Working Paper

Department of Applied Economics and Management
Cornell University, Ithaca, New York 14853-7801 USA

Domestic Support Reform?
A Closer Look at EU Policies Applied to Processed Fruits and Vegetables

Bradley J. Rickard and Daniel A. Sumner

Domestic support reform?
A closer look at the EU policies applied to processed fruits and vegetables

Bradley J. Rickard
Assistant Professor, Department of Applied Economics and Management
Cornell University, Ithaca, NY 14853
Tel: 607.255.7417; E-mail: bjr83@cornell.edu

and

Daniel A. Sumner
Frank H. Buck, Jr. Professor, Department of Agricultural and Resource Economics
University of California, Davis, and
Director, Agricultural Issues Center, University of California

December 2008

Abstract:

Recent trade negotiations have attracted much attention to the consequences of domestic support applied to agricultural markets. In various markets, researchers have examined the economic effects of regimes and scenarios with less, or different forms of, domestic support including decoupled payments. Here we examine the domestic support regimes for processed fruits and vegetables in the European Union (EU) where major policy changes were applied in 2001 and again in 2008. The changes were billed as policy "reform" but no analysis has yet evaluated quantitatively the nature of what was reformed and what was not. A simulation model is used here to assess the price, production, and welfare effects of policies that have been applied to the EU processing tomato industry. Our results indicate that EU domestic support has increased EU tomato production by 7 to 12%, decreased production in other regions by 3 to 5%, and distorted the processing tomato market most during the period between 2001 and 2007.

Domestic support reform?
A closer look at the EU policies applied to processed fruits and vegetables

1. Introduction

Much research has been devoted to understanding the economic consequences of reducing or decoupling domestic support applied to agricultural commodities (*e.g.*, Hennessy, 1998; Sumner, 2000; Young and Westcott, 2000; Blandford, 2001; Sumner, 2005; Goodwin and Mishra, 2006). Trade negotiations have included discussions about the type of domestic support used by members at the Uruguay and Doha Rounds under the auspices of the World Trade Organization (WTO). One result of these discussions at the WTO was the formation of the "green box" and the identification of domestic support that was agreed to minimally distort agricultural production and trade. Beginning in the 1990s, government assistance in agriculture has shifted away from price support and towards income support, yet this trend has not been consistent across all WTO members and all agricultural commodities (Sumner, 2003; Rude, 2007).

In the United States, decoupled payments under the Agricultural Marketing Transition Act were introduced in the 1996 Farm Bill and have remained in subsequent Farm Bills. In 2003, the Common Agricultural Policy (CAP) in the European Union (EU) was reformed and a decoupled payment, known as the Single Farm Payment (SFP), was introduced for various animal products and field crops. In 2006 the SFP replaced price support regimes for cotton and olive oil sectors. Stuart (2005) and Roberts and Gunning-Trant (2006) examine agricultural sectors where decoupled payments had not replaced price supports, and highlighted the processed fruit and vegetable sectors in the EU. In 2007 the EU decided to reduce price supports that had been maintained for key processed horticultural products and phase in the SFP between 2008 and 2012. Domestic support has been important for processing peaches, pears and tomatoes, citrus, prunes, dried figs, and dried grapes. Here we focus on processing tomatoes as

they have received the largest share of domestic support applied to processed horticultural products in the EU.

Table 1 shows the quantity of tomatoes produced by five member states in the EU, California, and a rest-of-the-world region between 1978 and 2008. The EU and California are the two largest producers of processing tomatoes and collectively account for approximately 65% of global production. Total tomato production in the EU has increased over this time period from 4.8 to 8.7 million metric tons, an increase of 81%. Table 1 also shows that over the same time period, processing tomato production in California has increased from 4.8 to 10.7 thousand metric tons, an increase of 123%. Tomato production in regions outside of California and the EU increased from 7.2 to approximately 14.0 million metric tons between 1995 and 2008, an increase of nearly 100%.

Between 1995 and 2008 European production has clearly increased, yet most of the production increases in California occurred before 1995. Average EU production during the period between 2003 and 2005 was nearly 20% higher than average production over the period between 1998 and 2000. In California, average production during the 2003 to 2005 period was approximately equal to that during the 1998 to 2000 period. During this time there were also significant policy changes applied to processed horticultural products in the EU; we develop a model to simulate the impact that these policy changes have had on processing tomato markets in the EU and elsewhere.

2. An Overview of the Policies Applied to the Processing Tomato Complex

This research is motivated, in part, by the significant amount of government support and protection applied to EU fruit and vegetable industries (USITC, 2001; Strossman, 2003; Stuart, 2005), most notable in the processing tomato industry. EU policy applied to processing tomatoes

can be separated into three time periods which are differentiated based on the type of domestic support employed. Each regime will be described next to highlight the differences across the three regimes.

The EU domestic support program in place between 1978 and 2000 was a complex regime that included quotas, processor aid, and minimum prices to growers of processing tomatoes (Commission of the European Communities, 1996). The European Commission provided aid directly to tomato processors with the condition that processors paid growers a minimum price for processing tomatoes. The processor aid (and hence the minimum price) was then limited to a maximum quantity. The maximum quantity was referred to as a quota in EU sources, but to be more specific, we use the term entitlement quota. The entitlement quota specified a fixed quantity of eligible processing tomatoes, was assigned to individual processing plants, and was non-transferable. The total entitlement quota allocation was typically less than total production in the EU during the 1990s. However, in many years, not all member states exceeded their national entitlement quota allocation, and many processing plants in the EU did not exceed their quota allocations. Between 1978 and 2000, the total quota allocation increased as countries joined the EU.

Beginning in 2001, EU domestic support included a 34.50 euro per ton payment to tomato growers (Commission of the European Communities, 2000). The per-unit subsidy was approximately equivalent to an *ad valorem* subsidy of 43% in the market for processing tomatoes (given a subsidy of 34.50 euro and a final grower price of approximately 80 euros). The subsidy was known as producer aid in the EU, and it is referred to as grower payments here to avoid confusion with the processor aid from the pre-2001 regime. In 2001 grower payments were also introduced in the EU for processing peaches, pears and citrus; however, the processor aid and

entitlement quota regime was maintained for prunes, dried figs, and dried grapes (Strossman, 2003).

The 2001 regime for processing tomatoes also included a "threshold" quantity for each nation. Aggregate production in each nation relative to its threshold quantity served as a basis for adjusting payment rates in future years, but did not affect payment rates in any year. In practice, growers in a region were only penalized if they collectively exceeded their threshold level by at least 10%, and the EU exceeded the total EU threshold level (Commission of the European Communities, 2000). Therefore, the threshold quantity did not affect the incentives facing individual growers or processors. The domestic support regime that was in place between 2001 and 2007 continued a significant government outlay to owners of processing firms and tomato farmers in Italy, Spain, Greece, Portugal, and France. Between 1997 and 2007 the total government outlay for processing tomatoes ranged between 250 and 420 million euros annually (Brans, 2000; Strossman, 2003; De Belder and Brans, 2008) and was a large share of total revenue in the processing tomato industry.

In 2007 the European Commission decided to extend the SFP to various processing fruits and vegetables that had previously received price support. Processing tomatoes are set to receive two types of domestic support as the SFP is phased into existence between 2008 and 2011. Part of the support will be a coupled payment that continues the program that existed between 2001 and 2007 and is linked to production. In addition, during the period 2008 to 2011 processing tomato growers will receive a decoupled payment based on historical payment levels which will not be tied to current levels of production (Commission of the European Communities, 2007). During the transition period between 2008 and 2011 the ratio of coupled to decoupled payments

will be fixed; beyond 2011 EU growers will only receive a decoupled payment. A similar policy transition was applied to the EU olive oil sector beginning in 2006.

The effects of the three domestic support regimes applied to the EU processing tomato industry are examined here through a series of simulation experiments. We examine the production effects that would result from removing price supports at five different points in time between 1997 and 2008. The purpose of this analysis is not for economic history per se, but rather to facilitate a comparison of the 1978 to 2000 domestic support regime with the regimes that commenced in 2001 and in 2008.

