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of the Special Milk Classes Scheme of Canada
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Abstract

We examine the effects of Canada's Special Milk Classes Scheme on resource allocation and discuss the rationale for average total cost of production as a measure of payments. Our simple model divides the total supply of fluid milk into two classes: one for domestic consumption and the other for export. First we show that the regulated high price of milk sold for domestic consumption does not yield cross subsidization if the processed milk for export is traded freely in the international market. In addition, the price of milk processed and sold for export may not be lower than the average total cost in some cases. It implies that the average total cost standard does not necessarily provide the proper measure of the subsidy.

Keywords: Special Milk Classes Scheme of Canada, cross subsidization, average total cost, and agricultural subsidy.

JEL classification: F10; Q17; Q18; H20

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1. Introduction

Dairy products and their processed goods are under government control in many countries. One example is Canada's Special Milk Classes Scheme introduced in 1995. It established five different milk classes, which include four classes of milk for the domestic market and the fifth class for milk sold to processors who export their products. The Canadian Dairy Commission (CDC) regulates milk prices but the exporters/processors are required to negotiate the prices of milk with the CDC. Later Canada introduced a new class called "commercial export milk or cream (CEM)". Milk under this class is traded without any government intervention, but must not be sold for domestic consumption nor be processed for domestic sales. The scheme makes the price of milk sold to processors who export their products lower than the regulated price of milk sold for domestic consumption or production of processed goods sold in the domestic market.

The United States and New Zealand challenged Canada's Scheme at the WTO, claiming that it provided export subsidies in violation with the Agreement on Agriculture. The Appellate Body (AB) of the WTO is in favor of an "objective standard or benchmark which reflects the proper value of goods or services". The AB proposed the average total cost as such a standard or benchmark. That is, the identification of export subsidies must be based on the comparison between the price of milk paid by the processors/exporters and the average total cost of milk production.¹

Janow and Staiger (2001) criticized the use of the average total cost as a standard or benchmark. In a very simple partial equilibrium model, they found that the consumption tax on the milk sold for domestic consumption generates the same resource allocation as the special milk classes scheme. Under the average total cost

¹ WTO (2001) paras. 72-96.

standard, however, the special milk classes scheme is judged as export subsidy but the consumption tax is not. So they did not find an economic rationality for the average total cost standard.

In this paper we reexamine whether the milk class scheme makes the price of milk sold for exports lower than the average total cost, and derive the various effects the scheme has. We incorporate milk and cheese industries in a simple model. The price and supply of milk in the domestic market are controlled by the government and the “excess” milk is exported to foreign countries.²

We find that the scheme generates a gap between the regulated price of milk sold for domestic consumption and the price of milk sold for exports if there is a trade restriction on imports of cheese. If the scheme reduces the price of milk sold for exports, then cross subsidization will occur and the scheme has a similar effect as an export subsidy. But this may not happen in the extreme cases, and we may not identify the cross subsidization. In addition, if we incorporate heterogeneous domestic dairy farmers, the price of milk sold for exports is higher than the average total cost even if the government introduces the scheme.

Our model extends Janow and Staiger’s analysis and distinguishes between milk producers (dairy farmers) and processors/exporters (cheese producers). We show that the productivity of the processors/exporters plays an important role in explaining the price gap between the milk sold for domestic consumption and that sold for exports. In the case of heterogeneous dairy farmers, we find that cross subsidization may not occur and the average total cost standard may not identify a price gap.

This paper is organized as follows. In section 2 we describe the basic model

² Suzuki, Kinoshita and Kaiser (2001) introduces the State Trading Enterprises which control the price of milk sold for domestic consumption and set the pool price for milk sold for exports. In this paper, however, we assume that the government set the arbitrary regulated price based on the demand for milk in order to simplify the analysis.

which incorporate milk and cheese producers. In section 3 we consider the competitive equilibrium without the special milk classes scheme. Section 4 derives its effects on resource allocation. Section 5 shows the relationship between the average total cost and the price of milk sold for exports. Section 6 introduces heterogeneous milk producers. The final section gives concluding remarks.

2. The Basic Model

There are two countries: home (“Canada”) and foreign (“the U.S.”). In the home country, dairy farmers produce dairy products (“Milk”) and sell to producers of processed dairy products (“Cheese”) export. The dairy products are sold only in the domestic market and are not imported from the foreign country due to some trade barriers. The processed dairy products are consumed in the domestic market and also exported to the foreign country.

