Potential Implications of a Special Safeguard Mechanism in the WTO: the Case of Wheat*

by

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Abstract

The Special Safeguard Mechanism (SSM) was a key issue in the July 2008 failure to reach agreement in the WTO negotiations under the Doha Development Agenda. It includes both price (P-SSM) and quantity-triggered measures (Q-SSM). This paper uses a stochastic simulation model of the world wheat market to investigate the effects of policy makers implementing policies based on the SSM rules. As expected, implementation of the Q-SSM is found to reduce imports, raise domestic prices, and boost mean domestic production in the SSM regions. However, rather than insulating countries that use it from price volatility, it would actually increase domestic price volatility in developing countries, largely by restricting imports when domestic output is low and prices high. We estimate that implementation of the Q-SSM would shrink average wheat imports by nearly 50% in some regions, with world wheat trade falling by 4.7%. The P-SSM is discriminatory against low price, developing country exporters and tends to contribute to additional producer price instability.

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Potential Implications of a Special Safeguard Mechanism in the WTO: the Case of Wheat

The Special Safeguard Mechanism (SSM) was a key issue in the July 2008 failure to reach agreement in the WTO negotiations under the Doha Development Agenda. The draft agreement (WTO 2008a) would allow members to impose specified additional duties when the total volume of imports of an agricultural product exceeds a specified trigger level, or when import prices from a particular supplier fall below a trigger price. Given the substantial potential gains available under these negotiations (Martin and Mattoo 2008), the fact that the negotiations were unable to proceed for lack of consensus on this issue highlights its importance to many WTO members. Wolfe (2009, p1) attributes the breakdown of negotiations on this issue primarily to inadequate analysis of its operation and its implications. The availability of analysis based specifically on the proposed measure was certainly limited by the fact that the proposed SSM (WTO 2008a) is one of the most technically complex aspects of the entire Modalities; that it attempts to deal with variations in prices, rather than—as with tariffs—merely their level; and that it was presented to Ministers only days before the meeting.

Agricultural producers in developing countries are vulnerable to shocks both domestically—particularly from weather-related shocks to output—and from shocks to international markets. However, it must be remembered that consumers in developing countries are also particularly vulnerable to shocks to food prices, given that the poorest people spend as much as three quarters of their incomes on food. Policy measures that raise the price of food by imposing an import duty may help farmers whose incomes have fallen due to a harvest shortfall, but will do so at the expense of net buyers of food—including many farmers—as they will be hurt by the increase in the price of food. If farmers are isolated from world markets by poor infrastructure and communications, an even worse possibility emerges in which protection raises the cost of food to poor consumers linked to world markets, while providing little or no benefit to producers in more isolated locations. This highlights the need for careful analysis of the impact of special safeguards taking into account the potential differentiation between imported and domestic goods.

It is important to consider the implications of the measure for global markets since the SSM would apply to all developing countries, which now account for two-thirds of the value of world agricultural production[1]. Accordingly, the purpose of this paper is to assess the global implications of the proposed price- and quantity-based SSMs for a key agricultural staple, wheat, taking into account not just its direct impacts on import prices but also the resulting impacts on world prices when the measure is used by many developing countries at the same time. Our analysis also traces through the resulting impacts on key variables such as the volume of imports, domestic producer prices and the returns to land on which the incomes of many farm households depend. We consider the impacts of the SSM on the average level, and the volatility, of these variables, since part of the motivation for the measure appears to be to reduce the volatility of outcomes by offsetting shocks from international markets.

Countries are allowed to use just one of the P-SSM and Q-SSM measures in any given year. While it would be interesting to consider a situation in which countries choose between the price-based and quantity-based measures at each point in time, it is not clear which option policy makers would choose when both are available. Therefore, we focus on the important prior objective of assessing the P-SSM and Q-SSM taken separately.

We begin by examining some of the key prior contributions to the literature on the use of special safeguards. We then consider the nature of the specific proposals under consideration. We follow this with a diagrammatic assessment of the qualitative effects of such interventions, including an analysis of the extent to which it might be used. Finally, we use an empirical model to estimate the potential implications of the SSM for global and domestic markets.

What does the literature say?

While much technical work was available at the time of the Ministerial, many key questions had either not been asked, or had not been satisfactorily resolved. Important papers by Montemayor (2007, 2008) and Valdés and Foster (2005), focused on the broad potential impacts of different duty rates on imports into individual countries, without

[1] Estimate based on the share of world agricultural GDP in World Bank low and middle income countries.

taking into account the potential impacts on world markets. Not surprisingly, much of this initial work focused on the frequency with which such a measure could be used, with less attention to the question of whether it would achieve underlying economic goals motivating the SSM, such as moderating the impact of commodity market volatility on the incomes of farmers or to the living costs of poor consumers.

The analysis of Valdés and Foster (2005, p3) rules out the quantity-based measure *a priori* based on the argument that increases in import quantities are likely to be due to declines in harvests, making it difficult to justify restrictions on imports. They also express concern about the difficulties for developing countries in maintaining data on imports, and the inevitable lags between increases in imports and the implementation of any safeguard measures.

Finger (2009) raises a number of other important questions about the proposed SSM. Would, for instance, the mechanical trigger rules for the SSM allow import duties to be imposed when import prices are constant or rising? What objectives of the SSM would be consistent with such mechanical rules? And would use of the quantity trigger reduce—or actually increase—the variability of domestic prices by raising duties in periods of short domestic supply? He also raises questions about the shipment-by-shipment nature of the duty calculation under the price-based measure. When duties allowed under this measure are calculated by comparing the price of each shipment with the average price of all shipments, he finds that the nations exporting relatively lower-priced products—typically developing countries— would likely face considerably higher-than-average safeguard tariffs. The study by de Gorter, Kliauga and Nassar (2009) suggests that, under both the quantity and the price trigger, the overwhelming majority of invocations of the SSM in the four major markets of China, India, Indonesia and the Republic of Korea would be against exports from developing countries.

An important step forward in analysis of the proposed SSM was taken by Grant and Meilke (2009), who take into account the potential impact of the SSM as proposed in the July 2008 Modalities on international, as well as domestic, prices. Those authors find that application of the SSM increases the volatility of world prices. Although they believe that the impacts on world markets overall would be fairly modest, several developing countries – most notably in the Middle East – experience large increases in the volatility of their domestic prices. Due to their use of a net trade model (imports are not linked to particular exporters), these authors were unable to deal with the issue raised by Finger (2009) regarding the discriminatory nature of a P-SSM when it comes to lower priced, developing-country exports.

In the framework outlined below, we enrich the analysis of Grant and Meilke (2009) by incorporating the important features of key agricultural products such as wheat, which show evidence of strong differentiation by country of origin (Uri and Beach, 1997). This differentiation is partly due to differences in physical qualities of wheat from different countries and partly due to less tangible factors such as differences in the terms and conditions of sale, and results in price differences that will influence the extent to which the price-based triggers are invoked. Therefore, in this paper, we examine the price-based SSM and the quantity-based SSM within a modeling framework that allows for differences in relative prices of exports from different suppliers, thereby permitting us to test Finger's hypothesis of discrimination against developing country exporters.

Features of the Proposed Safeguard

The impacts of a SSM are likely to depend substantially on its specific design features. The SSM under discussion (WTO 2008a) is broadly based on the special agricultural safeguard (SSG), which includes two triggers—one based on the price of imports and one on the volume of imports (GATT 1994, p43). In contrast with standard WTO safeguards under Article XIX of GATT, there is no requirement to demonstrate that imports have caused injury to domestic producers.

The price-based safeguard (P-SSM) uses a reference price based on a three-year moving average of import prices from all sources (WTO 2008a). When the price of an individual shipment falls below 85 percent of the reference price, a duty can be used to remove 85 percent of the shortfall. A potentially important feature of this shipment-by-shipment trigger is that it will impose higher duties on imports from lower priced exporters. Finger (2009) and de Gorter, Kliauga and Nassar (2009) argue that the price-based safeguard measures generally impose higher duties on exports from developing countries.

The volume-based safeguard (Q-SSM) can be used when imports in a year exceed "base imports"—a rolling average of imports in the preceding three year period[2]. The duty that can be applied increases as imports exceed this base. Imports between 110 and 115 percent of the base allow an additional duty of 25 percent of the current binding or 25 percentage points. Imports between 115 and 135 percent of the base allow an additional duty of 40 percent of the binding, or 40 percentage points; while imports above 135 percent of the base allow an additional duty of 50 percent of the binding, or 50 percentage points. A volume-based safeguard can only be imposed for two years, and, if it is used twice in succession, cannot be used for another two years. If an SSM duty is imposed, and imports are lower than in the period before imposition, the trigger level is not reduced—thus avoiding a potential outcome where use of the duty itself causes the trigger to decline.

The draft Modalities do not, in general, permit total applied duties to exceed the pre-Doha limit. A major focus of debate has been on exceptions to this limit for the quantity safeguard, and two specific proposals have been advanced. The "Lamy compromise" would have permitted duties to exceed the bindings by 15 percentage points on 2.5 percent of tariff lines when imports exceeded the base by 40 percent (ICTSD 2008). The proposal by the G-33 (2008) and its negotiating partners would permit tariffs up to 30 percent (or percentage points) above the pre-Doha bindings on 7 percent of tariff lines, when imports exceed 110 percent of base levels. The draft modalities (2008a, para 145) consider increases of 15 percent above the bound rate or 12 percent above the bound rate.

In the next section, we examine the *qualitative* implications of using the quantity and price-based safeguards as a guide to understanding the model-based results in subsequent sections.

Qualitative Impacts of Using the Price and Quantity Triggers

The impacts of using a *price-based safeguard* in a small, trading economy are straightforward. To see this, it is useful to consider first the market for a single imported

[2] Since imports in any one year are compared against a three-year moving average of past imports, steady growth in imports of 5 percent per year compounds to a "surge" in imports of over 10 percent, against which a safeguard can be imposed.

food crop, such as that shown in Figure 1. The domestic supply of the good is shown by the curve S, while the demand is represented by curve D. The world price falls from an initial level of p_0 to p_1. If a duty of t is introduced, the decline in the domestic price can be completely offset[3]. A partially offsetting levy that diminished the size of the reduction in domestic prices by 85 percent would reduce the variance of domestic prices in response to this type of shock to 2 percent of its original level.

