THE REAL COST OF THE B.C. MILK BOARD

A CASE STUDY IN CANADIAN AGRICULTURAL POLICY

Herbert G. Grubel and Richard W. Schwindt

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Preface

One of the most notable aspects of agricultural policy in Canada during recent years has been the activity of marketing boards. Originally put in place to remove boom and bust cycles from the markets for agricultural products, and to ensure producers a "fair" return, marketing boards have become a highly politicized conduit for the transfer of income from consumers to producers. The extent to which marketing boards transfer income depends on their ability to maintain the price for the product at a higher level than would prevail in a free market. Marketing boards, like any cartel, are able artificially to maintain prices above the free market level by restricting the supply of the product available to the market. Unlike ordinary cartels which arise spontaneously from time to time and are usually illegal, marketing boards are usually encouraged and sanctioned by government and their powers therefore have the force of law.

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In general, cartels restrict the supply of their product by splitting up the market amongst their members. They do this by granting quotas to their members. These quotas entitle the holder to produce and sell some particular amount of the product. To become a member of the cartel, a producer must acquire a quota.

If a marketing board (cartel) is successful—i.e., confers benefits on its members—it will be under constant pressure to accept new members. However, if the marketing board is "mature", new quotas will only be issued to provide new production to meet growth in the whole market. As a consequence, new entrants to the market can only produce the product for sale at the controlled price (become a member of the cartel) if they purchase a quota from an existing member. Accordingly, the pressure of potential producers who are not members to join the cartel is reflected in the price that must be paid for a quota.

A high market price for a quota implies that the marketing board is successful and does convey substantial benefits (income) on its members. A low or zero price would reflect the fact that potential producers do not regard membership in the cartel as having any value. It follows from this that the market price of a quota can be used as an indicator of the extent to which the marketing board does confer a benefit on its members.

In this study, Professors Grubel and Schwindt have applied this principle to estimate the extent to which the British Columbia Milk Board transfers income from consumers to producers. In the course of their work, Grubel and Schwindt develop the principles of an analytical framework that can be applied to marketing boards in general and therefore their work is valuable in a broader context. It is also valuable because it clearly identifies the real cost of a marketing board and provides signal warning of the consequences of extending the power of marketing boards over other products. The Fraser Institute is publishing this study to document the consequences of marketing boards and to stimulate public discussion of the economic issues at stake.

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The public policy issues

The analysis conducted by Grubel and Schwindt leads them to the conclusion that the British Columbia Milk Board ought to be abolished. Having determined that the annual cost or tax for consumers is approximately $12 million (in 1975), they suggest that it would be cheaper and more efficient to subsidize needy farmers directly. (The subsidy involved in the current scheme amounts to about $12,000 per farm. The cost or "tax" for consumers is $48 per year for a family of four or 7¢ per quart of milk consumed.) One of the more serious problems involved in the current scheme is the fact that it does not discriminate between high and low income consumers and producers. All farmers receive the subsidy and all consumers pay the tax to finance it.

If the subsidy were paid only to farmers in need, it is likely that the total cost of the subsidy programme would be significantly reduced. Also, if the programme were financed from general tax revenues and not exclusively by raising the price of milk, it would not be as strongly regressive as is the current scheme. The effect of the Board, at least in some cases, is to transfer income from some low income consumers to some higher income farmers. To this extent, abolishing the Milk Board would provide an increase in the community's welfare.

Capital losses

Marketing boards confer benefits upon holders of quotas. New entrants to the market must pay an amount for the quotas that reflects the expected future flow of benefits. In other words, owner-sellers of quotas acquire capital gains —purchasers, for their part, anticipate that they will recoup the cost of the quota from the benefits that the Board will confer upon them. Therefore, removing the effect of the Board from the marketplace will confer capital losses because the quotas will become worthless. In some cases, particularly for producers who have just acquired their quotas, this loss could be quite substantial. In the case of the typical farm discussed in the study, the cost of quota could amount to as much as $87,500 for a herd of 50 cows.