2.1 A closer examination of EU Processor Aid

Some forms of domestic support are specified in *ad valorem* terms, and others can be converted to *ad valorem* equivalents. The domestic support regime that was in place in the EU between 2001 and 2007 was essentially a per-unit subsidy, and modeling it as an *ad valorem* equivalent captures the crux of the policy details. Modeling the partially decoupled regime that began in 2008 is also relatively straight-forward. However, calculating an *ad valorem* equivalent becomes more difficult as the complexity of, and the constraints on, a particular policy regime increase. The domestic support regime that was applied to processing tomatoes in the EU between 1978 and 2000 is one example. In this case, an understanding of, and properly modeling, the policy is required to accurately assess the economic consequences.

The domestic support regime that was applied to the processing tomato industry in the EU prior to 2001 included a government payment to processors (processor aid) and a legislated minimum price that processors paid to growers. Furthermore, a non-transferable entitlement quota that was plant-specific, restricted the quantity that was eligible for the payments and minimum prices. The production effects of this regime varied across processors, and depended

on plant-level characteristics. Because of the complexities of this policy regime and its dependence of plant-level characteristics, the domestic support regime prior to 2001 cannot be easily modeled in *ad valorem* equivalent terms.

Our understanding of the EU domestic support regimes is based on the published EU regulations, and was further developed through discussions with industry sources (Amézaga, 2002). Two main sources of complexity need to be addressed and included in the model. First, the domestic support regime that was in place between 1978 and 2000 did not affect all processors across EU member states equally. More specifically, the effects of the domestic support regime prior to 2001 varied across processing plants, and depended on the ratio of production to entitlement quota. Second, the analysis is complicated by the fact that many processors actually paid an average price for processing tomatoes rather than the minimum price for in-quota processing tomatoes and another (lower) price for over-quota processing tomatoes.

To address the first complexity, the simulation model needs to accommodate disaggregate plant-level production data in the EU. One way to disaggregate the data is to classify processing plants into three groups: those that produced less than, at, and greater than their quota entitlement quantity. A similar framework was used by Frandsen *et al*. (2003) and Witzke and Heckelei (2002), to examine policy reform scenarios in the EU sugar market.

For all three groups, EU domestic support prior to 2001 reduced the processors' net marginal costs for the entitlement quota quantity in the market for processed tomato products. In a vertically linked market with fixed factor proportions, the marginal cost in an output market is the sum of marginal costs from input markets. Any change in the marginal cost for processed products will have implications in input markets. Figure 1 provides a stylized illustration of the net marginal costs in this industry; the group with the highest net marginal cost is also the group

that produced less than entitlement quota, and although this may not be the case for all high cost plants, it is believed to be approximately true for the group as a whole. The net marginal cost for the group that produced less than the entitlement quota is depicted as MC^L; MC^A represents the net marginal cost for the group that produced at quota and MC^G represents the net marginal cost for the group with production that was greater than the quota entitlement.

In Figure 1, $\mathcal{Q}^c$ is used to represent the entitlement quota allocation for group c, where $c \in [L, A, G]$. For each group, the net marginal cost function (MC^c) shifts up for quantities beyond the entitlement quota. The effects are illustrated in the output market because observations on the price are available, and the price in the output market is approximately constant across the three groups in the EU (P^0 represents the initial equilibrium price of the processed product in Figure 1). The intersection of the equilibrium price, P^0, and the relevant net marginal cost for group c is the quantity produced by that group, denoted as Q^c. Removing domestic support (and thus increasing the net marginal costs for the entitlement quota quantity) would have reduced production by the group producing less than quota (Q^L), and by the group producing at the quota quantity (Q^A); however, processor aid is partially infra-marginal for group A, as the production effect is dampened by the presence of the entitlement quota.

For the group that is producing at quantities greater than quota entitlement, it would appear that the processor aid is infra-marginal. Since production is greater than entitlement quota in group G, any change in processor aid would affect net marginal costs for quantities less than the entitlement quota in group G, but not the net marginal costs for quantities greater than the entitlement quota in group G. If the processor aid only applied to the in-quota production, removal of the policy would leave production among processors in group G at Q^G. However, the analysis needs to address the second source of complexity and incorporate the observation that

7

the benefits of the domestic support regime were not only provided to the in-quota quantities in group G. Processing firms in this group pooled the processor aid benefits across the total quantity supplied by group G. The pooling of processor aid benefits yielded an average net marginal cost curve (or a pooled net marginal cost curve), represented as MC^G_{pool} in Figure 1. In this case, production with the domestic support regime in place would have been Q^G_{pool}, and removing the policy (while holding price constant) would have decreased production for this group as well.

Figure 2 outlines the aggregate production effects of the processor aid applied to processing tomatoes in the EU. The bold line in Figure 2 shows the aggregate marginal cost for the three groups under the regime that applied prior to 2001. The equilibrium price (with the pre-2001 domestic support regime in place) is determined in the aggregate market (Figure 2) and is also shown in Figure 1. Additionally, Figure 2 shows that total production would have fallen if the pre-2001 domestic support regime was removed (total production would fall from Q^0 to Q^{No}). Figure 2 also shows what the marginal cost of the processed tomato product would have been if the processor aid was applied at the full rate (as it did for group L) for all groups; in this case total production under the pre-2001 regime would have been Q^{Full} in Figure 2.

2.2 Understanding the production effects of EU Processor Aid

EU processor aid affects production in the three groups differently, and the total impact in the market for EU processed tomato products is a weighted sum of the individual effects. To assess the total impact we need to characterize the production effects in each group and the share of production that originates from each group. The production effects in groups A and G are different but are both partially infra-marginal whereas the full effect of processor aid is applied in group L. Calculating the share of production from each group is complicated because

production and entitlement quota data is only available at the EU member state level and each member state includes some processors in each group classification.

The net marginal cost of the processed tomato product in group c in region y is equal to the vertical sum of net marginal costs in the input markets. Our notation uses subscript j to denote an output market and subscript i to denote an input market. In Equation (1) AID_j^y represents a vertical shift in the net marginal cost of processed product j in region y due to the processor aid applied under the pre-2001 domestic support regime. The rate at which processor aid affects marginal costs for product j in group c in region y is characterized by Φ_j^{cy}.

(1) $\quad MC_j^{cy} = \sum_i MC_i^{cy} - \Phi_j^{cy} \, AID_j^{cy}$

In group L the processor aid is not infra-marginal; therefore the rate of processor aid applied to product j for group L in region y, denoted as Φ_j^{Ly}, is set at 1.0. The applied rate is less than 1.0 in group A and group G; we set Φ_j^{Gy} according to the degree to which the processor aid is pooled across the quantity supplied by the group that produced beyond quota entitlement. For the group producing at a level greater than quota entitlement, the total value of the processor aid payment is spread across total production in group G (Q^G_{pool}). As a result, the effective amount of processor aid per unit of processed product is reduced to a level that equates the total payment across total production. Equation (2) shows the calculation used to characterize the applied rate of processor aid in group G.

