MARKET AND WELFARE EFFECTS OF MANDATORY COUNTRY-OF-ORIGIN LABELING IN THE US SPECIALTY CROPS SECTOR

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"Do the benefits outweigh the costs, or vice versa?
This is no time for exaggeration or hysteria, but for reasoned and careful analysis"
Board of Directors, United Fresh Fruit & Vegetable Association (2003)

This study provides a new framework of analysis of the market and welfare effects of mandatory country of origin labeling (MCOOL) for fruits and vegetables that accounts for heterogeneous consumer preferences for domestic products, differences in producer agronomic characteristics, and retailer market power when buying and selling these products. The market and welfare effects of MCOOL are shown to be case-specific and dependent on the labeling costs at the farm and retail levels, the strength of consumer preference for domestic products, the market power of retailers, the marketing margin along the supply chain, and the relative costs of imported and domestic products. Simulation results for the US markets of apples and tomatoes indicate that for the regulation to increase total economic welfare in these markets, the consumer demand after MCOOL would need to increase by 2.6% to 7.0% for domestic apples and by 8.2% to 22.4% for domestic tomatoes, depending on the market power of retailers and the size of the labeling costs.

I. Introduction

Public Law 107-171 of the US Farm Security and Rural Investment Act of 2002 requires country-of-origin labeling (COOL) for beef, lamb, pork, fish, perishable agricultural commodities (fresh and frozen fruits and vegetables), and peanuts. While the stated goals of this policy are to allow domestic consumers to make informed consumption decisions and to enable domestic producers to receive higher prices due to a presumed consumer preference for domestic products (GAO 1999), the effects of COOL on the interest groups involved have been the subject of a heated on-going debate.

Advocates of COOL[1] argue the existence of an "overwhelming" consumer support for country of origin information and benefits that substantially outweigh the costs of this labeling regime (Van Sickle et al 2003). Opposing groups[2] have responded by pointing out that if COOL

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[1] Among the supporters of COOL are the Minnesota Apple Growers Association, Florida Tomato Exchange, California Tomato Growers Exchange, Washington Growers Clearing House, Washington State Farm Bureau, Washington Farmers Union, New York State Vegetable Growers Association, New York National Farmers Organization, Grower Shipper Association of Central California, California National Farmers Organization, California Farm Bureau Federation, Nebraska Farmers Union, Platte County Farm Bureau of Nebraska, American Corn Growers Assoc. of Nebraska, Nebraska Grange, and the Nebraska Women Involved in Farm Economics (Americans for Country of Origin Labeling 2007).

[2] According to WalMart Watch (2007), the top five groups with the highest lobbying expenditures against COOL are the American Farm Bureau Federation, Grocery Manufacturers of America, Cargill, Inc., Wal-Mart Stores, Inc., and National Food Processors Association.

were beneficial, the market would have provided it voluntarily[3] (Krissoff et al 2004; Golan et al 2001) and oppose a mandatory COOL (MCOOL) regime (American Meat Institute 2004; Produce Marketing Association 2003; American Frozen Food Institute 2003). Opposing groups have also expressed concerns about the potential competitive disadvantage that non-integrated producers might face due to higher record-keeping costs[4] (National Pork Producers Council 2003; Food Marketing Institute 2003), as well as about the possibility of COOL being interpreted as a non-tariff barrier to trade at the WTO (Rude et al 2006; Carter and Zwane 2003; Crummet 2002). This reaction to MCOOL has resulted in the implementation of policy for all covered commodities except for fish and shellfish being delayed until September 30, 2008 (Public Law 108-199; Public Law 109-97).

In addition to being scrutinized by the interest groups involved, mandatory COOL has received considerable attention in the agricultural economics literature with the main focus being on estimating the consumer willingness-to-pay for labeled products (Loureiro and Umberger 2005, 2003; Mabiso et al 2005; Umberger et al 2003a,b; Wimberley et al 2003; Schupp and Gillespie 2001), and, to a lesser extent, the costs associated with its implementation (Sparks Companies Inc. 2003; Davis 2003; Hayes and Meyer 2003; Food Marketing Institute 2001). Despite the understanding that the implementation of mandatory COOL will affect both the demand and supply sides of the regulated markets, only a few studies (Schmitz et al 2005; Krissoff et al 2004; Brester et al 2004; Lusk and Anderson 2004; VanSickle et al 2003; Grier and Kohl 2003; Plain and Grimes 2003) have focused on analyzing the system-wide economic effects of mandatory COOL.

The Agricultural Marketing Service (AMS) of USDA, using a computable general equilibrium (CGE) model to analyze the effects of COOL on all covered commodities but peanuts, projected that COOL will have a negative impact on both consumer welfare and the domestic production and trade of covered commodities (Federal Register 2003). In particular, AMS projects that production of fresh produce will decline by 0.15% to 0.49%, exports by 0.17% to 0.62%, imports by 0.2% to 0.26%, and price will increase by 0.11% to 0.43% relative to their 2003 values over a 10 year period, causing revenues for the fruit and vegetable industry

[3] It is important to note that while the USDA has, prior to COOL, established other standards that allowed voluntary labeling of beef and other products (such as “U.S.A. Beef”, “Fresh American Beef,” “Product of U.S.A.”), no producer found it optimal to participate in any of these programs (Federal Register 2002).

[4] The Agricultural Marketing Service of USDA has estimated that domestic producers, food handlers, and retailers would spend between $582 million and $3.9 billion on COOL recordkeeping in the first year alone if the labeling requirement were enforced for all commodities originally covered in the legislation (Federal Register 2003).

to fall by $12 to $18 million. Two limiting assumptions of the AMS study are that the retail sector is perfectly competitive and that COOL has no effect on domestic consumer demand for (labeled) US-grown products.

While the potential demand effects of COOL are explicitly considered by Schmitz et al (2005), Lusk and Anderson (2004), Brester et al (2004), VanSickle et al (2003), Plain and Grimes (2003) and Grier and Kohl (2003), none of these studies accounts for imperfect competition among retailers. In addition, all these studies focus on the potential market effects of COOL on the meat industry. Even though 23.1% of all covered fruits, 16.6% of all covered vegetables, and 9.1% of all covered peanuts are of foreign origin (GAO 2003, p.19), there is, to our knowledge, no specific study of the system-wide effects of mandatory COOL on these crops.

The objective of this paper is to develop a general theory-consistent methodological framework and systematically analyze the market and welfare effects of the implementation of MCOOL for specialty crops. Our framework accounts for both the demand and supply effects of COOL discussed earlier and their ramifications for equilibrium prices, quantities and the welfare of the interest groups involved.

In addition to being the first to systematically analyze the market and welfare effects of MCOOL for specialty crops, a distinct feature of this study is that it explicitly accounts for differences in consumer preferences for domestic and imported products, differences in agricultural producer efficiency, and retailer market power when buying and selling these products. Consumer and producer heterogeneity are key components of our model and are critical to understanding the co-existence of products with different attributes under a mandatory labeling regime. It should be noted that our framework of analysis builds upon the methodological framework developed by Fulton and Giannakas (2004) in their analysis of the effects of the introduction of genetically modified products into the food system under different regulatory and labeling regimes.

The rest of this paper is as follows. Section II provides some background information on the MCOOL regulation. In Section III, the pre- and post-COOL equilibria are derived and compared to determine the market and welfare effects of the MCOOL regulation. In Section IV, the theoretical model is calibrated with actual US data on apples and tomatoes and simulated on different values of the key parameters affecting the economic effects of MCOOL. Section V summarizes and concludes the study.

II. COOL

As mentioned previously, the US Farm Security and Rural Investment Act of 2002 mandated a COOL regime for beef, lamb, pork, fish, perishable agricultural commodities (fresh and frozen fruits and vegetables), and peanuts. The criteria a covered commodity must meet to bear a "United States country of origin" label are specified by Public Law 107-171. For meat, the animal is required to be born, raised and slaughtered in the US. For wild fish, the product must be harvested in US waters or by a US-flagged vessel and processed in the US or aboard a US-flagged vessel. Farm-raised fish must be hatched, raised, harvested, and processed in the US. Fruit, vegetable, and peanut products must be grown in the US. Under the proposed rule, a product is of mixed origin when the final production step occurs in the US but one or more prior production steps occur outside the US (USDA 2007).[5]

It is important to note that COOL is not a food safety or animal health measure since it "does not provide the traceability required to permit the government to rapidly respond to a contamination or disease outbreak" (Federal Register 2003, p. 61945). Both imported and domestic food products must meet the same food safety standards determined by the Food Service Inspection System (FSIS) and/or the Food and Drug Administration (FDA) Agency.

To convey the country of origin information, retailers must use a label, stamp, mark, placard, or other clear and visible sign on the covered commodity or on the package, display, holding unit, or bin containing the commodity at the final point of sale to consumers (Federal Register 2003, p.61946). Interestingly, not all sellers of the regulated products are required to inform consumers about the country of origin of these products. In particular, grocery stores with an annual invoice value of less than $230,000 for fruit and vegetables as well as food service establishments (such as restaurants, food stands, and delicatessens and salad bars within retail stores) are excluded from COOL requirements.

Covered commodities that are ingredients in a processed food item are also excluded from COOL requirements. An ingredient is a component either in part or in full of a finished retail

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[5] Note that state and regional labeling programs that fail to notify consumers of the country of origin of covered agricultural commodities (such as ''Washington apples'', "Georgia's Vidalia onions", ''Idaho potatoes'', and ''California Grown'') cannot be accepted in lieu of COOL (Federal Register 2003, p. 61950). Several States have implemented mandatory programs for country of origin labeling of certain commodities. For example, Alabama, Arkansas, Mississippi, and Louisiana have origin labeling requirements for certain seafood products; Wyoming, Idaho, North Dakota, South Dakota, Louisiana, Kansas, and Mississippi have origin labeling requirements for particular meat products; and Florida and Maine have origin labeling requirements for fresh produce items. To the extent that these State country-of-origin labeling programs encompass commodities not covered by the COOL regulation, the States may continue to operate them.

food product. A processed food item is a retail item derived from a covered commodity that has undergone a physical or chemical transformation and has a different character, or an item derived from a covered commodity that has been combined with either other covered commodities or other substantive food components resulting in a distinct retail item that is no longer marketed as a covered commodity. Specific processing that results in a change in the character of the covered commodity includes cooking (e.g., frying, broiling, grilling, boiling, steaming, baking, roasting), curing (e.g., salt curing, sugar curing, drying), smoking (cold or hot), and restructuring (e.g., emulsifying and extruding, compressing into blocks and cutting into portions).

Examples of fruits and vegetables combined with different covered commodities include bags of salads and pre-cooked meals that contain snap peas and meat. Examples of fruits and vegetables that have undergone significant transformation are oranges that have been squeezed and made into orange juice and apples that have been mashed and made into fresh apple sauce. When a retail item is derived from a perishable agricultural commodity combined with non-substantive components and the character of the covered commodity is retained, the resulting product is not considered a processed food item and is subject to COOL. Examples include products such as strawberries packaged with sugar, a preservative, or other flavoring (Federal Register 2003, p. 61947).

Table 1 summarizes the cases under which an agricultural product is required to bear COOL according to its final use and the establishment where the final product is sold. In analyzing the market and welfare effects of COOL, the rest of our study focuses on covered agricultural commodities (AC, hereafter) sold through retail establishments with an annual invoice value for fruits and vegetables in excess of $230,000. The estimated share of agricultural production sold through retailers covered by mandatory COOL is 41.4% (Federal Register 2003, p.61964).

Table 1. COOL requirements for agricultural commodities.

		Final product purchased by consumers at	
		Retail Establishments	**Food Service Establishments and Small Retailers**
Final use of the agricultural commodity	**Agricultural Commodity** (AC): fresh, frozen, canned, bagged, etc.	Require COOL	Exempt from COOL
	Ingredient in Processed Food Item: bagged salad, dips, soups, frozen food, etc.	Excluded from COOL	Exempt from COOL

III. The model

As mentioned previously, our analysis focuses on the decisions and welfare of consumers, producers and retailers of products subject to COOL. Retailers face a demand for AC from consumers that is satisfied with domestic and imported AC. Since origin information is a credence attribute, in the absence of COOL (*status quo*) both types of products are traded together as a non-labeled good (figure 1, panel a). After MCOOL introduction (figure 1, panel b), retailers must inform consumers about the origin of the AC, allowing them to distinguish between domestic and imported ACs and make informed consumption decisions (utility effect). However, the implementation of, and compliance with, COOL requirements generates additional costs throughout the supply chain (cost effect). These costs include the cost of segregation and identity preservation, the cost of labeling, and the costs of monitoring and enforcing the COOL regime (Federal Register 2003). The allocation of these costs to the interest groups involved depends, of course, on the market structure and the elasticities of the relevant demand and supply schedules.

In the remaining of this Section, the behavior of heterogeneous consumers, heterogeneous producers, and retailers with potential market power when buying and/or selling the AC are analyzed first, followed by the derivation of the market equilibria before and after the introduction of MCOOL. The market and welfare effects of MCOOL are obtained then through a comparison of these pre- and post-COOL equilibria.

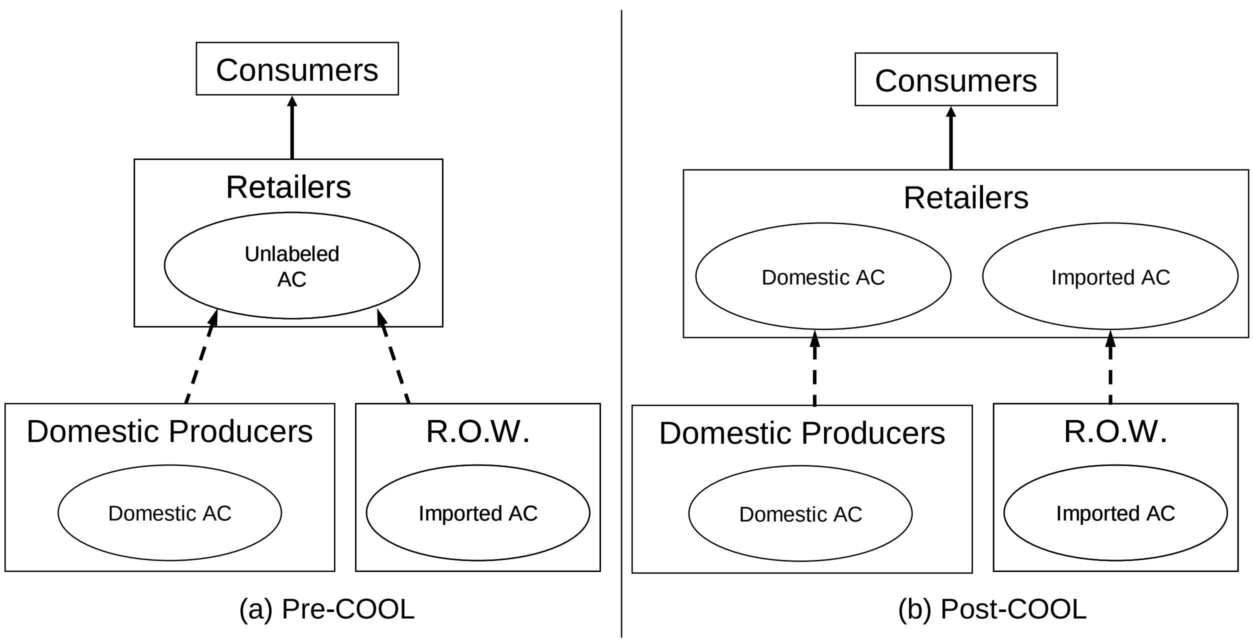

Figure 1. Market for fresh products before and after MCOOL. R.O.W.: Rest of the World

A. Pre-MCOOL

1. Consumer behavior

Prior to the MCOOL introduction, domestic and imported ACs are marketed together as a non-labeled good. Consumers in our model have the choice between a unit of the covered AC under study (e.g. apples or peanuts) and a unit of a substitute product (e.g. bananas or almonds, respectively). Consumers differ in the utility they derive from the unit consumption of the AC. Let *r*, $r \in [0, R]$, be the attribute that differentiates consumers, where $r=0$ represents the consumer that values the AC the most and $r=R$ corresponds to the consumer that derives the lowest utility from the consumption of the unlabeled AC. The consumer with differentiating characteristic *r* has the following utility function:

(1) $U_{NL} = U - \Theta r - p_{NL}$ if a unit of the non-labeled AC is consumed

$U_s = U - p_s$ if a unit of a substitute product is consumed

The parameter *U* represents a constant per unit base level of utility derived from the consumption of the AC and the substitute product; Θ is a nonnegative utility discount factor associated with the consumption of the AC; and p_{NL} and p_s are the consumer prices for the non-labeled AC and the substitute, respectively. Since U_{NL} and U_s capture the difference between the consumer valuation and the price of the AC and the substitute, they are a direct measure of the consumer surplus associated with the consumption of the two products.

The consumer with differentiating characteristic r_{NL}, where $r_{NL} : U_{NL} = U_s$, is indifferent between consuming a unit of the non-labeled AC and a unit of the substitute product (see figure 2). Consumers with differentiating characteristic $r \in [0, r_{NL})$ strictly prefer the non-labeled AC, while consumers with differentiating characteristic $r \in (r_{NL}, R]$ strictly prefer the substitute product. Assuming consumers are uniformly distributed with respect to *r*, the demand for unlabeled AC, x_{NL}^D, is:

(2) $x_{NL}^D = r_{NL} = \left(p_s - p_{NL}\right)/\Theta$

The inverse demand for the unlabeled AC is then:

(3) $p_{NL}\left(x_{NL}^D\right) = p_s - \Theta x_{NL}^D$

Aggregate consumer welfare, W^C, is given by the area under the effective utility curve shown by the upper envelope (dashed line) in figure 2 and equals:

(4) $W^C = \Omega + (p_s - p_{NL})^2 / 2\Theta$

where Ω is the area below the U_s curve.

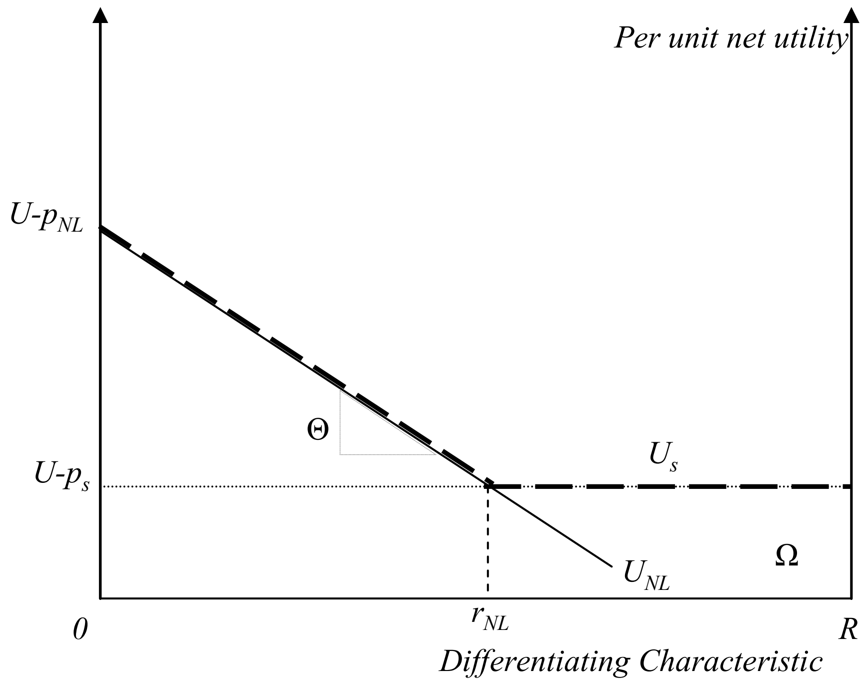

Figure 2. Consumer decisions and welfare before MCOOL

2. Producer behavior

Domestic producers choose whether to produce a unit of the AC under analysis or a unit of an alternative crop. Producers differ in the net returns they receive from the production of these crops due to differences in the agronomic characteristics of the land used in production (e.g. soil quality, humidity and location), their management skills, the adopted technology, etc. Let a, $a \in [0, A]$, be the parameter that captures producer heterogeneity. Producers are ordered according to their net returns from the production of the AC, from the most efficient producer ($a=0$), to the least efficient one ($a=A$). The net returns function of the producer with differentiating attribute a is:

(5) $\pi_{US} = p_{US}^f - (w_{US} + \delta a)$ if a unit of the AC is produced

$\pi_o = p_o^f - w_o$ if a unit of an alternative crop is produced

where p_{US}^f and p_o^f are the farm prices of the AC and the alternative crop, respectively; and w_{US} and w_o are the costs of producing the AC and alternative products that are constant across producers (such as the costs of seeds, fertilizers etc.). The parameter δ is a non-negative costenhancement factor and δa is the cost component that varies across producers and captures the degree of relative inefficiency of the producer with a>0 (i.e., the difference in production costs of AC between the producer with an a>0 and the most efficient producer with a=0). For simplicity of exposition, we assume a fixed proportions technology between the farm product and the final consumer product, and normalize the returns to the alternative crop to zero.

The producer with differentiating attribute a_{US}, where $a_{US} : \pi_{US} = \pi_o$, is indifferent between producing a unit of the AC and a unit of the alternative crop (see figure 3). Producers with differentiating attribute $a \in [0, a_{US})$ find it optimal to grow the AC, while producers with $a \in (a_{US}, A]$ grow the alternative product. The quantity of AC supplied domestically is:

(6) $$x_{US}^S = a_{US} = \frac{p_{US}^f - w_{US}}{\delta}$$

and the supply function of domestic AC can be written as:

(7) $$p_{US}^f\left(x_{US}^S\right) = w_{US} + \delta x_{US}^S$$

Aggregate producer welfare is given by the area under the effective net returns curve in figure 3 and equals:

(8) $$W^P = \frac{\left(p_{US}^f - w_{US}\right)^2}{2\delta}$$

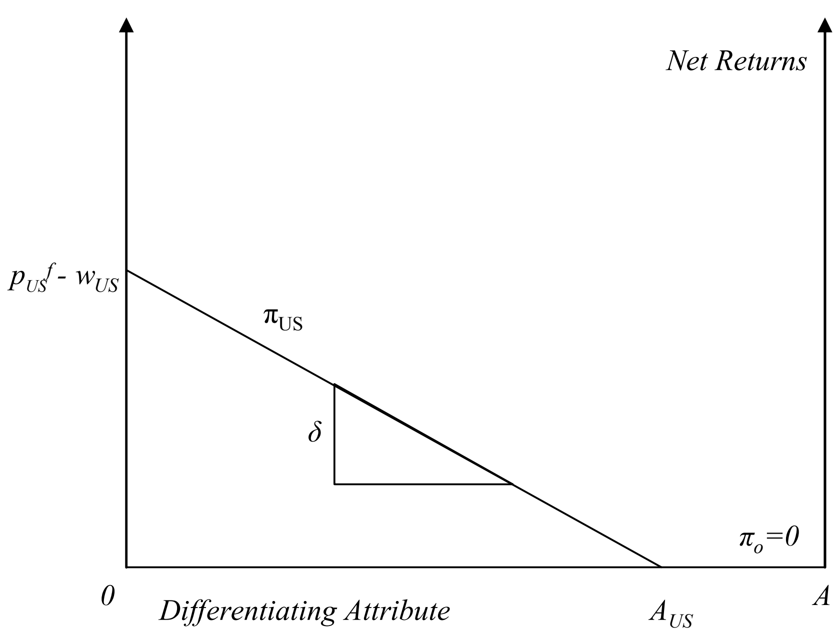

Figure 3. Producer decisions and welfare before MCOOL

3. Retailer behavior

Retailers buy AC from domestic producers and importers and sell them to consumers. In the absence of a segregation and labeling regime, domestic and imported ACs are marketed together. Let the quantity of imported AC be:

$$(9)\quad x_M^S = \frac{p_M^S - A}{b}$$

where p_M^S is the price paid by retailers for the imported AC, A is a shifter of the supply of AC from the "rest of the world" (ROW) (capturing production conditions in the ROW, costs of transportation, exchange rate effects, etc), and b is a slope parameter.

The supply function of imported AC is then:

$$(10)\quad p_M^S\left(x_M^S\right) = A + bx_M^S$$

and the total supply of unlabeled AC faced by retailers (i.e., the sum of the domestically grown and imported ACs), S_{NL}, is:

$$(11)\quad p_{NL}^S\left(x_{NL}^S\right) = \begin{cases} w_{US} + \delta x_{NL}^S & if\ A \geq p_{NL}^S \geq w_{US} \\ A + bx_{NL}^S & if\ A \leq p_{NL}^S \leq w_{US} \\ \dfrac{bw_{US} + \delta A + \delta b x_{NL}^S}{(\delta + b)} & if\ p_{NL}^S > \max\{A, w_{US}\} \end{cases}$$

To focus on the empirically relevant case when any unlabeled AC has a strictly positive probability of being of foreign origin, our analysis considers the case when $p_{NL}^S > \max\{A, w_{US}\}$, while, to capture potential retailer market power[6] when buying and selling AC (see Dimitri et al 2003), the problem of retailer *i* (*i=1, ..., N*) is expressed as:

$$(12)\quad \max_{x_{NLi}} \Pi_i = \left[p_{NL}\left(x_{NL}^D\right) - p_{NL}^S\left(x_{NL}^S\right) - IM\right] x_{NLi}$$

where *IM* represents the per unit marketing margin (capturing all costs incurred through the supply chain from the farm gate or the port of entry to the shelf). All other variables are as previously defined.

Using (3) and (11), the optimality condition is:

$$(13)\quad \frac{\partial \Pi_i}{\partial x_{NLi}} = 0 \Rightarrow \sum_i \frac{\partial \Pi_i}{\partial x_{NLi}} = 0 : p_{NL}\left(x_{NL}^D\right) - \Theta \theta_{NL}^D x_{NL}^D = p_{NL}^S\left(x_{NL}^S\right) + IM + \frac{\delta b \theta_{NL}^S}{(\delta + b)} x_{NL}^S$$

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[6] Sexton et al (2003) and Richards and Patterson (2003) find direct econometric evidence on the market power of retailers over suppliers for grapefruit, apples and lettuce; and over consumers for apples, oranges, grapefruit, fresh grapes, tomatoes and lettuce. Glaser et al (2001) find indirect evidence of the market power of retailers over bagged salad shippers in the form of slotting fees, and over lettuce shippers in the form of rebates and volume discounts.

where $\theta_{NL}^{S} = \frac{\partial x_{NL}^{S}}{\partial x_{NLi}} \frac{x_{NLi}}{x_{NL}^{S}}$ and $\theta_{NL}^{D} = \frac{\partial x_{NL}^{D}}{\partial x_{NLi}} \frac{x_{NLi}}{x_{NL}^{D}}$ represent, respectively, the conjectural variation elasticities on the supply and demand faced by retailer *i* (i.e., the firm's expectations on the percentage change of the aggregate quantities supplied and demanded caused by a percentage change in the quantities purchased and sold by it, respectively). The parameters θ_{NL}^{S} and θ_{NL}^{D} take values between zero and one with a higher value representing a higher degree of market power. It is important to note that this framework of analysis can capture cases where retailers have market power when buying and selling (oligemporism/monemporism), when retailers have market power only when selling (oligopoly/monopoly), when retailers have market power only when buying (oligopsony/monopsony), and when retailers do not have any market power.

The optimality condition (13) requires retailers to choose the level of output that equates their perceived marginal revenue (left term in (13), represented by MR in figure 4) with their perceived marginal outlay (right term in (13), represented by MO in figure 4). Aggregate retailer profits are obtained as the sum of the individual profits over all retailers, i.e.,

$$(14)\quad \Pi = \sum_{i=1}^{N} \Pi_i$$

4. Market Equilibrium

Figure 4 depicts the market equilibrium before the introduction of MCOOL. Based on the optimality condition in equation (13), the equilibrium quantity of non-labeled product is:

$$(15)\quad x_{NL}^{Eq.} = \frac{(\delta + b)(p_S - IM) - bw_{US} - \delta A}{\delta b(1 + \theta_{NL}^{S}) + \Theta(\delta + b)(1 + \theta_{NL}^{D})}$$

and it depends positively on the price of the substitute in consumption, and negatively on the cost of domestic and imported products, the marketing margin, the utility discount factor for the non-labeled product, and the market power of retailers in buying and selling.