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Farmers who purchase quotas realize when they buy them that they are taking a risk in that the value of the quotas could fall. (The Milk Board itself continues to deny that quotas have a value, undoubtedly because of what a value for quotas implies.) Accordingly, one is tempted to adopt a *caveat emptor* attitude towards the losses. However, one must realize that in large measure it is the possibility of these losses that welds the interests of farmers against those who would dismantle the Board. Thus, in any first step in the direction of abolition it would be useful to at least determine the extent of the potential losses involved.

Since the single largest hurdle to be overcome in the abolition of marketing boards is the vested interest of quota holders, it may be that an effective plan for abolition has to include partial compensation for the capital losses involved. Compensation for losses suffered as a result of changes in public policy is an area that, even in principle, is fraught with difficulties and one cannot venture there without a feeling of unease. This is particularly true when the whole situation has been created by public policy in the first place.

Grubel and Schwindt do not offer a scheme for the compensation of those who stand to lose as a result of the abolition of the Board. This is understandable given the almost infinite variety of schemes possible and the very impossibility of designing a scheme that would, even in principle, be "equitable" from every point of view. In the interest of providing a basis for discussion, we present the following suggestions, which are just two of the many that could be advanced:

Compensation scheme I

The benefits to producers that arise from the operation of a marketing board accrue as a direct result of the maintenance of a price for the product that is above the price that would exist in a free market. It therefore seems sensible to tie the

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compensation scheme to the difference between the price of milk as it would have been under the influence of the Milk Board and the price that will be established by market forces after the Board has been abolished.

In practice, this would involve calculating the price of milk as is currently done using the Milk Board formula on, say, a quarterly basis. The difference between this price and the free market price of milk (which would be lower) would constitute the basis for the compensation. Multiplying this difference by the total quota (in quarts equivalents) would yield a total benefits value. If the total amount of this benefits value were paid to producers, they would be fully compensated. This should probably be done for the first year after the Milk Board is abolished. In the subsequent year only, say, eighty per cent of the total value of benefits should be paid; in the third year, sixty per cent and so on until at the end of six years no benefits are being paid under the compensation programme.

Compensation scheme II

The second suggestion for a compensation scheme is not as administratively simple as the foregoing but would probably give rise to a smaller total cost.

The scheme would require each producer to submit to the provincial government the capital cost amortization schedule that he has been using for federal income tax purposes. Since the producer can deduct the cost of quotas in the calculation of his income tax liability, it is highly probable that each producer has kept careful record of the "capital consumption" to which he is entitled. On the basis of these records, it would be possible to determine the exact amount of capital loss entailed for each producer. Compensation could then be paid as some fraction of the total capital loss as in the first scheme.

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Conclusions

Professors Grubel and Schwindt have shown in their study that marketing boards, by nature, are unlikely to serve the public interest. Moreover, they conclude that as a system for subsidizing the farm sector they are inequitable, inefficient and ineffective. The tax burden implicit in the higher prices that consumers must pay for agricultural products falls on all consumers regardless of income—it is therefore a regressive tax. The subsidies implicit in the marketing board scheme are paid to farmers irrespective of their incomes. Moreover, new farmers must buy the right to produce (in the form of quotas) from existing farmers. Thus, new farmers do not get the benefits of the subsidy inherent in the operation of marketing boards until they have paid off the debt owing to the farmer from whom they bought the quota. Therefore, the popular view that marketing boards encourage the growth and development of the farm sector seems highly questionable.

This study documents these facts in the case of the British Columbia Milk Board. It is being published by the Fraser Institute in the public interest. The Fraser Institute has been pleased to support the work of Professors Grubel and Schwindt. However, owing to the independence of the authors, the views expressed by them may or may not conform severally or collectively with those of the members of the Institute.

