The Impacts of Export Subsidy Reduction Commitments in the Agreement on Agriculture

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1.   Introduction

Export subsidy reductions is one of the three pillars of commitments made in the Agreement on Agriculture (hereafter "the Agreement") in the World Trade Organization (WTO). However, very little research has been undertaken. Discipline on export competition measures is deemed to be an important accomplishment, because it has been included in agriculture for the first time.   The purpose of this research is to assess the extent to which export subsidy commitments have been effective, and what modifications are needed to improve their performance. To do so, an overview of policy developments is undertaken, with a focus on the economics of the bindings imposed on export subsidies.

Several commentators argue that export subsidies are the most distorting of agricultural policy interventions, and so should be outlawed (e.g. Josling; McCalla). However, an export subsidy has the same trade distorting effects as an import barrier for the same market supply/demand conditions. The source of this confusion may be that competing export subsidy programs by two or more countries is self-defeating. However, this is true for import restrictions as well, which lower world prices and require other countries to increase tariffs to maintain the same level of producer support. Indeed, import barriers by some countries increase the need for export subsidies by others and vice versa. Hence, disciplines on export subsidies should receive the same urgency as that on market access[1].

Trade liberalization under export subsidy reduction schedules includes limits on both expenditures and physical quantities. The effects of those limits vary under different scenarios. We isolate the factors affecting export subsidy expenditures in the intervening years, in order to measure the binding effect of limits on volume versus value limits on export subsidies. Several

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[1] Export Subsidies are illegal in the GATT, which is an indication of this political bias.

other issues regarding export subsidy policy commitments are identified. We analyze the relative effectiveness of volume versus value constraints under changing market conditions. For example, for the scheduled reductions the volume limit is always binding for a given static scenario, but value can become binding if the ratio of the reductions follows certain proportions, or if changes in baseline conditions occur. The choice of base period and world market developments may be contributing to subsidy reductions rather than genuine efforts by governments to reduce price supports that determine subsidy levels. Export subsidy limits on both expenditures and physical quantities are also negated somewhat by aggregation across products and over time.

The traditional approach to measuring the liberalizing effects of protection bindings has treated protection (tariffs and subsidies) as deterministic. The liberalizing effects of the introduction of a new binding or a reduction in an existing binding on export subsidies is traditionally defined as zero if the binding is above the applied rate, and one otherwise. This approach ignores the impact of bindings above the mean and moreover, it overstates the marginal impact of reductions in bindings below the applied rate.

For the specific case of bindings and rules as trade liberalization, we apply the methodology developed by Martin and Francois (1997) as a "general approach …allowing the benefits of new bindings, reductions in existing bindings and improvements in the rules of the trading system to be evaluated". This method treats protection as a random variable by considering the effects of a binding on the mean and variance of protection, as opposed to the traditional approach where protection is treated as deterministic. The value of export subsidies will be analyzed using this methodology in order to quantify the trade liberalization effects of the rules and changes in the rules under the Uruguay round reduction commitments and beyond.

2.   An Overview of Export Subsidy Commitments in the Agreement

Limits on and reductions in the volume and value of export subsidies for 25 countries (and the prohibition of new subsidies) was the cornerstone of export subsidy commitments in the Agreement. Additional countries have recently joined the reduction commitments. Each country agreed to reducing the volume of subsidized exports by 21 percent over 6 years from a 1986-90 average base period level (14 percent over a 10-year period for developing countries), and reduce the value of export subsidies by 36 percent (24 percent over 10 years for developing countries). The Agreement provides flexibility by allowing countries to redistribute the value of subsidies or the volume of subsidized exports between years but the cumulative totals through the year 2000/01 are not to exceed those that would have resulted from full compliance. Countries were also permitted to aggregate products within a commodity group in their commitments.

WTO notifications have the European Union spending the lion's share (over 80 percent) of total world export subsidies (Table 1).

Table 1: Total Export Subsidy Commitments

	Base	1995/96	1996/97	1997/98	2000 bound
European Union (million ECU)	11,700	4,800	5,500	4,400	7,400
United States (million US$)	930	26	122	113	590
World total (million US$)	21,000	6,900	7,000	5,500	13,400

The United States export subsidy expenditures were less than several countries including South Africa (which eliminated export subsidies in 1997) and Switzerland. Canada eliminated transportation subsidies for exports and so reduced their support in this category dramatically (See Chart 1 for Baseline and Chart 2 for 1995/96 levels in the Appendix). Several countries and commodity sectors have exceeded their commitments (see Table 2; de Gorter; Ruiz).

3.   The Economics of Volume versus Value Commitments on Export Subsidies

A key policy issue is whether the formula for further cuts in export subsidies should focus on volumes or expenditures. Indeed the volume exported is part of the value of export subsidies. Assuming both restrictions in volume and value are binding in the baseline, with no change in economic conditions (excess supply and demand curves do not shift), the effects of both types of bindings are not obvious.

Assume for example, that in the baseline, both the volume of subsidized exports and the value of export subsidy expenditures are limiting. Let us first consider the case when the excess supply and demand curves do not shift over time. A 21 percent reduction in the volume of exports with an export subsidy may result in exports being equal to or less than the free trade level Q^* (where the per unit export subsidy will fall to zero). In this case, the volume constraint will be more liberalizing and any reduction beyond Q^* would not be necessary. Reducing the volume of exports receiving a subsidy results in a lower price gap, which becomes zero at Q^*. One needs a less than 100 percent reduction in the volume of subsidized exports to reach free trade, unlike the case for reductions in export expenditures.

Per-unit subsidy and volume exported are limited by the shape and position of excess supply and excess demand curves. If the volume commitment is binding, it is not possible to apply a larger per-unit subsidy. Therefore, in a static analysis, value bindings would not be necessary if there is a volume constraint.

For the case where only value is constrained, it is not possible to subsidize more exports with a decreasing per-unit subsidy, because the per-unit subsidy increases with exports. Therefore, if value commitment is binding, there is no need for a volume binding in a static analysis. Hence, we need to analyze the relative effectiveness of each type of binding.