(2) $\quad \Phi_j^{Gy} = \Theta^G / Q^G$

The total supply of the processed tomato product is the vertical sum of marginal costs for inputs and the horizontal sum of net marginal costs across the groups, assuming that firm-level entry and exit decisions do not affect costs for other firms. The line labeled $MC^{No\ Aid}$ in Figure 2 illustrates the total marginal cost with no processor aid and the line labeled $MC^{Full\ Aid}$ shows what

the total marginal cost would be for the processed product if the processor aid was not infra-marginal in any group. Adding net marginal costs across the three groups generates nine distinct subsections in the aggregate marginal cost shown by the bold line in Figure 2. Moving along the bold line from left to right illustrates how the total marginal cost increases as production in each group increases. Equation (3) shows the calculation used to characterize the total marginal cost for the processed tomato product in region y.

$$(3) \qquad MC_j^y = \sum_i \sum_c (MC_i^{cy} - \gamma_j^{cy} \Phi_j^{cy} AID_j^{cy})$$

The key component in this calculation is the net effect that EU processor aid had on the total marginal cost of producing processed tomato products. This parameter is determined by the rate at which processor aid was applied to each group, denoted as Φ_j^{cy}, and the share of production generated by each group, denoted as γ_j^{cy}. The effective *ad valorem* rate of the processor aid in the market for processed tomato products is shown as α_j^y in Figure 2; the value of α_j^y is embedded in Equation (3) and reproduced in Equation (4).

$$(4) \qquad \alpha_j^y = \sum_c \gamma_j^{cy} \Phi_j^{cy}$$

Since the entitlement quota was assigned to individual processing plants in the EU, data describing the share of production from each group (*i.e.*, γ_j^{cy}) would be the ideal unit of observation. However, data are not available on the share of EU processing plants that produced less than, at, and greater than entitlement quota. Production and entitlement quota data are available for member states, but not at the plant level. In 1997, Italy and Greece were the EU countries with the highest production of processing tomatoes and had the highest ratio of production to entitlement quota. By 2000 Italy and Spain were largest tomato-producing member states and had the highest production to entitlement quota ratios. Over this time period

France and Portugal were the EU member states that produced the least amount of processing tomatoes, and the countries with the lowest ratio of production to entitlement quota.

Data describing production levels for member states (AMITOM, 2008) are combined with information from industry sources to calculate each group's share of total EU production. Table 2 shows the production and quota quantities for member states in 1997 and 2000; data in 1997 are used to describe patterns in the mid-1990s and data from 2000 describe patterns in the late-1990s. In 2000, approximately 60% of production in Italy and Spain, and 20% of production in Greece, Portugal, and France is expected to have been in the group producing greater than quota. Approximately 60% of production in Greece, and 20 to 30% of production in the other countries is expected to have been in the group producing at quota. Hence, approximately 60% of production in Portugal and France, and between 10 and 20% of production in the other countries is expected to have been in the group producing less than quota. Table 2 also shows that fewer plants processed in excess of quota allocations and a greater share operated at levels below quota entitlements in 1997 relative to 2000.

3. Simulation Model

A simulation model is developed here that allows us to examine the impacts of various domestic support measures that have been applied to processed fruit and vegetable products in the EU. Following work by Feenstra (1986), Desquilbet and Guyomard (2002), and Rickard and Sumner (2008) a model is developed to consider changes in taxes and subsidies that apply to vertically linked products. This nested model allows for a direct comparison of policies that apply to processed products or inputs used to manufacture processed products, and facilitates a discussion of policy reform in the processing tomato industry in the EU. The simulation experiments employed here examine the production and trade effects of the three domestic support regimes

that have been applied to EU processing tomatoes between 1978 and 2008. While the focus of our results will be for Europe, we also highlight the implications for processing tomato markets in the United States and a residual rest-of-the-world region that includes all countries outside of the EU and the United States.

The model considers three regions, two inputs, and five outputs. The three regions are the European Union (*E*), United States (*U*), and rest of the world (*R*). Inputs include the farm-produced commodity (*F*) and marketing and processing services (*M*). Processed tomato products at the wholesale level include two bulk canned tomato products and three bulk tomato paste products. Product *J1* is canned tomato products produced and exported by the EU, *J2* is canned tomato products produced and exported by the United States, *J3* is the tomato paste product produced and exported by the EU, *J4* is the tomato paste product produced and exported by the United States, and *J5* is the tomato paste product produced and exported by the rest-of-the-world region and imported into the EU duty-free. The various processed tomato products utilize the same inputs in production, although in different proportions.

Rickard and Sumner (2008) provide a system of equations to describe supply, demand, and market clearing conditions for an industry that includes policy parameters along a vertical market chain. An equilibrium displacement model was developed by totally differentiating the system of equations and converting them to elasticity form. The simulation model is reproduced below and is employed to solve the proportional changes in quantities and prices as functions of various elasticity and share parameters.

In equation (5) through (12), the term *Q* is used to denote a quantity in an output market, *X* denotes a quantity in an input market, *P* denotes a price in an output market, and *W* denotes a price in an input market. For prices in input markets and quantities in input and output markets,

the suffix D denotes a variable on the demand side, and the suffix S denotes a variable on the

supply side. Equilibrium adjustments can be simulated by exogenously specifying changes in

the policy parameters. In the following equations, for any variable A, E(A) represents the relative

change in A, that is, E(A) represents dA/A where d refers to a total differential.

(5) $E(QD_j^y) = \eta_{jj}^y E(P_j^y) + \sum_{k \neq j} \eta_{jk}^y E(P_k^y)$

(6) $E(XD_{hj}^y) = E(QS_j^y) + \sum_{i \neq h} \kappa_{ij}^y \sigma_j^y [E(WD_i^y) - E(WD_h^y)]$

(7) $E(XS_h^y) = \varepsilon_h^y E(WS_h^y)$

(8) $E(P_j^y) = \sum_h \kappa_{hj}^y E(WD_h^y) + E(1+\alpha_j^y)$

(9) $E(P_j^y) = E(P_j^w) + E(1+\beta_j^y)$

(10) $E(WS_h^y) = E(WD_h^y) + E(1+\delta_h^y)$

(11) $E(QD_j^y) = (QS_j^y/QD_j^y)E(QS_j^y) + \sum_{z \neq y}[(QS_j^z/QD_j^y)E(QS_j^z) - (QD_j^z/QD_j^y)E(QD_j^z)]$

(12) $E(XS_h^y) = \sum_j \lambda_{hj}^y E(XD_{hj}^y)$

Equation (5) describes the relationship between changes in price and consumption of

processed products. The price elasticity of demand for processed product j with respect to the

price of another processed product k in region y, is represented by η_{jk}^y. Equation (6) outlines the

linkage between changes in input and output quantities. The cost share of input h in the

production of j in region y is denoted as κ_{hj}^y and the Allen partial elasticity of input substitution

for producing j, in region y, is denoted by σ_j^y. Equation (7) shows how input price changes affect

input quantities; here the own-price elasticity of supply of input h in region y is represented by

ε_h^y. Equations (8), (9), and (10) are used to determine prices; equation (8) is used to determine

output prices in production regions, equation (9) is used to determine output prices in

consumption regions, and equation (10) is used to determine prices in input markets. Equation

(11) is the international market clearing condition for output markets and Equation (12) is the

market clearing condition for the input markets. The industry share of input h used in the production of j in region y is λ_{hj}^{y}. The model with five outputs, two inputs, and three regions (with trade in the output markets) yields a system of ninety-three equations.

Three policy parameters are included in the simulation model: α_{j}^{y} in Equation (8) represents the *ad valorem* price wedge created by a subsidy applied to product j by region y; β_{j}^{y} in Equation (9) represents the *ad valorem* price wedge created by a border measure applied to product j by region y; and δ_{h}^{y} in Equation (10) represents the *ad valorem* price wedge created by a subsidy applied to input h by region y.

The results from the simulation model also yield changes in measures of economic welfare. The changes in economic welfare accruing to consumers of product j in region y (ΔCS_{j}^{y}) and to the factors of production in region y (ΔPS_{h}^{y}) are measured in terms of changes in factor and product prices and quantities.

(13) $\Delta CS_{j}^{y} = -P_{j}^{y} QD_{j}^{y} \mathrm{E}(P_{j}^{y})[1 + 0.5\mathrm{E}(QD_{j}^{y})]$

(14) $\Delta PS_{h}^{y} = WS_{h}^{y} XS_{h}^{y} \mathrm{E}(WS_{h}^{y})[1 + 0.5\mathrm{E}(XS_{h}^{y})]$

The change in total producer surplus in region y is the sum of the producer surplus from each factor market, $\Delta PS^{y} = \sum_{h}(\Delta PS_{h}^{y})$, and the change in the total consumer surplus in region y is the sum of the consumer surplus from each output markets, $\Delta CS^{y} = \sum_{j}(\Delta CS_{j}^{y})$.