January 1977 **Michael Walker**

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I. INTRODUCTION

This study has three main objectives:

- *first,* it presents a theoretical and empirical analysis explaining the observed value of milk marketing quotas in the Lower Fraser Valley of British Columbia,
- *second,* it estimates the annual income transfers from B.C. milk consumers to producers implicit in the value of these marketing quotas and,
- *third,* it demonstrates that if society wants to raise the income of dairy farmers by the same amount as it does through the marketing board, it can do so at a much lower social cost through direct income transfers rather than through the raising of output prices combined with restrictions on output.*

*Ian J. McAskill collected basic data while on a B.C. Summer Employment grant. R. Mirza carried on work involving the computer. T. Borcherding, J. Forbes and H. Argue made useful comments on an earlier draft of the paper. S. Easton helped with the calculation of the welfare costs.

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This case study of the effects of a local marketing board in one industry discusses, with minor qualifications, all of the important issues confronting Canada in its choice of an appropriate agricultural policy in the future. This policy in the late 1970's is at a cross-roads, leading either to a greater use of marketing boards with resultant inflationary pressures and inefficiencies, or to a reduction in the power of existing boards, with accompanying widespread social benefits.[1]

The likely direction of future policies is far greater power of Canadian agricultural marketing boards as a result of Bill C-176 which established in 1972 the **National Farm Products Marketing Council.** This legislation became necessary because during the post-war years provincial marketing boards for many different agricultural products grew in strength and ability to distort free market prices. However, their ability to do so individually has been constrained by the lack of co-operation among provincial boards. "The provincial boards found that provincial control of a commodity could be made insignificant by operations in other provinces." (Forbes, 1974, p. 4). Therefore, further price distortions can be effected only through the national co-ordination of provincial marketing board policies, which Bill C-176 makes possible.

In 1976, only egg and turkey producers had established a national marketing board authority under Bill C-176. However, efforts are underway to organize national boards for other products. This paper is designed to show, through the case study of the effects of one provincial marketing board, that the interest of the Canadian public lies in organized opposition to the further spread of national marketing boards and in policies aimed at a reduction in the power of existing provincial boards.

The late 1970's appear to be an opportune time for mounting such an attack on marketing boards. In recent years, income of farmers has been considerably above average and the time to get rid of marketing boards is when farm incomes are high. At the same time, the Canadian public is concerned about inflationary pressures which could be abated by the elimination of marketing boards. Furthermore, concern has been voiced about the slow growth of

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labour productivity in Canada. This productivity would be raised by the removal of artificial incentives to farmers to remain in unproductive agricultural pursuits.

The paper contains in Part II a theoretical analysis of the determinants of the value of milk marketing quotas. In Part III, we present the results of an empirical study of the functional relationship between quota values and the profits from milk production as determined by the milk prices set by the B.C. Milk Board. In Part IV, we interpret the consumer and social cost of the programme, implicit in the Board's policies evidenced by our empirical study of the quota prices. The paper closes with the presentation of some policy proposals based on the preceding analysis.

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II. THE THEORETICAL DETERMINANTS OF MARKETING QUOTA VALUES

The B.C. Milk Board, like all agricultural marketing boards, has two primary objectives:

- *first,* to eliminate cyclical and unpredictable price fluctuations for milk and,
- *second,* to set prices at a level to assure farmers a "fair" return to their work and investment.

The dairy industry's basic problems, which have given rise to demands for marketing boards, can best be described with the help of Figure 1, where we show market demand and supply schedules for fresh drinking milk[2] as a function of its price. The left panel shows conditions during the summer when the demand schedule for milk D_1D_1, in conjunction with the supply schedule S_1S_1, leads to a competitive equilibrium price P_s. In the right panel, representing conditions during the winter months, the demand schedule D_2D_2, and supply schedule S_2S_2, lead to the price P_w. The two demand schedules in the two periods are assumed to be identical because the demand for fresh milk is relatively stable throughout the year. The supply schedules are in different positions during the two periods because dairymen schedule calving, which results in greater output of milk, for the spring, and because of the availability of low cost pasture feed throughout the summer.