We develop an analytical framework that allows us to analyze the economics of volume versus value as a static framework, and under different supply and demand conditions. In the static analysis, we analyze the case where there is no change in baseline market conditions before reductions take place. Export subsidy reductions are applied only once. The dynamic analysis will consider the scenarios in which changes occur in the baseline scenario in the meantime. In other words, changes in excess supply and excess demand curves occur before the reductions are realized. Also, changes that occur after the reduction commitments are met are analyzed.

Static Analysis

Assume in the baseline scenario that a given country applies a per-unit subsidy s_0 to a given commodity, resulting in exports Q_0. Assume that s_0 and Q_0 determine the initial value and volume that will be reduced as specified in the commitments.

Consider an inverse excess supply curve

(1) $P_d = a + bQ$

where P_d is the domestic price, and an inverse excess demand curve

(2) $P_w = c + dQ$

where P_w is the world price and Q is imports (imports = exports). The per-unit export subsidy in the base time $t = 0$ is:

(3) $s_0 = P_{d} - P_w = (a - c) + (b - d)Q_0$

The value of the export subsidy in the baseline is given by

(4) $V_0 = \left[(a - c) + (b - d)Q_0\right]Q_0$

Define β as the proportion of baseline values of export subsidies that is allowed. This is the value of export subsidies remaining after the reductions are accomplished. Hence, $\beta = 1 - V_{red}$, where V_{red} is the required percentage reduction in the value of export subsidies. Define α as

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the proportion of baseline volume of subsidized exports that is allowed (after reductions).

Hence, $\alpha = 1 - Q_{red}$, where Q_{red} is the percentage reduction in the volume of subsidized exports.

To compare the effect of a reduction in volume versus value, define

(4a) $\quad V_\beta = \left[(a-c)+(b-d)Q_0\right]\beta\,Q_0$

where V_β is the value in dollars of export subsidies remaining, after the value reduction commitment is met, and

(4b) $\quad V_\alpha = \left[(a-c)+(b-d)\alpha\,Q_0\right]\alpha\,Q_0$

where V_α is the value in dollars of export subsidy remaining, after volume reduction commitment is met. Equating equations (4a) and (4b), we can determine the conditions under which α and β generate volume exported and value of export subsidies that are equally binding, that is when $V_\beta = V\alpha$:

(5) $\quad V_\beta = \left[(a-c)+(b-d)Q_0\right]\beta\,Q_0 = \left[(a-c)+(b-d)\alpha\,Q_0\right]\alpha\,Q_0 = V_\alpha$

Solving equation (5) for Q_0 gives:

(6) $\quad Q_0 = \dfrac{(\alpha-\beta)(a-c)}{(\beta-\alpha^2)(b-d)}$ where $0<\alpha<1,\ 0<\beta<1$

Solving equation (3) for Q_0, substituting in equation (5) and solving for β gives:

(7) $\quad \beta = \alpha^2 - s_0(c-a)(1-\alpha)\alpha$

Proposition 1: For identical reductions in volume and value ($\alpha = \beta < 1$), the volume reduction is always binding. This result is independent of the elasticities of excess supply and excess demand.

Proof: By definition, baseline value and volume are equally binding, and $\alpha = \beta = 1$ when no reductions were imposed. By imposing the restriction $\alpha = \beta < 1$ in equation (5), we can show that the volume reduction becomes binding, because the left-hand side of equation (5) becomes

larger (note that $\alpha^2 < \alpha$ because $0 < \alpha < 1$). V_α is the value of export subsidy after the volume reduction commitment is met, and if it is smaller than V_β, the volume reductions are more binding for any $\alpha = \beta < 1$.

However, we cannot infer from proposition 1 that reductions in value have to be larger than reductions in volume in order to be binding at the same Q_0. To determine the values of α and β where reductions are equally binding, we impose the following restrictions on equation (6): $Q_0 > 0$, $c > a$ (excess supply intercept is smaller than excess demand intercept) and $d < 0$ (slope of the excess demand curve is negative). Therefore, $(a-c) < 0$, and $(b-d) > 0$. The conditions that satisfy $Q > 0$ on (6) are: $\beta > \alpha$ or $\beta < \alpha^2$. These are necessary but not sufficient conditions for volume and value reductions to be equally binding at positive quantities traded. Note that these conditions do not determine the exact relationship between α and β, but they do rule out some combinations of α and β that are not equally binding.

Corollary: For the current reduction commitments (21% in volume and 36% in value[2]), the value reduction will never be binding because:

$\beta = 0.64$ or 0.76 (1- V_{red} for developed and developing countries, respectively)

$\alpha = 0.79$ or 0.86 (1- Q_{red} for developed and developing countries, respectively)

$\alpha^2 = 0.62$ or 0.74

These values of α and β do not satisfy $\beta > \alpha$ or $\beta < \alpha^2$, and therefore cannot be equally binding. If we substitute these values of α and β in equation (5), V_β becomes larger than V_α, showing that V_α is binding. Therefore, the value of export subsidies after the 21% or 14% volume reduction is smaller than the volume left from a 36% or 24% value reduction, and hence the volume limit is binding.

Proposition 2: For a reduction in value to be binding, the ratio of the reduction commitments in value and volume has to be smaller than the ratio of the initial and reduced per unit export subsidy.

Proof: We rewrite equation (5) in general form, where ES(.) is the excess supply curve, and ES = Pd = a + bQ; ED(.) is the excess demand curve, and ED = Pw = c + dQ:

$$(8) \qquad V_\beta = \left[ES(Q_0) - ED(Q_0) \right] \beta\, Q_0 \quad < \quad \left[ES(\alpha\, Q_0) - ED(\alpha\, Q_0) \right] \alpha\, Q_0 = V_\alpha$$

where $V_\beta < V_\alpha$ determines that the final value of the subsidy after an 1 - β reduction in value will be smaller (and therefore binding) than the final value of the subsidy after a 1 - α reduction in volume. Solving equation (8) for β/α gives:

$$(9) \qquad \frac{\beta}{\alpha} < \frac{\left[ES(\alpha Q_0) - ED(\alpha Q_0) \right]}{\left[ES(Q_0) - ED(Q_0) \right]} \quad \Rightarrow \quad \frac{\beta}{\alpha} < \frac{s}{s_0}$$

When $\beta/\alpha < s/s_0$, value can be binding; when $\beta/\alpha > s/s_0$ volume can be binding (but still the relative values of α and β have to satisfy $\beta > \alpha$ or $\beta < \alpha^2$ for value to be possibly binding). Therefore, at baseline, $\alpha = \beta = 1$ and $s = s_0$ (no reductions, both volume and value are binding). In order to get $s < s_0$ (reduction in per-unit subsidy), α has to be either larger than β, which contradicts Proposition 1, or β has to be smaller than α^2, which seems more logical. This confirms that reductions in value (1 - β) have to be significantly larger than reductions in volume $(1 - \alpha)$ in order for value commitments to be binding.