Imports would, of course, decline relative to their level without the safeguard. Had domestic prices fallen from p_0 to p_1, imports would have increased from $(q_0 – d_0)$ to $(q_1 – d_1)$. For a small economy in which producer output is distributed independently of world output, average farm income would rise and the variability of farm income would decline. The average cost of food to consumers would rise because of the safeguard tariff, but the variability in the cost of food would decline. Consumers eat less food because of its higher price, which generates an economic cost measured by area *def* in Figure 1. Another cost—measured by area *bcg*—arises because lower-cost imports are replaced by higher-cost domestic production.

If such a measure is being introduced for a group of countries that is collectively large, then the world market price for this commodity is no longer constant. In this case, it is useful to consider import demand from the group of countries using the safeguard (ED), together with the export supply (ES) from the rest of the world, as illustrated in Figure 2. An increase in supply—perhaps from a large harvest—that shifts the excess supply curve from the rest of the world from ES to ES′ would, in the absence of a safeguard mechanism, cause the world price to decline from p_0 to p_1. The decline in prices in importing countries would cause their imports to increase from m_0 to m_1. If a safeguard measure reduces the decline in import prices in importing markets, the decline in world prices must be larger, because more of the price adjustment is forced onto the exporting countries. If 85 percent of the decline in world prices is offset by a safeguard measure, the increase in imports for any given reduction in world prices is reduced to 15 percent of its level in the absence of safeguards. As a consequence, world prices must decline further, as illustrated by p_2 in Figure 2.

[3] Complete stabilization would require a full set of taxes and subsidies on imports and exports.

For the importing countries, the reduction in the world price to p_2 resulting from the safeguard requires a second-round increase in the safeguard duty on top of that shown in Figure 1. For each country, the decline in the world price it faces is not just the initial reduction from p_0 to p_1 but that from p_0 to p_2 shown in Figure 2. Average world prices decline, since the measure sometimes increases—and never reduces—duties. Another key impact of the widespread use of a safeguard in importing countries is an increase in the *volatility* of world prices (see Tyers and Anderson 1992, p264).

An important implication of the analysis in Figure 2 is that it may not be enough, when analyzing the impacts of introducing a safeguard covering all developing countries, to simply consider experience in the absence of a safeguard. Once the safeguard is introduced in a number of important markets, the volatility of world prices is likely to be greater than would otherwise be the case. If this effect is large, it will increase the probability that the safeguard will be triggered in any period.

As noted in Fraser and Martin (2008) and in Valdés and Foster (2005), the implications of a quantity-based safeguard depend heavily upon the source of the shock. If the cause is a decline in world prices of the type shown in Figure 1, for instance, imports rise from (q_0- d_0) to (q_1- d_1). If this decline is large enough to trigger the volume-based safeguard, then a volume-based safeguard could also be used as an alternative to a price-based safeguard. If the same additional duty were generated by either safeguard, then there would be no effective difference. Because the link between the size of the price decline and the tariff imposed under the Q-SSM is weak, this safeguard may permit a larger response than the price-based measure, and may even cause the domestic price to rise when the import price falls.

If the world price does not decline, but imports increase, then the volume safeguard can be triggered even though the price-based safeguard is not. In this situation, it is very important to *examine the cause of the increase in imports*. In the case of agriculture, such an increase is likely to be due to either a shift in the domestic supply curve, such as a decline in the harvest associated with poor weather conditions—although increases in demand, as considered by Sen (1981), may also be important on occasion. The South Centre (2009, p2) concludes that over 85 percent of import surges are not accompanied by declines in import prices, suggesting that most import surges are driven by domestic shocks, such as declines in domestic production.

In Figure 3, we focus on a reduction in domestic supply. Domestic supply is initially shown by the supply curve S, which shows domestic production of q_0 at price p_0. Domestic demand is represented by curve D, and demand at price p_0 by d_0. Imports are initially given by (q_0-d_0). In the absence of a volume-based safeguard, a decline in domestic supply from S to S′ does not affect the domestic price. Imports increase to make up the increased gap between domestic demand and supply, allowing the domestic price to remain stable. If a volume-based safeguard is available, and is used, the effect is to apply an additional duty, and hence to raise the domestic price.

Clearly, as is evident from Figure 3, the effect of a volume-based measure in this situation is to destabilize the domestic price. For consumers[4], the adverse impact on prices could have been avoided by importing to make up the shortfall. For producers, prices are destabilized, but revenues and net returns may be stabilized or destabilized. If the tariff imposed is slightly larger[5] than the decline in the quantity of output, producer gross revenues will be stabilized. However, the effect on producer net returns may be quite different, depending upon the nature of the shift in the supply curve (Martin and Alston 1994, 1997).

It is clear that the imposition of a volume-based SSM would reduce imports below the level that would have prevailed in the absence of such a measure. In Figure 3, the initial level of imports is given by (d_0- q_0). Without a safeguard, imports would rise to (d_0- q_0'). It is clear that a safeguard will reduce imports below this level, perhaps to a level similar to (d_1- q_1'). Whether this is greater than or less than the initial level of imports is quite unclear. With the volume based safeguard, there is a link between the extent of import penetration *before* the imposition of the safeguard and the size of the duty that can be imposed in the following twelve months. An increase in imports of 35 percent would allow imposition of an additional duty of 50 percentage points. If, as is usually assumed, the elasticity of demand for imports is relatively high at the tariff-line

[4] It is important to note that—particularly in poor countries- consumers and producers are typically not distinct groups. Many farmers are net buyers of staple foods, and some households classified as urban for survey purposes are net sellers of these products (Ivanic and Martin 2008).

[5] For a small change in output, the proportional effect on producer revenues is given by dp/p + dq/q where dp and dq are the changes in prices and quantities. For larger changes, this effect is dp/p + dq/q + dp/p.dq/q

level, this may be enough to reduce imports substantially. However, given the short term nature of the measure, significant supply response is unlikely, reducing the probability that imports would be reduced below their initial level.

How Might the SSM be Used?

Because the SSM provides an option, but not an obligation, to protect, it is difficult to be sure how frequently it might be utilized. One view is that most developing countries have considerable binding overhang, with their bound tariffs considerably above their applied rates, so it is unlikely that an SSM measure would make a significant difference to the protection allowed under WTO rules. Another is that decisions about the duties applied under an SSM are likely to be taken in a different forum from those regarding ordinary tariffs, and this may have real implications for choices about border protection. In many countries, applied tariff levels are decided by a tariff committee, which includes representation from different parts of government, and which frequently takes a broad view about the desirability of low tariffs for export competitiveness and the overall efficiency of the economy. If decisions about SSM duties are taken by a body with a narrower focus, there may be greater willingness to provide protection that benefits producers in a particular sector.

One promising approach to assessing the extent of its likely utilization is to examine the frequency with which the special agricultural safeguard (SSG) provided under the Uruguay Round was used. Some studies have suggested that the SSG was applied very infrequently relative to the number of times that it might have been used. Morrison and Sharma (2005) conclude that the ratio of SSG invocations to cases where these were permitted under the SSG was about one percent. They suggested three reasons for non-application of these measures: (i) the complexity of the formulas, (ii) high tariff bindings in many developing countries, which make it feasible to raise applied tariffs or apply additional duties without exceeding bound rates, and (iii) that the costs of introducing such measures might have been judged to exceed the benefits.

Several other reasons for the apparently limited use of the SSG have been offered. Finger (2009) notes that many major users of the SSG posted minimum prices when the Uruguay Round agreement came into effect. Under these circumstances, exporters knew that pricing at a lower level would result in a duty, and so had a strong incentive to price at the minimum posted price so that the SSG would not be invoked. Another reason for low official notifications of SSG use appears to be that many members have ignored the requirement to report use of the SSG to the WTO's Committee on Agriculture within 10 days of implementation (Hallaert 2005). Despite this, Hallaert concludes that the use of the SSG has increased over time as WTO members become more familiar with its provisions.

Another possible reason for limited use of the SSG is that it was frequently not politically attractive because of the weak relationship between its mechanical formulas and policy makers' goals. While the quantity-based SSG might permit the use of safeguards following a crop failure, policy makers may not have wanted to use this measure under these circumstances because of pressure from consumers concerned about high food prices.

We now turn to our empirical framework which permits a more thorough assessment and comparison of the implications of the proposed P-SSM and Q-SSM measures.

Empirical Framework and Scenario Design

For our analysis, we build on a paper by Valenzuela et al. (2007), which uses a stochastic simulation approach to validating Computable General Equilibrium (CGE) models, with a focus on the world wheat market. In this study, we employ a more recent version of the GTAP model that has been specifically tailored to agricultural applications (Keeney and Hertel 2005). Nicknamed "GTAP-AGR", it incorporates segmented factor markets to mimic short run rigidities in supply response and more detailed information about supply and demand elasticities pertinent to agricultural production and food consumption.[6] We use the Armington import demand specification with econometrically estimated elasticities of substitution between varieties of wheat in the model to allow for differentiation between wheat produced in different countries (Hertel, Hummels et al.

[6] This model is first validated based on historical variation in production and prices, following the approach proposed by Valenzuela et al. (2007). For more details, see Appendix B.

2008). As we will see below, product differentiation by origin plays an important role in the price-based SSM.

Since demand for wheat is relatively stable and most shocks to the wheat market come from weather-induced shocks to production, we introduce supply-side shocks into the model. Specifically, we shock total factor productivity in wheat in each of the model regions by sampling from historical distributions of supply deviations from trend in all regions of the world.[7] The approach used in this stochastic simulation ensures that each time the impacts of a new policy regime are simulated, the identical set of stochastic shocks is administered. In this way, we eliminate the possibility that differences in our sample of supply side shocks might contribute to differences in outcomes across policy regimes.