Under free competition, the average price per unit of milk during the year is P_a since in the graph it has been chosen in such a way that equal quantities are sold above average during the summer ($Q_s^a Q_s$) and below average during the winter ($Q_w Q_w^a$) while the winter and summer prices differ from P_a by an equal amount ($P_aP_s = P_aP_w$). It is clear that for any given cyclical pattern of supply and prices there must be such an average price P_a for the period as a whole.

In Figure 2 we show the demand and supply curves for the summer and winter period combined and resulting in the equilibrium price P_a and quantity $Q^* = Q_s + Q_w$ for the complete period.

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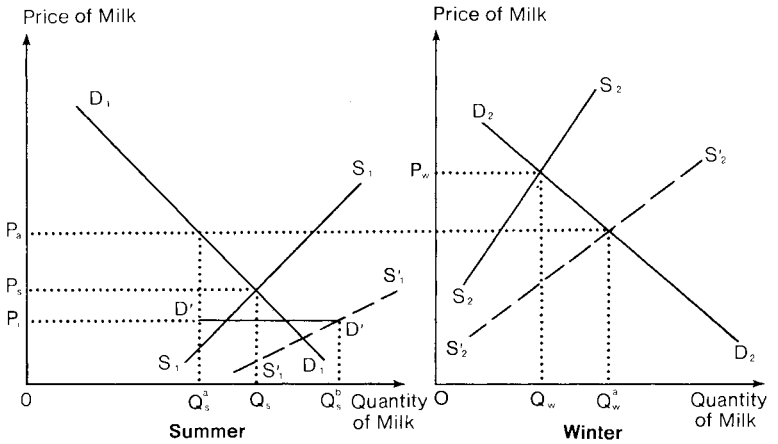
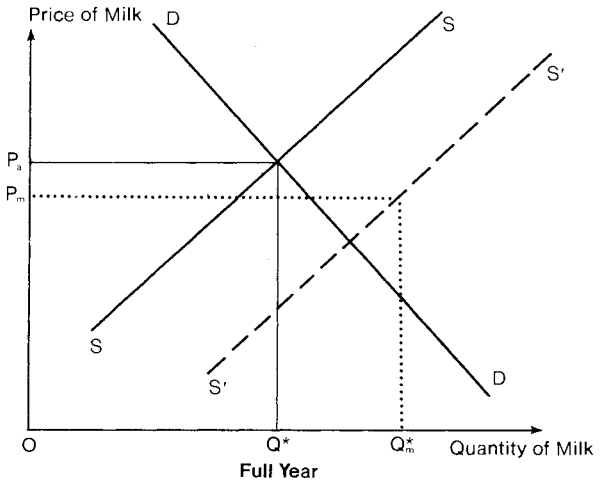
Figure 1—Seasonal Fluctuations in Milk Supply



The demand for milk is the same in summer (D_1D_1) as in winter (D_2D_2) but without marketing boards, large supply in summer (S_1S_1) leads to sales of OQ_s and price OP_s while small supply in winter (S_2S_2) leads to sales of OQ_w and price OP_w. With a marketing board, the price is OP_a throughout the year. The winter sales at that price require more cows, which results in supply curve $S'_2S'_2$ in winter and $S'_1S'_1$ in summer, with $Q^a_sQ^b_s$ sold as industrial milk and the weighted price of fresh and industrial milk OP_i.

Figure 2—Stabilized Milk Supplies During Full Year



The fresh milk price is OP_a and sales are OQ^* during the full year with the supply curve for fresh milk shown as SS. The supply curve for fresh and industrial milk combined is S'S' and the weighted average price for the two types is OP_m, at which OQ^*_m is sold as industrial milk.

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Given this simplified model of the fresh milk industry, the case for price stability and the creation of a milk Marketing Board can now be made simply as follows. Consumers, *ceteris paribus,* prefer a stable milk price throughout the year over the instability created by the market. With stable prices, consumers can plan expenditure patterns more easily and do not have to make adjustments in their expenditure patterns and budgets that are necessary under free market conditions. Assuming for a moment that fresh milk can be stored cheaply, these consumer benefits are attainable at only the small cost of storing the milk as the Marketing Board purchases $Q_s^a Q_s$ excess supply of milk during the summer and sells it in winter to meet the excess demand $Q_w Q_w^a$. To recover the storage costs, a premium is charged in winter over the summer price P_a.