This relationship allows us to forecast of the effects of bindings on the reduction of per-unit subsidies for a given set of parameters. Therefore, when reductions are negotiated, a country can analyze the final per-unit export subsidy resulting from the proposed α and β reductions for each commodity sector, and determine the reduction in exports for given supply

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[2] For developing countries, the reductions are 14% in volume and 24% in value.

and demand conditions.

Proposition 3: For a larger initial per-unit export subsidy, *ceteris paribus*, volume reduction commitments are relatively more effective.

Proof: In the baseline, assume that both value and volume are binding, no reductions were applied, and $\alpha = \beta = 1$. Then, reductions are applied to value and volume. From equation (7), we can show that the larger the initial subsidy s_0, the larger the reductions in value have to be for each $(1 - \alpha)$ reduction in volume:

(7) $$\beta \leq \alpha^2 - s_0(c-a)(1-\alpha)\alpha$$

For expenditure reductions to be binding, β has to be sufficiently small, and therefore reduction in expenditures has to be sufficiently large (because $\beta = 1 - V_{red}$ or the proportion of the value of export subsidies allowed by the reduction in value). We can conclude that the higher the initial subsidy, *ceteris paribus*, the more likely that volume reductions will be binding, because β is decreasing in s_0. Intuitively, we can understand that volume reductions happen in one dimension, while value reductions involve reduction of an area (exports multiplied by the per-unit export subsidy). Therefore, for a larger area (which implies a larger per-unit export subsidy, *ceteris paribus*) the value reductions would affect volume of exports less dramatically than a reduction in volume itself.

Proposition 4: For larger initial quantities exported (*ceteris paribus*), value reductions are relatively more likely to bind.

Proof: Define the equilibrium (free trade) quantity as:

(10) $$Q^* = \frac{(c-a)}{(b-d)}$$

Solving equation (3) for Q_0 gives:

$$(11) \quad Q_0 = \frac{s_0 + (c - a)}{(b - d)}$$

which shows that $Q_0 > Q^*$. There is a maximum reduction in volume that will make $Q_0 = Q^*$, which is the free trade equilibrium and $s = 0$. Let us define $\hat{\alpha}$ as the minimum α (or the maximum reduction in volume) that will bring exports to the free trade equilibrium such that

$$(12) \quad \hat{\alpha} Q_0 = Q^* \quad \Rightarrow \quad \hat{\alpha} = \frac{Q^*}{Q_0}$$

The range of volume reductions (α) is then $[\hat{\alpha}, 1]$ and the range of value reductions (β) is $[0,1]$. This can be represented by the following diagram:
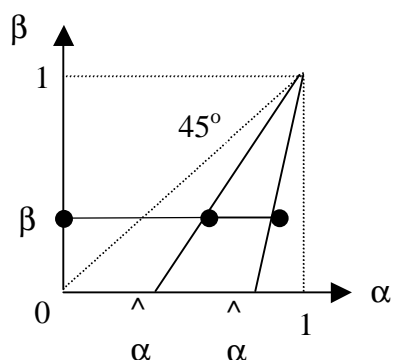
This diagram shows that the same β is equally binding at increasing reductions in volume (decreasing $\hat{\alpha}$), when Q_0 increases.

From (12), we differentiate α with respect to Q_0, which gives:

$$(13) \quad \frac{\partial \hat{\alpha}}{\partial Q_0} = -\frac{Q^*}{Q_0^2} < 0$$

Therefore, for larger initial quantities Q_0, *ceteris paribus*, the reductions in volume to achieve free trade have to be larger (for the same per-unit export subsidy). Also, $\hat{\alpha}$ has to be smaller for the same reduction in expenditures β. Therefore, a reduction in volume has to be larger to be as binding for the same reduction in expenditures, for larger Q_0. Value commitments

are relatively more likely to be binding for larger volumes exported, *ceteris paribus*.

Note from (13) that α is not linear in volume. For larger volumes we need increasing reductions in α to achieve free trade. Also, the area to the right of the solid lines on the diagram is the area of volume binding. Recalling that $\alpha = 1 - Q_{red}$, and Q_{red} is the percentage reduction in volume of subsidized exports, the smaller the area, the more volume reductions are binding, and that occurs with smaller Q_0, for which the range of reductions for volume to achieve free trade is relatively smaller.

Proposition 5: For more elastic curves, *ceteris paribus*, value reduction commitments become relatively more effective.

Proof: Note that on equation (7), β is a function of volume restrictions α, initial per-unit subsidies s_0 and intercepts a and c. The value reduction $1 - \beta$ is not a function of elasticities.

However, we can use the findings in propositions 3 and 4 to set the framework for analyzing how bindings are affected by the value of trade elasticities. Proposition 3 shows that a value reduction is more effective for smaller per-unit subsidies: we then keep a, c and (implicitly) Q_0 constant in (7) and decrease s_0. This is only achieved by making the excess demand and supply curves more elastic. In Figure 1a below, this corresponds to decreasing the per-unit subsidy from distance gh $= s_0$ to the bold segment s' at Q_0. This proves that more elastic curves (smaller per-unit export subsidies, *ceteris paribus*) make the value reduction more effective.

Proposition 4 states that for larger initial quantities exported (*ceteris paribus*), value reductions are more likely to bind. So we keep c, a and s_0 constant, and increase Q_0. Again, this is only achieved by making the excess demand and supply curves more elastic. For increasing Q_0, *ceteris paribus*, the curves become more elastic. Therefore, for more elastic curves value reductions are more likely binding, given that in Proposition 4 we proved that for increasing Q_0

expenditure reductions are more likely to bind.   In Figure 1b below, this corresponds to increasing initial volume from Q_0^1 to Q_0^2.   This proves that more elastic curves (larger initial volume, *ceteris paribus*) make the value reduction more effective.