The equilibrium consumer price of the non-labeled AC is derived from equations (3) and (15) as:

$$(16)\quad p_{NL}^{Eq.} = \frac{p_S\left[(\delta + b)\theta_{NL}^{D}\Theta + (1 + \theta_{NL}^{S})\delta b\right] + \Theta\left[bw_{US} + \delta A + (\delta + b)IM\right]}{\delta b(1 + \theta_{NL}^{S}) + \Theta(\delta + b)(1 + \theta_{NL}^{D})}$$

and depends positively on the price of the substitute in consumption, the cost of domestic and imported products, the marketing margin and the market power of retailers, and negatively on the utility discount factor associated with the consumption of the non-labeled AC.

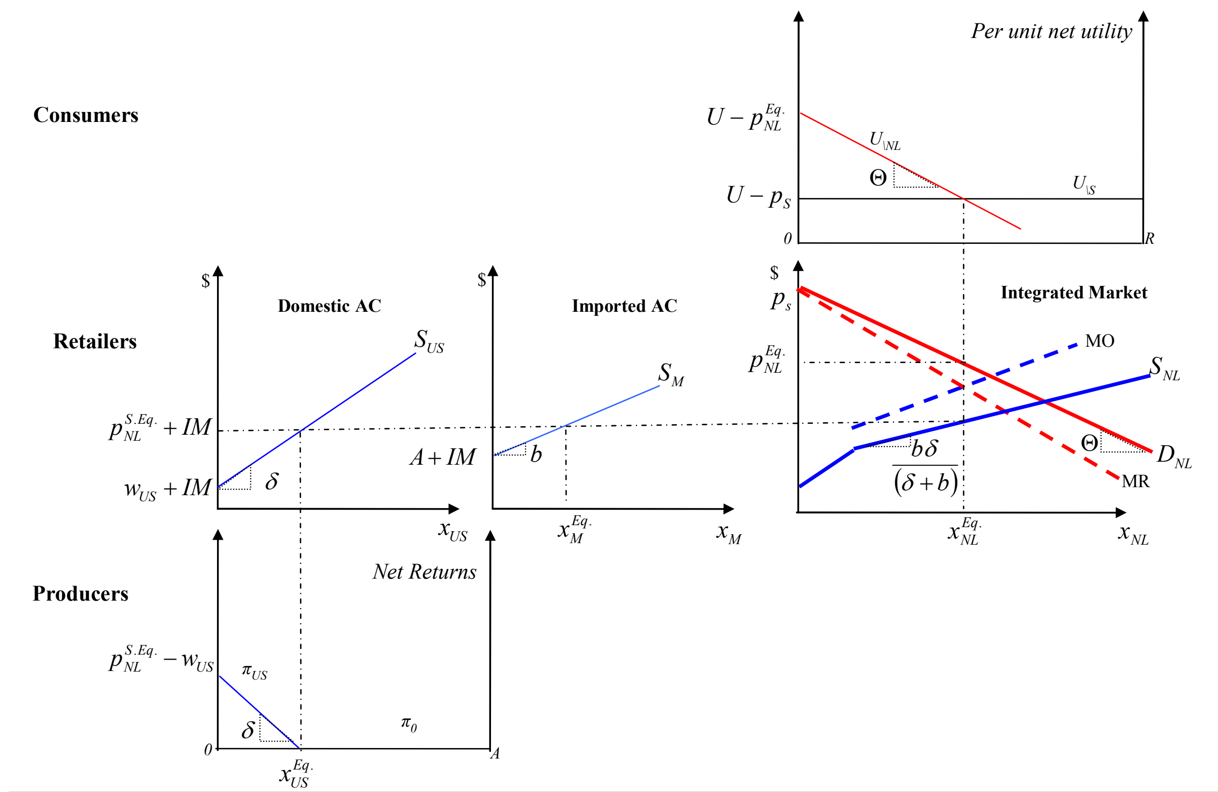

Figure 4. Market equilibrium before MCOOL

The equilibrium price paid by retailers to domestic producers and importers of the non-labeled AC is (using equations (11) and (15)):

$$(17)\quad p_{NL}^{S.Eq.} = \frac{\delta b(\delta + b)(p_S - IM) + (bw_{US} + \delta A)\left[\Theta(\delta + b)(1 + \theta_{NL}^D) + \delta b \theta_{NL}^S\right]}{\left[\delta b(1 + \theta_{NL}^S) + \Theta(\delta + b)(1 + \theta_{NL}^D)\right](b + \delta)}$$

and depends positively on the price of the substitute in consumption and the cost of domestic and imported products, and negatively on the marketing margin, the utility discount factor, and the market power of retailers when buying and selling.

The equilibrium quantity produced by domestic farmers is (using equations (6) and (16)):

$$(18)\quad x_{US}^{S.Eq.} = \frac{b(\delta + b)(p_S - IM - w_{US}) + \left[\Theta(\delta + b)(1 + \theta_{NL}^D) + \delta b \theta_{NL}^S\right](A - w_{US})}{\left[\delta b(1 + \theta_{NL}^S) + \Theta(\delta + b)(1 + \theta_{NL}^D)\right](b + \delta)}$$

and depends positively on the price of the substitute and the cost of imported products, and negatively on the cost of domestic products, the utility discount factor, and the marketing margin.

Finally, the equilibrium quantity of imported AC is obtained from equations (10) and (17) as:

$$(19)\quad x_M^{S.Eq.} = \frac{\delta(\delta + b)(p_S - IM - A) - \left[\Theta(\delta + b)(1 + \theta_{NL}^D) + \delta b \theta_{NL}^S\right](A - w_{US})}{\left[\delta b(1 + \theta_{NL}^S) + \Theta(\delta + b)(1 + \theta_{NL}^D)\right](b + \delta)}$$

and depends positively on the price of the substitute and the cost of the domestic product, and negatively on the marketing margin, the utility discount factor and the cost of imported products.

5. Welfare Analysis

The expression for aggregate consumer welfare is obtained by substituting the equilibrium consumer price for the unlabeled AC (given by equation (16)) in equation (4):

$$(20)\quad W^C = \frac{\Theta\left[b\left(p_S - IM - w_{US}\right) + \delta\left(p_S - IM - A\right)\right]^2}{2\left[\delta b\left(1+\theta_{NL}^S\right) + \Theta(\delta + b)\left(1+\theta_{NL}^D\right)\right]^2} + \Omega$$

and it depends positively on the price of the substitute in consumption, and negatively on the marketing margin, the cost of domestic and imported products, the market power of retailers when buying and selling, and the utility discount factor for the unlabeled AC.[7]

The expression for aggregate producer welfare is obtained from equations (8) and (17) as:

$$(21)\quad W^P = \frac{\delta\left\{b(b+\delta)\left(p_S - IM - w_{US}\right) + \left(A - w_{US}\right)\left[\Theta(b+\delta)\left(1+\theta_{NL}^D\right) + \delta b\theta_{NL}^S\right]\right\}^2}{2\left\{\left[\delta b\left(1+\theta_{NL}^S\right) + \Theta(\delta+b)\left(1+\theta_{NL}^D\right)\right](b+\delta)\right\}^2}$$

and it depends positively on the price of the substitute in consumption and the cost of the imported product, and negatively on the marketing margin, the cost of the domestic product, the utility discount factor,[8] and the market power of retailers when buying and selling.

Finally, the expression for aggregate retailer profits is obtained from equations (12), (14), (16) and (17) as:

$$(22)\quad \Pi = \frac{\left\{\begin{matrix}\left(p_S - IM - w_{US}\right)\left[\Theta b(b+\delta)\theta_{NL}^D + \delta b^2\theta_{NL}^S\right] \\ +\left(p_S - IM - A\right)\left[\Theta\delta(b+\delta)\theta_{NL}^D + \delta^2 b\theta_{NL}^S\right]\end{matrix}\right\}\left\{\begin{matrix}b\left(p_S - IM - w_{US}\right) \\ +\delta\left(p_S - IM - A\right)\end{matrix}\right\}}{\left[\delta b\left(1+\theta_{NL}^S\right) + \Theta(\delta+b)\left(1+\theta_{NL}^D\right)\right]^2(b+\delta)}$$

and it depends positively on the price of the substitute in consumption and the market power when buying and selling, and negatively on the marketing margin, the cost of domestic and imported products, and the utility discount factor.[9]

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[7] A necessary condition for $\partial W^C / \partial\Theta < 0$ is that $\delta b\left(1+\theta_{NL}^S\right) < \Theta(\delta+b)\left(1+\theta_{NL}^D\right)$; i.e., the direct reduction in utility after an increase in Θ is not offset by a decrease in the consumer price.

[8] A necessary condition for $\partial W^P / \partial\Theta < 0$ is that $\left(p_s - IM - w_{US}\right)(\delta+b)b > \left(w_{US} - A\right)\left[\Theta(\delta+b)\left(1+\theta_{NL}^D\right) + \delta b\theta_{NL}^S\right]$, while a sufficient condition is $A > w_{US}$.

[9] A necessary condition for $\partial\Pi^P / \partial\Theta < 0$ is that $\theta_{NL}^D\left(1+\theta_{NL}^D\right)(\delta+b)\Theta + 2\delta b\theta_{NL}^S > \delta b\theta_{NL}^D\left(1-\theta_{NL}^S\right)$, while a sufficient condition is $2\theta_{NL}^S > \theta_{NL}^D\left(1-\theta_{NL}^S\right)$.

B. Post-MCOOL

After the implementation of the COOL regulation, retailers are required to inform consumers about the origin of the AC, allowing them to distinguish between domestic and imported ACs and make an informed consumption decision (utility effect). To comply with the regulation, all those involved in supplying a covered commodity to a retailer (e.g., producers, distributors, handlers, etc.) will be required to maintain records identifying the immediate previous source and immediate subsequent recipient of a covered commodity (Federal Register 2003, p. 61951). Thus, COOL implementation is expected to result in extra recordkeeping costs for both producers and retailers of the regulated AC (cost effect). Following the structure of the previous section, we start by analyzing the behavior of consumers, producers and retailers and then we proceed to determining the equilibrium prices, quantities and welfare of these groups under MCOOL. Comparing these equilibrium conditions to those prior to the introduction of MCOOL (derived in Section III.A) enables us to determine the market and welfare effects of the introduction of MCOOL.

1. Consumer behavior

Under COOL consumers have the choice between the labeled domestic AC, the labeled imported AC, and the substitute product. The utility function of the consumer with differentiating attribute *r* becomes:

(23) $U_{US} = U - \mu r - p_{US}$ if a unit of the labeled domestic AC is consumed

$U_M = U - \lambda r - p_M$ if a unit of the labeled imported AC is consumed

$U_s = U - p_s$ if a unit of a substitute product is consumed

where p_{US} and p_M are the unit consumer prices of labeled domestic and imported products, respectively, and λ and μ are non-negative utility discount factors associated with the consumption of domestic and imported products, respectively. To capture the potential consumer preference for domestic products,[10] it is assumed that $\lambda > \mu$ with the difference $\gamma = \lambda - \mu$ reflecting the strength of consumer preference for domestic products – i.e., the greater is γr, the stronger is

[10] Mabiso et al (2005) conducted an experimental auction in Georgia, Florida and Michigan to elicit WTP for US origin labeling in apples and tomatoes and found that consumers were willing to pay about 49 cents per pound of produce for country of origin labeling. Umberger et al. (2003a) found that 73% of survey participants in Denver and Chicago were willing to pay premiums of 11% or more for steak and 24% or more for ground beef when those were labeled as beef of US origin.

the preference for domestic products of the consumer with differentiating attribute r.[11] This formulation of the utility function captures the notion of vertical product differentiation (Mussa and Rosen 1978), according to which if both imported and domestic products were offered at the same price, all consumers would choose the domestic AC. To capture the empirically relevant case where these products co-exist in the market under MCOOL, we focus our analysis on the case where $p_{US} > p_M$.

The consumer with differentiating characteristic $r_M : U_M = U_{US}$ is indifferent between consuming a unit of the imported and a unit of the domestic product (see figure 5). Similarly, the consumer with characteristic $r_{US} : U_{US} = U_s$ is indifferent between consuming a unit of the domestic product and a unit of the substitute product. The quantities demanded of labeled imported and domestic products are, respectively:

(24) $$x_M^D = r_M = \frac{p_{US} - p_M}{\gamma}$$

(25) $$x_{US}^D = r_{US} - r_M = \frac{\gamma(p_S - p_{US}) - \mu(p_{US} - p_M)}{\mu\gamma}$$

An increase in the price for the labeled domestic (imported) product reduces its demand and increases the demand for the labeled imported (domestic) product. An increase in consumer preference for the domestic products (due to a decrease in μ or/and an increase in λ) reduces the demand for the imported product and increases the demand for the domestic product.

The inverse demands for the two products under MCOOL are:

(26) $$p_M\left(x_M^D, x_{US}^D\right) = p_S - \lambda x_M^D - \mu x_{US}^D$$

(27) $$p_{US}\left(x_M^D, x_{US}^D\right) = p_S - \mu\left(x_{US}^D + x_M^D\right)$$

and aggregate consumer welfare is given by the area under the effective utility curve in figure 5 as:

(28) $$W_{COOL}^C = \frac{\left(p_{US} - p_M\right)^2}{2\gamma} + \frac{\left(p_S - p_{US}\right)^2}{2\mu} + \Omega$$

[11] Note that if γ=0 consumers would be indifferent between the domestic and the imported products (they would view them as perfect substitutes) and the cheapest version of the product would dominate the market under MCOOL. Note also that this formulation can easily be adapted to cases where the imported product is preferred over the domestic product.

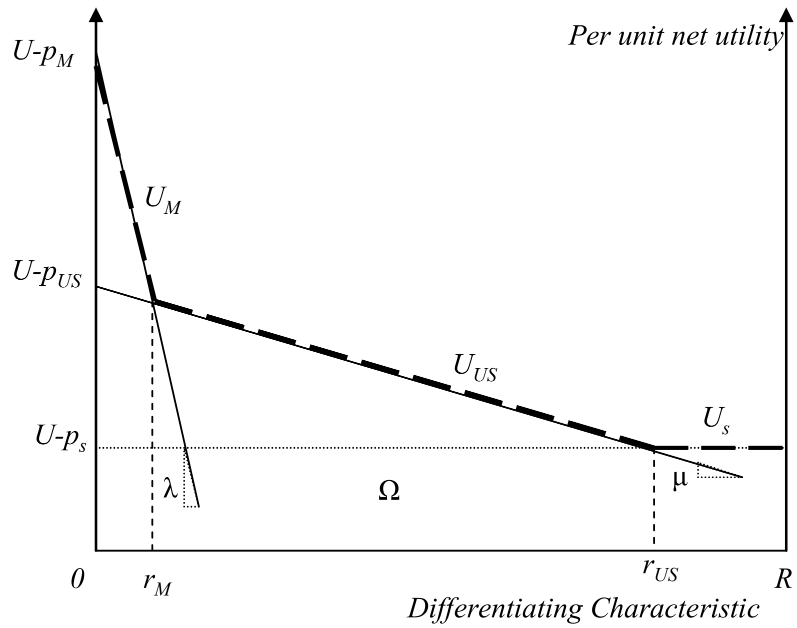

Figure 5. Consumer decisions and welfare under MCOOL

2. Producer behavior

As mentioned previously, in the presence of MCOOL producers need to maintain a recordkeeping system to provide credible information to retailers about the origin of the AC.[12] The marginal cost of recordkeeping is modeled as a constant *J.*[13] The quantity supplied of domestic AC is then:

(29) $$x_{US}^{S} = \frac{p'^{f}_{US} - w_{US} - J}{\delta}$$

The supply function of the domestic AC is:

(30) $$p'^{f}_{US}\left(x_{US}^{S}\right) = w_{US} + J + \delta x_{US}^{S}$$

and producer welfare becomes:

(31) $$W_{COOL}^{P} = \frac{\left(p'^{f}_{US} - w_{US} - J\right)^2}{2\delta}$$

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[12] The Sparks Companies Inc. (2003) study reports an estimated $20 million cost of labeling for fruit and vegetable producers, implying 0.03 cents/Lb or 1.6 cents/40Lbs. container (obtained by dividing $20 million by the 60 billion pounds of fruit and vegetable produced on a farm weight basis). Similarly, USDA reports an estimated labeling cost for fruits and vegetables of 0.025 cents/Lb or 1 cent/container (Federal Register 2003, p. 61966). The Food Marketing Institute estimates that the cost of compliance to fruit and vegetable suppliers would total $1.3 billion annually (Food Marketing Institute 2001).

[13] We assume that all domestic producers adopt the technology required to keep credible records. This is a reasonable assumption when producers are risk averse and want to maintain the option of selling their product to retailers and food companies.

3. Retailer behavior

Under COOL, retailers face increased costs of segregation and labeling of the AC.[14] This extra cost is denoted by *K* and the problem of retailer *i* becomes:

$$(32)\qquad \max_{x_{USi},x_{Mi}} \Pi_i^{COOL} = \left[p_{US}\left(x_{US}^D, x_M^D\right) - p'^{f}_{US}\left(x_{US}^S\right) - IM - K\right]x_{USi} + \left[p_M\left(x_{US}^D, x_M^D\right) - p_M^S\left(x_M^S\right) - IM - K\right]x_{Mi}$$

where all variables are as previously defined. Note that, since under the legislation that predated COOL imported food items must enter the US with some form of origin information,[15] importers will not incur additional labeling costs due to the COOL regulation.[16] Therefore, the supply of imported AC is given by equation (10).

The first order conditions to the retailer problem are:

$$(33)\quad \frac{\partial \Pi_i}{\partial x_{USi}} = 0 \Rightarrow \sum_{i=1}^{N} \frac{\partial \Pi_i}{\partial x_{USi}} = 0 : p_{US}\left(x_{US}^D, x_M^D\right) - \mu\theta_{US}^D\left(x_{US}^D + x_M^D\right) = p'^{f}_{US}\left(x_{US}^S\right) + IM + K + \delta\theta_{US}^S x_{US}^S$$

$$(34)\quad \frac{\partial \Pi_i}{\partial x_{Mi}} = 0 \Rightarrow \sum_{i=1}^{N} \frac{\partial \Pi_i}{\partial x_{Mi}} = 0 : p_M^D\left(x_{US}^D, x_M^D\right) - \theta_M^D\left(\mu x_{US}^D + \lambda x_M^D\right) = p_M^S\left(x_M^S\right) + IM + K + b\theta_M^S x_M^S$$

The optimality conditions for an interior solution require retailers to equate marginal outlays (RHS of equations (33) and (34)) with their perceived marginal revenues (LHS of these equations) in each market. Of course, if, in the unconstrained optimum, the perceived marginal revenue is lower than the marginal outlay in any market, then the Kuhn-Tucker conditions require the quantity of that product sold by retailers to be zero. It is important to note that, due to our assumptions that $\gamma>0$ and $p_{US} > p_M$, a scenario where imports are driven out of the market

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[14] The Sparks Companies Inc. (2003) study reports an estimated $1,534 to $3,034 million cost of labeling for processors, wholesalers, and retailers, equivalently to 2.56 to 5.06 cents/Lb on farm weight equivalent for fruits and vegetables (Calculated as the sum of the labeling costs for processors/wholesalers and for retailers, divided by the weight of fruits and vegetables on farm equivalent units). USDA estimates the incremental costs for intermediaries and retailers to amount to 2 cents/Lb (Federal Register 2003).

[15] Currently, mandatory COOL is already in place for many imported food items (Tariff Act of 1930 as amended, the Federal Meat Inspection Act as amended, and other related legislation), although not necessarily at the retail level. Effective legislation requires most imports to bear labels informing the "ultimate purchaser" of their country of origin. Ultimate purchaser has been defined by the US Bureau of Customs and Border Protection as the last US person who will receive the article in the form in which it was imported. The law requires that containers holding imported fresh fruit and vegetables must be labeled with country-of-origin information when entering the US. If produce in the container is packed in consumer-ready packing and sold to the consumer (e.g., grapes in bags), then that item must already be labeled as well. On the other hand, a retailer may take loose product out of a labeled container and display it in an open bin, selling each individual piece of produce with no origin information. Until mandatory COOL takes effect, the bin need not be labeled under current federal law. If the food is destined for a US processor or manufacturer where it will undergo "substantial transformation," that processor or manufacturer is considered the ultimate purchaser. As a result, imported orange juice concentrate, meat and other items have not been required to carry a country-of-origin mark after slaughter, cutting, or processing in the US (Federal Register 2003, p. 61948).

[16] Although USDA recognizes this fact (Federal Register 2003, p. 61970), the CGE model assumes labeling costs at the farm level are the same as those faced by the importer of agricultural commodities.

(i.e., $x_M^{Eq.}=0$ and $x_{US}^{Eq.}=\left[p_S-\left(w_{US}+J+IM+K\right)\right]/\left[\delta\left(1+\theta_{US}^S\right)+\mu\left(1+\theta_{US}^D\right)\right]$) is not possible. However, under those assumptions, a scenario where all consumers buy imported products (i.e., $x_{US}^{Eq.}=0$ and $x_M^{Eq.}=\left[p_S-\left(A+IM+K\right)\right]/\left[b\left(1+\theta_M^S\right)+\lambda\left(1+\theta_M^D\right)\right]$) *is* possible though not very likely.

4. Market equilibrium under MCOOL

Figure 6 depicts the market equilibrium under MCOOL when both products co-exist in the market. From equations (33) and (34), we can derive the equilibrium quantities of domestic and imported products as:[17]

$$(35)\quad x_{US}^{Eq.}=\frac{\left\langle\begin{array}{l}\left(p_S-IM-K\right)\left[b\left(1+\theta_M^S\right)+\lambda\left(1+\theta_M^D\right)-\mu\left(1+\theta_{US}^D\right)\right]+\mu\left(1+\theta_{US}^D\right)A\\-\left(w_{US}+J\right)\left[b\left(1+\theta_M^S\right)+\lambda\left(1+\theta_M^D\right)\right]\end{array}\right\rangle}{\delta\left(1+\theta_{US}^S\right)\left[b\left(1+\theta_M^S\right)+\lambda\left(1+\theta_M^D\right)\right]+\mu\left(1+\theta_{US}^D\right)\left[b\left(1+\theta_M^S\right)+\gamma\left(1+\theta_M^D\right)\right]}$$

$$(36)\quad x_M^{Eq.}=\frac{\left\langle\begin{array}{l}\left(p_S-IM-K\right)\left[\delta\left(1+\theta_{US}^S\right)+\mu\left(\theta_{US}^D-\theta_M^D\right)\right]+\mu\left(1+\theta_M^D\right)\left(w_{US}+J\right)\\-\left[\delta\left(1+\theta_{US}^S\right)+\mu\left(1+\theta_{US}^D\right)\right]A\end{array}\right\rangle}{\delta\left(1+\theta_{US}^S\right)\left[b\left(1+\theta_M^S\right)+\lambda\left(1+\theta_M^D\right)\right]+\mu\left(1+\theta_{US}^D\right)\left[b\left(1+\theta_M^S\right)+\gamma\left(1+\theta_M^D\right)\right]}$$

The total size of the market for the AC is then:

$$(37)\quad x_{Total}^{Eq.}=x_M^{Eq.}+x_{US}^{Eq.}=\frac{\left\langle\begin{array}{l}\left[p_S-\left(w_{US}+J+IM+K\right)\right]\left[b\left(1+\theta_M^S\right)+\gamma\left(1+\theta_M^D\right)\right]\\+\delta\left(1+\theta_{US}^S\right)\left[p_S-\left(A+IM+K\right)\right]\end{array}\right\rangle}{\delta\left(1+\theta_{US}^S\right)\left[b\left(1+\theta_M^S\right)+\lambda\left(1+\theta_M^D\right)\right]+\mu\left(1+\theta_{US}^D\right)\left[b\left(1+\theta_M^S\right)+\gamma\left(1+\theta_M^D\right)\right]}$$

Both equilibrium quantities depend positively on the price of the substitute in consumption, and negatively on the marketing margin and the cost of labeling for retailers. The equilibrium quantity of domestic (imported) AC decreases (increases) with its cost of production and the labeling cost at the farm level, and increases (decreases) with the cost of the imported product. An increase in the market power of retailers in one market (when buying and/or selling) reduces the equilibrium quantity in that market, and increases the equilibrium quantity in the other market, resulting in a reduction in the total quantity of the product traded in equilibrium. An exogenous increase in the preference for domestic products (via a decrease in μ) increases the equilibrium quantity of domestic product,[18] reduces the equilibrium quantity of its imported

[17] The interior solution requires the following two conditions to hold simultaneously: $\left(p_S-IM-K-w_{US}-J\right)\left[b\left(1+\theta_M^S\right)+\lambda\left(1+\theta_M^D\right)\right]>\left(p_S-IM-K-A\right)\mu\left(1+\theta_{US}^D\right)$ and $\left(p_S-IM-K-A\right)\left[\delta\left(1+\theta_{US}^S\right)+\mu\theta_{US}^D\right]>\left(p_S-IM-K-w_{US}-J\right)\mu\theta_M^D+\mu\left(A-w_{US}-J\right)$.

[18] A necessary condition for $\partial x_{US}^{Eq}/\partial\mu<0$ is that $\left(p_s-IM-K-A\right)+x_{US}^{Eq.}\left[b\left(1+\theta_M^S\right)+\left(\lambda-2\mu\right)\left(1+\theta_M^D\right)\right]>0$. A sufficient condition is that $\left[b\left(1+\theta_M^S\right)+\left(\lambda-2\mu\right)\left(1+\theta_M^D\right)\right]>0$.

counterpart,[19] and increases the total size of the market for the agricultural product.