The appealing argument in favour of stabilizing fresh milk prices is complicated by the fact that this product historically could not be stored at any cost. Under these conditions, it is necessary to induce farmers to increase the number of dairy cows so that in winter supply is sufficient to meet demand at P_a equal to OQ_w^a as is shown in Figure 1. This larger dairy herd, however, leads to a greater supply of milk in the summer than is needed to meet demand at P_a, as is indicated by the supply curve $S_1'S_1'$ in the left panel of Figure 1. This excess supply of fresh milk produced during the summer is sold as "industrial milk" and is processed into cheese, butter, powdered milk and other products which can be stored and transported at relatively low cost.

Under free trade, the price received for this industrial milk is determined by the world price of these tradable products and the cost of producing them locally. Under the assumption of free trade, a given world price and the cost of producing the industrial milk products in the Fraser Valley, the price for industrial milk is given and known and the Fraser Valley dairy farmers can sell all they want at the going price. In the left panel of Figure 1, we show this world price as P_1 and the infinitely elastic world demand curve for industrial milk as $D'D'$. Equilibrium in the summer is at output Q_s^b, of which $Q_s^a Q_s^b$ is sold as industrial milk at P_i and OQ_s^a as fresh milk at P_a. In Figure 2, we have com-

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bined the winter and summer supply curve to obtain the full year schedule S′S′. The price P_m represents the weighted average of the fresh milk and industrial milk prices. Equilibrium is at output OQ^*_m with OQ^* sold as fresh and $Q^*O^*_m$ as industrial milk.

In the real world, industrial milk cannot be sold in unlimited quantities because similar programmes of price stabilization in other countries have led to a glut of industrial milk products in Canada and most other Western developed countries. We return to this problem in the empirical part of our study below. Here, the preceding, simplified model leads to the important conclusion that price stabilization efforts do not necessarily lead to excess supplies of milk or the raising of average prices paid by consumers during the full year, even if milk is not stored.

Two Further Considerations

Before we use the theoretical model just presented to show how the B.C. Milk Board programme raises the price of milk, we need to discuss two subsidiary but important points. *First,* we have been told by industry experts that it is now possible to produce powdered milk during periods of excess production and reconstitute it during periods of shortage, without loss of quality. Exhaustive tests on consumers have shown that a mixture of powdered milk, water and fresh milk, treated for aroma and consistency, results in drinking milk virtually indistinguishable from pure, fresh milk by taste, appearance, odour and nutritional value.

The use of this technology has been made illegal in Vancouver and many other parts of the world. One can only speculate about the cause of such prohibitions, but it is clear from our preceding analysis that the use of reconstituted milk as fresh milk would reduce the demand for fresh milk during winter months and cause a reduction in the size of dairy herds. While the use of the new technology would lower average prices for dairy products and therefore is in the interest of consumers and milk processors, it would be harmful to the economic interests of dairy farmers. Since the dairy farmers are organized much more effectively than consumers and processors, it is not surprising that legislation was passed prohibiting the sale of such milk and

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that is was not left to the consumer to choose between reconstituted milk (clearly labeled as such), at a lower price and pure, fresh milk at a higher price.

Second, in our simple model above we have assumed that the supply curve for milk shifts predictably and that the position of the demand curve is known. In the real world, of course, the supply and demand curves shift unpredictably as a result of factors affecting the cost of producing milk and of changes in consumers' tastes and income. These random influences on the prices and quantities in the milk industry complicate enormously the stabilization activities of milk marketing authorities.[3]

We cannot pursue here in detail modifications of the simple model necessitated by the existence of random together with cyclical disturbances. Instead, we shall assume that in principle, milk marketing boards can provide consumers with benefits from price stability without increasing the average price of milk even in the presence of random disturbances. This analytical strategy may assume away one of the most important arguments against milk marketing boards and all government stabilization activities, namely that speculative private markets are more efficient stabilizers; however, the strategy permits us to focus the remaining analysis on perhaps the most important argument against marketing boards, that they raise consumer prices and create windfall profits to holders of marketing quotas.