The change in net surplus for region y depends on the change in taxpayer surplus, and taxpayer surplus changes are comprised of two components. Equation (15) includes the welfare effects for taxpayers in region y from changes in border measures and in domestic support applied in output market j. Equation (16) includes the welfare effects for taxpayers in region y from changes in domestic support applied in input market h. Equation (17) shows the total change in taxpayer surplus in region y.

(15) $\quad \Delta TS_j{}^y = P_j^y QT_j^y[\mathrm{E}(P_j^y) + \mathrm{E}(QT_j^y) + \mathrm{E}(P_j^y)\mathrm{E}(QT_j^y)]$

$\qquad - P_j^w QT_j^y[\mathrm{E}(P_j^w) + \mathrm{E}(QT_j^y) + \mathrm{E}(P_j^w)\mathrm{E}(QT_j^y)]$

$\qquad - P_j^y QS_j^y(\alpha_j^y)$

(16) $\quad \Delta TS_h{}^y = WD_h^y XS_h^y[\mathrm{E}(WD_h^y) + \mathrm{E}(XS_h^y) + \mathrm{E}(WD_h^y)\mathrm{E}(XS_h^y)]$

$\qquad - WS_h^y XS_h^y[\mathrm{E}(WS_h^y) + \mathrm{E}(XS_h^y) + \mathrm{E}(WS_h^y)\mathrm{E}(XS_h^y)]$

(17) $\quad \Delta TS^y = \sum_j(\Delta TS_j{}^y) + \sum_h(\Delta TS_h{}^y)$

Although border measures do not change in the simulation experiments used here, changes in taxpayer surplus will accrue if tariffs are applied to processed products. If a change in domestic support affects the quantity traded, it will also have an indirect effect on the amount of tariff revenue generated. Equation (18) shows the calculation used to describe the net traded quantity for each product in each region regardless of whether the region imports or exports. Equation (19) represents the change in net surplus in region y (ΔNS^y).

(18) $\quad \mathrm{E}(QT_j^y) = (QS_j^y/QS_j^y - QD_j^y)\mathrm{E}(QS_j^y) - (QD_j^y/QS_j^y - QD_j^y)\mathrm{E}(QD_j^y)$

(19) $\quad \Delta NS^y = \sum_j(\Delta CS_j^y) + \sum_h(\Delta PS_h^y) + \Delta TS^y$

Reductions in the EU domestic support regime that applied in 1997 and 2000 are modeled as reductions in the *ad valorem* subsidy received by tomato processors; reductions in the regime that applied in 2001, 2007, and 2008 are modeled as reductions in the *ad valorem* subsidy paid to growers of processing tomatoes. We simulate separately the effects of removing EU domestic support at five different points in time. The results from the simulation model will describe the changes in prices, quantities, and welfare measures across the various output products, factors of production, and regions.

3.1 Model Parameterization

Our simulation model requires several parameters to describe the global processing tomato market. Elasticity parameters are needed for the supply of each input, the demand for each output, and the substitution possibilities between inputs; parameters are also needed for input shares, initial equilibrium quantities, cost shares, and policy shocks. The simulation model is used to assess five different policy experiments; each experiment examines a policy change in a particular year. Some parameters may remain constant throughout the experiments (*e.g.*, demand elasticities for processed tomato products) while other experiments will require parameters that are specific to the year being studied (*e.g.*, initial quantities). The full set of baseline parameters for supply, demand, and substitution elasticities, and shares are contained in Table 3, and each is discussed in detail below. Table 4 shows the initial quantities that were used in each of the five experiments.

Applying work by Davis and Espinoza (1998) and Zhao *et al*. (2000) prior distributions are applied to selected baseline parameters to understand the sensitivity of our results. A central tendency (equal to the baseline parameter) and a variance of 0.04 is specified and used to develop beta (3,3) distributions that are applied to all supply, demand, and substitution elasticities. The beta distributions selected here constrain demand elasticities to be negative and supply elasticities and substitution elasticities to be positive. The simulation model draws values for these parameters to generate an empirical distribution of results. The empirical distribution includes the results from 1000 iterations of the simulation model. No prior distributions are applied to parameter values that were based on information supplied by industry sources such as cost and industry shares, or parameters describing initial quantities.

The own- and cross-price elasticities of demand were calculated following an Armington specification (Armington, 1969). The calculation used to parameterize the Armington own-price elasticity of demand is shown in equation (20) and the calculation used to parameterize the Armington cross-price elasticities of demand is shown in equation (21). A summary of parameters used in the Armington specification are listed in Table 3.

(20) $\eta_{jj}^{y} = \zeta_{j}^{y} \eta^{y} - (1 - \zeta_{j}^{y}) \sigma^{y}$

(21) $\eta_{jk}^{y} = \zeta_{k}^{y} (\eta^{y} + \sigma^{y})$

The own-price elasticity of demand for product j is represented by η_{jj}^{y}, and η_{jk}^{y} represents the cross-price elasticity of demand for product j with respect to the price of product k. In equations (20) and (21), η^{y} is the overall elasticity of demand for processed tomato products in country y. The Armington specification also requires the elasticity of substitution (across the processed products) for each consuming region, represented by σ^{y}, and the share of consumption devoted to product j in region y. Information on consumption shares, represented by ζ_{j}^{y}, is derived from industry sources (Amézaga, 2002; Morning Star, 2008). The supply elasticities for each input in each region were drawn from distributions with specified means and variances that reflect decisions made in the intermediate-run.

Table 5 outlines the information used to calculate the EU *ad valorem* level of support in the processing tomato sector in selected years. Domestic support parameters are required for the EU only, as no domestic support was directly applied to processing tomato sectors in the other regions. The top section of Table 5 shows the parameters used to calculate the effective rates of support for EU processed tomato products (α_{J1}^{E} and α_{J3}^{E}) in 1997 and 2000. In both years we examine the effect of processor aid in the three groups and then calculate the weighted effect for the EU processed tomato product market. The proportion of processing plants that were

considered to fit into each of the groups are listed in the second column of Table 5. Overall, the shares are an approximation and used to reflect the idea that a greater proportion of plants produced at quantities greater than entitlement quota in 2000 relative to 1997. The level of processor aid and the processed product price (for tomato paste) are constant across the groups in each year; however, the applied rate of support varies across groups depending on the amount of support that is infra-marginal. In our baseline simulation model in 1997 and 2000, the applied rate of support for group L is 100% and 50% for group A. Following Equation (4) the weighted sum of applied rates across the three groups is 0.89 in 1997 and 0.64 in 2000. The weighted sum is higher in 1997 for two reasons; first, group L generates a greater share of production in 1997 and second, the processor aid as a share of product price is higher in 1997.

The bottom section of Table 5 outlines the parameters used to calculate the effective rate of support for processing tomatoes (denoted as δ_F^E) after 2000. All growers received a payment of €34.50 per ton of processing tomatoes in 2001; by 2007 growers in Spain had exceeded the Spanish national threshold quantity and their payment was reduced by 10%. Given Spain's share of tomato production in the EU, the applied rate of support in the EU was reduced slightly in 2007. Each year between 2001 and 2011 price support applies to tomato production; the *ad valorem* rate of EU support in any year is the payment's share of the price received by growers. The final column in the lower section of Table 5 shows the effective rates of price support for EU processing tomatoes between 2001 and 2012.

4. Results

Assessing the effects of switching EU domestic support regimes is complicated because observations of a no-policy period do not exist. Therefore, we report the results for simulations where EU domestic support is eliminated at five different points in time. We consider the effects

of eliminating the domestic support regime in 1997 and in 2000; we also model the implications of removing the price support that was in place in 2001, 2007, and 2008. The proportional and quantity effects calculated from the simulation experiments are used to compare the degree of distortion associated with each regime. Each simulation imposes a policy shock to the system of equations and generates empirical distributions for the changes in prices and quantities, and associated welfare measures, for the two inputs and the five processed products. The empirical distributions are used to calculate the mean and a 95% confidence interval for price, quantity, and welfare variables across 1000 iterations.