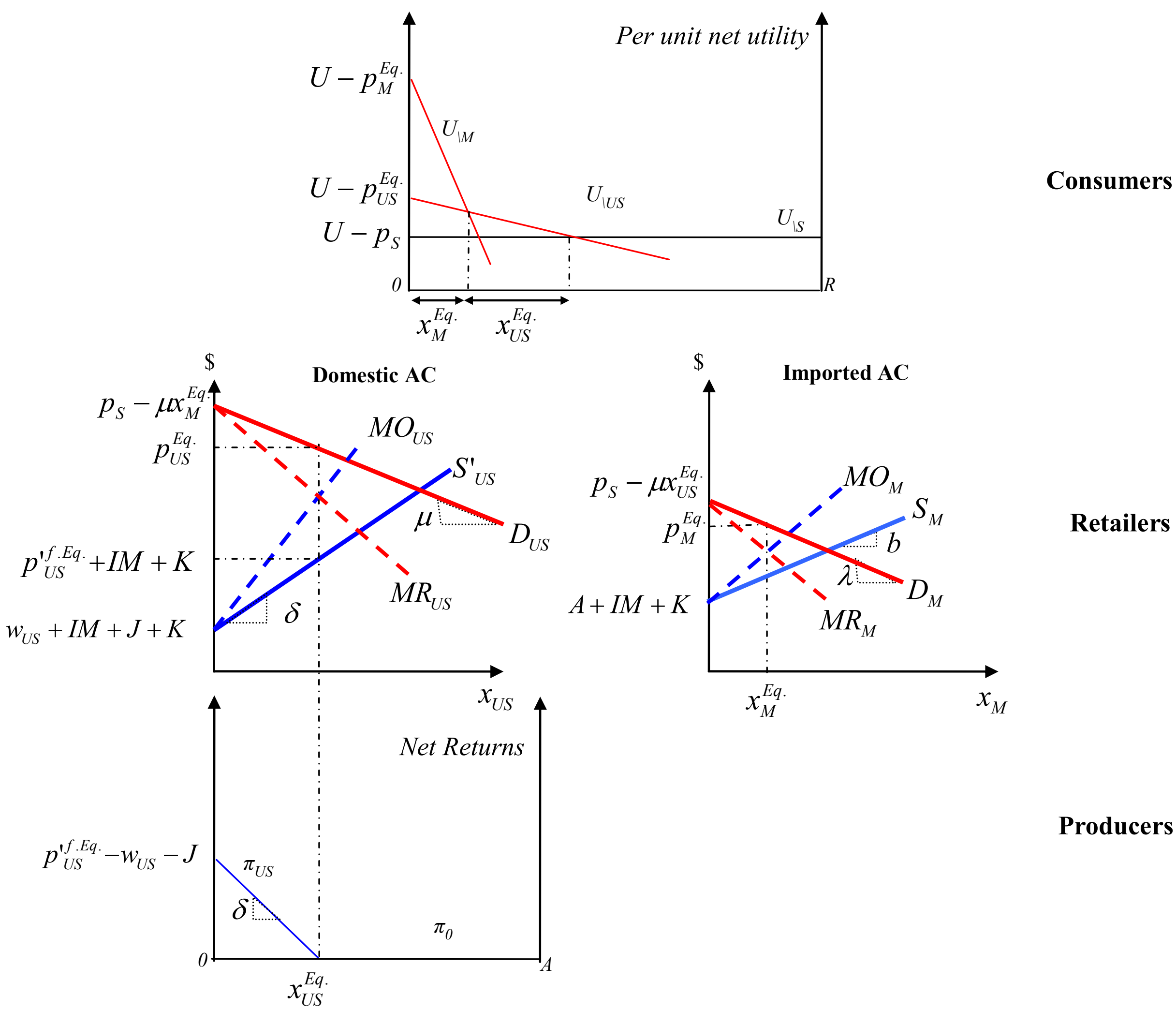

Figure 6. Market equilibrium under MCOOL

The equilibrium consumer prices for the domestic and the imported ACs are, respectively (using equations (26), (27), (35) and (36)):

$$(38)\quad p_{US}^{Eq.} = \frac{\left\langle \begin{array}{l} p_S\{b(1+\theta_M^S)[\mu\theta_{US}^D + \delta(1+\theta_{US}^S)] + (1+\theta_M^D)[\mu\gamma\theta_{US}^D + \delta\lambda(1+\theta_{US}^S)]\} \\ + \mu[b(1+\theta_M^S) + \gamma(1+\theta_M^D)](IM + K + w_{US} + J) \\ - \delta\mu(1+\theta_{US}^S)(p_S - IM - K - A) \end{array} \right\rangle}{\delta(1+\theta_{US}^S)[b(1+\theta_M^S) + \lambda(1+\theta_M^D)] + \mu(1+\theta_{US}^D)[b(1+\theta_M^S) + \gamma(1+\theta_M^D)]}$$

[19] A necessary condition for $\partial x_M^{Eq} / \partial \mu > 0$ is that $(\theta_{US}^D - \theta_M^D)(p_s - IM - K) + (1+\theta_M^D)(w_{US} + J) - (1+\theta_{US}^D)A > x_M^{Eq.}[b(1+\theta_M^S) + (\lambda - 2\mu)(1+\theta_M^D)]$, which tends to hold at low levels of γ, i.e. when $(\lambda - 2\mu) < 0$.

$$(39)\quad p_M^{Eq.} = \frac{\left\langle \begin{array}{l} b\left(1+\theta_M^S\right)\left\{\left[\delta\left(1+\theta_{US}^S\right)+\mu\theta_{US}^D\right]p_S+\mu\left(w_{US}+IM+K+J\right)\right\} \\ +\left[\delta\lambda\left(1+\theta_{US}^S\right)+\mu\gamma\left(1+\theta_{US}^D\right)\right]\left(\theta_M^D p_S+A+IM+K\right) \end{array}\right\rangle}{\delta\left(1+\theta_{US}^S\right)\left[b\left(1+\theta_M^S\right)+\lambda\left(1+\theta_M^D\right)\right]+\mu\left(1+\theta_{US}^D\right)\left[b\left(1+\theta_M^S\right)+\gamma\left(1+\theta_M^D\right)\right]}$$

and they depend positively on the price of the substitute in consumption, the marketing costs, the cost of the imported and domestic products, the labeling costs at the farm and retail levels, and the market power of retailers when buying and selling. The final price for the domestic product depends positively on the consumer preference for domestic products (see footnote **Error! Bookmark not defined.**) while

the final price for the imported product depends negatively on it (see footnote **Error! Bookmark not defined.**).

The equilibrium price received by US farmers is obtained from equations (30) and (35) as:

$$(40)\quad p_{US}^{'f.Eq.} = \frac{\left\langle \begin{array}{l} \delta\left[b\left(1+\theta_M^S\right)+\lambda\left(1+\theta_M^D\right)-\mu\left(1+\theta_{US}^D\right)\right]\left(p_S-K-IM\right)+\mu\delta\left(1+\theta_{US}^D\right)A \\ +\left\{b\left(1+\theta_M^S\right)\left[\delta\theta_{US}^S+\mu\left(1+\theta_{US}^D\right)\right]+\left(1+\theta_M^D\right)\left[\lambda\delta\theta_{US}^S+\gamma\mu\left(1+\theta_{US}^D\right)\right]\right\}\left(w_{US}+J\right) \end{array}\right\rangle}{\delta\left(1+\theta_{US}^S\right)\left[b\left(1+\theta_M^S\right)+\lambda\left(1+\theta_M^D\right)\right]+\mu\left(1+\theta_{US}^D\right)\left[b\left(1+\theta_M^S\right)+\gamma\left(1+\theta_M^D\right)\right]}$$

and depends positively on the price for the substitute in consumption,[20] the consumer preference for the domestic product, the cost of the domestic and imported products, the labeling costs at the farm level, and the market power of retailers when buying and selling the imported product, and negatively on the marketing margin and the labeling cost at the retail level (see footnote 20), and the market power of retailers when buying and selling the domestic product.

Finally, the price paid by retailers for imported AC is (from equations (10) and (36)):

$$(41)\quad p_M^{S.Eq.} = \frac{\left\langle \begin{array}{l} b\left[\delta\left(1+\theta_{US}^S\right)+\mu\left(\theta_{US}^D-\theta_M^D\right)\right]\left(p_S-K-IM\right)+\mu b\left(1+\theta_M^D\right)\left(w_{US}+J\right) \\ +\left\{b\theta_M^S\left[\delta\left(1+\theta_{US}^S\right)+\mu\left(1+\theta_{US}^D\right)\right]+\left(1+\theta_M^D\right)\left[\lambda\delta\left(1+\theta_{US}^S\right)+\gamma\mu\left(1+\theta_{US}^D\right)\right]\right\}A \end{array}\right\rangle}{\delta\left(1+\theta_{US}^S\right)\left[b\left(1+\theta_M^S\right)+\lambda\left(1+\theta_M^D\right)\right]+\mu\left(1+\theta_{US}^D\right)\left[b\left(1+\theta_M^S\right)+\gamma\left(1+\theta_M^D\right)\right]}$$

and depends positively on the price of the substitute in consumption,[21] the cost of production of the imported and the domestic products, the labeling costs at the farm level, and the market power of retailers when buying and selling the domestic AC, and negatively on the consumer preference for the domestic product (see footnote **Error! Bookmark not defined.**) the

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[20] A necessary condition for $\partial p_{US}^{'f.Eq.}/\partial(p_S-K-IM)>0$ is that $b\left(1+\theta_M^S\right)+\lambda\left(1+\theta_M^D\right)>\mu\left(1+\theta_{US}^D\right)$, while a sufficient condition is that $\lambda\theta_M^D\geq\mu\theta_{US}^D$.

[21] A necessary condition for $\partial p_M^{S.Eq.}/\partial(p_S-K-IM)>0$ is that $\delta\left(1+\theta_{US}^S\right)>\mu\left(\theta_M^D-\theta_{US}^D\right)$, while a sufficient condition is that $\theta_M^D\leq\theta_{US}^D$.

marketing margin and the labeling cost at the retail level (see footnote 21), and the market power of retailers when buying and selling the imported AC.

5. Welfare under MCOOL

The above expressions can be used to derive the welfare of producers, consumers and retailers under MCOOL and determine the effect of exogenous parameters on the welfare of these groups. The analysis focuses on the three key demand and supply side parameters – the consumer preference for domestic products (γ) and the costs of COOL for domestic producers (*J*) and retailers (*K*). Table 2 summarizes the effect of these parameters on consumer and producer welfare and retailer profits when both domestic and imported products are traded domestically.

Table 2. Selected Comparative Static Results under MCOOL

Endogenous Variable	Exogenous Variable		
	γ	J	K
W^{C}_{COOL}	+	-	-
W^{P}_{COOL}	+	-	-
Π^{COOL}	+	-	-

Note: Table entries indicate the direction of the change that occurs in the endogenous variable for a change in the exogenous variable. Welfare results are derived via numerical simulation.

Consistent with *a priori* expectations, a stronger consumer preference for domestic products (i.e., higher γ) leads to lower retail and input prices for the imported product, higher retail and farm prices for the domestic product, an increase in the share of US grown products and an increase in the overall size of the market for the agricultural product. In terms of welfare, the greater is the consumer preference for domestic products the greater is the consumer welfare,[22] the producer welfare and the retailer profits under MCOOL.

Higher costs of compliance with COOL regulation (*J*, *K*) result in higher final prices charged to consumers, a smaller market for the AC, and reduced welfare for all interest groups involved. Higher recordkeeping costs at the farm level (*J*) increase the farm price and reduce the equilibrium quantity of domestic products. Since importers are already required by current

[22] This result applies for reasonable values of the consumer preference for domestic products. When the value of the utility discount factor for imported products is several times the value of the utility discount factor for the domestic product (and γ is very high), then an exogenous increase in the consumer preference for domestic products can generate an increase in the retail price of domestic products that offsets the increased consumer WTP for them. In such a case, the equilibrium quantity of domestic products falls and so do and consumer welfare and retailer profits.

legislation to keep records of origin, *J* does not apply to imported products, and a higher *J* results in a cheaper imported product (relative to the domestic product). Therefore, the market share of imported products increases with *J*. Higher recordkeeping costs at retail level, *K*, are associated with lower quantities of both products and lower prices paid to their suppliers. Note that *K* affects both types of products.

C. Market and welfare effects of MCOOL introduction

The change in consumer welfare after MCOOL introduction is the outcome of two opposite effects: a utility effect and a price effect. As mentioned previously, while in the pre-COOL situation consumers are uncertain about the type (origin) of the unlabeled AC, after the implementation of COOL consumers are able to assess the origin of the product and make informed consumption decisions. The utility effect consists of a reduction in the WTP for the imported product and an increase in the WTP for the domestic product (relative to the WTP for the non-labeled product) after the introduction of COOL (i.e., $\mu < \Theta < \lambda$). The price effect consists of the change in the price of the imported and domestic products in the post-MCOOL scenario relative to the price of the unlabeled product in the pre-MCOOL scenario.

Figure 7 illustrates the interaction of these price and utility effects on consumer welfare. Consumers with weak preference for domestic products (i.e., those with a low γr) are better off after COOL introduction since the reduction in the price of the imported product (relative to the price of the non-labeled product) is greater than the decrease in the WTP for the imported product (relative to the WTP for the unlabeled product). The welfare gains of consumers with weak preference for domestic food is given by area $\overset{\Delta}{abc}$. Consumers with a strong preference for domestic products are also better off after MCOOL introduction, since the increase in the price of the domestic product (relative to the price of the unlabeled product) is smaller than the increase in the WTP for the domestic product (relative to the WTP for the unlabeled product). The welfare gains of consumers with a strong preference for domestic products is given by area $\overset{\Delta}{fgh}$.

Consumers with moderate preference for domestic products lose after the introduction of COOL and their losses are given by area $\overset{\Delta}{cdf}$ in figure 7. From this total area, the part $\overset{\Delta}{cde}$ represents losses to consumers that consume the imported product after the introduction of COOL and whose benefits from the reduced price of the imported product are outweighed by the reduced utility associated with the consumption of the labeled imported product. The rest of the losses (i.e., area $\overset{\Delta}{edf}$) are incurred by consumers of the labeled domestic product whose benefits from the increased utility of the labeled domestic product are outweighed by the welfare losses from the increased price of the domestic product under COOL. The change in aggregate consumer welfare from the introduction of COOL is then given by $\overset{\Delta}{abc} + \overset{\Delta}{fgh} - \overset{\Delta}{cdf}$.

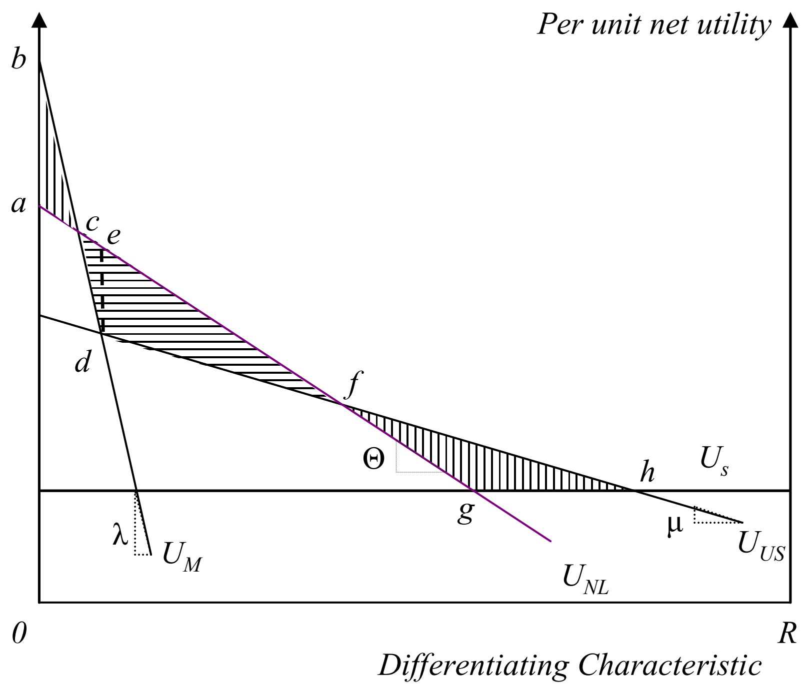

Figure 7. Consumer welfare change after MCOOL introduction

Similar to consumers, producers of the AC are also affected from the introduction of MCOOL. The change in producer welfare is also the result of two effects, namely a cost effect (*J*) and a price effect ($p'^{f.Eq}_{US} - p^{f.Eq}_{NL}$). A necessary and sufficient condition for producers to gain from MCOOL introduction is that the farm price increase exceeds the increase in labeling costs. In addition to all farmers of the regulated AC realizing a welfare increase, when the increase in the farm price exceeds the costs of COOL, at least some producers of the alternative crop (those located between $x^{Eq}_{US,NL}$ and x^{Eq}_{US} in figure 8, panel a) find it optimal to switch their production and enter the market of the AC. The increase in the size of the market for AC is given by $x^{Eq}_{US} - x^{Eq}_{US,NL}$ in figure 8, panel a. If, on the other hand, the increase in the farm price due to MCOOL is less than the farm costs of this labeling regime, the net returns to the production of the AC fall and some producers of the AC (those located between x_{US}^{Eq} and $x_{US,NL}^{Eq}$ in figure 8, panel b) will find it optimal to exit the market and switch their production to alternative crops.

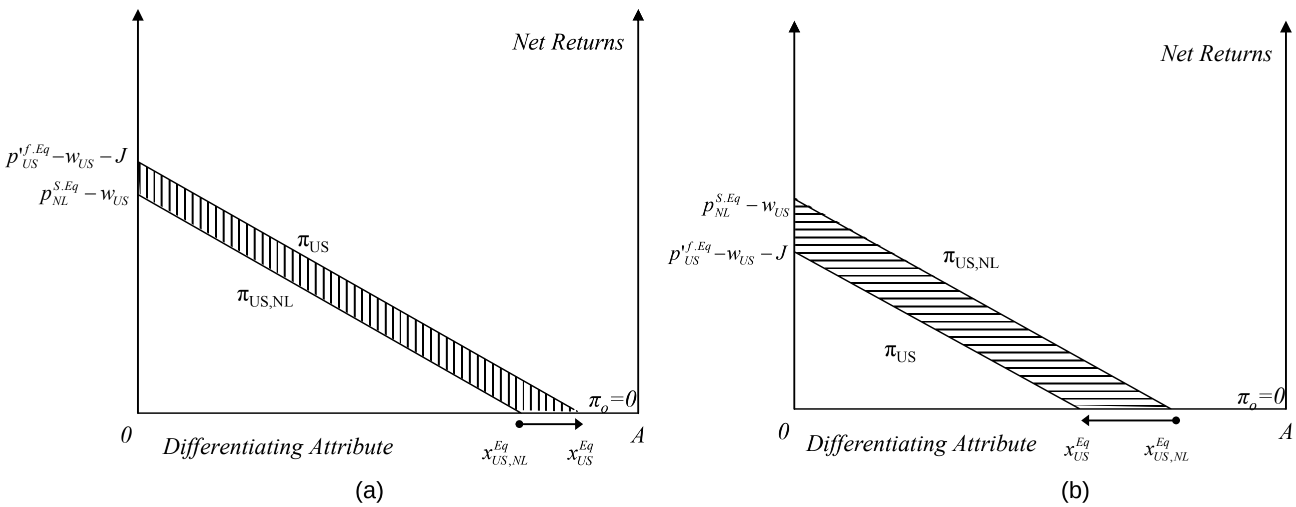

Figure 8. Change in producer welfare after MCOOL introduction. Panel (a): welfare increases and entry occurs. Panel (b): welfare decreases and exit occurs.

Figure 9 depicts the changes in the welfare of consumers and producers as well as the effect of MCOOL on retailer profits for the case where (i) $\mu<\Theta<\lambda$, (ii) retailers are highly concentrated and exercise market power when buying and selling the AC, (iii) the substitute in consumption is relatively expensive, and (iv) labeling costs (*J*, *K*) are relatively low. The pre-COOL situation is depicted in solid black lines, and the post-COOL scenario is depicted in red (demand side) and blue (supply side).

Similar to figures 7 and 8, welfare gains are represented by the vertically stripped areas, and losses by the horizontally stripped areas. As it can be seen in the utility space, aggregate consumer welfare declines after the introduction of COOL in this example.[23] As shown in the net returns space, aggregate producer welfare increases after COOL introduction and entry occurs in this example because the increase in the farm price is greater than the increase in the labeling cost at the farm level. As a consequence, the market share of domestic product increases.

The change in retailer profits after COOL introduction is the difference between the diamond-filled area in the integrated market in the pre-COOL situation and the sum of the dot-filled areas of the markets for the domestic and the imported products in the post-COOL

[23] Equivalently, this framework allows us to measure consumer welfare change as the difference between consumer surplus from the integrated market in the pre-COOL situation and the sum of consumer surplus in the markets for labeled domestic and imported products in the post-COOL scenario.

situation. Retailers benefit from COOL introduction since the increase in profits due to the labeling of the superior domestic products outweighs the reduction in profits due to the labeling of the inferior imported products.

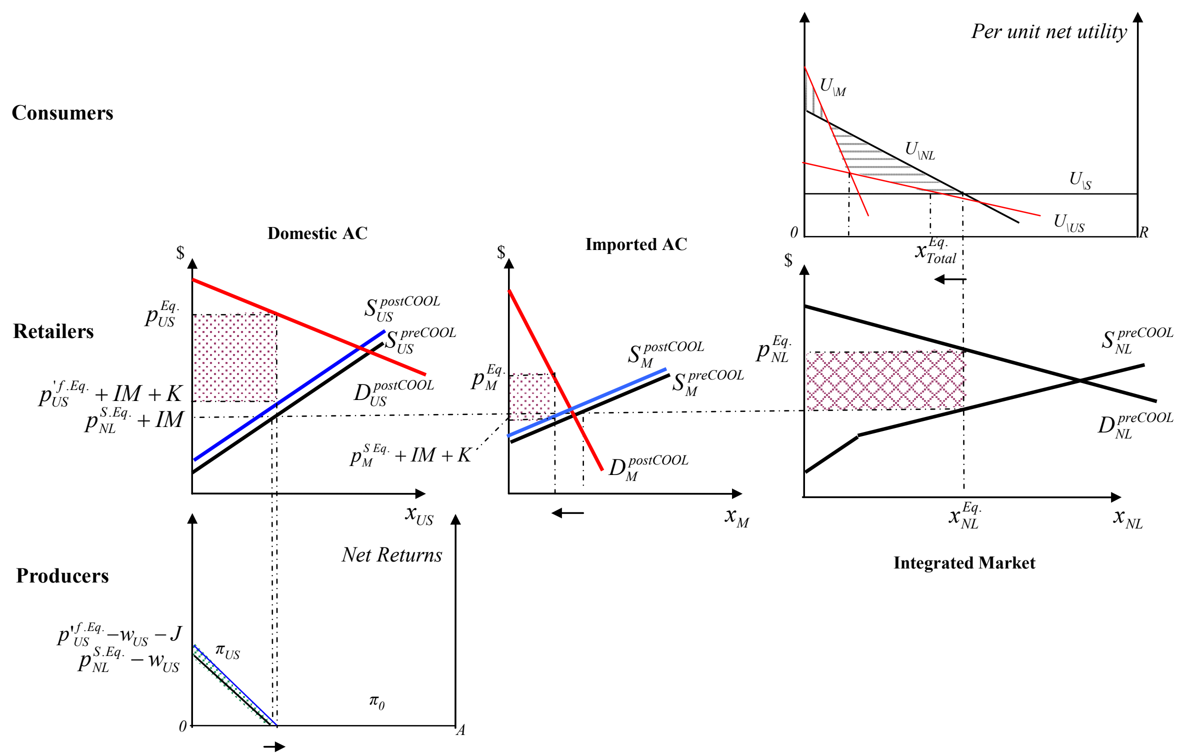

Figure 9. Market and welfare effects of MCOOL introduction

Before proceeding with the formal derivation of the market and welfare effects of MCOOL, it will be useful to state some key assumptions about the values of the parameters involved in the comparison of the pre- and post-COOL equilibria. Let ψ be the share of imported products in the total supply of the AC in the domestic economy. Under rational expectations, ψ gives then the probability that any given unit of unlabeled product in the pre-MCOOL scenario is an imported AC (Giannakas and Fulton, 2002), and the utility discount factor for the non-labeled product, Θ, is the weighted average of the utility discount factors associated with the consumption of the domestic and imported products, i.e., $\Theta=\psi\lambda+(1-\psi)\mu=\mu+\psi\gamma$. In the pre-COOL scenario, the expression for ψ is the solution to $\psi=x_M^{Eq}/\left(x_{US}^{S\,Eq}+x_M^{Eq}\right)$, or:

(42) $$\psi^*=\frac{\delta(b+\delta)(p_S-A-IM)-\left[\mu(b+\delta)\left(1+\theta_{NL}^D\right)+\delta b\theta_{NL}^S\right](A-w_{US})}{(b+\delta)\left[(b+\delta)(p_S-IM)+\gamma\left(1+\theta_{NL}^D\right)(A-w_{US})-\delta A-bw_{US}\right]}$$

The equilibrium quantity of domestic and imported ACs in the pre-COOL scenario can then be re-written as:

$$(43)\quad x_{US}^{Eq} = \frac{b(b+\delta)(p_S - w_{US} - IM) + \left[\lambda(b+\delta)(1+\theta_{NL}^{D}) + \delta b\theta_{NL}^{S}\right](A - w_{US})}{(b+\delta)\left[b\delta(1+\theta_{NL}^{S}) + (1+\theta_{NL}^{D})(\mu b + \lambda\delta)\right]}$$

$$(44)\quad x_{M}^{Eq} = \frac{\delta(b+\delta)(p_S - A - IM) - \left[\mu(b+\delta)(1+\theta_{NL}^{D}) + \delta b\theta_{NL}^{S}\right](A - w_{US})}{(b+\delta)\left[b\delta(1+\theta_{NL}^{S}) + (1+\theta_{NL}^{D})(\mu b + \lambda\delta)\right]}$$

and the domestically consumed quantity of unlabeled AC as:

$$(45)\quad x_{Total}^{Eq} = \frac{\delta(p_S - A - IM) + b(p_S - w_{US} - IM) + \gamma(1+\theta_{NL}^{D})(A - w_{US})}{b\delta(1+\theta_{NL}^{S}) + (1+\theta_{NL}^{D})(\mu b + \lambda\delta)}$$

All three equilibrium quantities depend positively on the consumer preference for domestic products. An exogenous increase in γ (due to a reduction in μ) increases consumer WTP for the unlabeled product in the pre-COOL scenario. The resulting expansion of the demand has a positive effect on all quantities and prices, with the utility effect dominating the price effect and impacting positively the welfare of all economic agents.

After the implementation of COOL, the equilibrium conditions are altered, and the market and welfare effects due to the regulation depend on all the parameters of the model. Table 3 summarizes the effect of labeling costs (*J* and *K*) and the consumer preference for domestic products (γ) on the changes in the prices, quantities and welfare of the groups involved due to the introduction of MCOOL.

Table 3. Market and Welfare Effects of COOL introduction

Endogenous Variable	Exogenous Variable		
	J	K	γ
$\Delta p_{US}^{Eq.}$	+	+	+
$\Delta p_{M}^{Eq.}$	+	+	-
$\Delta p_{US}^{f.Eq.}$	+	-	+
$\Delta p_{M}^{S.Eq.}$	+	-	-
$\Delta x_{US}^{Eq.}$	-	-	+
$\Delta x_{M}^{Eq.}$	+	-	-
$\Delta x_{Total}^{Eq.}$	-	-	+
ΔW^{C}	-	-	+
ΔW^{P}	-	-	+
$\Delta\Pi$	-	-	+

$\Delta W^C + \Delta W^P + \Delta\Pi$	-	-	+

Note: Δ denotes change due to the introduction of MCOOL. Table entries indicate the direction of the change that occurs in the endogenous variable for a change in the exogenous variable. All results are derived via numerical simulation.

The stronger is the consumer preference for domestic products, the higher is the likelihood that consumers, producers and retailers will benefit from the introduction of MCOOL.[24] The likelihood that the equilibrium quantity of domestic (imported) product, its retail and farm (import) prices will increase after the implementation of COOL is positively (negatively) related to the strength of the consumer preference for domestic products.[25]

The impacts of labeling costs on the effects of MCOOL are directly proportional to the effects described in the analysis of the post-COOL scenario in Table 2. The higher are the labeling costs, the lower is the likelihood of an increase in consumer welfare, producer welfare, and retailer profits due to the introduction of MCOOL.

IV. Simulation Results

The objective of the simulation analysis is to quantify the effects of MCOOL introduction for fresh-market apples and tomatoes under different scenarios. The choice of the specific products was based on their significance for the fruit and vegetable sectors (they are both the second most popular products in their respective categories) as well as on the co-existence of imported and domestic products in these markets year-round.

The main difference between the scenarios examined here is on the assumptions about the own-price elasticity of demand for the unlabeled product (i.e., prior to the introduction of MCOOL) and the market power of retailers. Under each scenario, two types of assessments are provided. First, the market and welfare effects of MCOOL introduction are determined for the case when the consumer preference for domestic products is relatively low. In particular, the *status quo* in all scenarios is calibrated assuming that $\gamma = 0.1\mu$ (i.e., the consumer preference for domestic products is 10% of the utility discount factor associated with the consumption of these

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[24] Only for extremely high values of γ is the likelihood of an increase in consumer welfare due to the introduction of MCOOL negatively related to the strength of consumer preference for domestic products, since the price effect tends to be higher than the utility effect. When extremely high values of γ are combined with high monopolistic power and low monopsonistic power, the likelihood of an increase in retailer profits due to the introduction of MCOOL is negatively related to the strength of consumer preference for domestic products since the increase in labeling costs offsets the increase in prices.

[25] Only for extremely high values of γ is the likelihood of a decrease in the quantity of imported AC and its retail and import prices after the implementation of COOL negatively related to the strength of the consumer preference for domestic products.

products). Second, we derive the value consumers would need to place on the origin information of apples and tomatoes so that all interest groups (i.e., consumers, producers and retailers) would benefit from the implementation of COOL.