The Price-Raising Effect of Marketing Boards

As already noted, marketing boards have two purposes:

- *first,* the stabilization of prices and,
- *second,* assuring producers a "fair" return to their work and investment.

Unfortunately, there is no unique, operational definition of a "fair" return in economics and the legislation setting up the marketing boards has failed to provide one. Consequently, it is impossible to establish unambiguously whether the marketing boards have set stable prices which yield just fair returns or returns which are above or below "fair".

However, economic analysis permits us to establish unambiguously whether the prices set by marketing boards

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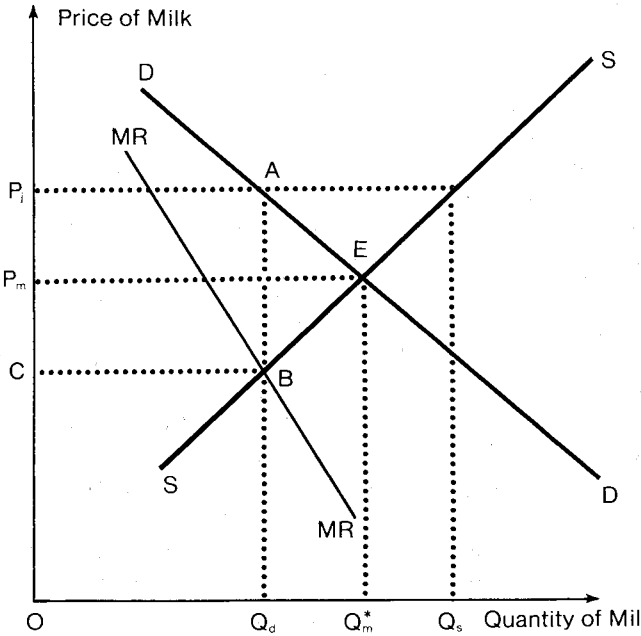
Figure 3—The Value of Excess Price Over Cost



The full year demand and supply curves for milk are shown, as in Figure 2, DD and SS respectively, with equilibrium price and quantity for the full year at OP_m and OQ_m^* respectively. Restriction on supply by quota legislation of OQ_d results in unit cost OC and the unit price OP_i, leaving an excess of CP_i of price over cost of production per unit of output. The value of this excess is $CBAP_i$ per time period. The present value of this future stream of excess income is capitalized in the value of the quotas. The demand curve has implicit in it the marginal revenue curve MR-MR and the particular quantity of quotas shown gives rise to maximum possible excess revenue.

are above those which would have prevailed in the absence of the boards. We can do so by considering the fact that the supply curve shown in Figure 3 is that of the industry resulting from the free and unconstrained behaviour of farmers reacting to market prices. Abstracting from short-run disequilibria, the supply curve indicates how much milk producers are prepared to put on the market per year while earning a "normal" rate of return, given the cost of feed, land, capital, labour and all other inputs, (including the farmers' and their families' labour), and the satisfaction received from working the land and being one's own boss, while adjusting costs for expected increases in the value of land and capital stock. Individual farmers, like all other

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independent businessmen, are assumed to enter or leave their industry if the product prices they can obtain yield above or below normal returns, respectively. This adjustment by some marginal businessmen changes the quantities supplied at the disequilibrium prices and assures that those remaining in the industry earn normal profits. By staying in the industry, producers reveal their preference for the kind of work and returns over a multitude of other opportunities to employ their skills and capital. Economists believe that it is meaningless to ask farmers in the industry whether they consider the returns they earn to be "fair". The results are unpredictable, but there is a strong presumption that they would say the returns are "unfair", even though through their actions they reveal that they prefer this particular use of their labour and capital over any other available to them in a free economy.