We denote the price of milk for domestic use as p and that for export as q . The price of milk in the Home country must be identical without any government intervention in a competitive market regardless of usage, i.e., the milk used to make cheese to be exported must be priced equally to that used for other domestic purposes. However, in the Canadian case, the milk market is not competitive. In fact, the government controls the price and supply of the milk for domestic use, and the surplus milk is supplied to the producers of exported cheese under the Canada’s Special Milk Classes Scheme. As a consequence, the price of milk processed for domestic consumption may be different from the price of milk processed for export.

The dairy farmers in the home country produce milk. The total cost function of milk is $C(Q_s)$ where Q_s is the total output of milk in the home country. We assume

that the cost function is non-decreasing in Q_s . The technology of milk production exhibits increasing returns to scale if the average cost is decreasing in Q , decreasing returns to scale if it is increasing in Q , and constant returns to scale if it is constant in Q .

On the other hand, the production function of cheese is $h(Q)$ with $h'(Q) \equiv dh(Q)/dQ > 0$ and $h''(Q) \equiv dh'(Q)/dQ < 0$. If h'' approaches zero, h' becomes constant and one unit of cheese production requires $1/h'$ unit of milk.

The domestic demand for cheese in the home country is $D(r)$, where r is the domestic price of cheese and $D'(r) \equiv dD(r)/dr < 0$. The foreign country imports cheese from the home country. We denote the foreign import demand function as $F(w)$ where w is the world price of cheese and $F'(w) \equiv dF(w)/dw < 0$.

2.1 The Benchmark Case

Let us consider the benchmark case where the government of the home country does not intervene in the milk market. We also assume that the domestic and the world markets of cheese are perfectly competitive. Then, the price of milk processed for export must equal the one for domestic use, i.e., $q = p$. In addition, the domestic price of cheese must equal the world price of cheese, i.e., $r = w$.

The cheese producers in the home country maximize their profits $\pi = wh(Q) - qQ$. The profit maximization condition gives the demand for milk which satisfies $wh'(Q) = q$. We can denote the milk demand function as $Q(q, w)$, where $Q_q \equiv \partial Q / \partial q = 1/wh'' < 0$ and $Q_w \equiv \partial Q / \partial w = -h'/wh'' > 0$. We also have $Q_w = -h'Q_q$. Here we can define the price elasticity of milk demand as $\varepsilon_Q \equiv -(q/Q)Q_q$. When h''

approaches zero or h' becomes constant, then ε_Q approaches infinity. On the other hand if h'' approaches infinity, then ε_Q becomes zero. The supply function of cheese is $Z(q, w) = h(Q(q, w))$. An increase in the world price of cheese increases the amount of cheese supply, i.e., $Z_w \equiv \partial Z / \partial w = h' Q_w = -(h'')^2 Q_q > 0$. On the other hand, an increase in the milk price will reduce the supply of cheese, i.e., $Z_q \equiv \partial Z / \partial q = h' Q_q < 0$.

The milk producers in the home country maximize their profits under the domestic competitive market. The price of milk must be equal to the marginal cost of milk production. The supply function of milk, $S(q)$, is derived from the condition that $q = C'(Q_s)$.

The equilibrium prices of cheese and milk are determined from the market clearing conditions in their respective markets. The total demand for cheese consists of the domestic demand and the foreign import demand. Therefore the market clearing condition for cheese is $D(w) + F(w) = Z(q, w)$. We also define the export supply function of cheese as $E(q, w) \equiv Z(q, w) - D(w)$ where $E_w = Z_w - D' > 0$ and $E_q = Z_q < 0$. The export supply function is increasing in the world price of cheese, and an increase in the milk price reduces the export supply. Then, the equilibrium condition for cheese can be expressed as $E(q, w) = F(w)$. On the other hand, we must have $Q(q, w) = S(q)$ for the milk market in equilibrium.

From the market clearing condition for cheese, we obtain the world price which depends on the milk price, $w(q)$. Total differentiation of the equilibrium condition yields

$$\frac{dw}{dq} = \frac{\varepsilon_Q}{(F/Q)\varepsilon_F + (D/Q)\varepsilon_D + (q/w)\varepsilon_Q} \geq 0$$

where $\varepsilon_F \equiv -(w/F)F_w$ is the price elasticity of foreign import demand function and $\varepsilon_D \equiv -(r/D)D_r$ is the price elasticity of domestic cheese demand function. It shows that $dw/dq = 0$ when $\varepsilon_F \rightarrow +\infty$ or $\varepsilon_Q \rightarrow 0$.