The model is calibrated using actual data on prices, quantities and costs of production, and simulated for different values of the market power of retailers and the own-price elasticity of demand. The costs of compliance with MCOOL provisions for producers and intermediaries are derived from Sparks Inc. (2003) and the Federal Register (2003). These are, to our knowledge, the only studies that report estimates of the costs of compliance with COOL provisions for fruits and vegetables. Both studies estimate the cost of compliance for producers of fruits and vegetables to be $0.6 per ton, while Sparks Inc. (2003) estimates the cost of compliance for intermediaries to be almost twice the estimate of the Federal Register (2003) ($76.2 and $40 per ton, respectively).[26]

The market and welfare effects of MCOOL are determined as follows. First, we use the equations for the equilibrium conditions in the pre-COOL situation, the assumed ratio γ/μ, and observed data on quantities, prices, and cost of production for each crop to solve for the unknown parameters Θ, λ, μ, b, δ, γ. These values are then used in conjunction with simulated values on the market power of retailers (θ_i^D and θ_i^S) to solve for the marketing margin (*IM*) that is consistent with the observed pre-COOL data. After assigning a value to each parameter of the model in the pre-COOL situation, the post-COOL equilibrium conditions are derived from the relevant equations for specific values of the labeling costs at the farm and retail levels. The effects of the implementation of MCOOL are derived then by comparing the equilibrium prices, quantities, and welfare measures in the pre- and post-COOL scenaria.

Regarding the determination of the value consumers would need to place on the origin information for an interest group to benefit from the implementation of COOL, we first derive the combination of parameters λ, μ, b, δ, and *IM* that would generate an increase in the welfare of this interest group for the observed quantities and prices in the *status quo* (i.e., the pre-COOL situation), the labeling costs, and the assumed price of the substitute and retailer market power. From the set of possible solutions, we identify then the combination of parameters that includes the lowest value for the consumer preference for domestic products.[27]

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[26] See footnotes 12 and 14.

[27] For example, to derive the set of parameters under which the introduction of MCOOL would increase consumer welfare, equations (43) , (44), (17) and (16) are equated, respectively, to the observed equilibrium quantities of

A. Fresh-market apples

As mentioned previously, apples are the fruit with the second highest average per capita consumption in the US (with the most popular fruit being the orange (Lucier et al 2006)). About 94% of fresh apples are purchased by consumers at retail stores (such as supermarkets, grocery stores, and convenience stores), while the other 6% is purchased by food service establishments (Perez et al 2001). Fresh table grapes are the fruit with the third highest average per capita consumption in the US, and are considered a substitute product for fresh apples.

Our model is calibrated, alternatively, for two different values of the own-price elasticity of demand for unlabeled apples ($\eta = p_{NL}^{S} / \Theta x_{NL}^{Eq.}$): an elastic demand obtained by using the retail price of fresh table grapes as the price of the substitute product, and an inelastic demand obtained by assuming that the price of a composite substitute product is three times the price of apples. The retail price for grapes, the retail and grower prices for apples, and the quantities of US grown and imported apples for fresh consumption in 2004 were derived from Pollak and Perez (2006). The variable cost of production of apples is derived as an average from Glover et al (2002), Caprile et al (2001), Frost et al (2000), The Ohio State University Extension (2002), and Hinman et al (1998). The shifter of the supply of apples for fresh consumption from the ROW, *A*, is derived from Jerardo (2003) and Pollak and Perez (2006) (see Appendix 1). Table 4 presents the data used for the calibration of the model and the calibrated values of the parameters that are common across the different scenarios on the market power of retailers.

Table 4. Values of the parameters of the model for apples

Parameter (units)	**Value** (η=1.15)	**Value** (η=0.5)
Data:		
p_{NL} ($/ton)	2,000.00	2,000.00
p_{NL}^{S} ($/ton)	560.00	560.00
A ($/ton)	263.84	263.84
w_{US} ($/ton)	310.98	310.98
$x_{US}^{S.Eq}$ (1,000 tons)	1,881.178	1,881.178
$x_{M}^{S.Eq}$ (1,000 tons)	214.880	214.880
$x_{NL}^{Eq.} = x_{US}^{S.Eq.} + x_{M}^{S.Eq.}$ (1,000 tons)	2,096.058	2,096.058
Calibrated parameters:		

domestic and imported products, and their farm and retail prices; while the difference between equations (4) and (28) is equated to $10 thousand. The system is then solved simultaneously for λ, μ, b, δ, and *IM*.

p_S ($/ton)=$U$	3,740.00	6,000.00
Θ	0.83014773	1.90838558
λ	0.90389610	2.07792208
μ	0.82172373	1.88902007
b	1.37748837	1.37748837
δ	0.13238702	0.13238703
γ	0.08217237	0.18890201

The first part of the analysis assesses the market and welfare effects of MCOOL introduction for the case where consumer preference for domestic products is relatively low. Table 5 summarizes those effects for different scenarios on the market power of retailers and labeling costs when the demand for unlabeled apples is elastic (η=1.15). In particular, the second and third columns show the effects of MCOOL under perfect competition in the retail and input markets. In this case, the retail prices increase and the input prices decrease relative to the pre-MCOOL situation. The market for apples shrinks and so does the equilibrium quantity of domestic apples. However, the market share of domestic apples, $1-\psi$, increases slightly. Since the consumer valuation of origin information is low in this case, consumers lose from the introduction of MCOOL, as the increase in retail prices offsets the benefits from the origin information. Producers also lose from the introduction of MCOOL, as the farm price falls and the cost of production increases (by the amount of the labeling costs) in the post-MCOOL scenario.

The fourth and fifth columns show the effects of MCOOL when retailers have medium monopsonistic and monopolistic power. In this case, the implementation of MCOOL negatively affects the welfare of all groups of economic agents in the high labeling cost scenario (i.e., when the ratio of labeling costs for retailers to the retail price in the pre-MCOOL situation amounts to 3.81%), but positively affects producer welfare in the low labeling cost scenario (i.e., when the cited ratio is only 2%). Consumers as a group are always worse off after MCOOL introduction since the utility effect is smaller than the price effect. The last two columns in Table 5 show the effects of COOL on apples when retailers have medium monopolistic power and high monopsonistic power.[28] The direction and magnitude of the results are similar to those from the fourth and fifth columns.

Comparing the results across different scenarios on the market power of retailers for a specific estimate of labeling costs (i.e., columns 2, 4, 6; and columns 3, 5, 7 in Table 5) indicates that the higher is the retailer market power, (a) the lower is the increase in retail prices (due to the retailers' "MR" and "MO" curves being steeper), (b) the lower is the decrease in the welfare

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[28] A scenario with $\theta_i^S = \theta_i^D = 1$ cannot be calibrated when η=1.15.

of each group (except for producer welfare in the low labeling cost scenario, which actually increases), the farm price of domestic apples, and the domestic and total equilibrium quantities of apples, (c) the higher is the reduction in the import price of apples, and (d) the higher is the increase in the market share of domestic apples after MCOOL introduction.

Table 5. Market and welfare effects of MCOOL on apples when η=1.15 and *γ*=0.1*μ*

Market and Welfare Effects	Market Power					
	$\theta_i^D=0;\theta_i^S=0$; *IM*=1,440		$\theta_i^D=0.5;\ \theta_i^S=0.5$; *IM*=443		$\theta_i^D=0.5;\ \theta_i^S=1$; *IM*=317	
	K=76.2 J=0.60	*K=40 J=0.60*	*K=76.2 J=0.60*	*K=40 J=0.60*	*K=76.2 J=0.60*	*K=40 J=0.60*
Δp_{US}	3.52%	1.94%	2.40%	1.35%	2.34%	1.33%
Δp_M	2.70%	1.11%	1.62%	0.56%	1.57%	0.55%
Δp_{US}^f	-1.03%	-0.20%	-0.21%	0.35%	-0.11%	0.42%
Δp_M^S	-3.95%	-3.17%	-5.85%	-5.33%	-6.45%	-5.94%
$\Delta x_{Total}^{Eq.}$	-3.06%	-1.23%	-1.77%	-0.54%	-1.69%	-0.52%
Δx_{US}^{Eq}	-2.56%	-0.69%	-0.70%	0.54%	-0.49%	0.70%
$\Delta(1-\psi)$	0.52%	0.55%	1.08%	1.10%	1.22%	1.23%
K / p_{NL}^{Eq}	3.81%	2.00%	3.81%	2.00%	3.81%	2.00%
$J / p_{NL}^{S.Eq}$	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%
ΔW^C	-6.90%	-3.35%	-4.40%	-2.01%	-4.26%	-1.96%
ΔW^P	-5.05%	-1.37%	-1.40%	1.09%	-0.98%	1.41%
$\Delta\Pi$	n.a.	n.a.	-4.28%	-1.89%	-4.05%	-1.75%
ΔW_{Total}	-6.69%	-3.12%	-4.17%	-1.77%	-3.97%	-1.67%

i = NL, US, M; K, J, IM : expressed in \$/ton; n.a.: not applicable. $W_{Total}=W^C+W^P+\Pi$

Table 6 summarizes the market and welfare effects of MCOOL under different market structures and labeling costs when the demand for unlabeled apples is inelastic (η=0.5). Producers always gain in this case, while consumer welfare, retailer profits and total economic welfare fall after the implementation of MCOOL under the alternative specifications of market power and labeling costs. Although the total size of the market for apples decreases, the market share of domestic apples, $1-\psi$, increases in all scenarios when η=0.5.

Comparing the results across different scenarios on retailer market power for specific labeling costs (i.e., columns 2, 4, 6; and columns 3, 5, 7 in table 6) indicates that the higher is the monopsonistic power of retailers: (a) the lower is the increase in the retail price of domestic apples, (b) the lower is the decrease in the total quantity of apples, consumer welfare, retailer profits, and total economic welfare, (c) the higher is the increase in the quantity of domestic apples, their farm price, market share, and producer welfare, (d) the higher is the decrease in the import price of apples, (e) the lower is the increase in the retail price of imported apples under high labeling costs and (f) the higher is the increase in the retail price of imported apples under low labeling costs after the introduction of MCOOL.

Table 6. Market and welfare effects of MCOOL introduction when η=0.5 and γ=0.1μ

	Market Power					
Market and Welfare Effects	$\theta_i^D = 0; \theta_i^S = 0$; *IM*=1,440		$\theta_i^D = 0; \theta_i^S = 0.5$; *IM*=1,313		$\theta_i^D = 0; \theta_i^S = 1$; *IM*=1,186	
	K=76.2 J=0.60	*K=40 J=0.60*	*K=76.2 J=0.60*	*K=40 J=0.60*	*K=76.2 J=0.60*	*K=40 J=0.60*
Δp_{US}	3.88%	2.18%	3.82%	2.17%	3.77%	2.17%
Δp_M	2.08%	0.37%	2.05%	0.39%	2.01%	0.39%
Δp_{US}^f	0.24%	0.63%	0.31%	0.69%	0.35%	0.72%
Δp_M^S	-6.17%	-5.82%	-6.75%	-6.40%	-7.05%	-6.71%
$\Delta x_{Total}^{Eq.}$	-0.93%	-0.07%	-0.90%	-0.07%	-0.88%	-0.07%
Δx_{US}^{Eq}	0.29%	1.18%	0.45%	1.31%	0.55%	1.37%
$\Delta(1-\psi)$	1.24%	1.25%	1.37%	1.38%	1.44%	1.44%
K / p_{NL}^{Eq}	3.81%	2.00%	3.81%	2.00%	3.81%	2.00%
$J / p_{NL}^{S.Eq}$	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%
ΔW^C	-2.77%	-1.08%	-2.72%	-1.07%	-2.67%	-1.07%
ΔW^P	0.59%	2.37%	0.90%	2.63%	1.10%	2.77%
$\Delta\Pi$	n.a.	n.a.	-1.79%	-0.13%	-1.74%	-0.13%
ΔW_{Total}	-2.59%	-0.90%	-2.49%	-0.84%	-2.39%	-0.79%

i = NL, US, M; K, J, IM : expressed in \$/ton; n.a.: not applicable. $W_{Total} = W^C + W^P + \Pi$

The second part of the analysis derives the value consumers would need to place on the origin information for all interest groups (i.e., consumers, producers and retailers) to benefit from the implementation of COOL. The value of the origin information for each consumer is directly related to their preference for domestic products, *γr*. The higher is the consumer preference for domestic products, the higher is the consumer valuation of the origin information. Irrespectively of the distribution of consumer preferences, a higher *γ* implies a higher consumer preference for domestic products. Table 7 reports how much consumers would need to value domestic over imported products for each interest group to benefit from COOL when the demand for unlabeled apples is elastic (η=1.15) and the prices and quantities are those from table 4. Results are reported both in absolute terms, *γ*, and in relative terms (relative to the utility discount factor for domestic apples, i.e. *γr/μr= γ/μ*, which is dimensionless). The greater are *γ* and *γ/μ*, the higher is the consumer valuation of the origin information.

Table 7. Minimum γ for each interest group to benefit from MCOOL under alternative labeling costs and market power when η=1.15

Labeling Costs	Interest group	Market power		
		$\theta_i^D = 0$; $\theta_i^S = 0$ *IM*=1,440	$\theta_i^D = 0.5$; $\theta_i^S = 0.5$ *IM*=443	$\theta_i^D = 0.5$; $\theta_i^S = 1$; *IM*=317
K=76.2 *J=0.60* Source: Sparks Inc. (2003)	Consumers	*μ= 0.739* *γ= 0.889* *γ/μ= 120.27%*	*μ= 0.769* *γ= 0.597* *γ/μ= 77.58%*	*μ= 0.765* *γ= 0.635* *γ/μ= 83.03%*
	Producers	*μ= 0.806* *γ= 0.240* *γ/μ= 29.75%*	*μ= 0.817* *γ= 0.125* *γ/μ= 15.32%*	*μ= 0.818* *γ= 0.116* *γ/μ= 14.23%*
	Retailers	*n.a.*	*μ= 0.778* *γ= 0.504* *γ/μ= 64.70%*	*μ= 0.782* *γ= 0.469* *γ/μ= 59.96%*
	Aggregate welfare	*μ= 0.760* *γ= 0.683* *γ/μ= 89.87%*	*μ= 0.782* *γ= 0.473* *γ/μ= 60.55%*	*μ= 0.782* *γ= 0.468* *γ/μ= 59.86%*
K=40 *J=0.60* Source: Federal Register (2003)	Consumers	*μ= 0.782* *γ= 0.474* *γ/μ= 60.66%*	*μ= 0.798* *γ= 0.317* *γ/μ= 39.74%*	*μ= 0.796* *γ= 0.337* *γ/μ= 42.31%*
	Producers	*μ= 0.817* *γ= 0.123* *γ/μ= 15.10%*	*μ= 0.825* *γ= 0.050* *γ/μ= 6.04%*	*μ= 0.827* *γ= 0.034* *γ/μ= 4.16%*
	Retailers	*n.a.*	*μ= 0.802* *γ= 0.270* *γ/μ= 33.61%*	*μ= 0.804* *γ= 0.251* *γ/μ= 31.20%*
	Aggregate welfare	*μ= 0.793* *γ= 0.359* *γ/μ= 45.22%*	*μ= 0.805* *γ= 0.248* *γ/μ= 30.82%*	*μ= 0.805* *γ= 0.245* *γ/μ= 30.41%*

i = NL, US, M; K, J, IM are expressed in $/ton; n.a: Not applicable.

For each scenario on the market power of retailers, a comparison across the results obtained for different labeling costs is performed. However, a comparison of the results obtained across different scenarios on the market power of retailers for a specific labeling cost is non-informative and is, therefore, not attempted. It should be noted that the simulated market structures across scenarios are very different (in terms of the implied marketing margin, and the supply and demand elasticities in the post-MCOOL scenario), and, given that all scenarios are calibrated for the same set of pre-MCOOL prices and quantities, the resulting market and welfare effects of the regulation are not directly comparable across scenarios. In addition, the market equilibrium conditions and the welfare equations are non-linear on parameters that change across different scenarios on the market power of retailers (μ, λ, γ, θ_{NL}^{D}, θ_{NL}^{S}, θ_{US}^{D}, θ_{M}^{D}, θ_{US}^{S}, θ_{M}^{S}) making the total effect of simultaneous changes on the values of these parameters dependent not only on their change in levels but also on their rate of change and the initial values of the rest of the parameters in the model.

As expected, the minimum consumer preference for domestic apples under which each group of economic agents is better off after MCOOL introduction is smaller in the low-labeling cost scenario than in the high-labeling cost scenario (compare the bottom rows with the top rows of table 7). Producers are the most likely winners from COOL in the scenarios considered here, followed by retailers and consumers (as the minimum consumer preference for domestic apples under which producers gain from COOL is lower than the corresponding values for retailers and consumers).

Richards and Patterson (2003) report that the monopsonistic power of retailers of fresh apples accounts for about 44% of the price-cost margin, while their monopolistic power accounts for about 50% of the price-cost margin. From our simulations, if the monopsonistic power represents 60% and the monopolistic power represents 18% of the spread between the retail price and the grower-import price (i.e., $\theta_{NL}^{D} = 0.5$ and $\theta_{NL}^{S} = 1$), the relative consumer preference for domestic products (i.e., relative to the utility discount factor for domestic apples) should be at least 42.31% (83.03%) in order for consumers to benefit from MCOOL under the low (high) labeling cost scenario. Equivalently, the utility discount factor for the imported product should be 1.42 (1.83) times the utility discount factor for the domestic product for consumers to benefit from MCOOL under low (high) labeling costs.

An increase in total economic welfare after the implementation of MCOOL requires a relative consumer preference for domestic products of at least 30.41% (59.86%) in the low (high) labeling cost scenario when retailers have medium monopolistic power and high monopsonistic power (i.e., $\theta_{NL}^{D} = 0.5$ and $\theta_{NL}^{S} = 1$). However, if the underlying market structure is competitive in the retail and input markets (i.e., $\theta_{NL}^{D} = 0$ and $\theta_{NL}^{S} = 0$), the relative consumer preference for domestic products should be at least 45.22% (89.87%) for the total economic welfare to increase after the implementation of MCOOL in the low (high) labeling cost scenario.

As mentioned earlier, the difference in the magnitude of the required consumer preference for domestic products is due to the implied demand and supply elasticities in the post-MCOOL scenario for alternative specifications of the market power (see Appendix 2).

Table 8 reports how much more consumers would need to value domestic over imported products for each interest group to benefit from COOL when the demand for unlabeled apples is inelastic (η=0.5) and the prices and quantities are those from table 4. Similar to the results from table 7, the consumer valuation of origin information required for consumers, producers and retailers to benefit from COOL is smaller in the low- than in the high-labeling cost scenario. As in the previous case, producers are those most likely to benefit from COOL regulation, followed by retailers and consumers. Finally, consistent with *a priori* expectations, the consumer valuation of origin information needed to improve the welfare of all interest groups under MCOOL is higher when the demand for unlabeled apples is elastic than when it is inelastic (compare the third column of table 7 with the third column of table 8).

Table 8. Minimum *γ* for each interest group to benefit from MCOOL under alternative labeling costs and market power when η=0.5

Labeling Costs	Interest group	Market Power		
		$\theta_i^D = 0$ $\theta_i^S = 0$ *IM*=1,440	$\theta_i^D = 0$; $\theta_i^S = 0.5$; *IM*=1,313	$\theta_i^D = 0$; $\theta_i^S = 1$; *IM*=1,186
K=76.2 *J=0.60* Source: Sparks Inc. (2003)	Consumers	*μ= 1.825* *γ= 0.815* *γ/μ= 44.66%*	*μ= 1.822* *γ= 0.846* *γ/μ= 46.44%*	*μ= 1.818* *γ= 0.878* *γ/μ= 48.31%*
	Producers	*μ= 1.892* *γ= 0.162* *γ/μ= 8.57%*	*μ= 1.894* *γ= 0.138* *γ/μ= 7.28%*	*μ= 1.896* *γ= 0.118* *γ/μ= 6.22%*
	Retailers	*n.a.*	*μ= 1.869* *γ= 0.383* *γ/μ= 20.48%*	*μ= 1.869* *γ= 0.384* *γ/μ= 20.53%*
	Aggregate welfare	*μ= 1.838* *γ= 0.686* *γ/μ= 37.32%*	*μ= 1.839* *γ= 0.679* *γ/μ= 36.92%*	*μ= 1.840* *γ= 0.670* *γ/μ= 36.44%*
K=40 *J=0.60* Source: Federal Register (2003)	Consumers	*μ= 1.864* *γ= 0.434* *γ/μ= 23.27%*	*μ= 1.862* *γ= 0.449* *γ/μ= 24.12%*	*μ= 1.861* *γ= 0.466* *γ/μ= 25.03%*
	Producers	*μ= 1.900* *γ= 0.084* *γ/μ= 4.42%*	*μ= 1.904* *γ= 0.044* *γ/μ= 2.30%*	*μ= 1.907* *γ= 0.012* *γ/μ= 0.65%*
	Retailers	*n.a.*	*μ= 1.887* *γ= 0.204* *γ/μ= 10.82%*	*μ= 1.887* *γ= 0.204* *γ/μ= 10.82%*

	Aggregate welfare	μ= 1.872 γ= 0.359 γ/μ= 19.16%	μ= 1.872 γ= 0.354 γ/μ= 18.89%	μ= 1.873 γ= 0.348 γ/μ= 18.59%

i = NL, US, M; K, J, IM are expressed in \$/ton; n.a: Not applicable.

Mabiso et al (2005), using experimental auction and survey techniques, report that consumers are willing to pay, on average, \$0.49 per pound of apples for country of origin information (i.e., consumers are willing to pay, on average, \$0.49 more for a pound of apples labeled "Grown in the U.S." than for a non-labeled one). That amount represents 49% of the retail price of unlabeled apples used in the simulation (\$1 per pound). In our case, the highest value among the required minimum consumer valuations of the origin information for each group of economic agents to benefit from MCOOL corresponds to the case where $\theta_i^D = 0$, $\theta_i^S = 0$ and η=1.15. The relative consumer preference for domestic products in that scenario is 120.27% (i.e., the utility discount factor associated with the consumption of imported apples is 2.2 times the utility discount factor associated with the consumption of domestic apples), and the proportional increase in the price for domestic apples amounts to 5.1% (see appendix 2). A higher increase in the price of domestic apples (due to higher consumer valuation of the origin information) would ensure that all interest groups benefit from MCOOL under the scenarios considered here.

The AMS study estimated that the demand for all covered commodities (fruits and vegetables, peanuts, beef, lamb, pork, fish and shellfish) at the retail level would have to increase between 0.4 to 2.05% to offset the costs imposed on the economy by the proposed rule (Federal Register 2003). As mentioned earlier, the AMS estimates were obtained under the assumption of a perfectly competitive retail sector. Using similar assumptions on the market structure for apples, our analysis reveals that when the demand for unlabeled apples is elastic (inelastic), total economic welfare increases slightly when the relative consumer valuation of the origin information is 45.22% (19.16%), and the increase in the equilibrium quantity of domestic apples after the introduction of MCOOL amounts to 3.8% (2.9%). However, if the assumption of perfect competition is relaxed, the relative consumer valuation of the origin information required for total economic welfare to increase after the introduction of MCOOL is reduced, and so does the required increase in the equilibrium quantity of domestic apples (see Appendix 2).

B. Fresh-market tomatoes

Tomatoes are the vegetable with the second highest average per capita consumption in the US, (with the most popular vegetable being the potato (Lucier et al 2006)). According to Sexton et al (2003, p.6), about 45 to 50% of the fresh-market tomatoes are sold through retailers, while according to Lucier et al (2000) this proportion amounts to 70.2%. While we chose the latter estimate for the calibration of our model, it is important to note that, since we are interested in proportional changes in prices, quantities and welfare due to COOL, our results are not affected by this specific choice.

The retail and grower prices for fresh-market tomatoes, as well as the quantities of US grown and imported tomatoes for fresh consumption in 2004 were derived from Lucier and Jerardo (2006). The variable cost of production of tomatoes was derived as an average from Orzolek et al (2006), Ferreira et al (2006), Estes et al (2002a,b), and Le Strange et al (2000). The shifter of the import supply of tomatoes for fresh consumption, A, is an average of the reference prices for fresh-market tomatoes imported from Mexico, the main source of imported tomatoes in the US (see Appendix 3). Table 9 lists the data used for the calibration of the model and the calibrated values of the parameters that are common across the different scenarios on the market power of retailers.

Table 9. Values of the parameters of the model for tomatoes

Parameter (units)	**Value** (η=2)	**Value** (η=0.5)
Data:		
p_{NL} ($/ton)	2,900.00	2,900.00
p_{NL}^{S} ($/ton)	774.00	774.00
A ($/ton)	434.60	434.60
w_{US} ($/ton)	665.48	665.48
$x_{US}^{S.Eq}$ (1,000 tons)	1,406.63	1,406.63
$x_{M}^{S.Eq}$ (1,000 tons)	736.43	736.43
$x_{NL}^{Eq.} = x_{US}^{S.Eq.} + x_{M}^{S.Eq.}$ (1,000 tons)	2,143.07	2,143.07
Calibrated parameters:		
p_S ($/ton)=$U$	4,350.00	8,700.00
Θ	0.67660265	2.70641060
λ	0.71953708	2.87814831
μ	0.6541246	2.61649847
b	0.46087204	0.46087204
δ	0.07714893	0.07714893
γ	0.06541246	0.26164985

Similar to the case of apples examined earlier, the first part of the analysis assesses the market and welfare effects of MCOOL introduction for the case where consumer preference for domestic tomatoes is relatively low (γ=0.1μ). Table 10 summarizes those effects for different scenarios on the market power of retailers and labeling costs when the demand for unlabeled tomatoes is elastic (η=2). As expected, consumers, producers and retailers are more likely to benefit from MCOOL the lower are the labeling costs.

Producer welfare increases after MCOOL introduction in all cases considered in this study. Consumer welfare is smaller in the post-MCOOL scenario for all considered cases except for the one where the labeling costs are low and retailers have high monopsonistic and monopolistic power. Retailers gain from MCOOL introduction in the low labeling cost scenarios and lose in the high labeling cost scenarios. The equilibrium quantity of domestic tomatoes and their share of the total supply increase after the implementation of MCOOL in all scenarios considered here.

Table 10. Market and welfare effects of MCOOL on tomatoes when η=2 and γ=0.1μ

	$\theta_i^D=0;\theta_i^S=0;$ *IM*=2,126		$\theta_i^D=0.5;\ \theta_i^S=0.5;$ *IM*=1,313		$\theta_i^D=1;\ \theta_i^S=1;$ *IM*=534	
	K=76.2 *J=0.60*	*K=40* *J=0.60*	*K=76.2* *J=0.60*	*K=40* *J=0.60*	*K=76.2* *J=0.60*	*K=40* *J=0.60*
Δp_{US}	2.75%	1.61%	1.91%	1.15%	1.49%	0.92%
Δp_M	1.28%	0.13%	0.72%	-0.05%	0.44%	-0.14%
Δp_{US}^f	0.45%	0.88%	2.04%	2.33%	2.84%	3.06%
Δp_M^S	-5.06%	-4.68%	-12.39%	-12.14%	-16.06%	-15.87%
$\Delta x_{Total}^{Eq.}$	-2.25%	0.10%	-0.51%	1.05%	0.35%	1.52%
Δx_{US}^{Eq}	2.62%	5.73%	14.01%	16.09%	19.71%	21.26%
$\Delta(1-\psi)$	4.98%	5.63%	14.60%	14.88%	19.29%	19.44%
K/p_{NL}^{Eq}	2.63%	1.38%	2.63%	1.38%	2.63%	1.38%
$J/p_{NL}^{S.Eq}$	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%
ΔW^C	-6.72%	-2.22%	-3.73%	-0.69%	-2.18%	0.11%
ΔW^P	5.31%	11.79%	29.99%	34.76%	43.30%	47.05%
$\Delta\Pi$	n.a.	n.a.	-2.70%	0.34%	-1.53%	0.77%
ΔW_{Total}	-6.16%	-1.57%	-2.43%	0.65%	-1.05%	1.27%

i = NL, US, M; K, J, IM : expressed in \$/ton; n.a.: not applicable. $W_{Total}=W^C+W^P+\Pi$

Comparing the results across different scenarios on the market power of retailers for a specific estimate of labeling costs (i.e., columns 2, 4, 6; and columns 3, 5, 7 in table 10) indicates that the higher is the retailer market power: (a) the lower is the increase in the retail prices for domestic and imported tomatoes, (b) the lower is the decrease in consumer welfare, (c) the higher is the increase in the equilibrium quantity of US grown tomatoes, their farm price, market share, and producer welfare, (d) the higher is the decrease in the import price of tomatoes, (e) the lower is the decrease in the total quantity of tomatoes, retailer profits and total economic welfare under high labeling costs, and (f) the lower is the increase in the total quantity of tomatoes, retailer profits and total economic welfare under low labeling costs after MCOOL introduction.