Figure 1a	Figure 1b
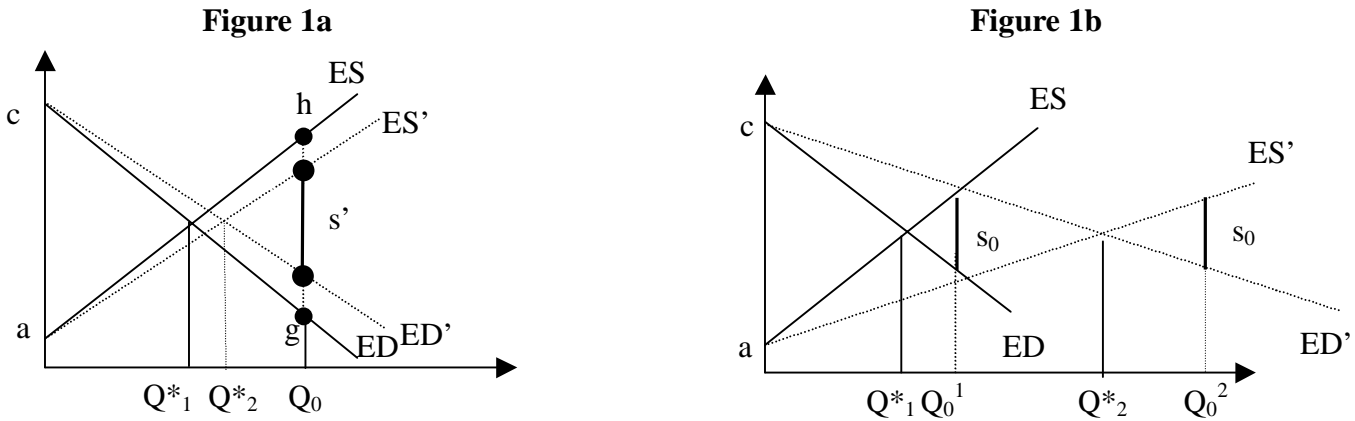
The analysis in propositions 1 to 5 is in static framework.   But conditions of trade may change, and therefore the analysis needs to be augmented to include a dynamic analysis where the free trade equilibrium shifts during the export subsidy reduction implementation period, or after the reductions have been accomplished.

## Dynamic Analysis: Shifts in the Free Trade Equilibrium

The second part of our analysis considers shifts in the excess supply and demand curves that occurred during the implementation time period, before or after reduction commitments are met.   Figure 2 depicts two cases: the free trade equilibrium point shifted to the left in panel (A) with negative (or inward) shifts in excess supply and/or excess demand; or the reverse in panel (B) where the free trade equilibrium shifted to the right due to positive (outward) shifts in excess supply and/or excess demand.   The effectiveness of a volume versus an expenditure constraint depends on the goal of the government.   Politicians have the option to maximize any one of at least four potential policy targets to fulfill political demands as best as possible under changing

market conditions and WTO export subsidy commitments: the per unit export subsidy, total export subsidy expenditures, the volume of exports subsidized, or domestic price levels.

If the free trade equilibrium shifts to the left, volume limits become less binding. We can have "water" in the volume limit, if value commitments bind at a lower Q. It is more likely that countries that reduced their schedule of exports over the implementation period will have to increase per-unit subsidy on a smaller volume of exports. It is possible, though, that countries will not be able to spend all their value allowances, if it means exports above the volume limit. It would be possible to keep the level of domestic prices if the shift is in excess supply.

If the trade equilibrium shifted to the right, value limits became less binding, so we can have "water" in the value limit. It is more likely that countries will have to reduce the per-unit subsidy, and that the domestic price will have to fall due to the volume binding. The volume of exports will be maximized if the value limit does not bind at a lower Q.

Figure 2: Shifts in the Free Trade Equilibrium with Export Volume/Value Limits

(A)   (B)

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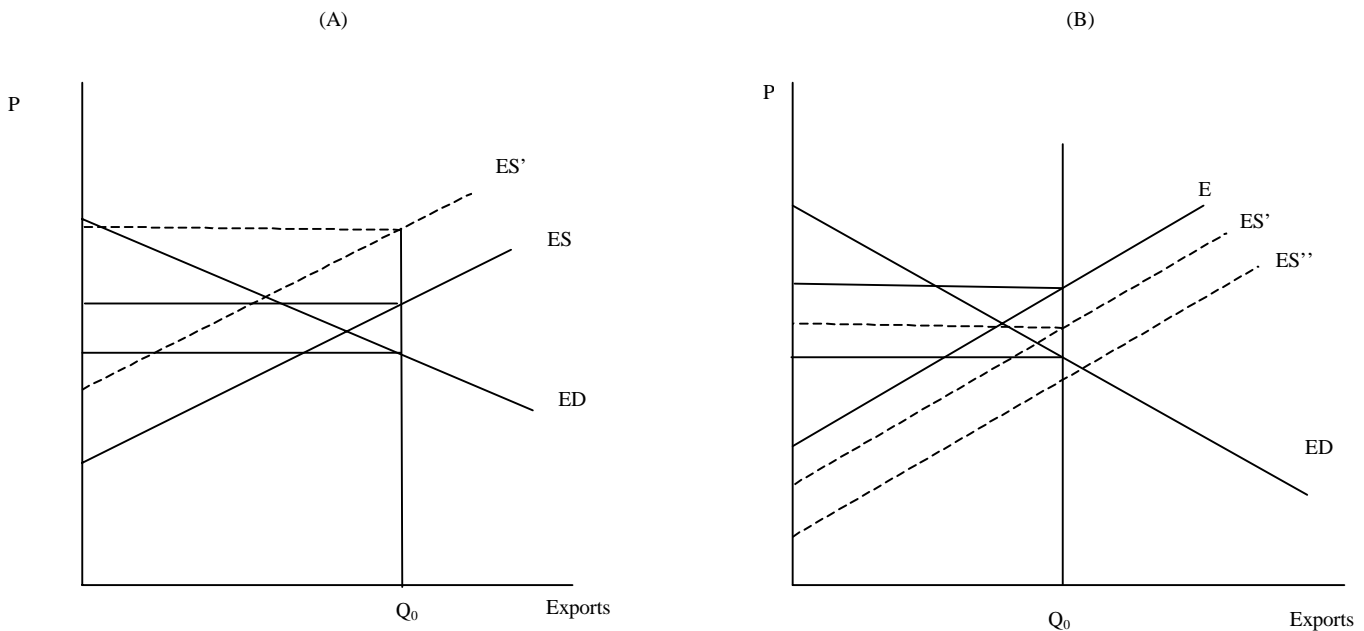
Proposition 6: Assume that both volume and value reductions are equally binding at Q_0 after the reductions have occurred. When exogenous shifts in ES and ED occur, volume constraints are always binding in the case of a positive shift, and expenditure constraints are always binding in the case of a negative shift.