We perform three different sets of stochastic simulations. The first set establishes our baseline (no-SSM). In this case, we assume that tariffs remain fixed at the level of scheduled applied tariff rates for 2001, except in those cases where countries had made international commitments to lower their WTO bound tariff rates—as in the case of China's accession to the WTO—or made international commitments to lower tariffs on a preferential basis.

In our second set of stochastic simulations, we permit developing countries to invoke the Q-SSM, as detailed in the next section. Our analysis focuses on the *differences* between the means and standard deviations of key variables of interest, which are computed as the outcome under Q-SSM less the outcome under the baseline simulation. In the third, and final, set of stochastic simulations, we allow developing countries to implement the P-SSM measures as detailed below. Again, we focus on differences in mean and standard deviations, computed as P-SSM less the baseline value. Those interested in the mean and standard deviations of model variables under any individual policy regime (as opposed to the differences reported in the text) can find these in the tables in Appendix A.

[7] Standard stochastic simulation techniques such as Monte Carlo procedures are cumbersome at best, given the large number of variables in the model so we follow Valenzuela *et al*. (2007), in approximating the distribution of supply shocks using Gaussian Quadrature. This has been shown to be an efficient means of assessing the consequences of stochastic variation in parameters of or shocks to CGE models (DeVuyst and Preckel 1997) and its implementation has been automated in the GEMPACK software we use for solving our model (Arndt 1996; Pearson and Arndt 2000).

The SSM duties considered in scenarios two and three would be distinct from—and additional to—initial applied tariff rates, in the same way that anti-dumping duties and Article XIX safeguard duties are in addition to scheduled applied tariff rates. Many developing countries have the opportunity to raise applied rates relative to bindings, with China being a notable exception. Therefore, in the case of China, we have imposed a ceiling of 30 percentage points for the SSM duty, as has been proposed by the G-33 for cases where the applied tariff plus the SSM exceed the bound rate. All other regions are modeled according to the draft modalities, and applied tariffs plus the endogenously determined SSM remain below the bound rates in all cases.

Implementing the Safeguards Proposal: The Quantity Trigger

The quantity trigger permits developing countries to apply a tariff on imports whenever volumes reach 110% of a three year moving average. The resulting tariff can be as high as 25% of the bound tariff or 25 percentage points, whichever is higher. If imports exceed 115% of the baseline, then the additional duty cannot exceed 40% of the bound tariff, or 40 percentage points. Finally, in the third tier, 50% of the bound tariff or 50 percentage points is available once imports reach 135% of the baseline. In the case of China, where binding overhang has largely been eliminated, we allow for a duty of up to 30 percentage points, as proposed by the G-33 for cases where the combination of applied tariffs and the SSM duty exceeds the bound tariff.

We model this quantity-based SSM as a non-linear complementarity problem. More specifically, letting T_i be the SSM tariff, and QR_i be the ratio of observed imports to the trigger level of imports for SSM tier *i= 1, 2, 3*, we have the following complementary slackness condition:

$T_i \geq 0 \perp (1 - QR_i) \geq 0$ which implies that either:

$T_i \geq 0, (1 - QR_i) = 0$ (SSM is binding) or:

$T_i = 0, (1 - QR_i) \geq 0$ (SSM is non-binding)

We adopt the 2001 benchmark year as the baseline level of imports. Therefore, in our subsequent analysis, countries are permitted to apply a tier 1 safeguard tariff once imports reach 110% of their 2001 levels. With the Q-SSM, we assume that—when imports reach but do not exceed a trigger level—the duty is adjusted to keep imports at that trigger level[8]. The full duty permitted at a given trigger level is imposed only when imports exceed the specified trigger level. Attention then focuses on whether the next higher trigger is reached and the next higher duty imposed.

Table 1 reports on the *power* of the SSM tariff (i.e., 1 + the *ad valorem* tariff rate) for both the Quantity-based and Price-based SSM scenarios. The Q-SSM columns relate to the tier 1 and tier 2 tariffs applied to imports *from all sources*, while the P-SSM columns report the *bilateral changes* in power of the SSM tariff under the P-SSM regime. In this section, we focus on the Q-SSM. For example, the mean power of the tier 1 SSM tariff in China is 9.7% higher than its value (simply 1.0) in the baseline (No-SSM) regime.

When *cif* prices are unchanged, a one percentage point change in the *power of the SSM tariff* translates directly into a one percentage point change in the domestic price of imported wheat. In the absence of the SSM, this tariff – and hence the power of the tariff – is unchanged. However, when the SSM is present, all regions except for Other East Asia (where the SSM is always non-binding) show a positive mean change in the power of the tier-1 SSM tariff, ranging from 2.9% in MENA to 10.7% in Brazil, where domestic production is extremely volatile. Only China and Brazil invoke the tier-2 SSM tariff; the tier-3 tariff is not utilized in our simulations.[9]

Table 2 reports the changes in mean and standard deviations of key variables in Developing Country (WTO definition) markets: SSM – No-SSM values, expressed as a percent of baseline values. There are two sets of columns for each variable: the P-SSM and Q-SSM on which we focus in this section. The developing country regions listed in Table 2 are the ones permitted to apply the SSM, and they are assumed to do so whenever imports reach 110% of baseline levels. If the second tier of safeguards is breached (imports reach 115% of baseline), then an additional tariff may be applied.

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[8] An alternative, and potentially much more trade-restrictive, scenario would involve imposing the full duty permitted whenever imports reached the trigger in the past twelve months, even if this results in imports falling below the trigger.

[9] It is also of interest to know how the SSM tariff would change if only a single region utilized the SSM. In separate simulations, not reported here, we have undertaken the stochastic simulations numerous times, in each case only permitting one of the regions to impose the tariffs. Not surprisingly, this results in lower mean tariffs in the SSM-invoking country. That is to say, the effect of all developing countries utilizing the SSM is to increase the frequency and intensity of single region safeguard tariffs.

By invoking the SSM tariff with some frequency, developing countries raise the mean, tariff-inclusive price of imported wheat over the course of the stochastic simulations. When the quantity-based SSM regime is imposed, the mean import price in China rises by 10.2%, relative to the mean import price in the absence of Q-SSM (see the Import Price Column of Table 2, Q-SSM entry). By restricting imports when domestic production is low and prices are high, the expected domestic price of imports rises significantly as compared to the No-SSM mean values across all markets, with the exception of Other East Asia. This is expected to have particularly adverse impacts on the urban poor, who tend to spend a higher share of their income on staple foods when compared to wealthier households.

Now turn to the import quantity variable in Table 2, as reported in the second group of columns. Here, the expected value of imports into China is reduced under the Q-SSM regime. To better understand this, it is useful to explain that, in the absence of an SSM regime, the expected value of imports in China is 41.1% above the base level (Appendix Table A1). This large, positive mean value arises because, when domestic production is low, the demand for imports is very strong; hence there is a large percentage increase from the base level. However, when domestic production is high, gross imports cannot fall below zero. So, the expected value of imports in a stochastic environment is higher than in the baseline. When we overlay the quantity-triggered SSM regime on this same stochastic production environment, the mean change in imports becomes negative, and equals -3.3% of the baseline import value for China (Appendix Table A1). So the difference, which is reported in Table 2, is -44.4%; that is, the presence of the Q-SSM regime reduces mean imports by more than 44% of base period volume in China. Other regions with large reductions in mean imports due to the Q-SSM regime are Argentina (-46.9%) and Brazil (-23.1%). Indeed, (again with the exception of Other East Asia) all the developing country regions show lower mean import volumes under the Q-SSM regime.

Not surprisingly, higher prices for imports translate into higher mean prices for domestic products (although the two are imperfectly linked due to the Armington, product-differentiation assumption), and higher mean returns to producers of wheat under the SSM scenario. For example, in China, mean wheat prices rise from 3.7% (Appendix

Table A1: no SSM) to 8.4% (Appendix Table A1: SSM) for a difference of 4.7%, as reported under the domestic price/Q-SSM column in Table 2. This, in turn, boosts mean land rents under the Q-SSM in China's wheat sector by 13.9% relative to their mean value in the absence of Q-SSM. Higher producer returns boost expected output – which is now 3.4% higher than under the No-SSM regime. Expected producer returns (land rents) rise in all developing country regions excepting OEASIA (see above) and Argentina, where they fall by -7.6% relative to the No-SSM case, because Argentina is a net exporter of wheat and producers are hurt by the SSM implementation in other countries. The largest increase in land rents between the two policy regimes is for Brazilian wheat producers (20.4% rise in mean land rents due to Q-SSM), but other gains are also substantial. Not surprisingly, the Q-SSM also results in higher mean wheat output in these regions, with the largest deviation from the non-SSM mean change arising in Brazil (4.6% higher under Q-SSM: Table 2: Output column).

The top portion of Table 3 reports changes (SSM - non-SSM) for key variables in developed country wheat markets. Here, we see the mirror image of the developing country results. Mean output prices are lower, and mean land rents and output are lower in all of the developed country markets as a result of the Q-SSM. Mean import quantities are higher in all developed regions excepting Australia and Canada. On average, producers in these countries are adversely affected by the protection imposed in developing countries. In the case of Canadian wheat producers, for example, rather than rising by 8.1%, on average (Appendix Table A1), wheat land rents fall by 0.7% (Appendix Table A1) for a difference of -8.8%, relative to base land rents, as reported in Table 3. Australian wheat producers show nearly as large a change in mean land rents as a consequence of the Q-SSM in developing countries. Consequently, expected output in the developed country markets is also lower under Q-SSM than under the No-SSM scenario (final column of Table 3).

Globally, mean wheat trade volume is reduced sharply, with mean trade volume declining from 7.3% (No SSM) to just 2.6% (Appendix Table A5) under the quantity-based SSM for a difference of -4.7%, as reported in Table 4[10] . The deviation in expected global wheat prices (Q-SSM – no SSM) reported in Table 4 is -0.8% due to the Q-SSM regime.