Table 11 summarizes the market and welfare effects of MCOOL introduction for different scenarios on the market power of retailers and labeling costs when the demand for unlabeled tomatoes is inelastic (η=0.5). All economic agents benefit from the implementation of MCOOL when the demand for tomatoes is inelastic with the producer welfare increasing by at least 43%. The introduction of MCOOL results also in a significant increase in the equilibrium quantity of domestic tomatoes, a significant reduction in the equilibrium quantity of imported tomatoes, and consequently, a 23% increase in domestic tomatoes' market share.

Table 11. Market and welfare effects of MCOOL on tomatoes when η=0.5 and γ=0.1μ

	$\theta_i^D=0;\theta_i^S=0;$ *IM*=2,126		$\theta_i^D=0;\ \theta_i^S=0.5;$ *IM*=2,055		$\theta_i^D=0;\ \theta_i^S=1;$ *IM*=1,984	
	K=76.2 J=0.60	*K=40 J=0.60*	*K=76.2 J=0.60*	*K=40 J=0.60*	*K=76.2 J=0.60*	*K=40 J=0.60*
Δp_{US}	3.37%	2.16%	3.36%	2.15%	3.36%	2.17%
Δp_M	-1.13%	-2.36%	-0.73%	-1.94%	-0.47%	-1.67%
Δp_{US}^f	2.80%	2.92%	3.27%	3.39%	3.55%	3.67%
Δp_M^S	-14.09%	-14.02%	-16.90%	-16.81%	-18.58%	-18.49%
$\Delta x_{Total}^{Eq.}$	1.69%	2.32%	1.70%	2.32%	1.70%	2.31%
Δx_{US}^{Eq}	19.40%	20.27%	22.77%	23.61%	24.77%	25.59%
$\Delta(1-\psi)$	17.42%	17.54%	20.71%	20.81%	22.68%	22.76%
K/p_{NL}^{Eq}	2.63%	1.38%	2.63%	1.38%	2.63%	1.38%
$J/p_{NL}^{S.Eq}$	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%
ΔW^C	0.50%	1.74%	0.43%	1.65%	0.37%	1.58%
ΔW^P	42.57%	44.65%	50.72%	52.80%	55.67%	57.74%
$\Delta\Pi$	n.a.	n.a.	6.91%	8.15%	5.65%	6.88%
ΔW_{Total}	1.01%	2.26%	1.17%	2.41%	1.25%	2.48%

i = NL, US, M; K, J, IM : expressed in \$/ton; n.a.: not applicable. $W_{Total}=W^C+W^P+\Pi$

Comparing the results across different scenarios on retailer market power for specific labeling costs (i.e., columns 2, 4, 6; and columns 3, 5, 7 in table 11) indicates that the higher is the monopsonistic power of retailers, (a) the higher is the increase in the equilibrium quantity of domestic tomatoes, their farm price, and the market share of domestic tomatoes, (b) the higher is the increase in the welfare of producers and the total economic welfare, (c) the lower is the decrease in the retail price of imported tomatoes, and (d) the lower is the increase in consumer welfare and retailer profits after MCOOL introduction.

The second part of the analysis derives the value consumers would need to place on the origin information for all interest groups (i.e., consumers, producers and retailers) to benefit from the implementation of COOL regulation. Table 12 reports how much consumers would need to value domestic over imported products for each interest group to benefit from COOL when the demand for unlabeled apples is elastic (η=2) and prices and quantities are those from table 9.

Table 12. Minimum *γ* for each interest group to benefit from MCOOL under alternative labeling costs and market power when η=2

Labeling Costs	Interest group	$\theta_i^D=0$; $\theta_i^S=0$; *IM*=2,126	$\theta_i^D=0.5$; $\theta_i^S=0.5$; *IM*=1,330	$\theta_i^D=1$; $\theta_i^S=1$; *IM*=534
K=76.2 *J=0.60* Source: Sparks Inc. (2003)	Consumers	*μ= 0.597* *γ= 0.231* *γ/μ= 38.60%*	*μ= 0.623* *γ= 0.157* *γ/μ= 25.29%*	*μ= 0.636* *γ= 0.119* *γ/μ= 18.79%*
	Producers	*μ= 0.661* *γ= 0.046* *γ/μ= 6.92%*	*For all γ≥0*	*For all γ≥0*
	Retailers	*n.a.*	*μ= 0.631* *γ= 0.133* *γ/μ= 21.16%*	*μ= 0.641* *γ= 0.102* *γ/μ= 15.97%*
	Aggregate welfare	*μ= 0.613* *γ= 0.185* *γ/μ= 30.25%*	*μ= 0.636* *γ= 0.119* *γ/μ= 18.78%*	*μ= 0.646* *γ= 0.089* *γ/μ= 13.81%*
K=40 J=0.60 Source: Federal Register (2003)	Consumers	*μ= 0.636* *γ= 0.118* *γ/μ= 18.62%*	*μ= 0.648* *γ= 0.082* *γ/μ= 12.68%*	*μ= 0.655* *γ= 0.063* *γ/μ= 9.58%*
	Producers	*μ= 0.668* *γ= 0.024* *γ/μ= 3.54%*	*For all γ≥0*	*For all γ≥0*
	Retailers	*n.a.*	*μ= 0.657* *γ= 0.057* *γ/μ= 8.63%*	*μ= 0.661* *γ= 0.047* *γ/μ= 7.05%*
	Aggregate	*μ= 0.644*	*μ= 0.659*	*μ= 0.664*

	welfare	*γ= 0.095* *γ/μ= 14.73%*	*γ= 0.051* *γ/μ= 7.75%*	*γ= 0.037* *γ/μ= 5.52%*

i = NL, US, M; K, J, IM are expressed in $/ton; n.a: Not applicable.

As expected, the minimum consumer preference for domestic tomatoes under which each group of economic agents is better off after MCOOL introduction is smaller in the low-labeling cost scenario than in the high-labeling cost scenario (compare the bottom rows with top rows of table 12). Producers are those most likely to gain from COOL in the scenarios considered here, followed by retailers and consumers (as the minimum consumer preference for domestic tomatoes under which producers gain from COOL is lower than the corresponding values for retailers and consumers).

An increase in total economic welfare after the implementation of MCOOL requires a relative consumer preference for domestic products of at least 14.73% (30.25%) in the low (high) labeling cost scenario when retailers have no market power. However, if retailers behave as a monemporist (i.e., $\theta_{NL}^{D} = 1$ and $\theta_{NL}^{S} = 1$), the relative consumer preference for domestic products should be at least 5.52% (13.81%) for the total economic welfare to increase after the implementation of MCOOL in the low (high) labeling cost scenario. The difference in the magnitude of the required consumer preference for domestic products is due to the implied demand elasticities in the post-MCOOL scenario for alternative specifications of the market power (see appendix 4).

Table 13 reports how much consumers would need to value domestic over imported products for each interest group to benefit from COOL when the demand for unlabeled tomatoes is inelastic (η=0.5) and prices and quantities are those from table 9. Similar to the results from table 12, the required consumer valuation of origin information for consumers, producers and retailers to benefit from the regulation is smaller the lower the labeling costs. Producers and retailers are highly likely to benefit from COOL regulation when η=0.5 while the required consumer valuation of origin information for consumer welfare (total economic welfare) to increase after MCOOL introduction is positively (negatively) related to the monopsonistic power of retailers in the pre-COOL scenario. Finally, the consumer valuation of origin information needed to improve the welfare of all interest groups under MCOOL is higher when the demand for unlabeled tomatoes is elastic than when it is inelastic (compare the third column of table 12 with the third column of table 13).

Table 13. Minimum γ for each interest group to benefit from MCOOL under alternative labeling costs and market power when η=0.5

Labeling Costs	Benefited group	$\theta_i^D = 0$ $\theta_i^S = 0$ *IM*=2,126	$\theta_i^D = 0$; $\theta_i^S = 0.5$; *IM*=2,055	$\theta_i^D = 0$; $\theta_i^S = 1$; *IM*=1,984
K=76.2 *J=0.60* Source: Sparks Inc. (2003)	Consumers	*μ= 2.631* *γ= 0.218* *γ/μ=8.29%*	*μ= 2.629* *γ= 0.224* *γ/μ=8.52%*	*μ= 2.628* *γ= 0.228* *γ/μ=8.69%*
	Producers	*μ= 2.701* *γ= 0.016* *γ/μ=0.61%*	*For all γ≥0*	*For all γ≥0*
	Retailers	*n.a.*	*For all γ≥0*	*For all γ≥0*
	Total Aggregate	*μ=2.643* *γ= 0.185* *γ/μ=7.01%*	*μ=2.650* *γ= 0.166* *γ/μ=6.25%*	*μ=2.653* *γ= 0.156* *γ/μ= 5.90%*
K=40 *J=0.60* Source: Federal Register (2003)	Consumers	*μ= 2.668* *γ= 0.112* *γ/μ=4.20%*	*μ= 2.666* *γ= 0.117* *γ/μ=4.39%*	*μ= 2.665* *γ= 0.120* *γ/μ=4.50%*
	Producers	*μ= 2.703* *γ= 0.009* *γ/μ=0.33%*	*For all γ≥0*	*For all γ≥0*
	Retailers	*n.a.*	*For all γ≥0*	*For all γ≥0*
	Total Aggregate	*μ=2.674* *γ= 0.094* *γ/μ= 3.52%*	*μ=2.684* *γ= 0.064* *γ/μ= 2.39%*	*μ= 2.689* *γ= 0.052* *γ/μ= 1.93%*

i = NL, US, M; K, J, IM are expressed in \$/ton; n.a: Not applicable.

Mabiso et al (2005) report that consumers are willing to pay, on average, \$0.48 per pound of tomatoes for country of origin information (i.e., consumers are willing to pay, on average, \$0.48 more for a pound of tomatoes labeled "Grown in the U.S." than for a non-labeled one). This represents 33% of the retail price for unlabeled tomatoes used in the simulation (\$1.45 per pound). In our case, the highest consumer valuation of origin information needed for all groups to benefit from MCOOL corresponds to the case where $\theta_i^D = 0, \theta_i^S = 0$ and η=2. The relative consumer preference for domestic products in that scenario is 38.6% (i.e., the utility discount factor associated with the consumption of imported tomatoes is about 1.4 times the utility discount factor associated with the consumption of domestic tomatoes), and the proportional increase in the price for domestic tomatoes amounts to 3.5% (see appendix 4). A higher increase in the price of domestic tomatoes (due to higher consumer valuation of the origin information) would ensure that all interest groups benefit from MCOOL under all scenarios considered here.

Using similar assumptions to those used in the AMS study (Federal Register 2003), we find that when the demand for unlabeled tomatoes is elastic (inelastic), total economic welfare increases slightly when the relative consumer valuation of the origin information is 14.73% (3.52%), and the increase in the equilibrium quantity of domestic tomatoes after the introduction of MCOOL amounts to 9.6% (8.2%). When the assumption of perfect competition is relaxed, the relative consumer valuation of the origin information required for total economic welfare to increase after the introduction of MCOOL is smaller, while the required increase in the equilibrium quantity of domestic tomatoes is higher (see Appendix 4).

V. Conclusions

This study provides a new framework of analysis of the market and welfare effects of mandatory COOL for fruits and vegetables that accounts for heterogeneous consumer preferences for domestic products, differences in producer agronomic characteristics, and retailer market power when buying and selling these products. The market and welfare effects of MCOOL have been shown to be case-specific and dependent on the labeling costs at the farm and retail levels, the strength of consumer preference for domestic products, the market power of retailers, the marketing margin along the supply chain, and the relative costs of imported and domestic products.

Once consumer heterogeneity is incorporated into the analysis, previous arguments that all consumers will benefit from the implementation of MCOOL are easily rejected. Our analysis shows that, in most cases, only some consumers will benefit from the regulation, namely those with very weak and those with very strong preference for the domestic product. Producers are shown to benefit from the regulation when the labeling costs at the farm level are offset by a farm price increase after MCOOL introduction, while retailers are shown to gain from COOL when the benefits from the supply of labeled superior domestic products outweigh the costs of labeling and supplying the inferior imported produce.

Simulation results for the US markets of apples and tomatoes indicate that for the regulation to increase total economic welfare in these markets, the consumer demand after MCOOL would need to increase by 2.6% to 7.0% for domestic apples and by 8.2% to 22.4% for domestic tomatoes, depending on the market power of retailers and the size of the labeling costs.

Before concluding this study, it is important to note that our finding that the introduction of MCOOL can create winners and losers among consumers, producers and retailers, provides a rationalization of the widely differing views on the desirability of COOL in the US. When combined with our finding that the economic ramifications of COOL are case-specific, this result also underlines the need for a case-by-case analysis of the market and welfare effects of COOL. In this context, an appropriate calibration of the framework of analysis developed in our study for other specialty crops could provide policy makers and stakeholder groups with valuable insights on the potential effects of COOL regulation on different food product markets.

References:

American Frozen Food Institute, 2003. "Bill of Unintended Consequences: How a New Country of Origin Marking Regulation Would Harm American Food and Agriculture," http://www.farms.com/cool/COO_whitepaper.pdf, last accessed April 4, 2007.

Americans for Country of Origin Labeling, http://www.americansforlabeling.org/supporters.htm, last accessed May 8, 2007.

American Meat Institute, 2004. "Response to Docket No. LS-03-04," http://www.meatami.com/Template.cfm?Section=Country-of-Origin_Labeling2&CONTENTID=3310&TEMPLATE=/ContentManagement/ContentDisplay.cfm, last accessed April 4, 2007.

Brester, G., Marsh, J., and J. Atwood, 2004. "Distributional Impacts of Country-of-Origin Labeling in the U.S. Meat Industry," *Journal of Agricultural and Resource Economics* 29(2): 206-27.

Caprile, J.L., Grant, J.A., Holtz, B.A., Kelley, K.M., Mitcham, E.J., Klonsky, K.M., and R. L. De Moura, 2001. "Sample Costs to Establish an Apple Orchard and Produce Apples, Granny Smith Variety, San Joaquin Valley-North," University of California Cooperative Extension, http://coststudies.ucdavis.edu.

Carter, C. and A. Zwane, 2003. "Not so Cool? Economic Implications of Mandatory Country-of-Origin Labeling," University of California Giannini Foundation Agricultural and Resource Economics Update, May/June.

Crummett, M, 2002. "Implications of the U.S. Farm Act on Canadian Agriculture," *Estey Centre Journal of International Law and Trade Policy* 3(2): 239-255.

Davis, E. 2003. "Estimates of start-up costs for Country-of-Origin Labeling Requirements to the Texas Beef Cattle and Beef Sectors," http://livestock-marketing.tamu.edu/publications/Start%20Up%20COOL.html, last accessed on April 4, 2007.

Dimitri, C., Tegene, A., and P. R. Kaufman, 2003. "U.S. Fresh Produce Markets. Marketing Channels, Trade Practices, and Retail Pricing Behavior," Agricultural Economic Report 825, Economic Research Service, U.S. Department of Agriculture.

Economic Research Service, 2007. Tomatoes Briefing Room. U.S. Department of Agriculture, http://www.ers.usda.gov/Briefing/Tomatoes/trade.htm, last accessed April 28, 2007.

Estes, E., Sanders, D., and H. Sampson, 2002a. "Tomatoes, Fresh Mkt., Staked, East. N.C.: Estimated Revenue, Operating Expenses, Annual Ownership Expenses, and Net Revenue Per Acre," Department of Agricultural and Resource Economics, North Carolina State University.

——, 2002b. "Tomatoes, Fresh Mkt., Staked, Mountains: Estimated Rev., Op. Exps., Annual Ownership Exps., and Net Revenue Per Acre. Irrigated Plasticulture," Department of Agricultural and Resource Economics, North Carolina State University.

Federal Register, 2002. "Establishment of Guidelines for the Interim Voluntary Country-of-Origin Labeling of Beef, Lamb, Pork, Fish, Perishable Agricultural Commodities and Peanuts Under the Authority of the Agricultural Marketing Act of 1946," U.S.

Department of Agriculture, Agricultural Marketing Service, 67 (198), October 11, www.ams.usda.gov/cool/ls0213.pdf.

——, 2003. "Mandatory Country of Origin Labeling of Beef, Lamb, Pork, Fish, Perishable Agricultural Commodities, and Peanuts: Proposed Rule," U.S. Department of Agriculture, Agricultural Marketing Service, 68 (210), October 30, www.ams.usda.gov/cool/ls0304.pdf.

Ferreira,W., Hassel,R., Melton,A., Smith, W.B., Smith,J.P., and G. Miller, 2006. "Vegetable Enterprise Budgets for South Carolina 2006/2007," Department of Applied Economics and Statistics, Clemson University, October.

Food Marketing Institute, 2001. "Mandatory country-of origin labeling. FMI Backgrounder," Washington, D.C.

——, 2003. "Testimony of Deborah White, Associate General Counsel, Regulatory Affairs, before the Committee on Agriculture United States House of Representatives Hearing on Country of Origin Labeling," www.fmi.org/gr/testimony/report.cfm?issueID=679, last accessed April 4, 2007.

Frost, W.E., Klonsky, K.M., and R.L. De Moura, 2000. "Sample Cost to Produce Apples, Sierra Nevada Foothills – 2000," University Of California, Cooperative Extension.

Fulton, M.E., and K. Giannakas, 2004. "Inserting GM Products into the Food Chain: The Market and Welfare Effects of Different Labeling and Regulatory Regimes," *American Journal of Agricultural Economics* 86: 360-69.

GAO (General Accounting Office), 1999. "Fresh produce: Potential Implications of Country-of-Origin Labeling," Testimony before the Committee on Agriculture, Nutrition, and Forestry, U.S. Senate, GAO/T-RCED-99-200, May 26.

——, 2003. "Country-of-Origin Labeling. Opportunities for USDA and Industry to Implement Challenging Aspects of the New Law," Report to Congressional Requesters, GAO-03-780, August.

Giannakas, K., and M.E. Fulton, 2002. "Consumption Effects of Genetic Modification: What if Consumers are Right?," *Agricultural Economics* 27: 97-109.

Glaser, L.K., Thompson G.D., and C.R. Handy, 2001. "Recent changes in Marketing and Trade Practices in the U.S. Lettuce and Fresh-Cut Vegetable Industries," Agriculture Information Bulletin 767, Economic Research Service, U.S. Department of Agriculture.

Glover, J., Hinman, H., Reganold, J. and P. Andrews, 2002. "A Cost of Production Analysis of Conventional vs. Integrated vs. Organic Apple Production Systems," Working Paper XB1041, Agricultural Research Center, College of Agriculture and Home Economics, Washington State University, January.

Grier, K., and D. Kohl, 2003. "Impacts of U.S. Country of Origin Labeling on U.S. Hog Producers," Virginia Polytechnic Institute and State University and the George Morris Centre, April.

Golan,E., Kuchler, F., and L. Mitchell, with contributions by Greene C. and A. Jessup, 2001. "Economics of Food Labeling," *Journal of Consumer Policy* 24: 117–184.

Hayes, D.J. and S.R. Meyer, 2003. “Impact of Mandatory Country of Origin Labeling on U.S. Pork Exports,” http://www.nppc.org/news/stories/2003/COOLReport.pdf, last accessed April 4, 2007.

Hinman, H., Williams, K., and D. Faubion, 1998. “Estimated Capital Requirements and Profitability of Establishing and Producing a High Density Fuji Apple Orchard in Eastern Washington,” Department of Agricultural Economics, Cooperative Extension, Washington State University.

Jerardo, A., 2003. “Import Share Of U.S. Food Consumption Stable At 11 Percent,” Electronic Outlook Report FAU-79-01, Economic Research Service, U.S. Department of Agriculture.

Krissoff, B., Kuchler, F., Nelson, K., Perry, J., and A. Somwaru, 2004. “Country-of-Origin Labeling: Theory and Observation,” Electronic Outlook Report WRS-04-02, Economic Research Service, U.S. Department of Agriculture.

Le Strange, M., Valencia, J., Weir, B., Mullen, R., Klonsky, K., De Moura, R., and S. Stoddard, 2000. “Sample Costs to Produce Fresh Market Tomatoes,” University of California Cooperative Extension.

Loureiro, M.L. andW.J. Umberger, 2003. “Estimating Consumer Willingness to Pay for Country-of-Origin Labeling,” *Journal of Agriculture and Resource Economics* 28: 287–301.

——, 2005. “Assessing Consumer Preferences for Country-of-Origin Labeled Products,” *Journal of Agriculture and Applied Economics* 37: 49–63.

Lucier, G., and A. Jerardo, 2006. “Vegetables and Melons Situation and Outlook Yearbook,” Electronic Outlook Report ERS-VGS-2006, Economic Research Service, U.S. Department of Agriculture, July 27.

Lucier, G., Lin, B., and J. Allshouse, 2000. “Factors Affecting Tomato Consumption in the United States,” Vegetables and Specialties Situation and Outlook Report VGS-282, Economic Research Service, U.S. Department of Agriculture, November.

Lucier, G., Pollack, S., Ali, M. and A. Perez, 2006. “Fruit and Vegetable Backgrounder,” Vegetables and Specialties Situation and Outlook Report VGS-313-01, Economic Research Service, U.S. Department of Agriculture, April.

Lusk, J., and J. Anderson, 2004. “Effects of Country-of-Origin Labeling on Meat Producers and Consumers,” *Journal of Agricultural and Resource Economics* 29(2): 185-205.

Mabiso, A., J. Sterns, L. House, and A. Wysocki, 2005. “Estimating Consumers’ Willingness-to-Pay for Country-of-Origin Labels in Fresh Apples and Tomatoes: A Double-Hurdle Probit Analysis of American Data Using Factor Scores,” Paper Presented at the American Agricultural Economics Association Annual Meeting, Providence, Road Island, July 26.

Mussa, M., and S. Rosen, 1978. “Monopoly and Product Quality,” *Journal of Economic Theory* 18: 301-17.

National Pork Producers Council, 2003. “COOL and the U.S. Pork Industry: Who Will Raise the Hogs?,” www.countryoforiginlabel.org/documents/nppcmcoolwhowillraisethehogs.pdf, last accessed April 4, 2007.

Orzolek, M., Bogash, S, Harsh, R.M, Kime, L., and J. Harper, 2006. "Tomato Production," *Agricultural Alternatives*, College of Agricultural Sciences Agricultural Research and Cooperative Extension, Pennsylvania State University.

Perez, A., Lin, B., and J. Allshouse, 2001. "Demographic Profile of Apple Consumption in the United States," Fruit and Tree Nuts Situation and Outlook Report FTS-292, Economic Research Service, U.S. Department of Agriculture, September.

Plain, R. and G. Grimes, 2003. "Benefits of COOL to the Cattle Industry," Working Paper 2003–2, Department of Agricultural Economics, University of Missouri-Columbia, May 21, http://agebb.missouri.edu/mkt/cool.htm, last accessed May 10.

Pollack, S., and A. Perez, 2006. "Fruit and Tree Nuts Situation and Outlook Yearbook," Market and Trade Economics Division Report FTS-2006, Economic Research Service, U.S. Department of Agriculture, October.

Produce Marketing Association, 2003. "Comments on Country of Origin Labeling," www.countryoforiginlabel.org/documents/040403producemarketassoccomments.pdf, last accessed April 4, 2007.

Richards, T., and P. Patterson, 2003. "Competition in Fresh Produce Markets: An Empirical Analysis of Channel Performance," Contractor and Cooperator Report 1, Economic Research Service, U.S. Department of Agriculture, September.

Rude, J., Iqbal, J., and D. Brewin, 2006."This Little Piggy Went to Market with a Passport: the Impacts of U.S. Country of Origin Labeling on the Canadian Pork Sector," *Canadian Journal of Agricultural Economics* 54: 401–420.

Schmitz, A., Moss, C., and T. Schmitz, 2005. "A Differential Examination of the Effect of Mandatory Country of Origin Labeling on the Beef Sector," Presented at the American Agricultural Economics Association Annual Meetings, Providence, Rhode Island, July.

Schupp, A. and J. Gillespie. 2001. "Consumer Attitudes Towards Potential Country-of-Origin Labeling of Fresh or Frozen Beef," *Journal of Food Distribution Research* 33 (3): 34-44.

Sexton, R., Zhang, M., and J. Chalfant, 2003. "Grocery Retailer Behavior in the Procurement and Sale of Perishable Fresh Produce Commodities," Contractors and Cooperators Report 2, Economic Research Service, U.S. Department of Agriculture, September.

Sparks Companies Inc., 2003. "COOL Cost Assessment," Prepared for the Sparks/CWB COOL Consortium, Memphis, Tennessee.

The Ohio State University Extension, 2000. "Ohio Enterprise Budgets: Apple Production Budget, Mature Trees," Department of Agricultural, Environmental, and Development Economics, Ohio State University.

Umberger, W.J., D.M. Feuz, C.R. Calkins, and B.M. Stiz, 2003a. "Country-of-Origin Labeling of Beef Products: U.S. Consumers' Perceptions," Paper presented at the 2003 FAMPS Conference "Emerging Roles for Food Labels: Inform, Protect, Persuade," Washington D.C., March 20-21.

——, 2003b. "Country-of-Origin Labeling of Beef Products: U.S. Consumers Perceptions," *Journal of Food Distribution Research* 34: 103–16.

U.S. Department of Agriculture, 2007. COOL web page, http://www.ams.usda.gov/cool/, last accessed on March 24, 2007.

United Fresh Fruit & Vegetable Association, 2003. “Maintain dialogue on country-of-origin labeling,” *The Packer*, September 15.

VanSickle, J., R. McEowen, C.R. Taylor, N. Harl, and J. Connor, 2003. ‘‘Country of Origin Labeling: A Legal and Economic Analysis,’’ International Agricultural Trade and Policy Center, University of Florida, PBTC 03–05, May.

Wal-MartWatch, 2007. “Wal-Mart: Opposed to Country of Origin Labeling,” http://walmartwatch.com/img/blog/cool_final.pdf, last accessed April 25, 2007.

Wimberley, R.C., B.J. Vander Mey, B.L.Wells, G.D. Ejimaker, C. Bailey, L.L. Burmeister, 2003. “Food from Our ChangingWorld: The Globalization of Food and How Americans Feel about It,” http://sasw.chass.ncsu.edu/global-food, last accessed April 4, 2007.

Appendix 1

Sources of data

The following data is obtained from Pollak and Perez (2006) for the calendar year 2004, which is the last year for which monthly data is available (specific references to pages in that publication in parenthesis):

- p_{NL} : US monthly average retail price for Red Delicious apples, adjusted to allow 4% of waste and spoilage incurred during marketing (p.30).
- p_{NL}^{S} : US monthly average grower price for apples (p.30).
- $x_{M}^{S.Eq}$: US imports of fresh apple, assumed to be destined for domestic consumption only (i.e., no re-exports) (p.191).
- $x_{US}^{S.Eq}$: Quantity of apples produced in the US for fresh utilization in the domestic market, calculated as the per capita consumption of fresh apples (p.19) multiplied by the US population in January, 2004 (p.176) minus US exports to the world (p.186).
- $x_{NL}^{Eq.} = x_{US}^{S.Eq.} + x_{M}^{S.Eq.}$: Total quantity of fresh apples consumed in the US.
- $\psi = x_{M}^{S.Eq} / x_{NL}^{Eq}$: Proportion of imported fresh apple in the domestic market.
- p_{S} : US monthly average retail price for fresh grapes (p.33).
- $x_{M}^{S.Eq}$, $x_{US}^{S.Eq}$, and $x_{NL}^{Eq.}$ are corrected by the proportion of at-home consumption (94%) reported by Perez et al (2001).

The following data on the proportion of variable costs in grower price was used in the derivation of the cost of production of US apples:

Variable/operation costs as a proportion of grower price	Type of apple	Sources
49.56%	Golden Delicious apples produced through a conventional production method	Glover et al (2002)
47.3%	Granny Smith apples	Caprile et al (2001)
97%	Sierra Nevada Foothills apples	Frost et al (2000)
45.8%	Not specified	The Ohio State University Extension (2000)
39%	Fuji Apples in mature apple orchad	Hinman et al (1998)

- w_{US} =average of variable costs as a proportion of grower price * p_{NL}^{S}

The value of the shifter of the supply of imported apples from the ROW is derived as:

- *A*= The average value of imports of apples in million US$ for 1999-2000 from Jerardo (2003) divided by the quantity of imported apples in million Lbs for 1999-2000 from Pollak and Perez (2006, p. 137).