Table 6 shows the mean price and quantity effects from each scenario for inputs and products in each region. The first column of results examines the implications of removing the processor aid in 1997. Here, results show that the removal of processor aid in 1997 would have decreased the EU tomato price by 26.1% and decreased EU tomato production by 12.9%. Reducing tomato production by 13% would have decreased EU production from 6.8 million tons to 5.9 million tons in 1997. Less tomato production would lead to 21.9% less canned tomato production and 8.4% less tomato paste production in the EU. Production decreases in canned tomatoes and paste depend on input share usage and substitution possibilities between both inputs and output products. Elimination of processor aid in 1997 would generate significant losses for EU producers and consumers, but the combined loss would have been outweighed by reduced taxpayer expenditures and yielded a net surplus gain in the EU of €83.1 million. Outside of the EU, removing the processor aid would increase prices and production of tomatoes and processed tomato products; it would also generate €49.4 million annually in additional producer surplus for U.S. and ROW growers and processors.

Between 1997 and 2000 the *ad valorem* rate of EU domestic support fell from 27.8% to 15.8% and this is evident in the effects shown for elimination of processor aid in 2000. The second column in Table 6 indicates that production of tomatoes and tomato products would decrease in the EU and increase elsewhere, yet the effects are smaller than those reported in 1997. Elimination of the processor aid in 2000 would have decreased EU tomato production from 8.4 million tons to 7.8 million tons; U.S. production would have increased by 0.1 million tons and ROW production would have increased by 0.2 million tons. The overall reduction in tomato production due to removal of the processor aid in 2000 would have decreased global consumer surplus by €150.1 million. Overall, the pattern of simulated effects is linked to the proportion of production that was considered infra-marginal during each period. In 1997 a greater share of total production was in group *L*, the group where the support was most production-distorting. By 2000, there were fewer producers in group *L* and more processors producing at or above quota entitlement where the policy effects were only partially infra-marginal.

The final three columns in Table 6 show price, quantity, and welfare results for scenarios without the payments paid to EU tomato growers in 2001, 2007, and 2008. Results in the third column show that tomato production would have fallen by 9.1%, or 0.8 million tons, and EU producer surplus would have decreased by €159.9 million in the absence of grower payments in 2001. Removing EU grower payments in 2001 would have increased tomato production in the United States by 0.8% and in the ROW by 1.9%, or equivalently by 0.3 tons across both regions. Again, similar to the removal of the processor aid, elimination of the grower payment would increase non-EU producer surplus and decrease non-EU consumer surplus. The results in the fourth column show the results for removing grower payments in 2007; here the results track

those from 2001 quite closely, however, elimination of the grower payment in 2007 would lead to slightly smaller production effects in the EU and elsewhere. In 2008 the EU regime replaced part of the price support with a decoupled payment, and both were paid to growers of tomatoes. The final column of results shows that the removal of the price support that remained in 2008 would have led to 3.9% less tomato production in the EU. Removing the partially decoupled regime in 2008 would also increase tomato production in regions outside of Europe, but to a lesser degree than would a fully coupled regime. For simplicity, we assume that the decoupled component of support in 2008 did not distort EU production.

The domestic support regime applied in 1997 led to an additional 0.9 million tons in the EU; this additional EU production during 1997 was equivalent to about 4% of global tomato supply. In 2000 the processor aid increased EU tomato production by 0.6 million tons. Furthermore, removal of EU support would have increased tomato production outside of the EU by 0.4 million tons in 1997 and by 0.3 million tons in 2000. The EU support paid directly to growers in the latter period increased EU production by 0.8 million tons in 2001 and by 0.7 million tons in 2007. The net effect of switching domestic support regimes in 2001 increased EU production and EU producer welfare, yet it was relatively insignificant for producers in the United States and negligible for producers in the ROW-region. Overall, the net effect of switching regimes in 2001 increased production of EU processing tomatoes by approximately 0.2 million tons per year.

In addition, although removal of processor aid reduced production of canned tomatoes and paste in the EU, removal of the grower payments did not affect EU processed products equally. Removal of domestic support would always have led to less tomato and paste production in the EU, yet during the period after 2000 our results show that elimination of the

grower payments would lead to more canned tomato production in the EU. Processor aid, a payment applied to processed products, encouraged EU processing plants to overproduce paste. Once the support was applied to tomatoes the incentive for some processors to produce paste was diminished and we see tomato use shifting from paste to canned tomato products.

5. Policy Implications

The primary beneficiaries of EU domestic support applied to the processing tomato market were consumers of processed tomato products in all regions and European producers. EU taxpayers and producers in non-EU regions would benefit most from eliminating EU domestic support. The decrease in EU production simulated here (as a result of removing domestic support) reduced the amount of processed tomato products available globally and reduced welfare for consumers in all regions. In fact, the large decrease in consumer surplus led to a reduction in net welfare in the United States and the ROW. However, the net change in global welfare was positive in each year due to the increase in net EU welfare. The relatively small changes in taxpayer expenditures in non-EU regions resulted from changes in tariff revenues associated with less global trade in processed tomato products.

Our simulation experiments that examine reform of EU domestic support in the processing tomato sector highlight three interesting results. First, the impacts for consumers in all regions were largest with the domestic support regime that applied prior to 2001. Domestic support applied to downstream products diverts a greater share of benefits to processors. Once the domestic support was applied to upstream products, the benefits are redistributed to producers. Second, processing tomato policy was on a path to reform between 1997 and 2000 and the trend was reversed in 2001. Relative to the pre-2001 regime, the domestic support regime used between 2001 and 2007 reduced costs to EU consumers; however, it did not lead to

greater overall economic efficiency in the EU. Third, price support that applies to a menu of processed products will lead to an inefficient allocation of inputs across the products. Shifting price support from output markets to input markets decreases the incentives to overproduce certain processed products. Furthermore, as input substitution possibilities increase between processed products, any shift of support from processors to growers will lead to a greater reallocation of tomatoes to their best use.

This research explored the evolution of domestic support regimes that have applied to different agricultural products along the supply chain in the processing tomato sector. It also contributes to a better understanding of the impact that EU policies have had in global horticultural markets. We examine the processing tomato sector here as it is important crop outside of Europe and it has received the largest share of EU support among processed horticultural crops. However, our general results would also apply to EU support that has applied to other processed fruit and vegetable sectors including peaches, pears, plums, figs, raisins, and citrus. The question of agricultural policy reform is examined here in detail and the degree of policy reform in the EU processing tomato market is complicated for two reasons. First, EU domestic support for horticultural products has been applied to different products along the supply chain, and second, much of the support prior to 2001 was infra-marginal. It appears that the transition to decoupled payments in 2008 will reduce production distortions in the processing tomato sector. However, the regime that was in place between 2001 and 2007 clearly stimulated additional production relative to the regime that was in place in 2000. Switching to the SFP in 2001 would have been the clearest path for reform, yet introducing the fully decoupled payment in 2012 might be considered a second best path to reform.