Next, turn to the lower panels of tables 3-5 which focus on volatility of key variables in the global wheat market, measured as the *changes in standard deviations* for the same percentage change variables covered in the top panel, under the Q-SSM and No-SSM regimes. For example, the standard deviation of the percentage change in the power of the tier 1 and tier 2 SSM tariffs on wheat imports into China are 11.6% and 1.8%, respectively, in the presence of the Q-SSM. Since these values do not change (remaining at their base values of 1.0) in the No-SSM case, this is also equal to the difference in the two standard deviations, as reported in the lower panel of Table 1.

Volatility in the power of the SSM tariff, translates directly into volatility in import prices (inclusive of the tariff). The standard deviation of the domestic price of imports in China is 14.1% in the presence of the SSM, 4.1% with No-SSM (see Appendix Table A1), for a difference of 10%, as reported in the lower panel of Table 2. Import quantities are inherently quite volatile in many of these countries, with standard deviations suggesting that all regions (excepting Other East Asia) will regularly exceed the 110% tier 1 threshold in the Q-SSM proposal. In the absence of the SSM, the greatest import volatility is in China, which has a standard deviation in import volume equal to 110.3% of baseline imports (see Appendix Table A1). Implementation of the SSM substantially reduces the volatility of imports into China, cutting the standard deviation to just half of this value (56.1%; see Appendix Table A1) so the change in standard deviation (Q-SSM – No-SSM) is equal to -54.2%. Argentina has a significant decline in wheat import volatility equal to a -48.3% difference in the standard deviation of wheat imports. The reduction in wheat import volatility in Brazil is also striking, dropping from a standard deviation of 79.2% to 54.5% of baseline import levels (see Appendix Table A1) for a difference of -24.7% as reported in the lower panel of Table 2. Most of the other regions cut their import volume volatility index by nearly one-half translating into

[10] We also considered the impact on global wheat trade of applying the SSM in one country/region only, as has been the case in most previous studies which have offered single country analyses. In this case, the change in world wheat trade is very similar to the no-SSM case.

changes in standard deviations ranging from -6.9% to -9.9% (Other East Asia again excepted).

When duties are imposed on import surges, domestic prices become more volatile (recall Figure 3), as shown in the next column in the lower panel of Table 2. In China, the standard deviation of domestic prices rises from 25% to 30.8% (see Appendix Table A1), for a difference of 5.8%, and in Brazil it rises from 46.2% to 50.5% (see Appendix Table A1) for a difference of 4.3% as reported in Table 2. The impact on producer returns as measured by land rents is more complex, with volatility increasing sharply in China and Brazil, but falling in Other East Asia, Mexico, Argentina, Rest of Latin America, as well as Africa and the Middle East. Finally, domestic output may be more stable under the SSM, since, in a bad year, when production is down and there is a strong incentive for imports to surge, this competing source of supply is frustrated by rising tariffs, thereby lending extra incentive to producers to offset the weather-induced decline in output.

The bottom panel of Table 3 reports changes in the standard deviations of key market variables in the developed countries. These are little affected by the SSM regimes in developing countries. Prices are slightly more volatile in the wheat exporting regions of Australia, Canada and USA, and output slightly more stable under Q-SSM than under No-SSM, but the differences are quite small. This reflects the predominance of developed countries in global wheat trade. Globally, the volatility of wheat trade volume is slightly reduced under Q-SSM, while price volatility is slightly increased (Table 4).

The Price Triggered SSM

Under the Price-Triggered SSM, countries are allowed to implement a safeguard tariff when the import price on a shipment falls below 85% of the baseline level (three year average). Retaining the previous notation of T for the safeguard tariff and introducing PR as the ratio of observed price per shipment to the price trigger, we have the following complementarity problem:

$T \geq 0 \perp (PR - 1) \geq 0$ which implies that either:

$T \geq 0, (PR - 1) = 0$ (P-SSM is binding) or:

$$T = 0, (PR - 1) \geq 0 \qquad \text{(P-SSM is non-binding)}$$

Note that, unlike the quantity-based system, there is only one tier in the price-based safeguard. In addition, the safeguard tariff imposed can only amount to 85% of the difference between the shipment price and the baseline price.

There are two key differences between the price and quantity-triggered SSM regimes. The first has to do with bilateral price differences for wheat, and the second has to do with the focus of the P-SSM on shipments instead of annual-average imports. Both of these features are important to our findings, and so deserve special discussion at this point. Turning first to the bilateral price issue, we note that, because the price of each shipment of wheat is compared to an MFN average price in order to evaluate whether the SSM has been triggered, it is important to account for bilateral differences in commodity prices.

To better understand these bilateral price differences, we compute average unit values for wheat exports from each region in the model over the period 2000-2004. These are reported in the first column of Table 5, as the ratio (PR) of each region's export unit value, relative to the global average export price. The entries in Table 5 show a general tendency for developing countries to have lower prices and developed countries to have higher ones, as shown by Schott (2004) for exports in general. But this is not always the case, with some high-income regions specializing in lower-priced varieties of wheat and some poorer countries having higher unit values. Regions with lower than average wheat export prices include: China, South Asia, Argentina, Rest of Latin America, Rest of Europe, Russia and the EU. Regions with relatively high unit values include: Australia, Canada, USA, Mexico, Brazil and Sub-Saharan Africa (largely South Africa).

The remainder of Table 5 uses these unit values and the bilateral trade pattern from 2001 to compute the ratio of a given bilateral exporter price to the average import price in each importing market (BIPR). Note that some exporters show significant variation in the price of their product, relative to other suppliers, across destination markets. For example, Australian bilateral relative prices range from 0.98 in China to 1.19 in Argentina. Canadian export price ratios vary from 1.02 to 1.24. In some cases (see italicized entries) this ratio falls below the 0.85 trigger point specified in the SSM. Therefore, we have truncated these values at 85% of the average import price for use in the empirical model, since values of BIPR below 0.85 are not permitted. For such exporter/importer pairs, any further decline in price will immediately trigger the SSM. In the case of high unit value exporters, (e.g., Canada), export prices will have to fall by more than 15% in order to trigger the SSM.

The second key difference between the two SSM approaches has to do with the application of the price trigger on a shipment-by-shipment basis. This contrasts with the year-to-year price volatility reproduced by the model. The price of grain varies considerably both within a given year, and across suppliers, but much of this variability is averaged out in the annual statistics used in our modeling work. Thus, in the absence of any adjustments, our model would not invoke the bilateral, shipment-based safeguards with sufficient frequency.

In an effort to remedy this problem, while retaining the same basic model structure, and retaining the capability to compare results between the price- and quantity-based safeguards, we introduce a multiplicative factor: $k_r = \alpha\beta_r$ which operates on the bilateral *cif* prices in the model in order to compute the appropriate price trigger: $ptrigger_{rs} = k_r pcif_{rs}$. Setting the parameter $\alpha = 1.15$ bridges the gap between annual price volatility and the monthly variations in price that we use as a proxy for the shipment-by-shipment volatility data that were not available. This factor was estimated using monthly price data for Canadian wheat over the period January, 1983 to June, 2008 as a proxy for the prices of individual shipments[11]. The second adjustment factor, β_r, is indexed by exporting region, and brings bilateral annual prices in line with those observed over the historical period. Together these ensure that the frequency with which the bilateral price trigger will be activated more accurately represents the reality of this bilateral, shipment-based measure.

Table 1 also reports the changes in the mean and the standard deviation of the power of the bilateral SSM tariff for the eight developing country regions. Note that the safeguard tariff now varies, not only by importer (rows in the table), but also by the

[11] We believe that the variability of prices across shipments is largely captured by the variability across suppliers and the intertemporal variability across months included in our analysis. However, we recognize that there are other elements, such as variation across wheat varieties, which make the variance across prices of shipments even greater than is captured in our analysis. Given this, we would expect the analysis to provide a lower-bound estimate of the frequency with which the P-SSM is invoked.

source country (exporters are listed in the columns of Table 1). The highest mean tariffs are imposed on the low-unit value exporters including Russia, China, Eastern Europe, South Asia and Argentina. The volatility ranking for the SSM tariffs is similar, as shown in the bottom panel of Table 1, which reports the standard deviation in the percentage change in the power of the price-based SSM tariff on each bilateral flow.

The P-SSM columns in tables 3-5 report the *changes* (P-SSM – No-SSM) in means and standard deviations of key variables in developing and developed country markets. The first thing to note is that the price-based safeguard has a much more uniform impact on import prices than was the case under the quantity-based SSM regime – slightly raising mean prices in nearly all regions. This is because the bilateral SSM duty levied against any individual exporter is now less likely to vary across importers. With *fob* prices to all destinations changing at the same rate, the only differences in these price-based, SSM duties arise due to differential trade and transport costs as well as differences in the weights determining average import price for each region. Whereas the quantity-based SSM was largely driven by domestic supply shocks, the price-based SSM is primarily driven by supply volatility in the exporting countries. Since the composite import price is a blend of products from different exporters, there is much less variation in the mean import price changes under the P-SSM regime. The rise in mean import prices are also quite a bit smaller now, as the P-SSM is only imposed on a subset of the exporting regions, and most importers are rather diversified in their export sourcing of wheat. This stands in sharp contrast to the Q-SSM which applies to all import sources. With marginally higher mean (tariff-inclusive) import prices, mean import volumes are lower than in the No-SSM case, and mean domestic prices are higher than under the No-SSM regime in each of our developing country regions except Argentina, which relies heavily on exports that are now facing SSM tariffs in other developing countries. Higher domestic prices boost land rents, which translate into slightly higher mean output in all developing country regions, save Argentina (top panel of Table 2). The expected change in global wheat exports falls from 7.3% (No-SSM) to 6.8% (P-SSM) (Appendix Table A5) for a difference of -0.5% as reported in Table 4, and there is no difference in mean global export price under P-SSM as compared to the No-SSM, as reported in Table 4.