Appendix 2

Table 14. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=1,440; *K*=76.2; *J*=0.6 ; *γ/μ*=120.27%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	2,073.90	192.72	10.2%
$x_{M}^{Eq.}$	214.88	142.15	-72.73	-33.8%
$x_{Total}^{Eq.}$	2,096.06	2,216.05	119.99	5.7%
$1-\psi$	89.7%	93.6%	0.04	4.3%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,000			
Price-Cost Margin	0			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,102.31	102.31	5.1%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,102.31	102.31	5.1%
Price-Cost Margin		0	n.a.	n.a.
$p_{US}^{f.Eq.}$		586.11	26.11	4.7%
$p_{M}^{Eq.}$		1,975.96	-24.04	-1.2%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,975.96	-24.04	-1.2%
Price-Cost Margin		0	n.a.	n.a.
$p_{M}^{S.Eq.}$		459.76	-100.24	-17.9%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,823,583	10	0.00%
W^P	234,226	284,675	50,449	21.54%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	2,057,800	2,108,258	50,459	2.45%

i = NL, US, M; n.a: Not applicable.

Table 15. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$; $\theta_i^S = 0.5$; *IM*=443; *K*=76.2; *J*=0.6 ; *γ/μ*=77.58%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	2,022.07	140.89	7.5%
$x_{M}^{Eq.}$	214.88	151.65	-63.22	-29.4%
$x_{Total}^{Eq.}$	2,096.06	2,173.73	77.67	3.7%
$1-\psi$	89.7%	93.0%	0.03	3.6%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,003			
Price-Cost Margin	996.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,068.47	68.47	3.4%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,098.87	95.45	9.5%
Price-Cost Margin		969.60	-26.98	-2.7%
$p_{US}^{f.Eq.}$		579.25	19.25	3.4%
$p_{M}^{Eq.}$		1,978.00	-22.00	-1.1%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		992.48	-10.94	-1.1%
Price-Cost Margin		985.51	-11.06	-1.1%
$p_{M}^{S.Eq.}$		472.86	-87.14	-15.6%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,823,583	10	0.00%
W^P	234,226	270,625	36,399	15.54%
Π	2,088,883	2,110,057	21,175	1.01%
W_{Total}	4,146,682	4,204,265	57,583	1.39%

i = NL, US, M; n.a: Not applicable.

Table 16. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$; $\theta_i^S = 1$; *IM*=317; *K*=76.2; *J*=0.6 ; *γ/μ*=83.03%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	2,021.59	140.41	7.5%
$x_{M}^{Eq.}$	214.88	157.16	-57.72	-26.9%
$x_{Total}^{Eq.}$	2,096.06	2,178.75	82.69	3.9%
$1-\psi$	89.7%	92.8%	0.03	3.4%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	877			
Price-Cost Margin	1,123.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,073.23	73.23	3.7%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		972.23	95.39	10.9%
Price-Cost Margin		1,100.99	-22.16	-2.0%
$p_{US}^{f.Eq.}$		579.19	19.19	3.4%
$p_{M}^{Eq.}$		1,973.40	-26.60	-1.3%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		873.50	-3.35	-0.4%
Price-Cost Margin		1,099.91	-23.25	-2.1%
$p_{M}^{S.Eq.}$		480.45	-79.55	-14.2%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,823,583	10	0.00%
W^P	234,226	270,495	36,269	15.48%
Π	2,354,192	2,398,615	44,422	1.89%
W_{Total}	4,411,991	4,492,693	80,701	1.83%

i = NL, US, M; n.a: Not applicable.

Table 17. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=1,440; *K*=40; *J*=0.6 ; *γ/μ*=60.66%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,988.43	107.25	5.7%
$x_{M}^{Eq.}$	214.88	167.87	-47.01	-21.9%
$x_{Total}^{Eq.}$	2,096.06	2,156.30	60.24	2.9%
$1-\psi$	89.7%	92.2%	0.02	2.7%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,000			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,054.80	54.80	2.7%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,054.80	54.80	2.7%
Price-Cost Margin		-	0.00	n.a.
$p_{US}^{f.Eq.}$		574.80	14.80	2.6%
$p_{M}^{Eq.}$		1,975.21	-24.79	-1.2%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,975.21	-24.79	-1.2%
Price-Cost Margin		-	0.00	n.a.
$p_{M}^{S.Eq.}$		495.21	-64.79	-11.6%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,823,583	10	0.00%
W^P	234,226	261,695	27,469	11.73%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	2,057,800	2,085,278	27,479	1.34%

i = NL, US, M; n.a: Not applicable.

Table 18. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$; $\theta_i^S = 0.5$; *IM*=443; *K*=40; *J*=0.6 ; *γ/μ*=39.74%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,963.48	82.30	4.4%
$x_{M}^{Eq.}$	214.88	172.10	-42.78	-19.9%
$x_{Total}^{Eq.}$	2,096.06	2,135.58	39.52	1.9%
$1-\psi$	89.7%	91.9%	0.02	2.4%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,003			
Price-Cost Margin	996.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,036.58	36.58	1.8%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,054.92	51.49	5.1%
Price-Cost Margin		981.67	-14.91	-1.5%
$p_{US}^{f.Eq.}$		571.49	11.49	2.1%
$p_{M}^{Eq.}$		1,982.04	-17.96	-0.9%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		984.46	-18.96	-1.9%
Price-Cost Margin		997.58	1.00	0.1%
$p_{M}^{S.Eq.}$		501.04	-58.96	-10.5%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,823,583	10	0.00%
W^P	234,226	255,169	20,942	8.94%
Π	2,088,883	2,099,162	10,279	0.49%
W_{Total}	4,146,682	4,177,913	31,232	0.75%

i = NL, US, M; n.a: Not applicable.

Table 19. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$; $\theta_i^S = 1$; *IM*=317; *K*=40; *J*=0.6 ; *γ/μ*=42.31%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,963.98	82.79	4.4%
$x_M^{Eq.}$	214.88	174.07	-40.81	-19.0%
$x_{Total}^{Eq.}$	2,096.06	2,138.04	41.98	2.0%
$1-\psi$	89.7%	91.9%	0.02	2.4%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	877			
Price-Cost Margin	1,123.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,038.93	38.93	1.9%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		928.41	51.56	5.9%
Price-Cost Margin		1,110.52	-12.63	-1.1%
$p_{US}^{f.Eq.}$		571.56	11.56	2.1%
$p_M^{Eq.}$		1,980.34	-19.66	-1.0%
Total Cost= $p_M^{S.Eq.} + IM + K$		860.60	-16.25	-1.9%
Price-Cost Margin		1,119.74	-3.41	-0.3%
$p_M^{S.Eq.}$		503.75	-56.25	-10.0%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,823,583	10	0.00%
W^P	234,226	255,297	21,071	9.00%
Π	2,354,192	2,375,937	21,745	0.92%
W_{Total}	4,411,991	4,454,817	42,826	0.97%

i = NL, US, M; n.a: Not applicable.

Table 20. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=1,440; *K*=76.2; *J*=0.6 ; *γ/μ*=29.75%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,881.22	0.04	0.0%
$x_{M}^{Eq.}$	214.88	183.42	-31.46	-14.6%
$x_{Total}^{Eq.}$	2,096.06	2,064.65	-31.42	-1.5%
$1-\psi$	89.7%	91.1%	0.01	1.5%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,000			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,076.80	76.81	3.8%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,076.80	76.81	3.8%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		560.60	0.61	0.1%
$p_{M}^{Eq.}$		2,032.85	32.85	1.6%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,032.85	32.85	1.6%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		516.65	-43.35	-7.7%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,720,986	-102,588	-5.63%
W^P	234,226	234,236	10	0.00%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	2,057,800	1,955,222	-102,578	-4.98%

i = NL, US, M; n.a: Not applicable.

Table 21. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$; $\theta_i^S = 0.5$; *IM*=443; *K*=76.2; *J*=0.6 ; *γ/μ*=15.32%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,881.22	0.04	0.0%
$x_{M}^{Eq.}$	214.88	186.80	-28.08	-13.1%
$x_{Total}^{Eq.}$	2,096.06	2,068.02	-28.04	-1.3%
$1-\psi$	89.7%	91.0%	0.01	1.4%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,003			
Price-Cost Margin	996.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,049.83	49.83	2.5%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,080.23	76.81	7.7%
Price-Cost Margin		969.60	-26.98	-2.7%
$p_{US}^{f.Eq.}$		560.60	0.61	0.1%
$p_{M}^{Eq.}$		2,026.43	26.43	1.3%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,040.92	37.50	3.7%
Price-Cost Margin		985.51	-11.06	-1.1%
$p_{M}^{S.Eq.}$		521.30	-38.70	-6.9%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,749,840	-73,733	-4.04%
W^P	234,226	234,236	10	0.00%
Π	2,088,883	2,008,122	-80,761	-3.87%
W_{Total}	4,146,682	3,992,198	-154,484	-3.73%

i = NL, US, M; n.a: Not applicable.

Table 22. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$ **;** $\theta_i^S = 1$ **; *IM*=317; *K*=76.2; *J*=0.6 ; *γ/μ*=14.23%**

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,881.22	0.04	0.0%
$x_{M}^{Eq.}$	214.88	186.20	-28.68	-13.3%
$x_{Total}^{Eq.}$	2,096.06	2,067.42	-28.64	-1.4%
$1-\psi$	89.7%	91.0%	0.01	1.4%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	877			
Price-Cost Margin	1,123.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,048.45	48.45	2.4%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		953.65	76.81	8.8%
Price-Cost Margin		1,094.80	-28.35	-2.5%
$p_{US}^{f.Eq.}$		560.60	0.61	0.1%
$p_{M}^{Eq.}$		2,026.77	26.77	1.3%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		913.52	36.67	4.2%
Price-Cost Margin		1,113.25	-9.90	-0.9%
$p_{M}^{S.Eq.}$		520.47	-39.53	-7.1%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,750,590	-72,983	-4.00%
W^P	234,226	234,236	10	0.00%
Π	2,354,192	2,266,847	-87,346	-3.71%
W_{Total}	4,411,992	4,251,672	-160,319	-3.63%

i = NL, US, M; n.a: Not applicable.

Table 23. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=1,440; *K*=40; *J*=0.6 ; *γ/μ*=15.10%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,881.22	0.04	0.0%
$x_{M}^{Eq.}$	214.88	197.62	-17.26	-8.0%
$x_{Total}^{Eq.}$	2,096.06	2,078.84	-17.22	-0.8%
$1-\psi$	89.7%	90.5%	0.01	0.8%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,000			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,040.60	40.61	2.0%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,040.60	40.61	2.0%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		560.60	0.61	0.1%
$p_{M}^{Eq.}$		2,016.21	16.21	0.8%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,016.21	16.21	0.8%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		536.21	-23.79	-4.2%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,768,795	-54,778	-3.00%
W^P	234,226	234,236	10	0.00%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	2,057,800	2,003,031	-54,768	-2.66%

i = NL, US, M; n.a: Not applicable.

Table 24. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$; $\theta_i^S = 0.5$; *IM*=443; *K*=40; *J*=0.6 ; *γ/μ*=6.04%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,881.22	0.04	0.0%
$x_{M}^{Eq.}$	214.88	196.67	-18.21	-8.5%
$x_{Total}^{Eq.}$	2,096.06	2,077.89	-18.17	-0.9%
$1-\psi$	89.7%	90.5%	0.01	0.9%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,003			
Price-Cost Margin	996.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,025.69	25.70	1.3%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,044.03	40.61	4.0%
Price-Cost Margin		981.67	-14.91	-1.5%
$p_{US}^{f.Eq.}$		560.60	0.61	0.1%
$p_{M}^{Eq.}$		2,015.90	15.90	0.8%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,018.32	14.90	1.5%
Price-Cost Margin		997.58	1.00	0.1%
$p_{M}^{S.Eq.}$		534.90	-25.10	-4.5%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,782,030	-41,543	-2.28%
W^P	234,226	234,236	10	0.00%
Π	2,088,883	2,042,920	-45,963	-2.20%
W_{Total}	4,146,682	4,059,185	-87,497	-2.11%

i = NL, US, M; n.a: Not applicable.

Table 25. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$ **;** $\theta_i^S = 1$ **; *IM*=317; *K*=40; *J*=0.6 ; *γ/μ*=4.16%**

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,881.22	0.04	0.0%
$x_{M}^{Eq.}$	214.88	194.36	-20.52	-9.5%
$x_{Total}^{Eq.}$	2,096.06	2,075.58	-20.48	-1.0%
$1-\psi$	89.7%	90.6%	0.01	1.0%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	877			
Price-Cost Margin	1,123.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,024.32	24.32	1.2%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		917.45	40.61	4.6%
Price-Cost Margin		1,106.87	-16.29	-1.4%
$p_{US}^{f.Eq.}$		560.60	0.61	0.1%
$p_{M}^{Eq.}$		2,017.63	17.63	0.9%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		888.57	11.72	1.3%
Price-Cost Margin		1,129.06	5.91	0.5%
$p_{M}^{S.Eq.}$		531.72	-28.28	-5.0%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,781,168	-42,405	-2.33%
W^P	234,226	234,236	10	0.00%
Π	2,354,192	2,301,705	-52,487	-2.23%
W_{Total}	4,411,992	4,317,109	-94,883	-2.15%

i = NL, US, M; n.a: Not applicable.

Table 26. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$; $\theta_i^S = 0.5$; *IM*=443; *K*=76.2; *J*=0.6 ; *γ/μ*=64.70%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,994.60	113.42	6.0%
$x_{M}^{Eq.}$	214.88	157.21	-57.67	-26.8%
$x_{Total}^{Eq.}$	2,096.06	2,151.81	55.75	2.7%
$1-\psi$	89.7%	92.7%	0.03	3.3%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,003			
Price-Cost Margin	996.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,064.84	64.84	3.2%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,095.24	91.81	9.2%
Price-Cost Margin		969.60	-26.98	-2.7%
$p_{US}^{f.Eq.}$		575.61	15.61	2.8%
$p_{M}^{Eq.}$		1,985.65	-14.35	-0.7%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,000.14	-3.29	-0.3%
Price-Cost Margin		985.51	-11.06	-1.1%
$p_{M}^{S.Eq.}$		480.51	-79.49	-14.2%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,808,540	-15,033	-0.82%
W^P	234,226	263,321	29,095	12.42%
Π	2,088,883	2,088,893	10	0.00%
W_{Total}	4,146,682	4,160,754	14,072	0.34%

i = NL, US, M; n.a: Not applicable.

Table 27. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$; $\theta_i^S = 1$; *IM*=317; *K*=76.2; *J*=0.6 ; *γ/μ*=59.96%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,976.42	95.24	5.1%
$x_{M}^{Eq.}$	214.88	165.03	-49.85	-23.2%
$x_{Total}^{Eq.}$	2,096.06	2,141.45	45.39	2.2%
$1-\psi$	89.7%	92.3%	0.03	2.8%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	877			
Price-Cost Margin	1,123.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,065.26	65.26	3.3%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		966.26	89.41	10.2%
Price-Cost Margin		1,099.00	-24.15	-2.2%
$p_{US}^{f.Eq.}$		573.21	13.21	2.4%
$p_{M}^{Eq.}$		1,987.87	-12.13	-0.6%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		884.35	7.50	0.9%
Price-Cost Margin		1,103.52	-19.63	-1.7%
$p_{M}^{S.Eq.}$		491.30	-68.70	-12.3%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,799,579	-23,994	-1.32%
W^P	234,226	258,543	24,316	10.38%
Π	2,354,192	2,354,202	10	0.00%
W_{Total}	4,411,991	4,412,324	333	0.01%

i = NL, US, M; n.a: Not applicable.

Table 28. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$; $\theta_i^S = 0.5$; *IM*=443; *K*=40; *J*=0.6 ; *γ/μ*=33.61%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,949.18	67.99	3.6%
$x_{M}^{Eq.}$	214.88	175.88	-39.00	-18.1%
$x_{Total}^{Eq.}$	2,096.06	2,125.06	29.00	1.4%
$1-\psi$	89.7%	91.7%	0.02	2.2%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,003			
Price-Cost Margin	996.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,034.69	34.69	1.7%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,053.02	49.60	4.9%
Price-Cost Margin		981.67	-14.91	-1.5%
$p_{US}^{f.Eq.}$		569.60	9.60	1.7%
$p_{M}^{Eq.}$		1,987.25	-12.75	-0.6%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		989.67	-13.75	-1.4%
Price-Cost Margin		997.58	1.00	0.1%
$p_{M}^{S.Eq.}$		506.25	-53.75	-9.6%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,816,111	-7,462	-0.41%
W^P	234,226	251,464	17,238	7.36%
Π	2,088,883	2,088,893	10	0.00%
W_{Total}	4,146,682	4,156,468	9,786	0.24%

i = NL, US, M; n.a: Not applicable.

Table 29. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$; $\theta_i^S = 1$; *IM*=317; *K*=40; *J*=0.6 ; *γ/μ*=31.20%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,940.62	59.44	3.2%
$x_{M}^{Eq.}$	214.88	179.22	-35.65	-16.6%
$x_{Total}^{Eq.}$	2,096.06	2,119.85	23.78	1.1%
$1-\psi$	89.7%	91.5%	0.02	2.0%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	877			
Price-Cost Margin	1,123.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,034.80	34.80	1.7%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		925.32	48.47	5.5%
Price-Cost Margin		1,109.49	-13.66	-1.2%
$p_{US}^{f.Eq.}$		568.47	8.47	1.5%
$p_{M}^{Eq.}$		1,989.82	-10.18	-0.5%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		867.71	-9.14	-1.0%
Price-Cost Margin		1,122.11	-1.04	-0.1%
$p_{M}^{S.Eq.}$		510.86	-49.14	-8.8%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,811,408	-12,165	-0.67%
W^P	234,226	249,262	15,035	6.42%
Π	2,354,192	2,354,202	10	0.00%
W_{Total}	4,411,992	4,414,872	2,880	0.07%

i = NL, US, M; n.a: Not applicable.

Table 30. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0$ **;** $\theta_i^S = 0$ **;** ***IM*=1,440; *K*=76.2; *J*=0.6 ; *γ/μ*=89.87%**

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	2,012.80	131.61	7.0%
$x_{M}^{Eq.}$	214.88	152.41	-62.46	-29.1%
$x_{Total}^{Eq.}$	2,096.06	2,165.21	69.15	3.3%
$1-\psi$	89.7%	93.0%	0.03	3.6%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,000			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,094.22	94.22	4.7%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,094.22	94.22	4.7%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		578.02	18.02	3.2%
$p_{M}^{Eq.}$		1,990.11	-9.89	-0.5%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,990.11	-9.89	-0.5%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		473.91	-86.09	-15.4%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,789,662	-33,911	-1.86%
W^P	234,226	268,147	33,921	14.48%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	2,057,800	2,057,810	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 31. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$; $\theta_i^S = 0.5$; *IM*=443; *K*=76.2; *J*=0.6 ; *γ/μ*=60.55%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,985.60	104.41	5.6%
$x_{M}^{Eq.}$	214.88	159.15	-55.73	-25.9%
$x_{Total}^{Eq.}$	2,096.06	2,144.74	48.68	2.3%
$1-\psi$	89.7%	92.6%	0.03	3.2%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,003			
Price-Cost Margin	996.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,063.64	63.64	3.2%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,094.05	90.62	9.0%
Price-Cost Margin		969.60	-26.98	-2.7%
$p_{US}^{f.Eq.}$		574.42	14.42	2.6%
$p_{M}^{Eq.}$		1,988.32	-11.68	-0.6%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,002.81	-0.61	-0.1%
Price-Cost Margin		985.51	-11.06	-1.1%
$p_{M}^{S.Eq.}$		483.19	-76.81	-13.7%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,803,670	-19,903	-1.09%
W^P	234,226	260,949	26,723	11.41%
Π	2,088,883	2,082,073	-6,810	-0.33%
W_{Total}	4,146,682	4,146,692	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 32. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$; $\theta_i^S = 1$; *IM*=317; *K*=76.2; *J*=0.6 ; *γ/μ*=59.86%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,976.24	95.05	5.1%
$x_{M}^{Eq.}$	214.88	165.07	-49.81	-23.2%
$x_{Total}^{Eq.}$	2,096.06	2,141.30	45.24	2.2%
$1-\psi$	89.7%	92.3%	0.03	2.8%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	877			
Price-Cost Margin	1,123.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,065.22	65.22	3.3%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		966.23	89.38	10.2%
Price-Cost Margin		1,098.99	-24.16	-2.2%
$p_{US}^{f.Eq.}$		573.18	13.18	2.4%
$p_{M}^{Eq.}$		1,987.94	-12.06	-0.6%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		884.40	7.55	0.9%
Price-Cost Margin		1,103.54	-19.61	-1.7%
$p_{M}^{S.Eq.}$		491.35	-68.65	-12.3%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,799,482	-24,091	-1.32%
W^P	234,226	258,494	24,268	10.36%
Π	2,354,192	2,354,025	-167	-0.01%
W_{Total}	4,411,991	4,412,001	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 33. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0$; $\theta_i^S = 0$; ***IM*=1,440; *K*=40; *J*=0.6 ; *γ/μ*=45.22%**

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,953.60	72.42	3.8%
$x_{M}^{Eq.}$	214.88	176.36	-38.51	-17.9%
$x_{Total}^{Eq.}$	2,096.06	2,129.97	33.90	1.6%
$1-\psi$	89.7%	91.7%	0.02	2.2%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,000			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,050.19	50.19	2.5%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,050.19	50.19	2.5%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		570.19	10.19	1.8%
$p_{M}^{Eq.}$		1,986.92	-13.08	-0.7%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,986.92	-13.08	-0.7%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		506.92	-53.08	-9.5%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,805,202	-18,371	-1.01%
W^P	234,226	252,607	18,381	7.85%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	2,057,800	2,057,810	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 34. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$; $\theta_i^S = 0.5$; *IM*=443; *K*=40; *J*=0.6 ; *γ/μ*=30.82%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,942.58	61.40	3.3%
$x_{M}^{Eq.}$	214.88	177.69	-37.19	-17.3%
$x_{Total}^{Eq.}$	2,096.06	2,120.27	24.21	1.2%
$1-\psi$	89.7%	91.6%	0.02	2.1%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,003			
Price-Cost Margin	996.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,033.82	33.82	1.7%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,052.15	48.73	4.9%
Price-Cost Margin		981.67	-14.91	-1.5%
$p_{US}^{f.Eq.}$		568.73	8.73	1.6%
$p_{M}^{Eq.}$		1,989.74	-10.26	-0.5%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		992.16	-11.26	-1.1%
Price-Cost Margin		997.58	1.00	0.1%
$p_{M}^{S.Eq.}$		508.74	-51.26	-9.2%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,812,701	-10,872	-0.60%
W^P	234,226	249,766	15,540	6.63%
Π	2,088,883	2,084,225	-4,658	-0.22%
W_{Total}	4,146,682	4,146,692	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 35. Market and welfare effects of MCOOL on apples when η=1.15; $\theta_i^D = 0.5$ **;** $\theta_i^S = 1$ **; *IM*=317; *K*=40; *J*=0.6 ; *γ/μ*=30.41%**

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,938.92	57.74	3.1%
$x_{M}^{Eq.}$	214.88	179.62	-35.26	-16.4%
$x_{Total}^{Eq.}$	2,096.06	2,118.54	22.48	1.1%
$1-\psi$	89.7%	91.5%	0.02	2.0%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	877			
Price-Cost Margin	1,123.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,034.50	34.50	1.7%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		925.09	48.24	5.5%
Price-Cost Margin		1,109.41	-13.74	-1.2%
$p_{US}^{f.Eq.}$		568.24	8.24	1.5%
$p_{M}^{Eq.}$		1,990.54	-9.46	-0.5%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		868.25	-8.60	-1.0%
Price-Cost Margin		1,122.29	-0.86	-0.1%
$p_{M}^{S.Eq.}$		511.40	-48.60	-8.7%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,823,573	1,810,529	-13,044	-0.72%
W^P	234,226	248,826	14,600	6.23%
Π	2,354,192	2,352,646	-1,546	-0.07%
W_{Total}	4,411,992	4,412,001	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 36. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=1,440; *K*=76.2; *J*=0.6 ; *γ/μ*=44.66%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,998.98	117.80	6.3%
$x_{M}^{Eq.}$	214.88	142.42	-72.46	-33.7%
$x_{Total}^{Eq.}$	2,096.06	2,141.40	45.33	2.2%
$1-\psi$	89.7%	93.3%	0.04	4.0%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,000			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,092.39	92.39	4.6%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,092.39	92.39	4.6%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		576.19	16.19	2.9%
$p_{M}^{Eq.}$		1,976.33	-23.67	-1.2%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,976.33	-23.67	-1.2%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		460.13	-99.87	-17.8%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,192,131	10	0.00%
W^P	234,226	264,479	30,252	12.92%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	4,426,347	4,456,610	30,262	0.68%

i = NL, US, M; n.a: Not applicable.

Table 37. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0.5$; *IM*=1,313; *K*=76.2; *J*=0.6 ; *γ/μ*=46.44%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,990.80	109.62	5.8%
$x_{M}^{Eq.}$	214.88	152.07	-62.81	-29.2%
$x_{Total}^{Eq.}$	2,096.06	2,142.87	46.81	2.2%
$1-\psi$	89.7%	92.9%	0.03	3.5%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,873			
Price-Cost Margin	126.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,096.50	96.50	4.8%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,964.73	91.31	4.9%
Price-Cost Margin		131.77	5.19	4.1%
$p_{US}^{f.Eq.}$		575.11	15.11	2.7%
$p_{M}^{Eq.}$		1,967.86	-32.14	-1.6%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,863.06	-10.36	-0.6%
Price-Cost Margin		104.80	-21.78	-17.2%
$p_{M}^{S.Eq.}$		473.44	-86.56	-15.5%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,192,131	10	0.00%
W^P	234,226	262,318	28,092	11.99%
Π	265,310	278,255	12,946	4.88%
W_{Total}	4,691,657	4,732,705	41,048	0.87%

i = NL, US, M; n.a: Not applicable.

Table 38. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 1$; *IM*=1,187; *K*=76.2; *J*=0.6 ; *γ/μ*=48.31%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,986.70	105.51	5.6%
$x_{M}^{Eq.}$	214.88	157.84	-57.04	-26.5%
$x_{Total}^{Eq.}$	2,096.06	2,144.53	48.47	2.3%
$1-\psi$	89.7%	92.6%	0.03	3.2%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,747			
Price-Cost Margin	253.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,100.60	100.60	5.0%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,837.62	90.77	5.2%
Price-Cost Margin		262.99	9.84	3.9%
$p_{US}^{f.Eq.}$		574.57	14.57	2.6%
$p_{M}^{Eq.}$		1,961.97	-38.03	-1.9%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,744.43	-2.42	-0.1%
Price-Cost Margin		217.54	-35.61	-14.1%
$p_{M}^{S.Eq.}$		481.38	-78.62	-14.0%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,192,131	10	0.00%
W^P	234,226	261,238	27,012	11.53%
Π	530,619	556,812	26,192	4.94%
W_{Total}	4,956,967	5,010,181	53,215	1.07%

i = NL, US, M; n.a: Not applicable.

Table 39. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=1,440; *K*=76.2; *J*=0.6 ; *γ/μ*=23.27%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,950.50	69.32	3.7%
$x_{M}^{Eq.}$	214.88	168.85	-46.03	-21.4%
$x_{Total}^{Eq.}$	2,096.06	2,119.35	23.29	1.1%
$1-\psi$	89.7%	92.0%	0.02	2.5%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,000			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,049.78	49.78	2.5%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,049.78	49.78	2.5%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		569.78	9.78	1.7%
$p_{M}^{Eq.}$		1,976.56	-23.44	-1.2%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,976.56	-23.44	-1.2%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		496.56	-63.44	-11.3%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,192,131	10	0.00%
W^P	234,226	251,806	17,580	7.51%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	4,426,347	4,443,937	17,590	0.40%

i = NL, US, M; n.a: Not applicable.