Substituting $w(q)$ into the market clearing condition of milk, we have $Q(q, w(q)) = S(q)$. This condition yields the equilibrium milk price. The slope of the milk demand curve is

$$\frac{dQ}{dq} = Q_q + Q_w \left(\frac{dw}{dq} \right)$$

The first term shows the direct effect of the milk price on the demand for milk. As the milk price increases, the demand for milk will decrease. The second term shows the indirect effect which appears as the world price of cheese changes. An increase in the milk price increases the world price of cheese. Then, the domestic cheese producers try to increase the supply of cheese, which leads to an increase in the milk demand. Although there are two opposite effects, we obtain

$$\frac{dQ}{dq} = - \frac{\{(F/Q)\varepsilon_F + (D/Q)\varepsilon_D\}(Q/q)\varepsilon_Q}{(F/Q)\varepsilon_F + (D/Q)\varepsilon_D + (q/w)\varepsilon_Q} \leq 0$$

Thus, the demand curve for milk is non-increasing in its price. As the supply curve is non-decreasing in the milk price, the market clearing condition gives us the equilibrium price of milk.

Let us denote the equilibrium price and supply of milk without government intervention as q_0 and Q_0 , respectively. The equilibrium price of milk is equal to the marginal cost of the dairy farmers. If entry or exit is free in the milk market, the excess profit must disappear in the long-run equilibrium. Then, the milk price equals the minimum total average cost of the dairy farmers. We denote the average cost function as $AC(Q_s) \equiv C(Q_s)/Q_s$, we have $q_0 = AC(Q_0)$.

3. The Milk Special Classes Scheme

Now suppose that the government of the home country introduces price and supply control over the milk processed for domestic consumption of cheese, and the “excess” milk is supplied at the competitive market price for the cheese producers who export cheese. Let us denote the regulated price of milk for processors (cheese producers) for domestic sales as p_1 . The government also controls the supply of milk for them at x_1 .

We assume that the cheese producers are required to input the milk sold for domestic consumption first. Then, the amount of cheese supplied in the domestic market is $h(x_1)$. The equilibrium price of cheese in the domestic market is determined so that the equilibrium condition $h(x_1) = D(r)$ is satisfied. The domestic cheese price is

expressed as a function of x_1 and $dr/dx_1 = h'(x_1)/D' \equiv h'_1/D'$. The consumption of cheese in the home country is given by $D(r(x_1))$.

The government sets the price of milk sold for domestic consumption. The profit of cheese production is expressed as

$$\pi_1 = rh(x_1) + w\{h(x_1 + y) - h(x_1)\} - (p_1x_1 + qy) \quad (1)$$

where y is the amount of milk processed for exports of cheese or “excess” milk.³ The first and second terms are the revenue from the domestic and foreign cheese sales, respectively, and the third term is the total cost. Maximizing the profits with respect to x_1 , we obtain the inverse demand of the milk sold for domestic consumption:⁴

$$p_1 = rh'(x_1) + w\{h'(x_1 + y) - h'(x_1)\} \quad (2)$$

Here we assume that cheese producers regard the prices of milk and cheese and the amount of milk sold for exports of cheese constant. The first term shows the marginal benefits from the domestic market. The second term is the marginal loss in the foreign market since the marginal supply of cheese in the foreign market decreases as x_1 increases. The government is assumed to set the price following equation (2).

We can derive the gap between the milk price sold for domestic consumption and the one for exports. As we see later, the marginal revenue of the milk sold for exports

³ If there is no government intervention, we have $r=w$ and $p_1=q$. Then, the profit function is identical to the one in the benchmark case.

⁴ The government can use equation (2) to determine x_1 for given p_1 .

will be the same as its marginal cost, i.e. the price of milk sold for exports:

$wh'(x_1 + y) = q$ (eq.(4)). Arranging equation (2), we obtain

$$p_1 - q = (r - w)h'(x_1) \quad (3)$$

We obtain two important implications on the milk price gap from equation (3). First, the price of milk sold for exports must be lower than the regulated milk price if the domestic cheese price is higher than its world price. The gap between the regulated price and the price of milk sold for domestic consumption is not generated only by the scheme. Some form of trade barriers in the cheese markets may be essential to the milk price gap. If the domestic and foreign markets for cheese are integrated and there is no trade barrier, i.e., $r = w$, the regulated price must be equal to the price of milk sold for domestic consumption. Secondly, equation (3) implies that the rate of shifting from the cheese price gap to the milk price gap becomes smaller as x_1 increases when $h'' < 0$, or as the productivity of cheese becomes lower.