The bottom panels of tables 2-4 report the changes in standard deviations associated with the percentage changes in market variables in the developing and developed country markets, as well as for global trade. Import quantities are more volatile in five of the nine developing country markets due to P-SSM, while domestic prices are more volatile in seven of the developing country regions under P-SSM (as opposed to under the No-SSM simulation). Global wheat export price volatility rises slightly (from 4.1% to 4.2% (Appendix Table A5) for a 0.1% increase – see Table 4) under the price-based SSM. Once this is taken into account, this measure appears to actually <u>increase</u> the volatility of domestic prices in most developing countries. This result highlights the pitfalls of approaches such as that used by Valdés and Foster (2005) that ignore the impacts of such a measure on world prices.

Synthesis: Comparison of Price and Quantity-based Triggers

Having analyzed the price- and quantity based SSM triggers separately, it is now important to compare the two types of safeguards. This can be done by contrasting results in the Q-SSM and P-SSM columns in tables 2-4. The first thing to note is that the quantity-based SSM regime (Q-SSM) tends to boost tariff-laden import prices by much more than the price-based SSM regime (P-SSM) in developing countries for the reasons discussed above. In addition, the impacts are more varied across importing countries. In China, Q-SSM boosts mean, duty-laden import prices by 10.2% over the No-SSM outcome, whereas the P-SSM regime raises them by less than 1%. Higher mean prices for imports in the domestic market under Q-SSM translate into lower mean import quantities. The quantity-based SSM also boosts domestic prices, land rents and output by a larger amount in all but two of the developing country regions (Other East Asia and Argentina are the exceptions). These larger changes are mirrored by larger output reductions in the developed countries under the Q-SSM regime. This is due to the tendency of the price-based SSM to discriminate against low unit value exporters which tend to be developing countries (as well as the European Union).

Whereas the quantity-based regime boosted import price variability in all developing country cases (Table 2, lower panel), the price-based SSM regime has a mixed effect on the standard deviation of tariff-laden import prices, when compared to the No-SSM case. The standard deviation of import prices is lower in four of the nine developing country regions, while it is not lower in any of the developed country regions. Import volatility decreases sharply under the Q-SSM for all developing country regions, yet increases under the P-SSM in five of the nine developing country regions. Domestic price volatility rises in seven of the nine developing country regions because of the increase in the volatility of export prices resulting from introduction of the P-SSM. The Q-SSM causes an increase in domestic price volatility for all developing country regions, save Argentina, and the rise is rather sharp in both China and Brazil where domestic production is quite volatile.

Finally, under the Q-SSM regime, the expected volume of world trade is substantially reduced, whereas the P-SSM regime appears to be less damaging to global trade levels. Both SSM regimes boost world price volatility slightly over the No-SSM case, as reported in Table 4.

Conclusions

The Special Safeguard Mechanism has been a controversial feature of the recent WTO negotiations under the Doha Development Agenda. Some advocates argue that the SSM is necessary in order to protect low-income domestic producers from the vagaries of world markets. However, economic principles suggest that widespread use of the SSM could destabilize world prices as well as deny domestic consumers access to affordable imports in the case of domestic shortages. This paper investigates the key components of the SSM proposal in the draft WTO Modalities of December 2008. It includes provisions for both quantity-based and price-based safeguard measures and shows that these safeguards operate in very different ways.

Our empirical analysis is conducted by stochastically simulating a model of the world wheat market. Our findings also suggest that, as specified, the Quantity-based SSM (Q-SSM) is an order of magnitude more damaging to world trade than its Price-based counterpart. Implementation of the Q-SSM policy reduces imports, raises domestic prices, and boosts mean domestic production in the SSM regions. Rather than insulating countries that use it from price volatility, this measure could actually increase price volatility in developing countries by restricting imports when they would otherwise alleviate the adverse impacts of harvest shortfalls. We estimate that implementation of the Q-SSM, by using the specified triggers and duties, would shrink the expected value of wheat imports by nearly 50% in some regions, with overall world wheat trade falling by 4.7%. A more restrictive scenario under which the full permitted duty is used whenever imports have reached the trigger in the past twelve months could result in even larger reductions in imports and greater volatility.

The price-based regime (P-SSM) is less damaging to world trade, as it is applied on a bilateral basis and most countries import wheat from a variety of sources, thereby diluting the impact of a safeguard tariff on some of its suppliers. As a result, the reduction in world trade is far less than under the Q-SSM regime. The same is true of the P-SSM impacts on prices and production. Our results suggest that the P-SSM would actually increase the volatility of producer prices in seven out of the nine developing countries considered, with trading partners potentially applying the P-SSM when the country has a good season and increases its exports.

Part of the rationale for the SSM is a concern that shocks from world markets could have adverse impacts on vulnerable producers and consumers in developing countries. However, by imposing the duties permitted under the SSM, developing countries are likely to increase, rather than decrease, the volatility of prices in domestic markets. If the flexibility provided under the SSM to raise protection to agricultural products is to be used, it is important to consider very carefully the actual impacts of such duties on domestic outcomes, rather than to mechanically implement the duties provided for under the SSM proposal.

Unfortunately for those developing countries opting not to use the SSM, they may see the volatility of their producer prices increase as a result of greater world price instability induced by the countries employing the SSM measures. This is particularly troublesome if one believes, as many feel is likely, that increased greenhouse gas concentrations in the atmosphere will give rise to greater climate volatility and hence greater volatility in the production of staple food products (Ahmed et al, 2009).

In closing, we note that many of the main arguments in favor of the SSM focus on the well-being of vulnerable agricultural producers. Yet many rural residents in poor countries are net purchasers of food, and in many countries, urban poverty is growing ever more significant. In this context, the potential for policies based on the SSM rules to lessen poverty vulnerability seems very questionable. Future work should take into account the poverty dimension of the Special Safeguard Mechanism as well as the broad dynamics considered in this paper.

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Figure 1. Impacts of a decline in world prices in a single country.

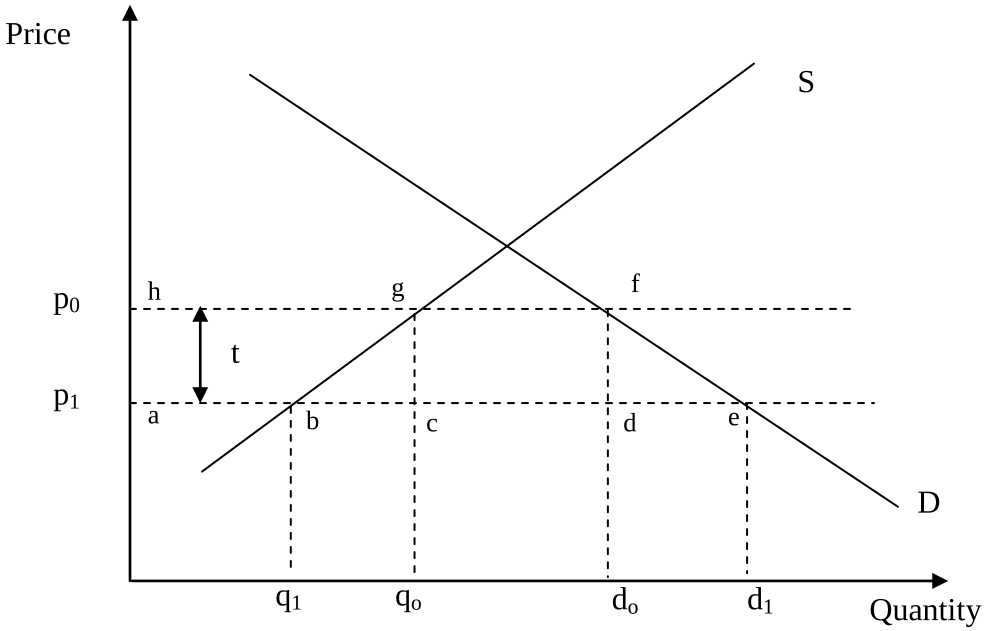

Figure 2. Implications of a price-based safeguard for the world market.