Table 40. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0.5$; *IM*=1,313; *K*=40; *J*=0.6 ; *γ/μ*=24.12%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,947.49	66.31	3.5%
$x_{M}^{Eq.}$	214.88	172.63	-42.25	-19.7%
$x_{Total}^{Eq.}$	2,096.06	2,120.12	24.06	1.1%
$1-\psi$	89.7%	91.9%	0.02	2.3%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,873			
Price-Cost Margin	126.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,051.70	51.70	2.6%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,922.80	49.38	2.6%
Price-Cost Margin		128.90	2.32	1.8%
$p_{US}^{f.Eq.}$		569.38	9.38	1.7%
$p_{M}^{Eq.}$		1,974.16	-25.84	-1.3%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,855.20	-18.23	-1.0%
Price-Cost Margin		118.97	-7.61	-6.0%
$p_{M}^{S.Eq.}$		501.77	-58.23	-10.4%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,192,131	10	0.00%
W^P	234,226	251,029	16,803	7.17%
Π	265,310	271,567	6,257	2.36%
W_{Total}	4,691,657	4,714,727	23,070	0.49%

i = NL, US, M; n.a: Not applicable.

Table 41. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 1$; *IM*=1,187; *K*=40; *J*=0.6 ; *γ/μ*=25.03%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,946.26	65.08	3.5%
$x_{M}^{Eq.}$	214.88	174.73	-40.15	-18.7%
$x_{Total}^{Eq.}$	2,096.06	2,120.98	24.92	1.2%
$1-\psi$	89.7%	91.8%	0.02	2.2%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,747			
Price-Cost Margin	253.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,053.70	53.70	2.7%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,796.06	49.21	2.8%
Price-Cost Margin		257.63	4.48	1.8%
$p_{US}^{f.Eq.}$		569.21	9.21	1.6%
$p_{M}^{Eq.}$		1,972.33	-27.67	-1.4%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,731.51	-15.34	-0.9%
Price-Cost Margin		240.82	-12.33	-4.9%
$p_{M}^{S.Eq.}$		504.66	-55.34	-9.9%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,192,131	10	0.00%
W^P	234,226	250,712	16,486	7.04%
Π	530,619	543,501	12,881	2.43%
W_{Total}	4,956,967	4,986,344	29,377	0.59%

i = NL, US, M; n.a: Not applicable.

Table 42. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=1,440; *K*=76.2; *J*=0.6 ; *γ/μ*=8.57%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,881.22	0.04	0.0%
$x_{M}^{Eq.}$	214.88	192.65	-22.22	-10.3%
$x_{Total}^{Eq.}$	2,096.06	2,073.88	-22.18	-1.1%
$1-\psi$	89.7%	90.7%	0.01	1.1%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,000			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,076.80	76.81	3.8%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,076.80	76.81	3.8%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		560.60	0.61	0.1%
$p_{M}^{Eq.}$		2,045.57	45.57	2.3%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,045.57	45.57	2.3%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		529.37	-30.63	-5.5%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,071,120	-121,002	-2.89%
W^P	234,226	234,236	10	0.00%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	4,426,347	4,305,356	-120,992	-2.73%

i = NL, US, M; n.a: Not applicable.

Table 43. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0.5$; *IM*=1,313; *K*=76.2; *J*=0.6 ; *γ/μ*=7.28%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,881.22	0.04	0.0%
$x_{M}^{Eq.}$	214.88	191.03	-23.85	-11.1%
$x_{Total}^{Eq.}$	2,096.06	2,072.25	-23.81	-1.1%
$1-\psi$	89.7%	90.8%	0.01	1.2%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,873			
Price-Cost Margin	126.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,074.74	74.74	3.7%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,950.23	76.81	4.1%
Price-Cost Margin		124.51	-2.06	-1.6%
$p_{US}^{f.Eq.}$		560.60	0.61	0.1%
$p_{M}^{Eq.}$		2,048.39	48.39	2.4%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,916.75	43.33	2.3%
Price-Cost Margin		131.64	5.07	4.0%
$p_{M}^{S.Eq.}$		527.13	-32.87	-5.9%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,069,572	-122,549	-2.92%
W^P	234,226	234,236	10	0.00%
Π	265,310	259,383	-5,926	-2.23%
W_{Total}	4,691,657	4,563,191	-128,466	-2.74%

i = NL, US, M; n.a: Not applicable.

Table 44. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 1$; *IM*=1,187; *K*=76.2; *J*=0.6 ; *γ/μ*=6.22%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,881.22	0.04	0.0%
$x_{M}^{Eq.}$	214.88	189.88	-25.00	-11.6%
$x_{Total}^{Eq.}$	2,096.06	2,071.10	-24.96	-1.2%
$1-\psi$	89.7%	90.8%	0.01	1.2%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,747			
Price-Cost Margin	253.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,072.68	72.68	3.6%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,823.65	76.81	4.4%
Price-Cost Margin		249.03	-4.13	-1.6%
$p_{US}^{f.Eq.}$		560.60	0.61	0.1%
$p_{M}^{Eq.}$		2,050.29	50.29	2.5%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,788.59	41.74	2.4%
Price-Cost Margin		261.70	8.55	3.4%
$p_{M}^{S.Eq.}$		525.54	-34.46	-6.2%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,069,057	-123,065	-2.94%
W^P	234,226	234,236	10	0.00%
Π	530,619	518,162	-12,458	-2.35%
W_{Total}	4,956,967	4,821,454	-135,512	-2.73%

i = NL, US, M; n.a: Not applicable.

Table 45. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=1,440; *K*=40; *J*=0.6 ; *γ/μ*=4.42%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,881.22	0.04	0.0%
$x_{M}^{Eq.}$	214.88	202.96	-11.92	-5.5%
$x_{Total}^{Eq.}$	2,096.06	2,084.18	-11.88	-0.6%
$1-\psi$	89.7%	90.3%	0.01	0.6%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,000			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,040.60	40.61	2.0%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,040.60	40.61	2.0%
Price-Cost Margin		-	0.00	#DIV/0!
$p_{US}^{f.Eq.}$		560.60	0.61	0.1%
$p_{M}^{Eq.}$		2,023.57	23.57	1.2%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,023.57	23.57	1.2%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		543.57	-16.43	-2.9%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,127,775	-64,347	-1.53%
W^P	234,226	234,236	10	0.00%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	4,426,347	4,362,011	-64,337	-1.45%

i = NL, US, M; n.a: Not applicable.

Table 46. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0.5$; *IM*=1,313; *K*=40; *J*=0.6 ; *γ/μ*=2.30%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,881.22	0.04	0.0%
$x_{M}^{Eq.}$	214.88	199.54	-15.34	-7.1%
$x_{Total}^{Eq.}$	2,096.06	2,080.76	-15.30	-0.7%
$1-\psi$	89.7%	90.4%	0.01	0.7%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,873			
Price-Cost Margin	126.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,038.54	38.54	1.9%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,914.03	40.61	2.2%
Price-Cost Margin		124.51	-2.06	-1.6%
$p_{US}^{f.Eq.}$		560.60	0.61	0.1%
$p_{M}^{Eq.}$		2,029.80	29.80	1.5%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,892.29	18.86	1.0%
Price-Cost Margin		137.51	10.93	8.6%
$p_{M}^{S.Eq.}$		538.86	-21.14	-3.8%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,122,300	-69,821	-1.67%
W^P	234,226	234,236	10	0.00%
Π	265,310	261,675	-3,635	-1.37%
W_{Total}	4,691,657	4,618,211	-73,446	-1.57%

i = NL, US, M; n.a: Not applicable.

Table 47. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 1$; *IM*=1,187; *K*=40; *J*=0.6 ; *γ/μ*=0.65%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,881.22	0.04	0.0%
$x_{M}^{Eq.}$	214.88	197.11	-17.77	-8.3%
$x_{Total}^{Eq.}$	2,096.06	2,078.33	-17.73	-0.8%
$1-\psi$	89.7%	90.5%	0.01	0.9%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,747			
Price-Cost Margin	253.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,036.48	36.48	1.8%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,787.45	40.61	2.3%
Price-Cost Margin		249.03	-4.13	-1.6%
$p_{US}^{f.Eq.}$		560.60	0.61	0.1%
$p_{M}^{Eq.}$		2,034.03	34.03	1.7%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,762.36	15.51	0.9%
Price-Cost Margin		271.67	18.52	7.3%
$p_{M}^{S.Eq.}$		535.51	-24.49	-4.4%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,118,997	-73,124	-1.74%
W^P	234,226	234,236	10	0.00%
Π	530,619	522,021	-8,599	-1.62%
W_{Total}	4,956,967	4,875,254	-81,713	-1.65%

i = NL, US, M; n.a: Not applicable.

Table 48. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0.5$; *IM*=1,313; *K*=40; *J*=0.6 ; *γ/μ*=20.48%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,920.74	39.56	2.1%
$x_{M}^{Eq.}$	214.88	175.14	-39.74	-18.5%
$x_{Total}^{Eq.}$	2,096.06	2,095.88	-0.18	0.0%
$1-\psi$	89.7%	91.6%	0.02	2.1%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,873			
Price-Cost Margin	126.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,082.59	82.59	4.1%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,955.46	82.04	4.4%
Price-Cost Margin		127.13	0.55	0.4%
$p_{US}^{f.Eq.}$		565.84	5.84	1.0%
$p_{M}^{Eq.}$		2,015.54	15.54	0.8%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,894.85	21.43	1.1%
Price-Cost Margin		120.69	-5.88	-4.6%
$p_{M}^{S.Eq.}$		505.23	-54.77	-9.8%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,111,088	-81,033	-1.93%
W^P	234,226	244,182	9,956	4.25%
Π	265,310	265,320	10	0.00%
W_{Total}	4,691,657	4,620,590	-71,067	-1.51%

i = NL, US, M; n.a: Not applicable.

Table 49. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 1$; *IM*=1,187; *K*=40; *J*=0.6 ; *γ/μ*=20.53%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,918.96	37.78	2.0%
$x_{M}^{Eq.}$	214.88	176.99	-37.89	-17.6%
$x_{Total}^{Eq.}$	2,096.06	2,095.95	-0.11	0.0%
$1-\psi$	89.7%	91.6%	0.02	2.0%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,747			
Price-Cost Margin	253.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,082.67	82.67	4.1%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,828.65	81.80	4.7%
Price-Cost Margin		254.02	0.87	0.3%
$p_{US}^{f.Eq.}$		565.60	5.60	1.0%
$p_{M}^{Eq.}$		2,014.75	14.75	0.7%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,770.82	23.97	1.4%
Price-Cost Margin		243.93	-9.22	-3.6%
$p_{M}^{S.Eq.}$		507.77	-52.23	-9.3%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,111,267	-80,854	-1.93%
W^P	234,226	243,729	9,502	4.06%
Π	530,619	530,629	10	0.00%
W_{Total}	4,956,967	4,885,625	-71,342	-1.44%

i = NL, US, M; n.a: Not applicable.

Table 50. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0.5$; *IM*=1,313; *K*=40; *J*=0.6 ; *γ/μ*=10.82%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,908.23	27.05	1.4%
$x_{M}^{Eq.}$	214.88	187.81	-27.07	-12.6%
$x_{Total}^{Eq.}$	2,096.06	2,096.05	-0.01	0.0%
$1-\psi$	89.7%	91.0%	0.01	1.4%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,873			
Price-Cost Margin	126.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,043.91	43.91	2.2%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,917.61	44.18	2.4%
Price-Cost Margin		126.30	-0.27	-0.2%
$p_{US}^{f.Eq.}$		564.18	4.18	0.7%
$p_{M}^{Eq.}$		2,005.55	5.55	0.3%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,876.12	2.70	0.1%
Price-Cost Margin		129.43	2.85	2.3%
$p_{M}^{S.Eq.}$		522.70	-37.30	-6.7%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,149,685	-42,436	-1.01%
W^P	234,226	241,011	6,785	2.90%
Π	265,310	265,320	10	0.00%
W_{Total}	4,691,657	4,656,016	-35,641	-0.76%

i = NL, US, M; n.a: Not applicable.

Table 51. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 1$; *IM*=1,187; *K*=40; *J*=0.6 ; *γ/μ*=10.82%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,909.20	28.02	1.5%
$x_{M}^{Eq.}$	214.88	186.85	-28.03	-13.0%
$x_{Total}^{Eq.}$	2,096.06	2,096.05	-0.01	0.0%
$1-\psi$	89.7%	91.1%	0.01	1.5%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,747			
Price-Cost Margin	253.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,043.89	43.89	2.2%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,791.16	44.31	2.5%
Price-Cost Margin		252.73	-0.42	-0.2%
$p_{US}^{f.Eq.}$		564.31	4.31	0.8%
$p_{M}^{Eq.}$		2,005.74	5.74	0.3%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,748.22	1.37	0.1%
Price-Cost Margin		257.53	4.37	1.7%
$p_{M}^{S.Eq.}$		521.37	-38.63	-6.9%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,149,669	-42,452	-1.01%
W^P	234,226	241,256	7,029	3.00%
Π	530,619	530,629	10	0.00%
W_{Total}	4,956,967	4,921,554	-35,413	-0.71%

i = NL, US, M; n.a: Not applicable.

Table 52. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=1,440; *K*=76.2; *J*=0.6 ; *γ/μ*=37.32%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,977.59	96.41	5.1%
$x_{M}^{Eq.}$	214.88	149.94	-64.94	-30.2%
$x_{Total}^{Eq.}$	2,096.06	2,127.53	31.47	1.5%
$1-\psi$	89.7%	93.0%	0.03	3.6%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,000			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,089.56	89.56	4.5%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,089.56	89.56	4.5%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		573.36	13.36	2.4%
$p_{M}^{Eq.}$		1,986.70	-13.30	-0.7%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,986.70	-13.30	-0.7%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		470.50	-89.50	-16.0%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,167,508	-24,614	-0.59%
W^P	234,226	258,850	24,624	10.51%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	4,426,347	4,426,357	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 53. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0.5$; *IM*=1,313; *K*=76.2; *J*=0.6 ; *γ/μ*=36.92%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,966.04	84.86	4.5%
$x_{M}^{Eq.}$	214.88	159.54	-55.34	-25.8%
$x_{Total}^{Eq.}$	2,096.06	2,125.58	29.52	1.4%
$1-\psi$	89.7%	92.5%	0.03	3.1%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,873			
Price-Cost Margin	126.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,091.58	91.58	4.6%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,961.46	88.03	4.7%
Price-Cost Margin		130.13	3.55	2.8%
$p_{US}^{f.Eq.}$		571.83	11.83	2.1%
$p_{M}^{Eq.}$		1,983.29	-16.71	-0.8%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,873.35	-0.07	0.0%
Price-Cost Margin		109.94	-16.63	-13.1%
$p_{M}^{S.Eq.}$		483.72	-76.27	-13.6%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,162,459	-29,662	-0.71%
W^P	234,226	255,834	21,608	9.23%
Π	265,310	273,374	8,064	3.04%
W_{Total}	4,691,657	4,691,667	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 54. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 1$; *IM*=1,187; *K*=76.2; *J*=0.6 ; *γ/μ*=36.44%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,958.50	77.32	4.1%
$x_{M}^{Eq.}$	214.88	165.24	-49.64	-23.1%
$x_{Total}^{Eq.}$	2,096.06	2,123.73	27.67	1.3%
$1-\psi$	89.7%	92.2%	0.02	2.8%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,747			
Price-Cost Margin	253.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,093.14	93.14	4.7%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,833.88	87.03	5.0%
Price-Cost Margin		259.25	6.10	2.4%
$p_{US}^{f.Eq.}$		570.83	10.83	1.9%
$p_{M}^{Eq.}$		1,982.37	-17.63	-0.9%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,754.63	7.78	0.4%
Price-Cost Margin		227.74	-25.41	-10.0%
$p_{M}^{S.Eq.}$		491.58	-68.42	-12.2%
K / p_{NL}^{Eq}		3.8%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,157,721	-34,401	-0.82%
W^P	234,226	253,875	19,649	8.39%
Π	530,619	545,381	14,762	2.78%
W_{Total}	4,956,967	4,956,977	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 55. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=1,440; *K*=40; *J*=0.6 ; γ/μ=19.16%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,936.55	55.36	2.9%
$x_{M}^{Eq.}$	214.88	175.08	-39.80	-18.5%
$x_{Total}^{Eq.}$	2,096.06	2,111.62	15.56	0.7%
$1-\psi$	89.7%	91.7%	0.02	2.2%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,000			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,047.93	47.93	2.4%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,047.93	47.93	2.4%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		567.93	7.93	1.4%
$p_{M}^{Eq.}$		1,985.14	-14.86	-0.7%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,985.14	-14.86	-0.7%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		505.14	-54.86	-9.8%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,178,141	-13,980	-0.33%
W^P	234,226	248,216	13,990	5.97%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	4,426,347	4,426,357	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 56. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0.5$; *IM*=1,313; *K*=40; *J*=0.6 ; *γ/μ*=18.89%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,932.41	51.23	2.7%
$x_{M}^{Eq.}$	214.88	178.21	-36.67	-17.1%
$x_{Total}^{Eq.}$	2,096.06	2,110.63	14.57	0.7%
$1-\psi$	89.7%	91.6%	0.02	2.0%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,873			
Price-Cost Margin	126.58			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,048.71	48.71	2.4%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,920.81	47.38	2.5%
Price-Cost Margin		127.90	1.33	1.0%
$p_{US}^{f.Eq.}$		567.38	7.38	1.3%
$p_{M}^{Eq.}$		1,985.70	-14.30	-0.7%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,862.89	-10.54	-0.6%
Price-Cost Margin		122.81	-3.77	-3.0%
$p_{M}^{S.Eq.}$		509.46	-50.54	-9.0%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,175,465	-16,656	-0.40%
W^P	234,226	247,158	12,932	5.52%
Π	265,310	269,044	3,734	1.41%
W_{Total}	4,691,657	4,691,667	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 57. Market and welfare effects of MCOOL on apples when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 1$; *IM*=1,187; *K*=40; *J*=0.6 ; *γ/μ*=18.59%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,881.18	1,929.73	48.55	2.6%
$x_{M}^{Eq.}$	214.88	179.94	-34.94	-16.3%
$x_{Total}^{Eq.}$	2,096.06	2,109.66	13.60	0.6%
$1-\psi$	89.7%	91.5%	0.02	1.9%
$p_{NL}^{Eq.}$	2,000			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,747			
Price-Cost Margin	253.15			
$p_{NL}^{f.Eq.}$	560.00			
$p_{US}^{Eq.}$		2,049.32	49.32	2.5%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,793.88	47.03	2.7%
Price-Cost Margin		255.45	2.30	0.9%
$p_{US}^{f.Eq.}$		567.03	7.03	1.3%
$p_{M}^{Eq.}$		1,986.69	-13.31	-0.7%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,738.69	-8.16	-0.5%
Price-Cost Margin		248.00	-5.15	-2.0%
$p_{M}^{S.Eq.}$		511.84	-48.16	-8.6%
K / p_{NL}^{Eq}		2.0%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	4,192,121	4,172,939	-19,182	-0.46%
W^P	234,226	246,471	12,245	5.23%
Π	530,619	537,566	6,947	1.31%
W_{Total}	4,956,967	4,956,977	10	0.00%

i = NL, US, M; n.a: Not applicable.

Appendix 3

Sources of data

The following data is obtained from Lucier and Jerardo (2006) for the calendar year 2005 (specific references to pages in that publication in parenthesis):

- p_{NL} : 12-month average retail price for fresh field-grown tomatoes, adjusted to allow for 10% waste and spoilage incurred during marketing (p.106).
- p_{NL}^{S} : 12-month average of FOB shipping-point price for fresh field-grown tomatoes (p.106).
- $x_{M}^{S.Eq}$: US imports of fresh tomatoes, assumed to be destined for domestic consumption only (i.e., no re-exports) (p.68).
- $x_{US}^{S.Eq}$: Quantity of tomatoes produced in the US for fresh consumption in the domestic market, calculated as the domestic production minus US exports to the world (p.68).
- $x_{NL}^{Eq.} = x_{US}^{S.Eq.} + x_{M}^{S.Eq.}$: Total quantity of fresh tomatoes consumed in the US.
- $\psi = x_{M}^{S.Eq} / x_{NL}^{Eq}$: Proportion of imported fresh tomatoes in the domestic market.

Note: to calibrate the model, $x_{M}^{S.Eq}$ and $x_{US}^{S.Eq}$ are adjusted by the proportion of fresh-market tomatoes for at-home consumption, 70.2% (Lucier et al 2000)

The following data on the proportion of variable costs in grower price was used in the derivation of the cost of production of US tomatoes:

Variable/operation costs as a proportion of total receipts per acre	Type of tomatoes	Sources
84.83%	Fresh market tomatoes; Furrow Irrigated; San Joaquin Valley - California	Le Strange et al (2000)
83.92%	Fresh market tomatoes; East, North Carolina	Estes et al (2002a)
87.76%	Fresh market tomatoes; Mountains, North Carolina	Estes et al (2002b)
87.88%	Fresh market tomatoes; Pennsylvania	Orzolek et al (2006)
85.52%	Tomatoes on plastic-drip irrigation; South Carolina	Ferreira et al (2006)

- w_{US} = average of variable costs as a proportion of total receipts per acre * p_{NL}^{S}

The value of the shifter of the supply of imported tomatoes is derived from Economic Research Service (2007) as:

- *A*= The annual weighted average reference price for tomatoes imported from Mexico, i.e., \$4.30 per 25-pound box from July 1 to October 22 and \$5.81 per 25-pound box from October 23 to June 30.

Appendix 4

Table 58. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=2,126; *K*=76.2; *J*=0.6 ; *γ/μ*=38.60%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,729.38	322.74	22.9%
$x_{M}^{Eq.}$	736.43	527.71	-208.71	-28.3%
$x_{Total}^{Eq.}$	2,143.06	2,257.10	114.03	5.3%
$1-\psi$	65.6%	76.6%	0.11	16.7%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,900			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		3,001.70	101.70	3.5%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		3,001.70	101.70	3.5%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		799.50	25.50	3.3%
$p_{M}^{Eq.}$		2,880.01	-19.99	-0.7%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,880.01	-19.99	-0.7%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		677.81	-96.19	-12.4%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,722	1,553,732	10	0.00%
W^P	76,324	115,367	39,043	51.15%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	1,630,046	1,669,099	39,053	2.40%

i = NL, US, M; n.a: Not applicable.

Table 59. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 0.5$; $\theta_i^S = 0.5$; *IM*=1,330; *K*=76.2; *J*=0.6 ; *γ/μ*=25.29%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,753.42	346.79	24.7%
$x_{M}^{Eq.}$	736.43	468.37	-268.05	-36.4%
$x_{Total}^{Eq.}$	2,143.06	2,221.80	78.73	3.7%
$1-\psi$	65.6%	78.9%	0.13	20.2%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,104			
Price-Cost Margin	795.81			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,966.92	66.92	2.3%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,207.74	103.55	4.9%
Price-Cost Margin		759.18	-36.64	-4.6%
$p_{US}^{f.Eq.}$		801.35	27.35	3.5%
$p_{M}^{Eq.}$		2,893.18	-6.81	-0.2%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,056.85	-47.34	-2.2%
Price-Cost Margin		836.34	40.52	5.1%
$p_{M}^{S.Eq.}$		650.46	-123.54	-16.0%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,721	1,553,731	10	0.00%
W^P	76,324	118,597	42,273	55.39%
Π	1,705,478	1,722,879	17,401	1.02%
W_{Total}	3,335,523	3,395,207	59,683	1.79%

i = NL, US, M; n.a: Not applicable.

Table 60. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 1$; $\theta_i^S = 1$; *IM*=534; *K*=76.2; *J*=0.6 ; *γ/μ*=18.79%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,768.57	361.94	25.7%
$x_{M}^{Eq.}$	736.43	434.57	-301.86	-41.0%
$x_{Total}^{Eq.}$	2,143.06	2,203.14	60.08	2.8%
$1-\psi$	65.6%	80.3%	0.15	22.3%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,308			
Price-Cost Margin	1,591.63			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,949.77	49.77	1.7%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,413.09	104.72	8.0%
Price-Cost Margin		1,536.67	-54.95	-3.5%
$p_{US}^{f.Eq.}$		802.52	28.52	3.7%
$p_{M}^{Eq.}$		2,897.87	-2.13	-0.1%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,245.45	-62.92	-4.8%
Price-Cost Margin		1,652.41	60.79	3.8%
$p_{M}^{S.Eq.}$		634.88	-139.12	-18.0%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,720	1,553,730	10	0.00%
W^P	76,324	120,655	44,331	58.08%
Π	3,410,955	3,435,806	24,851	0.73%
W_{Total}	5,041,000	5,110,191	69,191	1.37%

i = NL, US, M; n.a: Not applicable.

Table 61. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=2,126; *K*=40; *J*=0.6 ; *γ/μ*=18.62%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,584.27	177.63	12.6%
$x_{M}^{Eq.}$	736.43	610.56	-125.87	-17.1%
$x_{Total}^{Eq.}$	2,143.06	2,194.83	51.76	2.4%
$1-\psi$	65.6%	72.2%	0.07	10.0%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,900			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,954.30	54.30	1.9%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,954.30	54.30	1.9%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		788.30	14.30	1.8%
$p_{M}^{Eq.}$		2,881.99	-18.01	-0.6%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,881.99	-18.01	-0.6%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		715.99	-58.01	-7.5%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,722	1,553,732	10	0.00%
W^P	76,324	96,818	20,494	26.85%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	1,630,046	1,650,550	20,504	1.26%

i = NL, US, M; n.a: Not applicable.

Table 62. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 0.5$; $\theta_i^S = 0.5$; *IM*=1,330; *K*=40; *J*=0.6 ; *γ/μ*=12.68%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,661.25	254.62	18.1%
$x_{M}^{Eq.}$	736.43	520.16	-216.27	-29.4%
$x_{Total}^{Eq.}$	2,143.06	2,181.41	38.34	1.8%
$1-\psi$	65.6%	76.2%	0.11	16.0%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,104			
Price-Cost Margin	795.81			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,935.67	35.67	1.2%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,164.43	60.24	2.9%
Price-Cost Margin		771.25	-24.57	-3.1%
$p_{US}^{f.Eq.}$		794.24	20.24	2.6%
$p_{M}^{Eq.}$		2,892.92	-7.08	-0.2%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,044.51	-59.67	-2.8%
Price-Cost Margin		848.40	52.59	6.6%
$p_{M}^{S.Eq.}$		674.32	-99.67	-12.9%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,721	1,553,731	10	0.00%
W^P	76,324	106,456	30,132	39.48%
Π	1,705,478	1,722,534	17,056	1.00%
W_{Total}	3,335,523	3,382,721	47,197	1.41%

i = NL, US, M; n.a: Not applicable.

Table 63. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 1$; $\theta_i^S = 1$; *IM*=534; *K*=40; *J*=0.6 ; *γ/μ*=9.58%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,701.41	294.78	21.0%
$x_{M}^{Eq.}$	736.43	471.73	-264.69	-35.9%
$x_{Total}^{Eq.}$	2,143.06	2,173.15	30.09	1.4%
$1-\psi$	65.6%	78.3%	0.13	19.3%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,308			
Price-Cost Margin	1,591.63			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,926.49	26.49	0.9%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,371.71	63.34	4.8%
Price-Cost Margin		1,554.77	-36.85	-2.3%
$p_{US}^{f.Eq.}$		797.34	23.34	3.0%
$p_{M}^{Eq.}$		2,896.90	-3.10	-0.1%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,226.38	-81.99	-6.3%
Price-Cost Margin		1,670.51	78.89	5.0%
$p_{M}^{S.Eq.}$		652.01	-121.99	-15.8%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,720	1,553,730	10	0.00%
W^P	76,324	111,665	35,341	46.30%
Π	3,410,955	3,433,351	22,395	0.66%
W_{Total}	5,041,000	5,098,746	57,747	1.15%

i = NL, US, M; n.a: Not applicable.

