan	0	0	0
India	-25	-29	-30
Pakistan	-54	-57	-50
Sri Lanka	4	0	0
Bangladesh	-41	-35	0
Mexico	-12	-11	-9
Argentina	0	-23	-19
Brazil	-22	0	1
Rest Latin America	-9	-6	-3
MEast_NAfrica	0	-3	-5
Egypt	-33	14	-24
South Africa	0	0	-18
Madagascar	-34	0	0
Rest SSAfrica	-7	7	2

[a] The nominal assistance coefficient is 1+ NRA

Source: Authors' amendment to the GTAP model's protection database, drawing on Jensen and Anderson (2014)

Appendix Table 3. Change in economic welfare due to NRA changes from 2006 to 2008

(2007 US$ million)

	Region's Δwelfare from world's ΔNRA	Contribution from NRA changes due to:			Contribution of region's ΔNRA to Δglobal welfare
		ΔAllocative efficiency	ΔTerms of trade	ΔInvestment and saving	
WEurope	-778	-489	-283	-6	160
RestEEurope	-52	-15	-18	-18	0
Russia	173	19	184	-31	91
CentralAsia	634	187	447	0	-40
USA	2310	97	2300	-87	-1
Canada	252	-30	280	2	0
Australia	144	-68	211	1	-35
New Zealand	5	0	5	0	0
Japan	4641	5535	-1009	115	6170
China	710	62	412	237	-751
Singapore	-46	-4	-79	37	0
Indonesia	-551	-128	-469	46	-63
Malaysia	-243	15	-307	50	53
Philippines	-348	-11	-355	18	15
Thailand	1321	-106	1422	5	-964
Vietnam	710	19	657	35	0
RestAsia	-131	-43	-84	-4	0
PacificIslan	-43	-1	-42	0	0
HongKong	-69	0	-86	17	0
SouthKorea	-620	-61	-599	39	185
Taiwan	-86	-9	-120	43	0
India	1348	310	1063	-25	1138
Pakistan	-2601	-2667	583	-517	-3071
SriLanka	16	51	-35	0	3
Bangladesh	-906	-395	-473	-38	-730
Mexico	-175	44	-242	22	43
Argentina	200	-501	671	29	-661
Brazil	-43	-6	-44	6	74
RestLAmerica	-330	-5	-329	3	74
ME_NthAfrica	-1830	442	-2280	8	196
Egypt	-230	-291	74	-13	-338
SouthAfrica	-48	80	-125	-3	113
Madagascar	-59	1	-59	0	22
RestSSAfrica	-2245	-1002	-1271	28	-654
WORLD	**1030**	**1030**	**0**	**0**	**1030**

Source: Authors' GTAP model results