The profit maximization condition for cheese producers with respect to milk sold for exports is

$$wh'(x_1 + y) = q \quad (4)$$

We have the total demand for milk from (4): $Q(q, w) = x_1 + y$. The demand for milk sold for cheese exports is $y = Q(q, w) - x_1$. The total supply of cheese is given by

$$Z(q, w) = h(Q(q, w)).$$

The market clearing condition for cheese is

$$Z(q, w) - D(r(x_1)) = F(w) \quad (5)$$

From equation (5), we have the equilibrium world price of cheese as a function of q and x_1 . Let us denote the solution function as $w(q, x_1)$. Totally differentiating (5) gives

$$\frac{\partial w}{\partial q} \equiv w_q = \frac{\varepsilon_Q}{(F/D)\varepsilon_F + (q/w)\varepsilon_Q} \geq 0 \quad (6)$$

$$\frac{\partial w}{\partial x_1} \equiv w_{x_1} = \frac{h'(x_1)w/Q}{(F/Q)\varepsilon_F + (q/w)\varepsilon_Q} \geq 0 \quad (7)$$

An increase in the price of milk sold for exports reduces the supply of cheese. It increases the world price of cheese as is shown in equation (6). On the other hand, a reduction in the supply of milk sold for domestic consumption will increase the domestic cheese price and reduce the domestic consumption of cheese. It increases the export supply of cheese and reduces the world price of cheese.

The market clearing condition for milk sold for exports as $y = S - x_1$ or

$$Q(q, w) = S(q) \quad (8)$$

Substituting $w(q, x_1)$ into the market clearing condition of milk, we have

$$Q(q, w(q, x_1)) = S(q) \quad (9)$$

From this condition, we obtain the equilibrium price of milk sold for exports, $q(x_1) \equiv q_1$.

A change in the price of milk sold for exports has the following effect on the demand for milk.

$$\frac{dQ}{dq} = -\frac{(F/q)\varepsilon_F\varepsilon_Q}{(F/Q)\varepsilon_F + (q/w)\varepsilon_Q} \leq 0 \quad (10)$$

$$\frac{dQ}{dx_1} = Q_w w_{x_1} \geq 0 \quad (11)$$

From (10) we observe that the demand curve has a negative slope if ε_F and ε_Q are positive. Therefore we can find the unique equilibrium price of milk sold for exports if its supply curve is increasing in the output, i.e., $S' \equiv dS/dq > 0$.

The effect of a reduction in the supply of milk for the domestic use on the milk price for exports is given by

$$\frac{dq}{dx_1} = \frac{dQ/dx_1}{S' - (dQ/dq)} \geq 0 \quad (12)$$

If the government forces dairy farmers to reduce milk supply sold for domestic

consumption, the price of milk sold for exports will fall except for some cases.

First, from (7), the world price of cheese does not change when ε_F approaches infinity even if the government reduces the supply of milk sold for domestic consumption. When ε_F is infinity, the foreign import demand curve becomes a horizontal line. It implies that they can import any volume of cheese at the constant world price (i.e., the home country can be considered a small open economy). Therefore, the introduction of this scheme has no effect on the world price of cheese and the price of milk sold for exports.

Secondly the price of milk sold for exports does not change if $\varepsilon_Q = 0$. Since $Q_w = -h'Q_q$, we know that the total supply curve of cheese becomes a vertical line. A reduction in the supply of milk sold for domestic consumption will increase the export supply of cheese and the world price of cheese will decrease. But the total supply curve of cheese is insensitive to the cheese price, its total supply will not change. Then the total demand for milk will be the same amount and the price of milk sold for exports will not change. A reduction in the supply of milk sold for domestic consumption will be completely offset by an increase in the supply of milk sold for exports.

Finally the equilibrium world price of cheese is expressed as $w(q_1, x_1) \equiv w_1$ and the total supply of milk is $Q(q_1, w(q_1, x_1)) = S(q_1) \equiv Q_1$. The amount of milk sold for exports is given by $y_1 \equiv Q_1 - x_1$.