Table 1. Production of processing tomatoes: 1978 to 2008

Year	Italy	Spain	Portugal	Greece	France	EU	California	ROW
				(thousand metric tons)				
1978	2,220	586	612	1,029	363	4,810	4,798	
1979	3,477	553	553	1,084	383	6,050	5,760	
1980	2,962	541	454	1,445	399	5,801	5,025	
1981	3,007	568	387	1,124	406	5,492	4,444	
1982	3,038	585	487	1,008	375	5,493	5,578	
1983	4,183	654	558	1,075	304	6,774	5,415	
1984	5,765	743	731	1,484	355	9,078	5,977	
1985	3,899	746	742	1,318	392	7,097	5,533	
1986	2,917	473	542	706	242	4,880	5,878	
1987	2,928	573	421	825	234	4,981	6,077	
1988	3,131	679	456	961	277	5,504	5,941	
1989	3,857	818	617	1,308	323	6,923	7,791	
1990	3,560	1,022	823	1,059	322	6,786	8,444	
1991	3,426	845	706	1,129	321	6,427	8,971	
1992	3,222	790	447	913	247	5,619	7,193	
1993	3,505	961	501	1,028	236	6,231	8,118	
1994	3,683	1,279	865	111	276	6,214	9,751	
1995	3,535	916	831	1,177	281	6,740	9,624	7,163
1996	4,198	1,183	905	1,311	285	7,882	9,669	7,886
1997	3,665	990	722	1,183	286	6,846	8,472	8,173
1998	4,352	1,182	988	1,248	328	8,098	8,063	6,709
1999	4,932	1,510	999	1,250	372	9,063	11,102	9,133
2000	4,835	1,318	855	1,062	314	8,384	9,333	10,716
2001	4,806	1,463	917	939	298	8,423	7,837	10,376
2002	4,300	1,670	834	860	240	7,904	10,032	8,762
2003	5,300	1,713	894	927	249	9,083	8,390	12,018
2004	6,300	2,167	1,171	1,187	223	11,048	10,585	13,503
2005	5,200	2,611	1,202	880	200	10,093	8,707	14,497
2006	4,800	1,579	1,200	1,000	200	8,779	9,161	13,472
2007	4,600	1,650	1,000	860	150	10,957	8,260	13,866
2008[a]	4,800	1,900	1,000	1,000	150	11,200	8,850	14,000

Sources: AMITOM, 2008; CTGA, 2008.

[a] Production estimates.

Table 2. Processor aid, minimum prices, and quota entitlements: 1997 and 2000[a]

Country	Year	Processor Aid[b] (€ per ton)	Minimum Price (€ per ton)	Entitlement quota (metric tons)	Tomato production (metric tons)
Italy	1997	268	94	3,472	3,520
	2000	172	88	3,910	4,400
Spain	1997	268	94	1,006	981
	2000	172	88	1,011	1,382
Portugal	1997	268	94	940	772
	2000	172	88	940	970
Greece	1997	268	94	1,049	1,245
	2000	172	88	1,078	1,290
France	1997	268	94	370	286
	2000	172	88	299	330
EU	1997	268	94	6,836	6,804
	2000	172	88	6,938	8,372

Source: AMITON, 2008.

[a] Nominal prices are reported for processor aid payments and minimum prices.

[b] Processor aid levels shown here are applied to tomato paste; approximately 6.1 units of processing tomatoes are used to produce one unit of tomato paste. Per ton processor aid payments were prorated by the EU Commission for canned tomato products.

Table 3. Baseline parameters used in the simulation models[a, b]

Parameter description	Parameter notation	Baseline parameter value
Overall price elasticity of demand for processed tomato products	η^y	$E=-0.3$, $U=-0.5$, $R=-0.7$
Consumption share of product j	ζ_j^E ζ_j^U ζ_i^R	$J1=0.37$, $J2=0.01$, $J3=0.51$, $J4=0.02$, $J5=0.09$ $J1=0.02$, $J2=0.10$, $J3=0.02$, $J4=0.86$, $J5=0.01$ $J1=0.02$, $J2=0.01$, $J3=0.09$, $J4=0.04$, $J5=0.84$
Elasticity of substitution between processed products	σ^y	$E=5$, $U=7$, $R=10$
Price elasticity of supply for input h	ε_F^y ε_M^y	$E=0.5$, $U=0.5$, $R=0.6$ $E=1.0$, $U=1.0$, $R=1.5$
Cost share for input F in the production of j	κ_{Fj}^E κ_{Fj}^U κ_{Fj}^R	$J1=0.15$, $J3=0.45$ $J2=0.17$, $J4=0.50$ $J5=0.40$
Industry share of inputs used in the production of j	λ_j^E λ_j^U λ_i^R	$J1=0.39$, $J3=0.61$ $J2=0.10$, $J4=0.90$ $J5=1.0$
Elasticity of substitution between inputs for processed product j	σ_j^y	0.1 (for all processed products in all regions)

[a] There are five processed tomato products in our model: *J1* represents a canned tomato product produced and exported by the EU; *J2* represents a canned tomato product produced and exported by the United States; *J3* represents a tomato paste product produced and exported by the EU; *J4* represents a tomato paste product produced and exported by the United States; and *J5* represents a tomato paste product produced and exported by the rest-of-the-world region.

[b] Prior distributions were used for price elasticities of demand and supply, and all elasticities of substitution. Values shown represent the mean used in the beta (3,3) distribution.

Table 4. Baseline quantities used in the simulation models[a]

Parameter description	Year	Parameter notation	Baseline parameter value
Initial equilibrium quantity supplied of product j	1997	QS_j^E QS_j^U QS_j^R	$J1$=2.5, $J3$=4.5 $J2$=0.5, $J4$=8.0 $J5$=8.2
Initial equilibrium quantity demanded of product j	1997	QD_j^E QD_j^U QD_j^R	$J1$=2.20, $J2$=0.01, $J3$=3.30, $J4$=0.20, $J5$=0.75 $J1$=0.15, $J2$=0.45, $J3$=0.20, $J4$=7.40, $J5$=0.05 $J1$=0.15, $J2$=0.04, $J3$=1.00, $J4$=0.40, $J5$=7.20
Initial equilibrium quantity supplied of product j	2000	QS_j^E QS_j^U QS_j^R	$J1$=3.0, $J3$=5.5 $J2$=0.6, $J4$=8.7 $J5$=10.7
Initial equilibrium quantity demanded of product j	2000	QD_j^E QD_j^U QD_j^R	$J1$=3.20, $J2$=0.01, $J3$=4.30, $J4$=0.20, $J5$=0.75 $J1$=0.15, $J2$=0.55, $J3$=0.20, $J4$=8.10, $J5$=0.05 $J1$=0.15, $J2$=0.04, $J3$=1.00, $J4$=0.40, $J5$=9.90
Initial equilibrium quantity supplied of product j	2001	QS_j^E QS_j^U QS_j^R	$J1$=3.0, $J3$=5.5 $J2$=0.5, $J4$=7.5 $J5$=10.3
Initial equilibrium quantity demanded of product j	2001	QD_j^E QD_j^U QD_j^R	$J1$=2.70, $J2$=0.01, $J3$=4.30, $J4$=0.20, $J5$=0.75 $J1$=0.15, $J2$=0.45, $J3$=0.20, $J4$=6.90, $J5$=0.05 $J1$=0.15, $J2$=0.04, $J3$=1.00, $J4$=0.40, $J5$=9.50
Initial equilibrium quantity supplied of product j	2007	QS_j^E QS_j^U QS_j^R	$J1$=4.0, $J3$=7.0 $J2$=0.6, $J4$=7.7 $J5$=13.9
Initial equilibrium quantity demanded of product j	2007	QD_j^E QD_j^U QD_j^R	$J1$=3.70, $J2$=0.01, $J3$=5.80, $J4$=0.20, $J5$=1.10 $J1$=0.15, $J2$=0.55, $J3$=0.20, $J4$=7.10, $J5$=0.20 $J1$=0.15, $J2$=0.04, $J3$=1.00, $J4$=0.40, $J5$=12.6
Initial equilibrium quantity supplied of product j	2008	QS_j^E QS_j^U QS_j^R	$J1$=4.0, $J3$=7.2 $J2$=0.6, $J4$=8.3 $J5$=14.0
Initial equilibrium quantity demanded of product j	2008	QD_j^E QD_j^U QD_j^R	$J1$=3.70, $J2$=0.01, $J3$=6.00, $J4$=0.20, $J5$=1.10 $J1$=0.15, $J2$=0.55, $J3$=0.20, $J4$=7.40, $J5$=0.20 $J1$=0.15, $J2$=0.04, $J3$=1.00, $J4$=0.70, $J5$=12.7

[a] There are five processed tomato products in our model: $J1$ represents a canned tomato product produced and exported by the EU; $J2$ represents a canned tomato product produced and exported by the United States; $J3$ represents a tomato paste product produced and exported by the EU; $J4$ represents a tomato paste product produced and exported by the United States; and $J5$ represents a tomato paste product produced and exported by the rest-of-the-world region.