Proof: Suppose that reductions in value and volume are equally binding at αQ_0, such that $V_\beta = V\alpha$ and $s_0 (\alpha) = s_0 (\beta)$.

Outward (Positive) Shift:

For volume restriction α, the reduced per-unit export subsidy equals:

$$(14) \qquad s_\alpha = (a - c) + (b - d)\alpha Q_0$$

If a positive shift in excess demand occurs, the reduced per-unit subsidy becomes

$$(15) \qquad s_{\alpha,k} = (a - kc) + (b - d)\,\alpha Q_0$$

where $k > 1$ is an intercept shifter. Clearly $s_{\alpha,k} < s_\alpha$, and because volume is limited by αQ_0, the subsidy value is unambiguously reduced after the shift.

For value binding β, the reduced export subsidy expenditure equals

$$(4a) \qquad V_\beta = [(a - c) + (b - d)Q_0]\beta\, Q_0$$

If a positive shift in excess demand occurs, volume is not limited by αQ_0, so the new subsidy value becomes

$$(16) \qquad V_{\beta,k} = [(a - kc) + (b - d)Q_k]\beta\, Q_k$$

We can have the same value of export subsidy ($V_\beta = V_{\beta,k}$) with a smaller per-unit export subsidy and a larger quantity. Value of export subsidy does not change for value binding β after the shift.

Therefore, for an outward shift in excess demand, expenditures have to be reduced due to a volume binding, but do not need to change due to the value binding: that means that a volume

binding will be more trade liberalizing. The same reasoning is valid for a positive shift in excess

supply, where the new supply intercept is ka , and $0 < k < 1$.

Inward (Negative) Shift:

If a negative shift in excess demand occurs, the same reasoning is valid for volume and

expenditure reductions.   In the case of a volume binding, Q_0 doesn't change in equation (15), so

the per-unit subsidy $s_{\alpha,k}$ will increase, increasing the value of the subsidy. In this case, $0 < k < 1$.

 In the case of a value binding, in order to make $V_\beta = V_{\beta,k}$ (equations (4a) and (16), Q_0

has to be reduced, and the expenditures are reduced with respect with the initial Q_0.

Therefore, in the case of a negative shift in excess demand, expenditures become binding

and are more trade liberalizing. The same reasoning is valid for a negative shift in excess

supply, where the new supply intercept is ka , and $k > 1$.

Proposition 6 is only true if volume and expenditures are equally binding in baseline.

If value reduction commitments are binding after the reductions, however, a positive shift

on excess demand or excess supply can result in either volume or value commitments that are

binding, depending on the magnitude of the shift and on V_β and V_α. For a negative shift, value

continues to bind.

If volume reduction commitments are binding after the reductions, a negative shift on

excess demand or excess supply can result in either volume or value commitments that are

binding, depending on the magnitude of the shift and on V_β and V_α. For a positive shift, volume

continues to bind.

Propositions 1 to 6 will be used to discuss bindings under the following scenarios.

Level of Agricultural Prices

Given variations in world prices with shifts on the excess demand and supply curves, a binding on volumes exported will become limiting with any changes in domestic or world prices that reduce the per-unit subsidy (an outward shift in excess demand and/or in excess supply). Therefore, in periods of expansion of agricultural production and consumption, volume bindings are essential for keeping export subsidy values from escalating. This reasoning may seem counterintuitive, because for higher levels of world prices, the need for subsidies is reduced. However, this is true only with respect to the per-unit export subsidy, with no regards to what happens to total expenditures and volume of subsidized exports. The volume binding is more effective than the value binding with outward shifts in excess supply or excess demand curves.

A binding on the value of subsidy will become limiting with any changes in domestic or world prices that increases the per-unit subsidy (an inward shift in excess demand and/or in excess supply). In those periods of contraction of agricultural production and consumption, a limit on expenditures (value) on export subsidies will help to force consumers and producers to respond to real market conditions instead of consume and produce at levels that are artificially maintained by an increase in subsidies.

Elasticity of excess supply and demand

Effectiveness of a volume versus a value constraint may vary under different elasticities. As showed in Proposition 5, more inelastic excess supply and demand curves will have the volume limit be relatively more effective. The opposite is true for more elastic curves. For a given percentage reduction in the baseline export subsidy expenditures, a larger volume can be subsidized when the curves are elastic. As agricultural supply and demand are generally characterized as inelastic, it suggests that volume bindings are generally more effective.

Fixed Internal Price Supports

In a scenario where domestic price is fixed (guaranteed), the per-unit export subsidy must fluctuate to accommodate the difference between domestic and world prices (an open-ended export subsidy). However, the value and volume reduction commitments will limit the possibility of using of this type of instrument.

If the value commitment is binding, and therefore the total value of subsidies cannot be increased, domestic price will have to fall if the gap between world and domestic price becomes wider (an inward shift in world demand). But countries can use another type of mechanism. Countries can subsidize only part of the exports by the total amount of the gap and spend all the value allowed, and the rest will be traded at lower world prices. This represents "seasonal" subsidies, where exports receive subsidies during alternative sub-periods, such that the total of the period would not exceed the constraint, but individual sub-periods would. The mechanism allows countries to circumvent volume bindings. In contrast, for the case of an increase in world demand, the same binding volume can be subsidized by a smaller per-unit export subsidy, and therefore fixed domestic prices will not change.