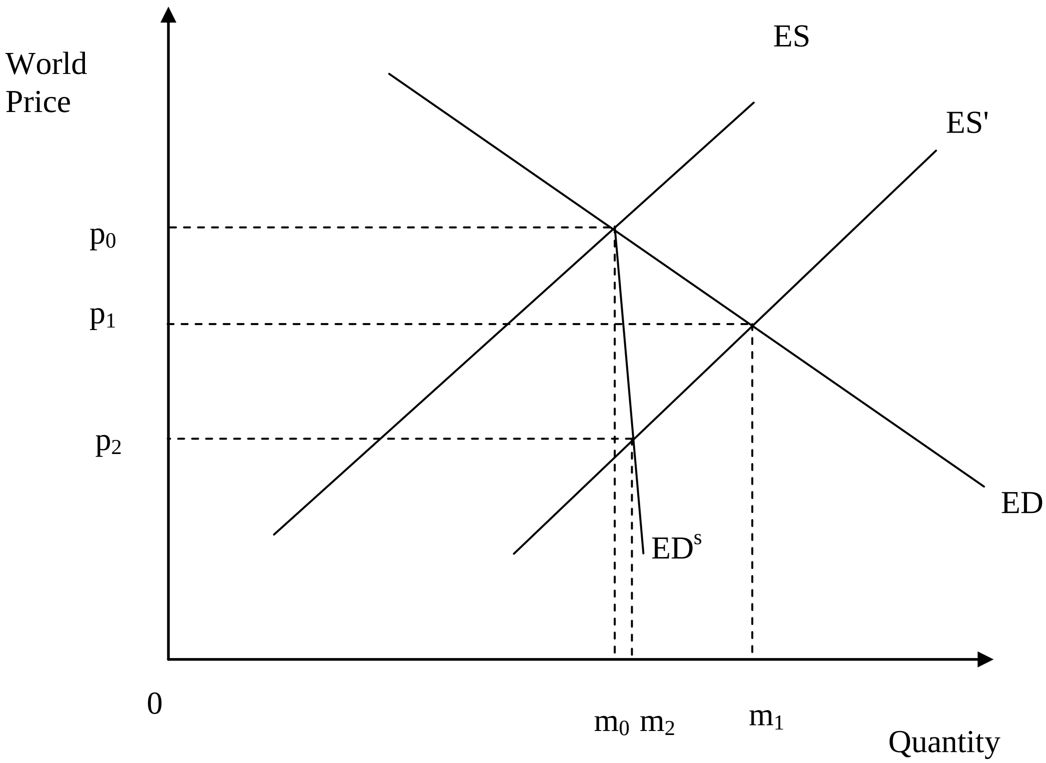

Figure 3. Potential effects of a volume-based safeguard

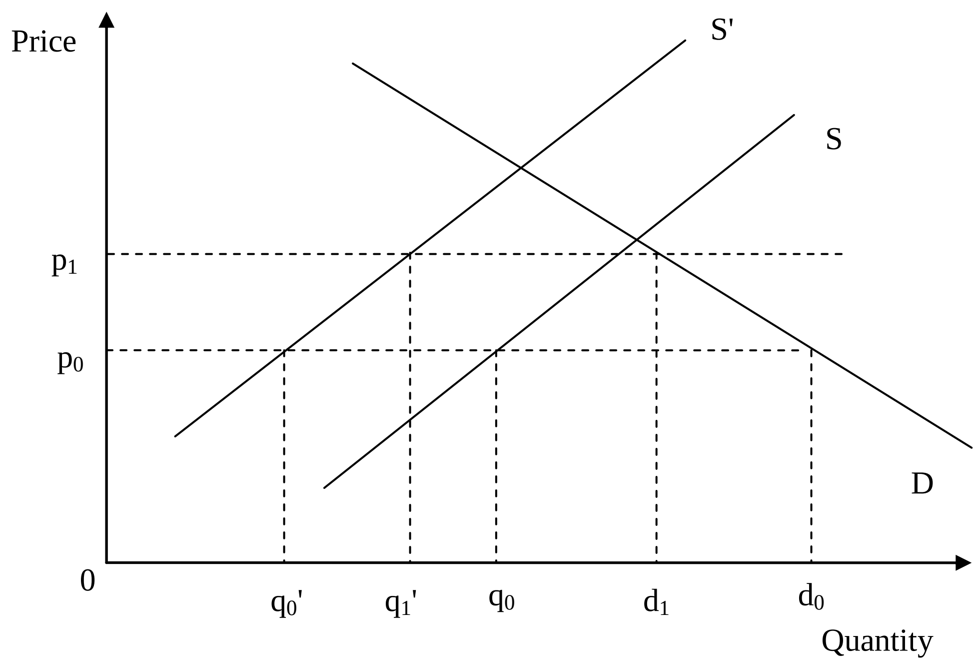

Table 1. Means and Standard Deviations for quantity-based and bilateral price-based Safeguards: percent change in power of the tariff

Percentage Changes in Means

	Quantity-based SSM		**Price-based SSM: p_TMS_SSM[wht**]**															
			Wheat Exporters															
Importing Regions	Tier 1 duty	Tier 2 duty	AUS	CHN	JPN	OEASIA	STHASIA	CAN	USA	MEX	ARG	BRZ	RLAmer	EU15	OEUR	RUS	MENA	SSA
CHN	9.7	1.2	0.44	9.96	0.07	0.37	5.11	0.03	0	0.63	4.47	2.83	3.26	0.63	7.68	13.12	1.47	0.01
OEASIA	0	0	0.38	8.15	0.01	0.07	4.07	0.02	0	0.47	5.17	1.36	3.08	0.4	7.67	13.12	0.87	0
STHASIA	4.2	0	0.38	8.99	0.01	0.04	3.87	0.02	0	0.47	4.49	0.75	3.1	0.4	7.95	12.19	0.87	0
MEX	4.3	0	0.46	9.96	0.07	0.21	5.11	0.03	0	0.63	4.81	2.83	3.26	0.7	8.13	13.12	1.15	0.01
ARG	5.7	0	0.12	0	0	0	0.03	0	0	0	3.13	0	0	0	4.5	8.95	0	0
BRZ	10.7	3.9	0.14	0.1	0	0	0.08	0	0	0	3.01	0	0	0	4.92	9.49	0	0
RLAmer	3.9	0	0.35	7.32	0	0	3.65	0	0	0.27	4.49	0.71	3.07	0.06	8.18	12.39	0.48	0
MENA	2.9	0	0.33	6.52	0	0	2.91	0	0	0.24	4.51	0.01	3.1	0.01	7.7	12.16	0.28	0
SSA	3.7	0	0.3	5.02	0	0	2.46	0	0	0.22	4.52	0	2.75	0	7.8	13.07	0.15	0

Percentage Changes in Standard Deviation

	Quantity-based SSM		**Price-based SSM: p_TMS_SSM[wht**]**															
			Wheat Exporters															
Importing Regions	Tier 1 duty	Tier 2 duty	AUS	CHN	JPN	OEASIA	STHASIA	CAN	USA	MEX	ARG	BRZ	RLAmer	EU15	OEUR	RUS	MENA	SSA
CHN	11.6	1.8	1.68	12.79	0.39	0.88	6.66	0.19	0	1.31	6.2	5.15	4.09	1.2	9.38	15.92	2.72	0.05
OEASIA	0	0	1.55	10.93	0.07	0.24	5.65	0.1	0	1.1	6.9	2.83	3.89	0.81	9.37	15.92	2.02	0
STHASIA	6.6	0	1.55	11.78	0.05	0.16	5.43	0.1	0	1.1	6.23	1.93	3.92	0.82	9.7	14.75	2.02	0
MEX	6.1	0	1.69	12.79	0.39	0.54	6.66	0.19	0	1.31	6.66	5.15	4.09	1.31	9.92	15.92	2.36	0.05
ARG	8	0	0.57	0	0	0	0.13	0	0	0	4.72	0	0	0	6.58	12.24	0	0
BRZ	11.8	5.5	0.61	0.28	0	0	0.33	0	0	0	4.53	0	0.02	0	7.02	12.74	0	0
RLAmer	5.9	0	1.42	10.04	0	0	5.27	0.02	0	0.76	6.23	1.86	3.89	0.24	9.98	15.01	1.41	0
MENA	4.7	0	1.36	9.18	0	0	4.48	0	0	0.7	6.24	0.05	3.91	0.05	9.4	14.72	1.03	0
SSA	6	0	1.24	7.57	0	0	3.98	0	0	0.63	6.26	0	3.63	0	9.52	15.86	0.72	0

Source: Authors' simulations

Table 2. Percentage Changes (SSM minus No-SSM) of mean outcomes and standard deviations for key variables in developing country wheat markets (percentage change from 2001 base)**

Difference in Mean Outcomes

	Import Price*		**Import Quantity**		**Producer Price**		**Land Rents**		**Output**	
Region	Q-SSM	P-SSM	Q-SSM	P-SSM	Q-SSM	P-SSM	Q-SSM	P-SSM	Q-SSM	P-SSM
CHN	10.2	0.5	-44.4	-1.6	4.7	0.1	13.9	0.3	3.4	0
OEASIA	-0.8	0.7	0.2	0	-0.5	0.4	-2.8	2.4	-0.9	0.7
STHASIA	3.3	0.6	-5.5	-1	1	0.1	2.7	0.3	0.8	0.1
MEX	3.5	0.3	-5.8	-0.5	1.7	0.1	6.2	0.5	2.3	0.2
ARG	5.8	0.5	-46.9	-7.3	-1.9	-1.5	-7.6	-6.7	-2.5	-2.6
BRZ	14.3	0.7	-23.1	-1.3	3.5	0.1	20.4	0.6	4.6	0.3
RLAmer	3	0.6	-6.4	-1.2	1	0.2	3.9	0.8	1.3	0.3
MENA	2.1	0.8	-4.7	-1.6	0.7	0.2	3.4	1.2	1.2	0.5
SSA	3	0.6	-7	-1.2	0.7	0.1	7.5	1.5	3.1	0.7

Difference in Standard Deviations

	Import Price*		**Import Quantity**		**Producer Price**		**Land Rents**		**Output**	
Region	Q-SSM	P-SSM	Q-SSM	P-SSM	Q-SSM	P-SSM	Q-SSM	P-SSM	Q-SSM	P-SSM
CHN	10	-3.8	-54.2	51.4	5.8	18.8	15.8	-28.9	-4	-15.8
OEASIA	0.2	0.3	0	-1.1	0.1	1.1	-0.2	-4	0	1.3
STHASIA	2.8	-0.1	-7.5	19.6	1.3	7.5	3.4	-23.5	-1	-8.2
MEX	2.1	0.3	-7.7	-0.1	2.3	2	-6.3	1.7	-3.3	2.5
ARG	2.6	1.4	-48.3	51.7	-0.2	5.6	-4.8	10	-1.1	5.1
BRZ	13	2.1	-24.7	10.2	4.3	34.3	17.8	-19.1	-5.5	11.5
RLAmer	2.1	-4.4	-7.6	-57.5	1.9	-37.8	-5.1	2.2	-3.2	-21.9
MENA	1.4	-11.5	-6.9	-49.4	1.1	-23.1	-2.8	-5.7	-2	-6.6
SSA	2.1	0.2	-9.9	5.1	1	1.6	-6.4	7.3	-4.6	5.1

Source: Authors' simulations

*Inclusive of the duty

**Deviations computed as (e.g.) mean of Q-SSM minus mean of No-SSM simulation. Appendix tables report original mean values which have been differenced to obtain the values reported here. Standard deviations reflect the variation in the year-to-year percentage change price and quantity variables.