Table 5. EU support in the processing tomato sector

Year	Subgroup[a]	Share (%)	Processor aid (€per ton)	Paste Price (€per ton)	Applied rate[b] (%)	α_{J1}^{E} α_{J3}^{E}
1997	L	40	268	750	100	0.357
	A	40	268	750	50	0.179
	G	20	268	750	89	0.318
	All	100	268	750		0.278
2000	L	20	172	710	100	0.242
	A	40	172	710	50	0.121
	G	40	172	710	64	0.154
	All	100	172	710		0.158

Year	Subgroup	Share (%)	Grower payment (€per ton)	Tomato Price (€per ton)	Applied rate[c] (%)	δ_{F}^{E}
2001	All	100	34.50	81	100	0.426
2007	All	100	34.50	85	98	0.398
2008	All	100	34.50	92	50	0.188

[a] Subgroup classifications are used in the pre-2001 period to describe the processing plants that produced less than (L), at (A), and greater than (G) quota entitlement.

[b] The applied rate of support for group G in the pre-2001 period is calculated using Equation (3).

[c] The applied rate of support for processing tomatoes in 2007 is 98% because the grower payment in Spain was reduced by 10% because they produced in excess of their threshold quantity. Combining a 10% reduction in grower payments with Spain's share of EU production in 2007 yields approximately a 2% reduction in the EU applied rate.

Table 6. Simulated effects from changes to EU domestic support

Region/Variables	Remove EU price support in:				
	1997	2000	2001	2007	2008
EU	Percent Change				
Tomato price[a]	−26.1	−15.3	−18.4	−16.8	−7.9
Tomato production	−12.9	−7.6	−9.1	−8.3	−3.9
Canned price	11.0	6.6	−1.6	−1.2	−0.5
Canned production	−21.9	−14.2	24.7	22.8	10.8
Paste price	7.5	4.5	7.5	7.4	3.5
Paste production	−8.4	−4.2	−27.4	−25.0	−11.8
EU	Change in million euro				
Producer surplus	−205.0	−150.9	−159.9	−188.1	−91.7
Consumer surplus	−120.3	−103.8	−15.3	−26.4	−15.7
Taxpayer surplus	408.4	292.1	241.9	292.3	146.2
Net economic surplus	83.1	37.3	66.8	77.8	38.9
U.S.	Percent Change				
Tomato price	3.3	1.9	1.6	1.5	0.8
Tomato production	1.7	1.0	0.8	0.8	0.4
Canned price	2.1	1.2	1.0	1.0	0.5
Canned production	5.2	2.9	2.6	2.4	1.1
Paste price	2.6	1.5	1.2	1.2	0.6
Paste production	1.4	0.8	0.6	0.6	0.4
U.S.	Change in million euro				
Producer surplus	24.1	15.1	10.7	11.0	6.3
Consumer surplus	−30.9	−20.1	−11.0	−12.1	−6.8
Taxpayer surplus	−4.9	−2.8	0.1	−0.1	0.1
Net economic surplus	−11.7	−7.7	−0.2	−1.2	−0.5
ROW	Percent Change				
Tomato price	5.3	3.1	3.2	3.2	1.5
Tomato production	3.2	1.9	1.9	1.9	0.9
Paste price	3.5	2.0	2.1	2.1	1.0
Paste production	3.4	2.0	2.0	2.0	1.0
ROW	Change in million euro				
Producer surplus	25.3	19.0	19.1	25.6	12.4
Consumer surplus	−36.1	−26.2	−23.4	−28.8	−14.9
Taxpayer surplus	−14.3	−8.4	−5.5	−5.7	−2.2
Net economic surplus	−24.9	−15.7	−9.7	−8.8	−4.7

[a] The reported value is the change in the price received by tomato growers; removing domestic support during the 2001 to 2008 period would also increase the processor price for tomatoes.

Figure 1. Net marginal costs for EU processed tomato products: 1978 to 2000
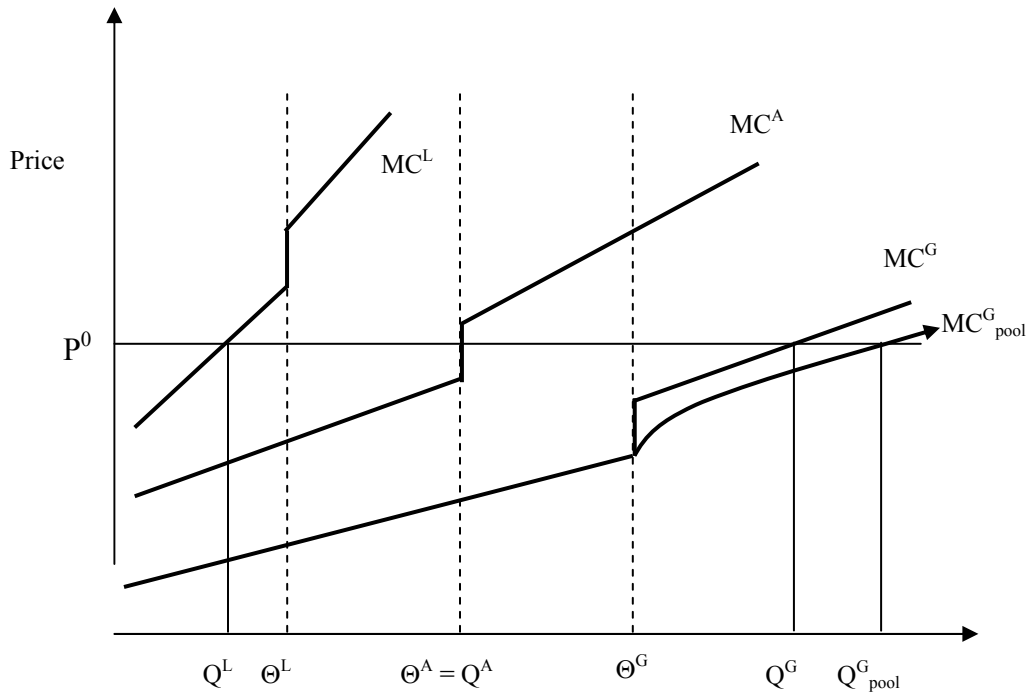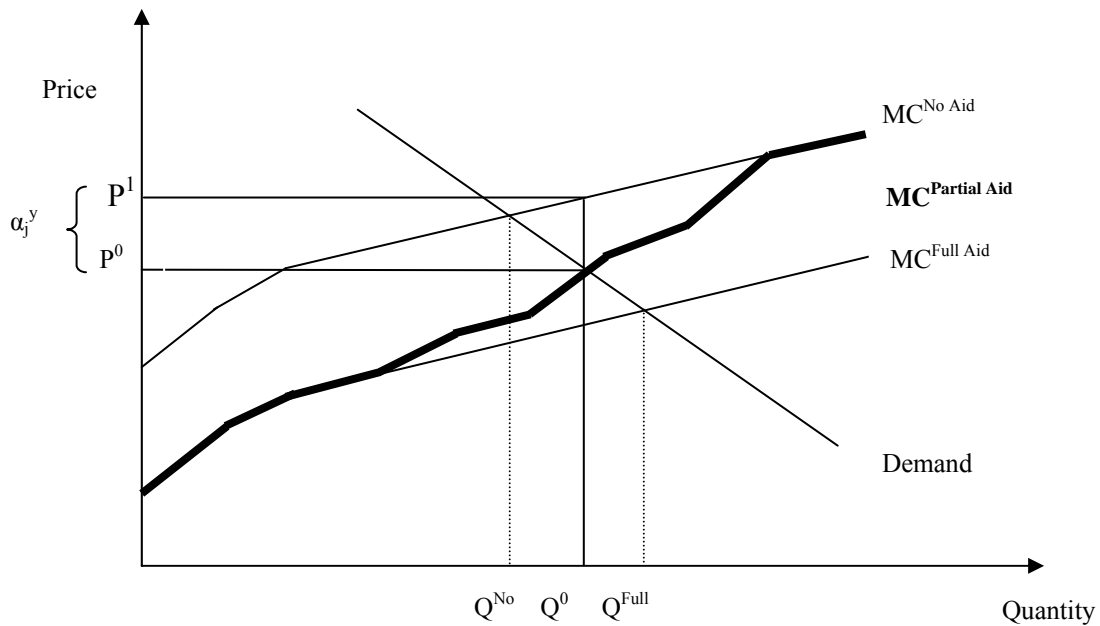

Figure 2. Aggregate effect of the EU processor aid: 1978 to 2000

References

Amézaga, J.J. (2002). Personal Communication. Alimentos Españoles, Alsat, S.L. Badajoz, Spain.