Table 64. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=2,126; *K*=76.2; *J*=0.6 ; *γ/μ*=6.92%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,406.73	0.09	0.0%
$x_{M}^{Eq.}$	736.43	671.11	-65.32	-8.9%
$x_{Total}^{Eq.}$	2,143.06	2,077.84	-65.23	-3.0%
$1-\psi$	65.6%	67.7%	0.02	3.1%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,900			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,976.81	76.81	2.6%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,976.81	76.81	2.6%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		774.61	0.61	0.1%
$p_{M}^{Eq.}$		2,946.09	46.10	1.6%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,946.09	46.10	1.6%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		743.89	-30.10	-3.9%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,722	1,436,941	-116,781	-7.52%
W^P	76,324	76,334	10	0.01%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	1,630,046	1,513,276	-116,771	-7.16%

i = NL, US, M; n.a: Not applicable.

Table 65. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=2,126; *K*=40; *J*=0.6 ; *γ/μ*=3.54%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,406.73	0.09	0.0%
$x_{M}^{Eq.}$	736.43	701.68	-34.74	-4.7%
$x_{Total}^{Eq.}$	2,143.06	2,108.41	-34.65	-1.6%
$1-\psi$	65.6%	66.7%	0.01	1.7%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,900			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,940.61	40.61	1.4%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,940.61	40.61	1.4%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		774.61	0.61	0.1%
$p_{M}^{Eq.}$		2,923.99	23.99	0.8%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,923.99	23.99	0.8%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		757.99	-16.01	-2.1%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,722	1,491,621	-62,100	-4.00%
W^P	76,324	76,334	10	0.01%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	1,630,046	1,567,956	-62,090	-3.81%

i = NL, US, M; n.a: Not applicable.

Table 66. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 0.5$; $\theta_i^S = 0.5$; *IM*=1,330; *K*=76.2; *J*=0.6 ; *γ/μ*=21.16%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,715.18	308.55	21.9%
$x_{M}^{Eq.}$	736.43	482.29	-254.14	-34.5%
$x_{Total}^{Eq.}$	2,143.06	2,197.47	54.41	2.5%
$1-\psi$	65.6%	78.1%	0.12	18.9%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,104			
Price-Cost Margin	795.81			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,963.97	63.97	2.2%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,204.79	100.60	4.8%
Price-Cost Margin		759.18	-36.64	-4.6%
$p_{US}^{f.Eq.}$		798.40	24.40	3.2%
$p_{M}^{Eq.}$		2,899.60	-0.40	0.0%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,063.26	-40.92	-1.9%
Price-Cost Margin		836.34	40.52	5.1%
$p_{M}^{S.Eq.}$		656.87	-117.12	-15.1%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,721	1,538,407	-15,313	-0.99%
W^P	76,324	113,481	37,156	48.68%
Π	1,705,478	1,705,488	10	0.00%
W_{Total}	3,335,523	3,357,376	21,853	0.66%

i = NL, US, M; n.a: Not applicable.

Table 67. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 1$; $\theta_i^S = 1$; *IM*=534; *K*=76.2; *J*=0.6 ; *γ/μ*=15.97%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,742.20	335.56	23.9%
$x_{M}^{Eq.}$	736.43	444.06	-292.36	-39.7%
$x_{Total}^{Eq.}$	2,143.06	2,186.26	43.20	2.0%
$1-\psi$	65.6%	79.7%	0.14	21.4%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,308			
Price-Cost Margin	1,591.63			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,947.73	47.74	1.6%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,411.06	102.69	7.8%
Price-Cost Margin		1,536.67	-54.95	-3.5%
$p_{US}^{f.Eq.}$		800.49	26.49	3.4%
$p_{M}^{Eq.}$		2,902.24	2.24	0.1%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,249.83	-58.54	-4.5%
Price-Cost Margin		1,652.41	60.79	3.8%
$p_{M}^{S.Eq.}$		639.26	-134.74	-17.4%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,720	1,542,959	-10,761	-0.69%
W^P	76,324	117,083	40,759	53.40%
Π	3,410,955	3,410,965	10	0.00%
W_{Total}	5,041,000	5,071,007	30,008	0.60%

i = NL, US, M; n.a: Not applicable.

Table 68. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 0.5$; $\theta_i^S = 0.5$; *IM*=1,330; *K*=40; *J*=0.6 ; *γ/μ*=8.63%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,618.04	211.40	15.0%
$x_{M}^{Eq.}$	736.43	539.35	-197.08	-26.8%
$x_{Total}^{Eq.}$	2,143.06	2,157.38	14.32	0.7%
$1-\psi$	65.6%	75.0%	0.09	14.3%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,104			
Price-Cost Margin	795.81			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,932.34	32.34	1.1%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,161.09	56.91	2.7%
Price-Cost Margin		771.25	-24.57	-3.1%
$p_{US}^{f.Eq.}$		790.91	16.91	2.2%
$p_{M}^{Eq.}$		2,901.76	1.76	0.1%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,053.36	-50.83	-2.4%
Price-Cost Margin		848.40	52.59	6.6%
$p_{M}^{S.Eq.}$		683.17	-90.83	-11.7%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,721	1,537,466	-16,255	-1.05%
W^P	76,324	100,990	24,665	32.32%
Π	1,705,478	1,705,488	10	0.00%
W_{Total}	3,335,523	3,343,943	8,420	0.25%

i = NL, US, M; n.a: Not applicable.

Table 69. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 1$; $\theta_i^S = 1$; *IM*=534; *K*=40; *J*=0.6 ; *γ/μ*=7.05%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,675.14	268.51	19.1%
$x_{M}^{Eq.}$	736.43	482.78	-253.65	-34.4%
$x_{Total}^{Eq.}$	2,143.06	2,157.93	14.86	0.7%
$1-\psi$	65.6%	77.6%	0.12	18.3%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,308			
Price-Cost Margin	1,591.63			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,924.46	24.46	0.8%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,369.69	61.32	4.7%
Price-Cost Margin		1,554.77	-36.85	-2.3%
$p_{US}^{f.Eq.}$		795.31	21.32	2.8%
$p_{M}^{Eq.}$		2,901.99	1.99	0.1%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,231.47	-76.90	-5.9%
Price-Cost Margin		1,670.51	78.89	5.0%
$p_{M}^{S.Eq.}$		657.10	-116.90	-15.1%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,720	1,543,529	-10,191	-0.66%
W^P	76,324	108,244	31,920	41.82%
Π	3,410,955	3,410,965	10	0.00%
W_{Total}	5,041,000	5,062,738	21,738	0.43%

i = NL, US, M; n.a: Not applicable.

Table 70. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=2,126; *K*=76.2; *J*=0.6 ; *γ/μ*=30.25%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,653.85	247.21	17.6%
$x_{M}^{Eq.}$	736.43	555.58	-180.84	-24.6%
$x_{Total}^{Eq.}$	2,143.06	2,209.43	66.37	3.1%
$1-\psi$	65.6%	74.9%	0.09	14.0%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,900			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,995.87	95.87	3.3%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,995.87	95.87	3.3%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		793.67	19.67	2.5%
$p_{M}^{Eq.}$		2,892.85	-7.14	-0.2%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,892.85	-7.14	-0.2%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		690.65	-83.34	-10.8%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,722	1,524,547	-29,175	-1.88%
W^P	76,324	105,509	29,185	38.24%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	1,630,046	1,630,056	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 71. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 0.5$; $\theta_i^S = 0.5$; *IM*=1,330; *K*=76.2; *J*=0.6 ; *γ/μ*=18.78%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,692.50	285.87	20.3%
$x_{M}^{Eq.}$	736.43	490.98	-245.44	-33.3%
$x_{Total}^{Eq.}$	2,143.06	2,183.49	40.43	1.9%
$1-\psi$	65.6%	77.5%	0.12	18.1%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,104			
Price-Cost Margin	795.81			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,962.22	62.22	2.1%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,203.04	98.85	4.7%
Price-Cost Margin		759.18	-36.64	-4.6%
$p_{US}^{f.Eq.}$		796.65	22.65	2.9%
$p_{M}^{Eq.}$		2,903.61	3.61	0.1%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,067.27	-36.92	-1.8%
Price-Cost Margin		836.34	40.52	5.1%
$p_{M}^{S.Eq.}$		660.88	-113.12	-14.6%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,721	1,529,492	-24,229	-1.56%
W^P	76,324	110,499	34,175	44.78%
Π	1,705,478	1,695,542	-9,937	-0.58%
W_{Total}	3,335,523	3,335,533	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 72. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 1$; $\theta_i^S = 1$; *IM*=534; *K*=76.2; *J*=0.6 ; *γ/μ*=13.81%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,721.52	314.89	22.4%
$x_{M}^{Eq.}$	736.43	451.83	-284.59	-38.6%
$x_{Total}^{Eq.}$	2,143.06	2,173.36	30.29	1.4%
$1-\psi$	65.6%	79.2%	0.14	20.7%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,308			
Price-Cost Margin	1,591.63			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,946.14	46.14	1.6%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,409.46	101.09	7.7%
Price-Cost Margin		1,536.67	-54.95	-3.5%
$p_{US}^{f.Eq.}$		798.89	24.89	3.2%
$p_{M}^{Eq.}$		2,905.82	5.82	0.2%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,253.41	-54.96	-4.2%
Price-Cost Margin		1,652.41	60.79	3.8%
$p_{M}^{S.Eq.}$		642.84	-131.16	-16.9%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,720	1,534,653	-19,067	-1.23%
W^P	76,324	114,321	37,997	49.78%
Π	3,410,955	3,392,036	-18,920	-0.55%
W_{Total}	5,041,000	5,041,009	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 73. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=2,126; *K*=40; *J*=0.6 ; *γ/μ*=14.73%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,541.75	135.12	9.6%
$x_{M}^{Eq.}$	736.43	630.56	-105.87	-14.4%
$x_{Total}^{Eq.}$	2,143.06	2,172.31	29.25	1.4%
$1-\psi$	65.6%	71.0%	0.05	8.1%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,900			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,951.02	51.02	1.8%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,951.02	51.02	1.8%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		785.02	11.02	1.4%
$p_{M}^{Eq.}$		2,891.21	-8.79	-0.3%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,891.21	-8.79	-0.3%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		725.21	-48.79	-6.3%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,722	1,538,365	-15,357	-0.99%
W^P	76,324	91,691	15,367	20.13%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	1,630,046	1,630,056	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 74. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 0.5$; $\theta_i^S = 0.5$; *IM*=1,330; *K*=40; *J*=0.6 ; *γ/μ*=7.75%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,608.41	201.77	14.3%
$x_{M}^{Eq.}$	736.43	543.80	-192.63	-26.2%
$x_{Total}^{Eq.}$	2,143.06	2,152.21	9.15	0.4%
$1-\psi$	65.6%	74.7%	0.09	13.9%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,104			
Price-Cost Margin	795.81			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,931.60	31.60	1.1%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,160.35	56.17	2.7%
Price-Cost Margin		771.25	-24.57	-3.1%
$p_{US}^{f.Eq.}$		790.16	16.17	2.1%
$p_{M}^{Eq.}$		2,903.81	3.81	0.1%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,055.41	-48.78	-2.3%
Price-Cost Margin		848.40	52.59	6.6%
$p_{M}^{S.Eq.}$		685.22	-88.78	-11.5%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,721	1,533,903	-19,817	-1.28%
W^P	76,324	99,791	23,467	30.75%
Π	1,705,478	1,701,839	-3,640	-0.21%
W_{Total}	3,335,523	3,335,533	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 75. Market and welfare effects of MCOOL on tomatoes when η=2; $\theta_i^D = 1$; $\theta_i^S = 1$; *IM*=534; *K*=40; *J*=0.6 ; *γ/μ*=5.52%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.64	1,658.90	252.26	17.9%
$x_{M}^{Eq.}$	736.43	489.86	-246.56	-33.5%
$x_{Total}^{Eq.}$	2,143.06	2,148.76	5.70	0.3%
$1-\psi$	65.6%	77.2%	0.12	17.6%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	1,308			
Price-Cost Margin	1,591.63			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,923.21	23.21	0.8%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		1,368.43	60.06	4.6%
Price-Cost Margin		1,554.77	-36.85	-2.3%
$p_{US}^{f.Eq.}$		794.06	20.06	2.6%
$p_{M}^{Eq.}$		2,905.25	5.25	0.2%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		1,234.74	-73.63	-5.6%
Price-Cost Margin		1,670.51	78.89	5.0%
$p_{M}^{S.Eq.}$		660.36	-113.63	-14.7%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	1,553,720	1,537,317	-16,403	-1.06%
W^P	76,324	106,155	29,830	39.08%
Π	3,410,955	3,397,538	-13,418	-0.39%
W_{Total}	5,041,000	5,041,009	9	0.00%

i = NL, US, M; n.a: Not applicable.

Table 76. Market and welfare effects of MCOOL on tomatoes when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=2,126; *K*=76.2; *J*=0.6 ; *γ/μ*=8.29%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.63	1,640.76	234.12	16.6%
$x_{M}^{Eq.}$	736.43	527.31	-209.12	-28.4%
$x_{Total}^{Eq.}$	2,143.06	2,168.07	25.00	1.2%
$1-\psi$	65.6%	75.7%	0.10	15.3%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,900			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,994.86	94.86	3.3%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,994.86	94.86	3.3%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		792.66	18.66	2.4%
$p_{M}^{Eq.}$		2,879.82	-20.18	-0.7%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,879.82	-20.18	-0.7%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		677.62	-96.38	-12.5%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	6,214,877	6,214,887	10	0.00%
W^P	76,324	103,845	27,521	36.06%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	6,291,202	6,318,733	27,531	0.44%

i = NL, US, M; n.a: Not applicable.

Table 77. Market and welfare effects of MCOOL on tomatoes when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0.5$; *IM*=2,055; *K*=76.2; *J*=0.6 ; *γ/μ*=8.52%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.63	1,701.92	295.28	21.0%
$x_{M}^{Eq.}$	736.43	468.01	-268.42	-36.4%
$x_{Total}^{Eq.}$	2,143.06	2,169.92	26.86	1.3%
$1-\psi$	65.6%	78.4%	0.13	19.5%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,829			
Price-Cost Margin	70.81			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,994.42	94.42	3.3%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,928.77	99.58	3.5%
Price-Cost Margin		65.65	-5.16	-7.3%
$p_{US}^{f.Eq.}$		797.38	23.38	3.0%
$p_{M}^{Eq.}$		2,889.52	-10.47	-0.4%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,781.68	-47.51	-1.7%
Price-Cost Margin		107.85	37.03	52.3%
$p_{M}^{S.Eq.}$		650.29	-123.71	-16.0%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	6,214,877	6,214,887	10	0.00%
W^P	76,324	111,732	35,408	46.39%
Π	151,757	162,204	10,447	6.88%
W_{Total}	6,442,959	6,488,823	45,864	0.71%

i = NL, US, M; n.a: Not applicable.

Table 78. Market and welfare effects of MCOOL on tomatoes when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 1$; *IM*=1,984; *K*=76.2; *J*=0.6 ; *γ/μ*=8.69%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.63	1,736.81	330.18	23.5%
$x_{M}^{Eq.}$	736.43	434.25	-302.18	-41.0%
$x_{Total}^{Eq.}$	2,143.06	2,171.06	28.00	1.3%
$1-\psi$	65.6%	80.0%	0.14	21.9%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,758			
Price-Cost Margin	141.63			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,994.64	94.64	3.3%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,860.64	102.27	3.7%
Price-Cost Margin		133.99	-7.63	-5.4%
$p_{US}^{f.Eq.}$		800.07	26.07	3.4%
$p_{M}^{Eq.}$		2,895.44	-4.56	-0.2%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,695.31	-63.06	-2.3%
Price-Cost Margin		200.13	58.51	41.3%
$p_{M}^{S.Eq.}$		634.73	-139.26	-18.0%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	6,214,877	6,214,887	10	0.00%
W^P	76,324	116,361	40,036	52.46%
Π	303,515	319,629	16,114	5.31%
W_{Total}	6,594,716	6,650,877	56,161	0.85%

i = NL, US, M; n.a: Not applicable.

Table 79. Market and welfare effects of MCOOL on tomatoes when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=2,126; *K*=40; *J*=0.6 ; *γ/μ*=4.20%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.63	1,543.00	136.37	9.7%
$x_{M}^{Eq.}$	736.43	611.82	-124.60	-16.9%
$x_{Total}^{Eq.}$	2,143.06	2,154.83	11.76	0.5%
$1-\psi$	65.6%	71.6%	0.06	9.1%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,900			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,951.12	51.12	1.8%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,951.12	51.12	1.8%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		785.12	11.12	1.4%
$p_{M}^{Eq.}$		2,882.57	-17.43	-0.6%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,882.57	-17.43	-0.6%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		716.57	-57.43	-7.4%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	6,214,878	6,214,887	10	0.00%
W^P	76,324	91,840	15,516	20.33%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	6,291,202	6,306,728	15,526	0.25%

i = NL, US, M; n.a: Not applicable.

Table 80. Market and welfare effects of MCOOL on tomatoes when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0.5$; *IM*=2,055; *K*=40; *J*=0.6 ; *γ/μ*=4.39%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.63	1,635.80	229.17	16.3%
$x_{M}^{Eq.}$	736.43	520.59	-215.83	-29.3%
$x_{Total}^{Eq.}$	2,143.06	2,156.40	13.34	0.6%
$1-\psi$	65.6%	75.9%	0.10	15.6%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,829			
Price-Cost Margin	70.81			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,950.57	50.57	1.7%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,887.47	58.28	2.1%
Price-Cost Margin		63.10	-7.71	-10.9%
$p_{US}^{f.Eq.}$		792.28	18.28	2.4%
$p_{M}^{Eq.}$		2,889.68	-10.32	-0.4%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,769.71	-59.47	-2.1%
Price-Cost Margin		119.96	49.15	69.4%
$p_{M}^{S.Eq.}$		674.53	-99.47	-12.9%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	6,214,878	6,214,887	10	0.00%
W^P	76,324	103,220	26,896	35.24%
Π	151,757	165,672	13,915	9.17%
W_{Total}	6,442,959	6,483,780	40,820	0.63%

i = NL, US, M; n.a: Not applicable.

Table 81. Market and welfare effects of MCOOL on tomatoes when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 1$; *IM*=1,984; *K*=40; *J*=0.6 ; *γ/μ*=4.50%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.63	1,685.37	278.74	19.8%
$x_{M}^{Eq.}$	736.43	471.87	-264.55	-35.9%
$x_{Total}^{Eq.}$	2,143.06	2,157.24	14.18	0.7%
$1-\psi$	65.6%	78.1%	0.12	19.0%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,758			
Price-Cost Margin	141.63			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,950.50	50.50	1.7%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,820.48	62.10	2.3%
Price-Cost Margin		130.02	-11.60	-8.2%
$p_{US}^{f.Eq.}$		796.10	22.10	2.9%
$p_{M}^{Eq.}$		2,893.92	-6.08	-0.2%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,676.45	-81.93	-3.0%
Price-Cost Margin		217.47	75.85	53.6%
$p_{M}^{S.Eq.}$		652.07	-121.93	-15.8%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	6,214,877	6,214,887	10	0.00%
W^P	76,324	109,570	33,246	43.56%
Π	303,515	321,759	18,244	6.01%
W_{Total}	6,594,717	6,646,217	51,500	0.78%

i = NL, US, M; n.a: Not applicable.

Table 82. Market and welfare effects of MCOOL on tomatoes when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=2,126; *K*=72.6; *J*=0.6 ; *γ/μ*=0.61%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.63	1,406.73	0.09	0.0%
$x_{M}^{Eq.}$	736.43	712.37	-24.06	-3.3%
$x_{Total}^{Eq.}$	2,143.06	2,119.10	-23.96	-1.1%
$1-\psi$	65.6%	66.4%	0.01	1.1%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,900			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,976.81	76.81	2.6%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,976.81	76.81	2.6%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		774.61	0.61	0.1%
$p_{M}^{Eq.}$		2,965.11	65.11	2.2%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,965.11	65.11	2.2%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		762.91	-11.09	-1.4%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	6,214,878	6,068,169	-146,709	-2.36%
W^P	76,324	76,334	10	0.01%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	6,291,202	6,144,503	-146,699	-2.33%

i = NL, US, M; n.a: Not applicable.

Table 83. Market and welfare effects of MCOOL on tomatoes when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=2,126; *K*=40; *J*=0.6 ; γ/μ=0.33%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.63	1,406.73	0.09	0.0%
$x_{M}^{Eq.}$	736.43	723.74	-12.68	-1.7%
$x_{Total}^{Eq.}$	2,143.06	2,130.47	-12.59	-0.6%
$1-\psi$	65.6%	66.0%	0.00	0.6%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,900			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,940.61	40.61	1.4%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,940.61	40.61	1.4%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		774.61	0.61	0.1%
$p_{M}^{Eq.}$		2,934.15	34.15	1.2%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,934.15	34.15	1.2%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		768.15	-5.85	-0.8%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	6,214,878	6,137,439	-77,438	-1.25%
W^P	76,324	76,334	10	0.01%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	6,291,202	6,213,774	-77,428	-1.23%

i = NL, US, M; n.a: Not applicable.

Table 84. Market and welfare effects of MCOOL on tomatoes when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=2,126; *K*=72.6; *J*=0.6 ; *γ/μ*=7.01%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.63	1,609.20	202.56	14.4%
$x_{M}^{Eq.}$	736.43	550.48	-185.94	-25.2%
$x_{Total}^{Eq.}$	2,143.06	2,159.68	16.62	0.8%
$1-\psi$	65.6%	74.5%	0.09	13.5%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,900			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,992.43	92.43	3.2%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,992.43	92.43	3.2%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		790.23	16.23	2.1%
$p_{M}^{Eq.}$		2,890.50	-9.50	-0.3%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,890.50	-9.50	-0.3%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		688.30	-85.70	-11.1%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	6,214,877	6,191,323	-23,555	-0.38%
W^P	76,324	99,889	23,565	30.87%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	6,291,202	6,291,212	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 85. Market and welfare effects of MCOOL on tomatoes when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0.5$; *IM*=2,055; *K*=72.6; *J*=0.6 ; *γ/μ*=6.25%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.63	1,660.82	254.19	18.1%
$x_{M}^{Eq.}$	736.43	494.42	-242.00	-32.9%
$x_{Total}^{Eq.}$	2,143.06	2,155.25	12.19	0.6%
$1-\psi$	65.6%	77.1%	0.11	17.4%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,829			
Price-Cost Margin	70.81			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,989.66	89.66	3.1%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,925.60	96.41	3.4%
Price-Cost Margin		64.07	-6.75	-9.5%
$p_{US}^{f.Eq.}$		794.21	20.21	2.6%
$p_{M}^{Eq.}$		2,907.79	7.79	0.3%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,793.85	-35.33	-1.2%
Price-Cost Margin		113.93	43.12	60.9%
$p_{M}^{S.Eq.}$		662.47	-111.53	-14.4%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	6,214,877	6,173,835	-41,042	-0.66%
W^P	76,324	106,401	30,077	39.41%
Π	151,757	162,732	10,975	7.23%
W_{Total}	6,442,959	6,442,969	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 86. Market and welfare effects of MCOOL on tomatoes when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 1$; *IM*=1,984; *K*=72.6; *J*=0.6 ; *γ/μ*=5.90%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.63	1,695.78	289.15	20.6%
$x_{M}^{Eq.}$	736.43	457.40	-279.03	-37.9%
$x_{Total}^{Eq.}$	2,143.06	2,153.18	10.12	0.5%
$1-\psi$	65.6%	78.8%	0.13	20.0%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,758			
Price-Cost Margin	141.63			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,988.31	88.31	3.0%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,857.48	99.11	3.6%
Price-Cost Margin		130.83	-10.80	-7.6%
$p_{US}^{f.Eq.}$		796.91	22.91	3.0%
$p_{M}^{Eq.}$		2,916.78	16.78	0.6%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,705.98	-52.40	-1.9%
Price-Cost Margin		210.80	69.18	48.8%
$p_{M}^{S.Eq.}$		645.40	-128.60	-16.6%
K / p_{NL}^{Eq}		2.6%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	6,214,877	6,165,521	-49,356	-0.79%
W^P	76,324	110,928	34,604	45.34%
Π	303,515	318,277	14,762	4.86%
W_{Total}	6,594,717	6,594,726	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 87. Market and welfare effects of MCOOL on tomatoes when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0$; *IM*=2,126; *K*=40; *J*=0.6 ; *γ/μ*=3.52%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.63	1,521.99	115.36	8.2%
$x_{M}^{Eq.}$	736.43	628.51	-107.91	-14.7%
$x_{Total}^{Eq.}$	2,143.06	2,150.50	7.44	0.3%
$1-\psi$	65.6%	70.8%	0.05	7.8%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,900			
Price-Cost Margin	-			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,949.50	49.50	1.7%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,949.50	49.50	1.7%
Price-Cost Margin		-	n.a.	n.a.
$p_{US}^{f.Eq.}$		783.50	9.50	1.2%
$p_{M}^{Eq.}$		2,890.26	-9.73	-0.3%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,890.26	-9.73	-0.3%
Price-Cost Margin		-	n.a.	n.a.
$p_{M}^{S.Eq.}$		724.26	-49.73	-6.4%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	6,214,878	6,201,855	-13,022	-0.21%
W^P	76,324	89,356	13,032	17.07%
Π	n.a.	n.a.	n.a.	n.a.
W_{Total}	6,291,202	6,291,212	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 88. Market and welfare effects of MCOOL on tomatoes when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 0.5$; *IM*=2,055; *K*=40; *J*=0.6 ; *γ/μ*=2.39%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.63	1,593.09	186.46	13.3%
$x_{M}^{Eq.}$	736.43	550.53	-185.89	-25.2%
$x_{Total}^{Eq.}$	2,143.06	2,143.63	0.57	0.0%
$1-\psi$	65.6%	74.3%	0.09	13.2%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,829			
Price-Cost Margin	70.81			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,945.62	45.62	1.6%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,884.17	54.99	1.9%
Price-Cost Margin		61.45	-9.36	-13.2%
$p_{US}^{f.Eq.}$		788.98	14.99	1.9%
$p_{M}^{Eq.}$		2,910.38	10.38	0.4%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,783.51	-45.67	-1.6%
Price-Cost Margin		126.86	56.05	79.2%
$p_{M}^{S.Eq.}$		688.33	-85.67	-11.1%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	6,214,878	6,177,326	-37,551	-0.60%
W^P	76,324	97,900	21,576	28.27%
Π	151,757	167,742	15,985	10.53%
W_{Total}	6,442,959	6,442,969	10	0.00%

i = NL, US, M; n.a: Not applicable.

Table 89. Market and welfare effects of MCOOL on tomatoes when η=0.5; $\theta_i^D = 0$; $\theta_i^S = 1$; *IM*=1,984; *K*=40; *J*=0.6 ; *γ/μ*=1.93%

Variables	Pre-COOL	Post-COOL	Absolute Change	Proportional Change
$x_{US}^{Eq.}$	1,406.63	1,642.79	236.16	16.8%
$x_{M}^{Eq.}$	736.43	498.12	-238.30	-32.4%
$x_{Total}^{Eq.}$	2,143.06	2,140.92	-2.14	-0.1%
$1-\psi$	65.6%	76.7%	0.11	16.9%
$p_{NL}^{Eq.}$	2,900			
Total Cost= $p_{NL}^{f.Eq.} + IM$	2,758			
Price-Cost Margin	141.63			
$p_{NL}^{f.Eq.}$	774.00			
$p_{US}^{Eq.}$		2,943.93	43.93	1.5%
Total Cost= $p_{US}^{f.Eq.} + IM + K$		2,817.19	58.82	2.1%
Price-Cost Margin		126.74	-14.89	-10.5%
$p_{US}^{f.Eq.}$		792.82	18.82	2.4%
$p_{M}^{Eq.}$		2,918.11	18.12	0.6%
Total Cost= $p_{M}^{S.Eq.} + IM + K$		2,688.54	-69.83	-2.5%
Price-Cost Margin		229.57	87.94	62.1%
$p_{M}^{S.Eq.}$		664.17	-109.83	-14.2%
K / p_{NL}^{Eq}		1.4%		
$J / p_{NL}^{S.Eq}$		0.1%		
W^C	6,214,878	6,168,061	-46,817	-0.75%
W^P	76,324	104,104	27,779	36.40%
Π	303,515	322,562	19,047	6.28%
W_{Total}	6,594,717	6,594,726	9	0.00%

i = NL, US, M; n.a: Not applicable.