Table 3. Percentage Changes (SSM minus No-SSM) of mean outcomes and standard deviations for key variables in developed country wheat markets (percentage change from 2001 base)**

Difference in Mean Outcomes

	Import Price*		**Import Quantity**		**Producer Price**		**Land Rents**		**Output**	
Region	Q-SSM	P-SSM	Q-SSM	P-SSM	Q-SSM	P-SSM	Q-SSM	P-SSM	Q-SSM	P-SSM
AUS	-0.1	-0.3	-5.0	4.5	-0.9	0.2	-6.7	0.6	-3.0	0.3
JPN	-0.8	0.2	0.2	-0.1	-0.5	0.1	-4.2	1	-1.4	0.3
CAN	-0.6	0.1	-2.0	0.4	-1.0	0.3	-8.8	2	-4.5	1.0
USA	-1.0	0.2	0.7	0.3	-0.7	0.2	-4.1	1.3	-1.8	0.6
EU15	-0.3	0.0	0.3	0.1	-0.2	0.0	-2.2	0.4	-1.3	0.2
OEUR	-0.5	-0.5	1.8	1.3	-0.1	-0.2	-0.6	-1	-0.3	-0.6
RUS	-0.2	-0.2	1.0	0.2	-0.1	-0.2	-0.3	-0.8	-0.2	-0.5

Difference in Standard Deviations

	Import Price*		**Import Quantity**		**Producer Price**		**Land Rents**		**Output**	
Region	Q-SSM	P-SSM	Q-SSM	P-SSM	Q-SSM	P-SSM	Q-SSM	P-SSM	Q-SSM	P-SSM
AUS	0.2	0.3	-0.3	4.9	0.2	0.2	-2.5	-1.9	-0.8	-0.7
JPN	0.1	0.0	0.1	0.0	0.1	0.0	-0.4	0.3	0.0	0.0
CAN	0.1	0.0	-0.2	0.0	0.0	0.0	-1.9	0.2	-0.8	0.0
USA	0.0	0.0	0.4	0.0	0.2	0.1	-1.5	0	-0.7	-0.1
EU15	0.0	0.0	0.1	0.0	0.0	0.0	-0.2	-0.1	-0.3	0.0
OEUR	0.0	0.1	1.0	0.7	-0.1	0.1	0.0	0.2	-0.1	-0.5
RUS	-0.1	0.1	1.2	0.3	-0.1	0.1	0.0	0.7	0.0	-0.6

Source: Authors' simulations

*Inclusive of the duty

**Deviations computed as (e.g.) mean of Q-SSM minus mean of No-SSM simulation. Appendix tables report original mean values which have been differenced to obtain the values reported here. Standard deviations reflect the variation in the year-to-year percentage change price and quantity variables.

Table 4. Changes* (SSM minus No-SSM) of mean outcomes and standard deviations for world wheat trade (percentage change from 2001 base)

	Difference in Means	
	Q-SSM	P-SSM
Volume	-4.7	-0.5
Price	-0.8	0

	Difference in Standard Deviation	
	Q-SSM	P-SSM
Volume	-2.1	0.1
Price	0.1	0.1

Source: Authors' simulations *Deviations computed as (e.g.) mean of Q-SSM minus mean of No-SSM simulation. Appendix tables report original mean values which have been differenced to obtain the values reported here. Standard deviations reflect the variation in the year-to-year percentage change price and quantity variables.

Table 5. Relative global export price ratio (PR) and bilateral import price ratios (BIPR) developing country exporters

		BIPR: Developing Country Wheat Importers								
Exporter	**PR**	CHN	OEASIA	STHASIA	MEX	ARG	BRZ	RLAmer	MENA	SSA
CHN	0.97	0.87	0.89	0.88	0.87	1.05	1.04	0.9	0.91	0.93
OEASIA	1	0.89	0.91	0.91	0.9	1.09	1.08	0.93	0.94	0.96
STHASIA	0.96	0.86	0.88	0.88	0.86	1.04	1.03	0.89	0.9	0.92
MEX	1.15	1.03	1.05	1.05	1.03	1.25	1.24	1.07	1.08	1.1
ARG	0.89	*0.85*	*0.85*	*0.85*	*0.85*	0.97	0.96	*0.85*	*0.85*	*0.85*
BRZ	1.05	0.94	0.96	0.96	0.94	1.14	1.13	0.97	0.99	1
RLAmer	0.9	*0.85*	*0.85*	*0.85*	*0.85*	0.98	0.97	*0.85*	*0.85*	0.86
MENA	1	0.89	0.91	0.91	0.9	1.09	1.08	0.93	0.94	0.96
SSA	1.15	1.03	1.05	1.05	1.03	1.25	1.24	1.07	1.08	1.1

Developed Country Exporters

		BIPR: Developing Country Wheat Importers								
Exporter	**PR**	CHN	OEASIA	STHASIA	MEX	ARG	BRZ	RLAmer	MENA	SSA
AUS	1.1	0.98	1	1	0.99	1.19	1.18	1.02	1.03	1.05
JPN	1.03	0.92	0.94	0.94	0.92	1.12	1.11	0.95	0.97	0.99
CAN	1.14	1.02	1.04	1.04	1.02	1.24	1.23	1.06	1.07	1.09
USA	1.1	0.98	1	1	0.99	1.19	1.18	1.02	1.03	1.05
EU15	0.98	0.88	0.89	0.89	0.88	1.06	1.05	0.91	0.92	0.94
OEUR	*0.85*	*0.85*	*0.85*	*0.85*	*0.85*	0.92	0.91	*0.85*	*0.85*	*0.85*
RUS	*0.85*	*0.85*	*0.85*	*0.85*	*0.85*	0.92	0.91	*0.85*	*0.85*	*0.85*

Source: Authors' calculations via COMTRADE and GTAP6 Databases
Notes: PR is the average of each exporter’s unit value divided by the world average export unit value from 2000 to 2004. BIPR equals PR divided by the 2001 weighted average import price for each importing region. Italicized values (*0.85*) have been truncated for purposes of incorporation into the model, for which this represents trigger point for the P-SSM.

Appendix A

Table A1. Percentage change in mean and standard deviations for key variables in developing country wheat markets (% change), Q-SSM

Percentage Change in Mean Outcomes

	*Import Price**		*Import Quantity*		*Producer Price*		*Land Rents*		*Output*	
Region	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM
CHN	0.5	10.7	41.1	-3.3	3.7	8.4	-3.7	10.2	-2.1	1.3
OEASIA	0.3	-0.5	0	0.2	0.7	0.2	2.8	0	0.4	-0.5
STHASIA	0.1	3.4	3.3	-2.2	1.3	2.3	-0.1	2.6	-0.3	0.5
MEX	0.6	4.1	1.8	-4	1	2.7	1.5	7.7	0.7	3
ARG	-1.7	4.1	41.3	-5.6	4.2	2.3	10.9	3.3	3.9	1.4
BRZ	2.3	16.6	19.4	-3.7	16.1	19.6	2.7	23.1	0.7	5.3
RLAmer	0.3	3.3	3.3	-3.1	1.2	2.2	2.2	6.1	0.9	2.2
MENA	-0.2	1.9	2.5	-2.2	0.5	1.2	-1	2.4	-0.3	0.9
SSA	-0.1	2.9	3.1	-3.9	0.8	1.5	-2	5.5	-0.7	2.4

Percentage Change in Standard Deviations

	*Import Price**		*Import Quantity*		*Producer Price*		*Land Rents*		*Output*	
Region	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM
CHN	4.1	14.1	110.3	56.1	25	30.8	11.6	27.4	12.8	8.8
OEASIA	4.6	4.8	0.9	0.9	5.5	5.6	29.8	29.6	16.9	16.9
STHASIA	4.4	7.2	20.4	12.9	12.9	14.2	6.1	9.5	8.7	7.7
MEX	4.7	6.8	22.1	14.4	8.1	10.4	17.6	11.3	16.4	13.1
ARG	6	8.6	69.5	21.2	11.9	11.7	29.6	24.8	23.7	22.6
BRZ	8.7	21.7	79.2	54.5	46.2	50.5	11.2	29	35.2	29.7
RLAmer	4.2	6.3	21.6	14	8.3	10.2	13.8	8.7	13.4	10.2
MENA	3.9	5.3	20	13.1	8	9.1	8.6	5.8	11.1	9.1
SSA	4	6.1	25.3	15.4	9.6	10.6	15.8	9.4	16.1	11.5

Source: Authors' simulations. * Inclusive of the duty

Table A2. Percentage Change in mean and standard deviations for key variables in developed country wheat markets (percentage change from 2001 base) Quantity Based SSM

Percentage Change in Mean Outcomes

	*Import Price**		*Import Quantity*		*Producer Price*		*Land Rents*		*Output*	
Region	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM
AUS	-7.4	-7.5	57.7	52.7	1	0.1	6.1	-0.6	2.5	-0.5
JPN	0.4	-0.4	0	0.2	0.6	0.1	4.6	0.4	0.6	-0.8
CAN	-1	-1.6	10.7	8.7	1	0	8.1	-0.7	3.8	-0.7
USA	0.5	-0.5	4.1	4.8	1	0.3	3.3	-0.8	1.5	-0.3
EU15	-0.2	-0.5	1.7	2	0.6	0.4	2	-0.2	1.2	-0.1
OEUR	-2	-2.5	28.7	30.5	3.2	3.1	0.2	-0.4	0	-0.3
RUS	-3.1	-3.3	42.7	43.7	7.3	7.2	0.5	0.2	-1.5	-1.7

Percentage Change in Standard Deviations

	*Import Price**		*Import Quantity*		*Producer Price*		*Land Rents*		*Output*	
Region	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM
AUS	8	8.2	58.2	57.9	6.4	6.6	41	38.5	28.5	27.7
JPN	4.5	4.6	2	2.1	4.5	4.6	34.6	34.2	15.6	15.6
CAN	5.1	5.2	20.8	20.6	4.8	4.8	30.2	28.3	20.7	19.9
USA	4.4	4.4	22.2	22.6	6.1	6.3	16	14.5	13.9	13.2
EU15	4.6	4.6	3.8	3.9	6	6	11.5	11.3	11.3	11
OEUR	4.6	4.6	68	69	19.1	19	5.6	5.6	16.8	16.7
RUS	15.5	15.4	69.3	70.5	31.1	31	14.2	14.2	17.7	17.7