Armington, P.S. (1969). A Theory of Demand for Products Distinguished by Place of Production. *IMF Staff Papers* 16: 159–176.

Blandford, D. (2001). Are Disciplines Required on Domestic Support? *Estey Centre Journal of International Law and Trade Policy* 2: 35–59.

Brans, H. (2000). European Union Fresh Vegetables Report and EU Export Subsidies for Fruits and Vegetables. *USDA-FAS GAIN Report* No. E20032.

California Tomato Growers Association–CTGA. (2008). Market Statistics. Available at: http://www.ctga.org

Commission of the European Communities. (1996). *Official Journal of the European Union*: OJ L 297. Council Regulation (EC) No 2200/96. Brussels, Belgium.

Commission of the European Communities. (2000). *Official Journal of the European Union*: OJ L 311. Council Regulation (EC) No 2699/2000. Brussels, Belgium.

Commission of the European Communities. (2007). *Official Journal of the European Union*: OJ L 350. Council Regulation (EC) No 1580/2007. Brussels, Belgium.

Davis, G.C., and M.C. Espinoza. (1998). A Unified Approach to Sensitivity Analysis in Equilibrium Displacement Models. *American Journal of Agricultural Economics* 80: 868–879.

De Belder, T., and H. Brans. (2008). EU-27 Market Development Reports: Fruits and Vegetables. *USDA-FAS GAIN Report* No. E48001.

Desquilbet, M., and H. Guyomard. (2002). Taxes and Subsidies in Vertically Related Markets. *American Journal of Agricultural Economics* 84: 1033–1041.

Feenstra, R.C. (1986). Trade Policy with Several Goods and 'Market Linkages'. *Journal of International Economics* 20: 249–267.

Frandsen, S., H. Jensen, W. Yu, and A.Walter-Jørgensen. (2003). Reform of EU sugar policy: Price cuts versus quota reductions. European Review of Agricultural Economics 30: 1–26.

Goodwin, B.K., and A.K. Mishra. (2006). Are Decoupled Farm Program Payments Really Decoupled? An Empirical Evaluation. *American Journal of Agricultural Economics* 88: 73–89.

Hennessy, D. (1998). The production effects of agricultural income support policies under uncertainty. *American Journal of Agricultural Economics* 80: 46–57.

Mediterranean International Association of the Processing Tomato–AMITOM. (2008). *Tomato News*. World Processing Tomato Council, Avignon, France.

Morning Star Company. (2008). Tomato Industry Data. Woodland, California. Available at http://www.morningstarco.com/industry/inddata.html

Rickard, B.J., and D.A. Sumner. (2008). Domestic Support and Border Measures for Processed Horticultural Products. *American Journal of Agricultural Economics* 90: 55–68.

Roberts, I., and C. Gunning-Trant. (2006). The European Union's Common Agricultural Policy: A Stocktale of Reforms. ABARE Research Report No 3275. Canberra, Australia.

Rude, J. (2007). Production effects of the European Union's Single Farm Payment. *Canadian Agricultural Trade Policy Research Network Working Paper* No 2007–6.

Strossman, C. (2003). European Union Trade Policy Monitoring Fruit and Vegetables: EU Subsidies. *USDA-FAS GAIN Report* No E23064.

Stuart. L. (2005). Truth or consequences: Why the EU and the USA must reform their subsidies, or pay the price. Oxfam Briefing Paper No 81. Oxfam International, London.

Sumner, D.A. (2000). Domestic Support and the WTO Negotiations. *The Australian Journal of Agricultural and Resource Economics* 44: 457–474.

Sumner, D.A. (2003). Implications of the USA Farm bill of 2002 for Agricultural Trade and Trade Negotiations. *The Australian Journal of Agricultural and Resource Economics* 47: 117–140.

Sumner, D.A. (2005). Production and Trade Effects of Farm Subsidies: Discussion. *American Journal of Agricultural Economics* 87: 1229–1230.

United States International Trade Commission–USITC. (2001). The Effects of EU Policies on the Competitive Position of the U.S. and EU Horticultural Products Sectors. *USITC Investigation* No 332–423. Washington, DC.

Witske, H.P., and T. Heckelei. (2002). *EU Sugar Policy Reform: Quota Reduction and Devaluation*. Paper presented at the American Agricultural Economics Association Annual Meeting, Long Beach, California.

Young, C.E., and Westcott, P. (2000). How decoupled is U.S. agricultural support for major crops? *American Journal of Agricultural Economics* 82: 762–767.

Zhao, X, W.E. Griffiths, G.R. Griffith, and J.D. Mullen. (2000). Probability distributions for economic surplus changes: The case of technical change in the Australian wool industry. *The Australian Journal of Agricultural and Resource Economics* 44: 83–106.

OTHER A.E.M. WORKING PAPERS

WP No	Title	Fee (if applicable)	Author(s)
2008-22	Measuring the Effects of the Clean Air Act Amendments on Ambient PM10 Concentrations: The critical importance of a spatially disaggregated analysis		Auffhammer, M., Bento, A. and S. Lowe
2008-21	The Optimal Minimum Wage for Poverty Minimization		Goto, H.
2008-20	Labor Market Competitiveness and Poverty		Goto, H.
2008-19	Do Investors Learn about Analyst Accuracy?		Chang, C., Daouk, H. and A. Wang
2008-18	Regional Inequality in China: An Overview		Fan, S., Kanbur, R. and X. Zhang
2008-17	China's Growth Strategies		Headey, D., Kanbur, R. and X. Zhang
2008-16	Dairy Farm Management Adjustments to Biofuels-Induced Changes in Agricultural Markets		Schmit, T., Boisvert, R., Enahoro, D. and L. Chase
2008-15	Cornell-SEWA-WIEGO 2008 Dialogue - Ahmedabad and Delhi Compendium of Personal and Technical Notes		Bali, N., Basu, K., Bhorat, H., Carre, F., Chen, M., Fields, G., Jhabvala, R., Kanbur, R., Lund, F., Unni, J. and I. Valodia
2008-14	Ethanol Plant Investigation using Net Present Value and Real Options Analyses		Schmit, T., Luo, J. and L. Tauer
2008-13	The Value of Private Risk Versus the Value of Public Risk: An Experimental Analysis of the Johannesson et al. Conjecture		Messer, K., Poe, G. and W. Schulze
2008-12	Social Preferences and Voting: An Exploration Using a Novel Preference Revealing Mechanism		Messer, K., Poe, G., Rondeau, D., Schulze, W. and C. Vossler
2008-11	Empirical Analysis of Stanchion and Parlor Milking Cost on New York Dairy Farms		Katsumata, K. and L. Tauer
2008-10	Are Higher 529 College Savings Plan Fees Linked to Greater State Tax Incentives?		Bogan, V.
2008-09	Microfinance Institutions: Does Capital Structure Matter?		Bogan, V.