4. The Average Cost and the Price of Milk Sold for Exports

In this section we will discuss the relationship between the average total cost and

the price of milk sold for exports. Let us consider conditions under which the price of milk sold for exports becomes lower than the total average cost. Introduction of the scheme may change the equilibrium price of milk sold for exports as shown by (12). It also changes the average total cost which depends on the total output of milk. The average total cost can be expressed as $AC(S(q(x_1)))$. From this definition, a change in the average total cost would be

$$dAC / dx_1 = AC' \cdot S' \cdot (dq / dx_1) \quad (13)$$

In order to identify the conditions we define the difference between the milk price for exports and the average total cost.

$$\lambda(x_1) \equiv AC(S(q(x_1))) - q(x_1) \quad (14)$$

Totally differentiating this equation, we obtain

$$d\lambda / dx_1 = (AC' \cdot S' - 1)(dq / dx_1) \quad (15)$$

If there is no government intervention initially, q equals the average total cost. The price of milk sold for exports becomes lower than the average total cost as the government reduces the supply of milk sold for domestic consumption if $d\lambda / dx_1 < 0$. This case appears when the average total cost is U-shaped.

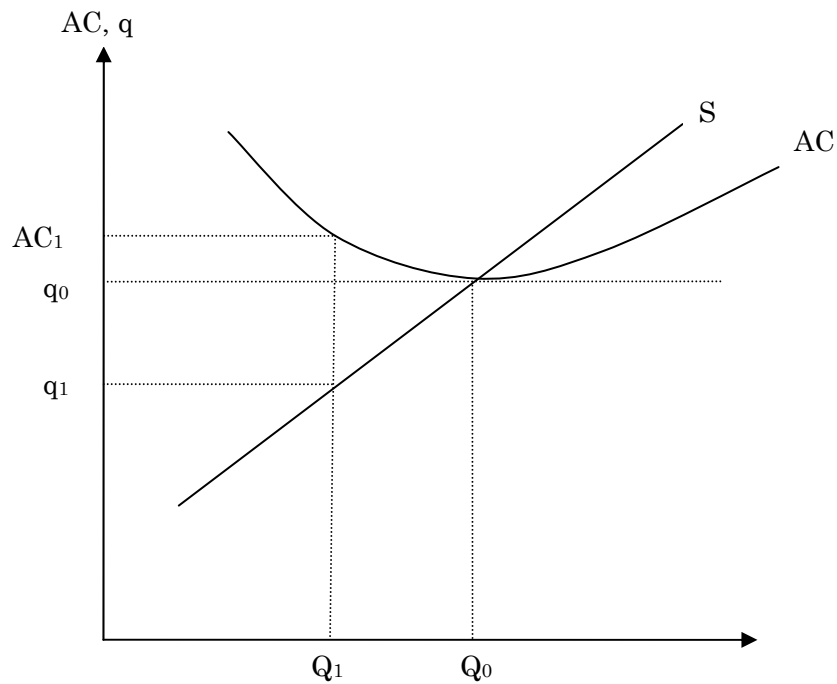


Figure 1

In Figure 1, S is the total supply curve (or the marginal cost curve) and AC is the total average cost curve. The initial price of milk is given by q_0 and the initial total supply of milk is Q_0 . The total average cost equals the price of milk. Suppose that an introduction of the scheme reduces the price of milk sold for exports to q_1 and the total supply of milk to Q_1 . Then the average total cost increases from q_0 to AC_1 . The price of milk sold for domestic consumption becomes lower than the average total cost. In order for the domestic dairy farmers to keep a positive production, the regulated price must be higher than the average total cost, implying that cross subsidization occurs under the scheme. Transferring the positive profit obtained from sales of milk sold for domestic consumption, the milk producers supply the milk sold for exports at a price lower than the average total cost. This scheme has the similar effects as an export subsidy to cheese producers.

The cross subsidization may not occur in some special cases. As we discuss in the last section, the price of milk sold for exports does not change if (i) the home country is a small open economy or (ii) the demand curve for milk is vertical. Then the milk producers keep the same total amount of milk supply. In this case the average total cost equals the initial average cost and the price of milk sold for exports.