Source: Authors' simulations *Inclusive of the duty

Table A3. Percentage change in mean and standard deviations for key variables in developing country wheat markets (percentage change from 2001 base) Price Based Safeguard

Percentage Change in Mean Outcomes

	*Import Price**		*Import Quantity*		*Producer Price*		*Land Rents*		*Output*	
Region	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM
CHN	0.5	1	41.1	39.5	3.7	3.8	-3.7	-3.4	-2.1	-2.1
OEASIA	0.3	1	0	0	0.7	1.1	2.8	5.2	0.4	1.1
STHASIA	0.1	0.7	3.3	2.3	1.3	1.4	-0.1	0.2	-0.3	-0.2
MEX	0.6	0.9	1.8	1.3	1	1.1	1.5	2	0.7	0.9
ARG	-1.7	-1.2	41.3	34	4.2	2.7	10.9	4.2	3.9	1.3
BRZ	2.3	3	19.4	18.1	16	16.1	2.7	3.3	0.7	1
RLAmer	0.3	0.9	3.3	2.1	1.2	1.4	2.2	3	0.9	1.2
MENA	-0.2	0.6	2.5	0.9	0.5	0.7	-1	0.2	-0.3	0.2
SSA	-0.1	0.5	3.1	1.9	0.8	0.9	-2	-0.5	-0.7	0

Percentage Change in Standard Deviations

	*Import Price**		*Import Quantity*		*Producer Price*		*Land Rents*		*Output*	
	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM
CHN	8	4.2	58.2	109.6	6.4	25.2	41	12.1	28.5	12.7
OEASIA	4.5	4.8	2	0.9	4.5	5.6	34.6	30.6	15.6	16.9
STHASIA	4.6	4.5	0.9	20.5	5.5	13	29.8	6.3	16.9	8.7
MEX	4.4	4.7	22.2	22.1	6.1	8.1	16	17.7	13.9	16.4
ARG	4.7	6.1	22.1	73.8	8.1	13.7	17.6	27.6	16.4	21.5
BRZ	6	8.1	69.5	79.7	11.9	46.2	29.6	10.5	23.7	35.2
RLAmer	8.7	4.3	79.2	21.7	46.2	8.4	11.2	13.4	35.2	13.3
MENA	15.5	4	69.3	19.9	31.1	8	14.2	8.5	17.7	11.1
SSA	3.9	4.1	20	25.1	8	9.6	8.6	15.9	11.1	16.2

Source: Authors' simulations. * Inclusive of the duty

Table A4. Percentage change in mean and standard deviations for key variables in developed country wheat markets (percentage change from 2001 base) Price Based SSM

Developed Country Markets

	*Import Price**		*Import Quantity*		*Producer Price*		*Land Rents*		*Output*	
Region	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM
AUS	-7.4	-7.7	57.7	62.2	1	1.2	6.1	6.7	2.5	2.8
JPN	0.4	0.6	0	-0.1	0.6	0.7	4.6	5.6	0.6	0.9
CAN	-1	-0.9	10.7	11.1	1	1.3	8.1	10.1	3.8	4.8
USA	0.5	0.7	4.1	4.4	1	1.2	3.3	4.6	1.5	2.1
EU15	-0.2	-0.2	1.7	1.8	0.6	0.6	2	2.4	1.2	1.4
OEUR	-2	-2.5	28.7	30	3.2	3	0.2	-0.8	0	-0.6
RUS	-3.1	-3.3	42.7	42.9	7.3	7.1	0.5	-0.3	-1.5	-2

Developed Country Markets

	*Import Price**		*Import Quantity*		*Producer Price*		*Land Rents*		*Output*	
Region	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM	No SSM	SSM
AUS	8	8.3	58.2	63.1	6.4	6.6	41	39.1	28.5	27.8
JPN	4.5	4.5	2	2	4.5	4.5	34.6	34.9	15.6	15.6
CAN	5.1	5.1	20.8	20.8	4.8	4.8	30.2	30.4	20.7	20.7
USA	4.4	4.4	22.2	22.2	6.1	6.2	16	16	13.9	13.8
EU15	4.6	4.6	3.8	3.8	6	6	11.5	11.4	11.3	11.3
OEUR	4.6	4.7	68	68.7	19.1	19.2	5.6	5.8	16.8	16.3
RUS	15.5	15.6	69.3	69.6	31.1	31.2	14.2	14.9	17.7	17.1

Source: Authors' simulations

* Inclusive of the duty

Table A5. Impacts on World Wheat Trade

	Mean		
	Baseline	Q-SSM	P-SSM
Volume	7.3	2.6	6.8
Price	0.1	-0.7	0.1

	Std Deviation		
	Baseline	Q-SSM	P-SSM
Volume	7.8	5.7	7.9
Price	4.1	4.2	4.2

Source: Authors' simulations

Appendix B

Model and Historical Validation

For this work, we build on a paper by Valenzuela et al. (2007), which uses a stochastic simulation approach to validating Computable General Equilibrium (CGE) models, with a focus on the world wheat market. In this study, we employ a more recent version of the GTAP model that has been specifically tailored to agricultural applications (Keeney and Hertel, 2005). Nicknamed "GTAP-AGR", it incorporates segmented factor markets to mimic short run rigidities in supply response and more detailed information about supply and demand elasticities pertinent to agricultural production and food consumption.

We use the Armington import demand specification with econometrically estimated elasticities of substitution between varieties of wheat in the model to allow for differentiation between wheat produced in different countries. As we will see below, product differentiation by origin plays an important role in the price-based SSM. Because we are interested in comparing a WTO trade regime with and without safeguards, we hold the tariff rates constant in our initial simulation. We then compare the outcomes from simulations in which tariff rates are varied in accordance with the rules under the SSM's price and quantity triggers.

Before using this model for analysis of alternative safeguard measures, we examine its performance relative to historical variation in production and prices. Here, we follow the approach proposed by Valenzuela et al. (2007). Appendix Table B.1 reports our findings. The first column under "production" is the regional standard deviation of wheat output reported in Valenzuela et al., 2007. Those authors used time series methods to decompose the non-systematic year-to-year variation in wheat output and then used the normalized standard deviation of these residuals to characterize the distribution of supply-side uncertainty in their model. From this column you can see that Australia and Brazil show the most volatile production, followed by Argentina and then Canada.

Since demand for wheat is relatively stable and most shocks to the wheat market come from weather-induced shocks to production, we introduce supply-side shocks as shifts in supply curves for wheat in the model. Specifically, we shock total factor productivity in wheat in each of the model regions. Standard stochastic simulation techniques such as Monte Carlo procedures are cumbersome at best, given the large number of variables in the model so we follow Valenzuela *et al*. (2007), in approximating the distribution of supply shocks using Gaussian Quadrature. This has been shown to be an efficient means of assessing the consequences of stochastic variation parameters or shocks to CGE models (DeVuyst and Preckel) and its implementation has been automated in the GEMPACK software we use for solving our model (Arndt and Pearson, Harrison and Pearson).

The second column in Appendix Table B.1 reports the model simulated production volatility, reported as the standard deviation in percentage change of output, from baseline, assuming symmetric, independent distributions for wheat supply shocks in each of the model regions. By virtue of our sampling strategy, the model results for production are very close to the historical variation.[6] The discrepancy between observed and simulated output volatility is greatest for China and for Canada where the standard deviations in year-to-year output changes differ by 3 percentage points. In light of the fact that we are mainly aiming for qualitative insights in this paper, we feel this modest deviation from historical variation is acceptable.

The most important part of Appendix Table B.1 is the price comparison offered in the right hand side panel of this table. Prices are endogenous functions of the supply shocks, operating in concert with the supply and demand elasticities[12]. So asking whether the model is able to broadly reproduce historical price variation is a very interesting question. Comparing columns three and four of Table 1, we see that the model predicts too little price variation for the exporting regions: Argentina, Australia, Canada, USA, and Mexico (the latter is not an exporter, but it is well-integrated into the net exporting, NAFTA region). On the other hand, the model over-predicts price volatility in the historically insulated import markets of China, Japan, South Asia, and Brazil. The under-prediction by the model without historically-based estimates of price insulation is consistent with the finding by Tyers and Anderson (1992). Valenzuela *et al* (2007, Table 3) show that moving away from price-insulating policies to a regime of fixed tariffs would substantially reduce the volatility of the prices faced by exporters such as Argentina and the United States, while only marginally increasing the volatility of prices in importing markets such as China and Japan. This is because most of the reduction in the variability of domestic prices in importing countries resulting from use of insulating policies is offset by the induced increase in the volatility of world prices.

[6] In fact, we calculate the stochastic shocks to exogenous wheat productivity in each region by computing the shock to TFP required to achieve a given production change, thereupon translating the historical distribution of output shocks accordingly. Since this is a non-linear, general equilibrium model, this approach to calibration is imperfect, and there are some discrepancies between the historical and model-based standard deviations in production.

[12] The demand elasticities used in this version of the model are intended to reflect a combination of demand for use in consumption and demand for stocks in the range where the SSM is likely to be applied.

Appendix Table B.1 Comparison of historical and model-based outcomes

	Production		*Prices*	
Region	Historical	Model	Historical	Model
AUS	28	29	17	6.4
CHN	10	13	21	25
JPN	14	16	4	4.5
STHASIA	8	9	7to10	12.9
CAN	18	21	15	4.8
USA	13	14	16	6.1
MEX	16	16	34	8.1
ARG	24	24	35	11.9
BRZ	34	35	27	46.2
RLAmer	12	13	9 to 30	8.3
EU15	9	11	6 to 8	6
OEUR	15	17	20 to 28	19.1
MENA	11	11	4 to 29	8

Sources: Valenzuela et al. (2007) for historicals, and authors' simulations.