Effects on Farmers' Revenues Stability

The bindings affect the way governments and producers can deal with instability in revenues and government expenditures. Note that the volume limit alone would reduce the instability on producer's revenues, because the government would be able cover the difference $P_d - P_w$ for any shifts in excess supply and excess demand (an open-ended export subsidy). The value limits, however, increase the instability of producer's revenues because the government can only subsidize the gap $P_d - P_w$ up to the value limit, but government expenditures are kept constant. This scenario can be compared with the "tariff versus quota effects" Nancy.

We analyzed the affects of positive and negative shifts in excess demand and excess supply on producers' revenues and government expenditures, given three baseline scenarios: when both volume and value were binding in baseline, when only volume was binding, and when only value was binding.

In the case of shifts in world demand, there is only one possible outcome in which producers can increase their revenues, and that is when only value is binding in the baseline and a positive shift in excess demand occurs. On the other hand, government expenditures do not change in almost all scenarios, and expenditures only increase in one scenario, that is when only volume is binding in the baseline, and a negative shift in excess demand occurs. The value limit is the cause for revenue instability (negative outcomes), and volume limit is the cause for non-materialized gains in the case of an expansion in excess demand. So when there is instability in revenues, it always occurs with lower revenues.

In the case of shifts in excess supply, most of the outcomes are ambiguous with respect to revenues, which is by itself a sign of instability. They depend on elasticities and on the relationship between α and β. When the outcome is unambiguous, it is negative (revenues decrease) as in the case of a positive shift in excess supply with both volume and value binding, and with volume only binding in baseline. The volume limit is the cause for decreases in revenues. Government expenditures are very stable, and only increase in one outcome, and this is when volume is binding in the baseline and there is a negative shift in excess supply.

4.   Bindings and Trade Liberalization

Export subsidies will change in response to a change in the underlying determinants of protection, namely prices and volume of trade, exchange rates, and other macroeconomic

conditions which are all stochastic. Therefore, we can treat export subsidies as a random variable with a probability distribution.

In using the value of exports as a variable, it is possible to evaluate the effects of the schedule of reductions in export subsidies. This is done by comparing the mean and variance of the underlying distribution of the value exported in the presence of a binding with those in the absence of a binding. The same approach can use volume, per-unit subsidy or other variables. The conventional approach (Tangermann 1997, Leetmaa 1997-1998, and de Gorter 1999) has a binding above the actual level of protection to have no effect, and implies that if the export subsidy bindings in the current commitments are above the levels exercised by countries, the commitments are not trade liberalizing. With this new approach, it is possible to measure the trade liberalizing effect of such bindings, considering that above-the-mean bindings do have an effect and that below-the-mean bindings are overestimated by the traditional approach.

If we assume protection is a random variable with a normal distribution, the expected level of subsidy is the mean of the distribution. If a binding is introduced, it rules out any possibility of protection above the binding level, and therefore the expected mean of the subsidy and the variability will decrease.

Data on value of export subsidies for the European Union for various commodity groups was collected for the years 1972-1999. Applying the methodology developed by Martin and Francois, the new mean of the distribution μ_1 is:

$$(17) \quad \mu_1 = \mu_0 - \sigma_0 \frac{1}{\sqrt{2\pi}} e^{-1/2(Z^*)^2} + (B - \mu_0)(1 - F(Z^*))$$

where μ_0 is the mean of the distribution of the variable from 1972-90[3], $Z = (V_0-\mu_0)/\sigma_0$ is the normalized variable, V_0 is the variable of value of export subsidies, and $Z^* = (B-\mu_0)/\sigma_0$ is the value of the normalized variable at the bound rate. B is the value binding and F is the cumulative density function of the variable. The binding value B is calculated as required in the Agreement, with a 36% reduction in the average value of subsidies from 1986-90.

Expression (17) was used to find the long run mean of value of subsidy following the introduction of a binding, and to compare it with the original mean.

The results for selected commodity groups are shown in Table 3.

Table 3.   Summary Statistics for Export Subsidies- European Union (million ECUs)

Commodity Group	Totals	Cereals	Rice	Olive Oil	Sugar	Beef/ Veal	Poultry/ Eggs	Wine
1. Average Value 1972-90: (μ_0)	8,163.38	2,135.46	67.93	30.27	1,128.36	1,001.66	136.93	26.71
2. Bound value: (B)	7,616.87	2,304.79	64.77	59.16	1,175.02	927.57	148.64	30.07
3. B - μ_0: (2-3)	(546.51)	169.33	(3.15)	28.89	46.66	(74.10)	11.71	3.37
4. Bound Mean (μ_1)	7,014.72	1,608.84	52.52	6.40	805.94	759.41	98.21	15.47
5. $\mu_1-\mu_0$: (4 -1)	(1,148.66)	(526.62)	(15.41)	(23.88)	(322.42)	(242.25)	(38.72)	(11.24)
6. 36% off original mean (μ_0*0.64)	5,224.56	1,366.69	43.47	19.37	722.15	641.06	87.63	17.09
7. B –(μ_0*0.64): (2 –6)	2,392.30	938.09	21.30	39.79	452.87	286.50	61.01	12.98
8. $\vartheta (\mu_1)/\vartheta B$	0.56	0.44	0.53	0.27	0.48	0.54	0.45	0.45

The results in row 5 of Table 3 show that the average value of export subsidies after the imposition of a binding (μ_1) is lower than the original average (μ_0). This means that even if the binding is above the actual values applied, it has an effect of decreasing the average value of export subsidies. When a binding is imposed above the actual levels of protection, it may seem that no liberalization in trade has occurred, or even that the levels of protection have increased.

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[3] We limited the period to 1972-1990 because after 1991, it became very clear that reductions on export subsidies would be required by the Agreement, and countries could react by increasing export subsidies while they could do

However, when looking at the levels over time, the liberalizing effect of imposing a binding becomes clear through the lower average of protection applied. This type of analysis is particularly applicable for export subsidies, because open-ended export subsidies in the EU generate an increase in instability of the value of export subsidies applied.