5. Heterogeneous Dairy Farmers

We assume so far that there are homogeneous domestic dairy farmers and homogeneous cheese producers in the home country. In this section we introduce heterogeneous milk producers. The technology of each firm is constant returns to scale so that the average and marginal costs are identical and constant in the output. For simplicity, we assume that each producer can produce one unit of milk because of capacity limits. (Marginal cost becomes too large beyond one unit of output.) Without loss of generality, we can assume that the average and marginal cost of the i -th producer is equal to $i+f$, where f is the average and marginal cost of the most efficient milk producer. In this case we have to make a distinction between the average cost of each firm and the average total cost in the industry level.

Then the supply curve of the home country becomes $S(q) = q - f$. As we see in the benchmark case (Section 2), the equilibrium price of milk is determined so that $Q(q, w(q)) = S(q)$ is satisfied. The equilibrium price is q_0 , which equals the marginal cost of the least efficient firm. The number of producers in the market will be $q_0 - f$, which equals the total supply of milk. Then the total cost in the milk industry is

$$TC = \int_0^{q_0-f} (x+f)dx = \frac{(q_0)^2 - f^2}{2} \quad (16)$$

The average total cost in the industry level is

$$AC = (q_0 + f)/2 \quad (17)$$

Figure 2 shows the equilibrium price and the average total cost in the industry level.

Therefore, the price of milk is higher than the average total cost in the industry level.

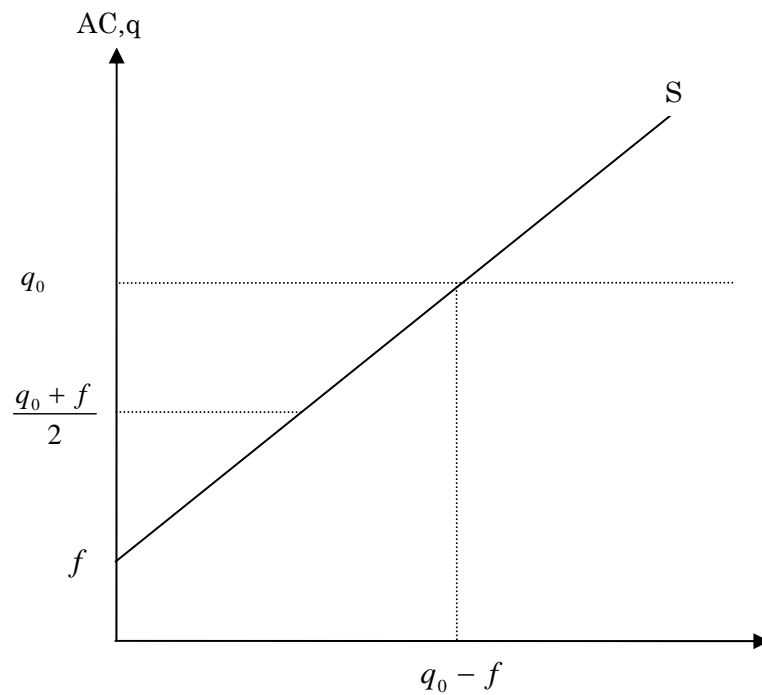


Figure 2

Now suppose that the government introduces the milk class scheme. We still keep the same assumptions regarding the cheese producers. Therefore, the equilibrium price

of milk sold for exports is determined so that equation (9), $Q(q, w(q, x_1)) = S(q)$, is satisfied. If we denote the equilibrium price of milk sold for exports as q_1 , then equilibrium total supply of milk will be $q_1 - f$. Since the average total cost of dairy farmers is $(q_1 + f)/2$, the price of milk sold for exports is higher than the average total cost even if the government introduces the milk class scheme.

6. Concluding Remarks

In this paper we have derived the effects of the milk classes scheme introduced by the Canadian government and have examined the rationality of the average total cost standard. The scheme generates a gap between the price of milk sold for domestic consumption and the one for exports, but the average total cost may or may not be lower than the price of milk sold for exports.

We have introduced milk and cheese producers separately but we have not considered the following feature of the industries. First, as is noted in the footnote, it may be more appropriate to use the pool price for milk to be exported. Introduction of the monopolistic State Trading Enterprise and the pool price system, we can also explain the price gap between the milk sold for domestic consumption and the one for exports. With the pool price, the price of milk for exports will be higher than the marginal cost of exporters, and we may obtain additional results on resource allocation. Secondly, we have not dealt with imperfectly competitive markets of milk or cheese. If the importers in a foreign country have market power, they can set a lower price to purchase the exported goods as inputs.

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