The value binding applied to export subsidies is already lower than the average value from 1972-90 for rice, beef/veal, and in aggregate (row 3). For some commodity groups, however, the bound value is above the average, for cereals, olive oil, sugar, poultry/eggs, and wine. Those commodities would have been less penalized by the bindings with respect to the average level of the value of their subsidies over the historical time period.

The results also show that the calculation of the bindings based on 1986-90 averages resulted in bound values that are higher than what would have resulted from a 36% reduction on the average for the whole period, as shown by the positive values in row 7 of Table 3. This is because the export subsidy expenditures from 1987 to 1989 were the highest for the entire time period 1972-1999 (Chart 3 below).

The relationship between the bound mean (μ_1) and the original mean (μ_0) is nonlinear. Therefore, a change in bound value B does not imply a one-for one change in the expected value of export subsidies. Differentiating (17) with respect to B gives:

(18) $\quad \dfrac{\partial \mu_1}{\partial B} = (1 - F(Z^*))$

The smaller the bound value B with respect to the mean value, the larger the effect of a reduction in the bound values on the average of export subsidy expenditures. This is because the

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so. Therefore, 1972-99 refers to a period where a hypothetical binding could be imposed on the distribution.

smaller the difference $B - \mu_0$ is, the smaller $F(Z^*)$ will be, and the change in μ_1 given a change in B will be closer to one.

The results in row 8 of Table 3 show that the largest reductions in the average of protection given a decrease in the binding will occur for rice, beef and veal and in aggregate.

Chart 3. Total Export Subsidies-European Union
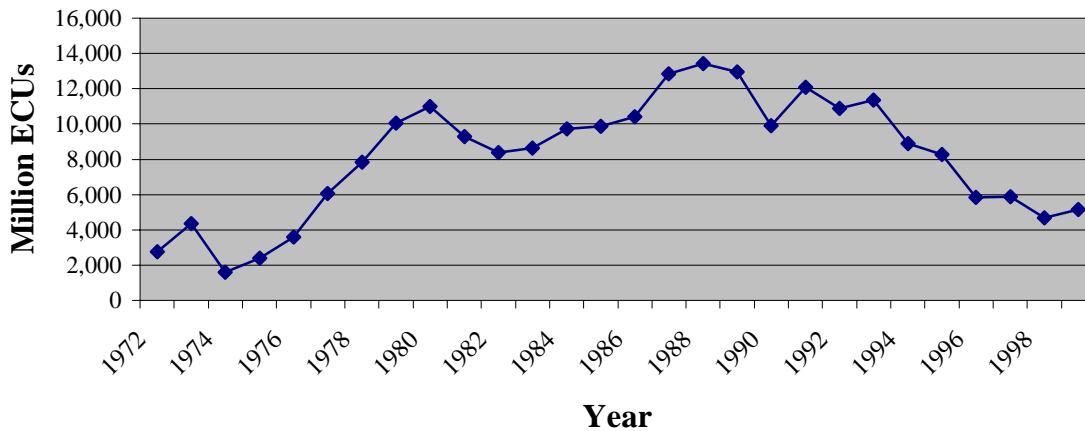
Conclusion

Volume and value bindings complement each other in decreasing the use of export subsidies. The relative effectiveness depends on their relative magnitudes and on the changes in excess supply and excess demand curves over time. Export subsidy reductions limit the use of fixed domestic support prices under certain circumstances. The bindings have a "size" effect of reducing value and volume of export subsidies, and a "risk" effect of creating instability in farm revenues, given changes in world supply and demand conditions. However, the simple mechanics of volume and value restrictions is not enough to describe the issues involving trade liberalization and reductions in export subsidies.

The statistical analysis of a time series on export subsidies makes it possible to quantify the effects of the bindings in a stochastic setting. If one simply compares the bindings with the

actual levels prior to the commitments, it may appear that the level of protection is higher under the new rules. But this is just because countries had means to manipulate their baseline levels in order to start the reductions at a higher level than their average level. The analysis shows that the imposition of bindings decreases the average protection applied and is trade liberalizing.

Several outstanding issues on export subsidies include how countries circumvent commitments by 'front-loading'' on future allowances, "banking'' on unused subsidies from previous periods, or via product aggregation, where export subsidies for inputs end up subsidizing final product beyond the limits as a way of transferring subsidies from one product group to another (Leetmaa and Ackerman). Those issues refer to manipulations of the baseline and schedule of reductions to circumvent commitments.

It is also important to extend the analysis on what concerns Export Promotion and Food Aid and Export Credit Guarantees as compensation or escape route from the commitments on exports subsidies. Many export subsidy commitments are also implicitly included (sometimes only partially) in the market access and domestic support components of the Agreement. This conflation means that a decrease in tariffs or domestic support will automatically require a fall in export subsidies (and vice-versa).

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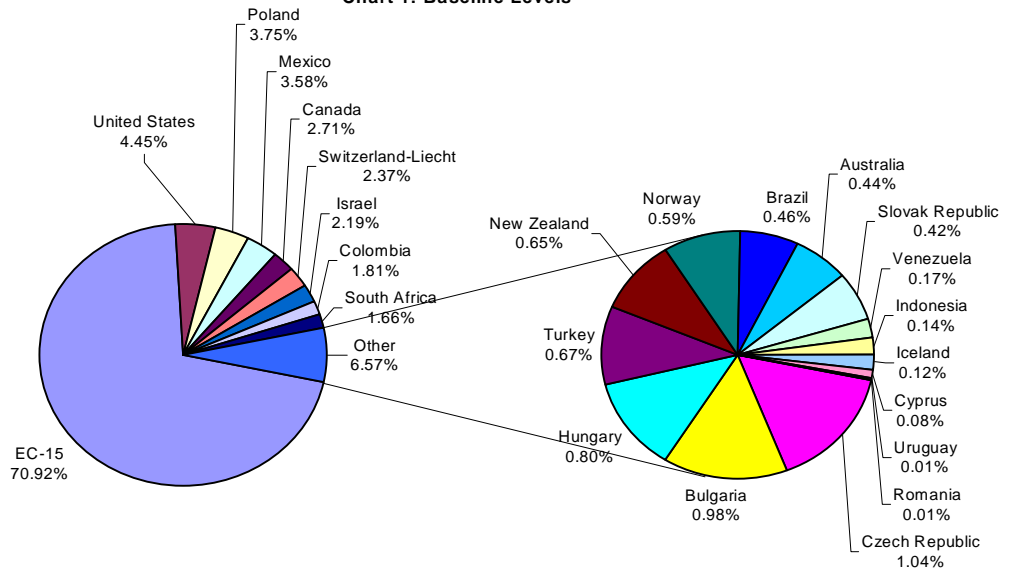
Appendix
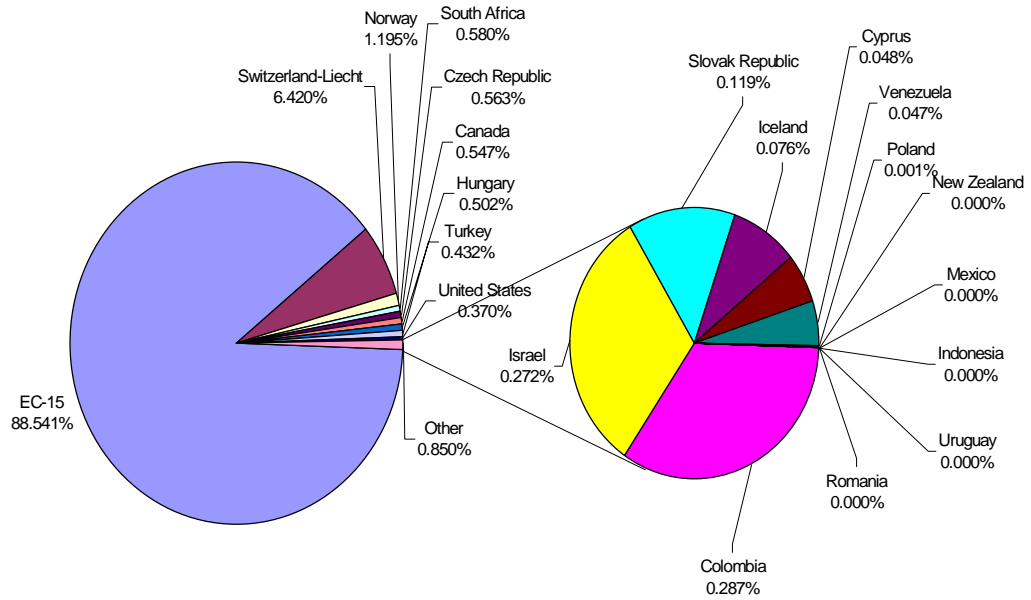
Chart 1: Baseline Levels

Chart 2: 1995/96 Levels

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Table 2: Countries Exceeding URAA Commitments on Export Subsidies, 1995, 1996 and 1997

1995-Value

Country	Commodity	Commitment 1995-96 U$ '000	Notification 1995-96 U$ '000	Value 1995-96 % of Comm
Cyprus	Cheese	187.23	759.57	405.68
Hungary	Corn	1,453.55	4,092.71	281.57
Hungary	Read pepper meal	2,411.41	3,536.74	146.67
Norway	Poultry meat	109.70	266.41	242.86
South Africa	Cocoa and preparations	854.97	922.84	107.94
South Africa	Tea	126.70	141.77	111.89

1995-Volume

Country	Commodity	Commitment 1995-96 t	Notification 1995-96 t	Volume 1995-96 % of Comm
Cyprus	Cheese	986.00	1,860.00	188.64
Norway	Poultry meat	27.40	58.60	213.87
South Africa	Beer	27,417.00	28,940.00	105.55
South Africa	Other milk products	444.00	616.00	138.74
South Africa	Wine products	23,598.00	24,217.00	102.62
Switzerland-Liecht	Bétail d'élevage	13,806.00	15,312.00	110.91

1996-Value

Country	Commodity	Commitment 1996-97 U$ '000	Notification 1996-97 U$ '000	Value 1996-97 % of Comm
EC-15	Rice	57,805.43	81,674.21	141.29
EC-15	Wine	60,972.85	67,420.81	110.58
Hungary	Read pepper meal	1,805.91	2,540.06	140.65
South Africa	Cocoa and preparations	675.13	2,177.49	322.53
South Africa	Vege, fruit and nut preps...	18,463.42	21,001.10	113.74
South Africa	Waters	756.56	1,086.77	143.65
South Africa	Wine products	4,591.23	8,230.04	179.26

1996-Volume

Country	Commodity	Commitment 1996-97 t	Notification 1996-97 t	Volume 1996-97 % of Comm
EC-15	Beef meat	1,073,900.00	1,177,400.00	109.64
EC-15	Olive oil	135,400.00	140,400.00	103.69
EC-15	Rice	157,100.00	226,500.00	144.18
EC-15	Wine	2,742,100.00	3,034,900.00	110.68
Israel	Vegetables	89.30	90.00	100.78
Poland	Sugar	122,900.00	143,000.00	116.35
South Africa	Vege, fruit and nut preps...	235,791.00	248,684.00	105.47
South Africa	Wine products	22,742.00	140,732.00	618.82

1997-Value

Country	Commodity	Commitment 1997-98 U$ '000	Notification 1997-98 U$ '000	Value 1997-98 % of Comm
Norway	Cheese	56,294.14	63,798.68	113.33
Norway	Sheepmeat	3,022.68	3,371.76	111.55
South Africa	Wine products	3,990.51	4,254.90	106.63

* No data available for the EEC in 1997-98

1997-Volume

Country	Commodity	Commitment 1997-98 t	Notification 1997-98 t	Volume 1997-98 % of Comm
Cyprus	Pig meat	958.00	16,311.00	1,702.61
Norway	Cheese	20,270.20	20,601.21	101.63
Norway	Eggs and egg products	1,787.30	2,092.01	117.05
Norway	Pigmeat	4,295.10	4,547.11	105.87
Norway	Sheepmeat	771.10	1,096.61	142.21
Poland	Sugar	118,300.00	176,532.26	149.22
South Africa	Beer	25,428.00	26,601.00	104.61
South Africa	Wine products	21,866.00	49,547.00	226.59
United States	Skim milk powder	92,217.00	96,303.00	104.43

Source: Author's calculations from the Notifications to the WTO