With this economic explanation of the meaning of the supply curve, let us now turn to Figure 3, where we show the industry's demand and supply curves for the full year with Q_m^* and P_m representing the equilibrium quantities and prices explained in Figure 2. The main point to be noted is that at the weighted average price, P_m, all fresh and industrial milk which is produced is also sold. Under these conditions, the Marketing Board has to introduce a system of quotas to dairy farmers, stipulating that only quota holders who supply a certain quantity of milk in the winter, when the price for fresh milk paid is *below* its cost of production, are entitled to sell to the Board a specified quantity of fresh milk during the summer, when the price paid is *above* its cost of production. Such a quota system is necessary to prevent the excess supply of milk in the summer months through either imports or the temporary ownership of dairycows, since during that period the relationship between the price and cost of producing milk encourages increased production.

Such a quota system does not in principle give rise to any value for quotas because the official price for milk received by farmers allows them to earn only a normal rate of return to their work and capital. Furthermore, with the milk price at that level, the Marketing Board should not be offered milk in quantities exceeding demand; the quantity

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of quotas made available should always be just equal to that demanded by farmers. Under these conditions, if the Marketing Board or a farmer wanted to sell a quota, they would not find any buyers. The average milk price would be just sufficient to cover production costs and yield a normal profit, leaving nothing to make interest and amortization payments on the purchase of a quota.

For the remainder of this paper, the preceding arguments are extremely important because our main analysis is built on the premise that the existence of a price for quotas must necessarily imply that the Milk Board has set the average price for milk at a level above one at which demand equals supply and, most crucially, at which the price equals cost of production, the latter including a normal profit for the farmer.[4] To establish this proposition, consider Figure 3 and assume that the B.C. Milk Board has set an average milk price not at P_m, but P_j. At this price, processors will demand OQ_d to be used for both fresh milk and in the manufacture of dairy products. However, from the supply curve it is seen that farmers can deliver OQ_d at unit cost of OC which is CP_j less than the price received by them. The dairy farmers of the Fraser Valley who hold the Milk Board quotas totalling OQ_d enjoy revenues which exceed their costs by an amount equal to the rectangle $CBAP_j$. In principle, this excess of revenue over cost can be used by the farmer to pay interest and amortization charges attributable to the purchase of quota. For the farmer who received quota at no cost at the outset of the programme this represents monopoly rents. Without such an excess of return over cost, farmers could not afford to buy the quotas and the quotas therefore would not have a value.

The B.C. Milk Board does not officially recognize that the quotas have value. They were issued at the inception of the system freely to those farmers producing at the time.[5] Because the Board allowed transferability, many recipients of quota subsequently sold their allocations to others, keeping all proceeds from the sales for their own use. Quota prices are determined for the most part through competitive bidding at livestock auction houses which act as brokers between buyers and sellers.

The empirical analysis in the next part of this paper

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uses a time series on the value of these quotas[6] to make inferences about the excess of price over cost of production per unit of output and the value of the annual transfers from consumers to producers implicit in the quota system. The principle of calculation is as follows:

> The value of a quota unit is equal to the sum of expected future stream of extraordinary profits, properly discounted, to which the owner of the quota is entitled. For example, consider that the right to deliver a quota unit equal to OQ_d pounds of milk per year gives rise to an extraordinary profit $CBAP_j$, equal to $1,000. Furthermore, assume that the interest rate is 10 per cent and that quota system is expected to stay in operation in perpetuity. Under these conditions, the quota unit has a capital value of $10,000 since, at the going interest rate, a perpetual annual stream of $1,000 requires the investment of $10,000.

In the real world, there is some uncertainty about how long quota systems will remain in operation and how big the future profits will be from holding the rights, so that the value of the quotas tends to fall short of the one calculated under the assumption that a present stream of profits is certain and available in perpetuity.

In practice, the value of the quota is established through competition among potential dairy farmers who obtain the best possible information about the current and future profitability of selling milk at the official Board price (they estimate the value of $CBAP_j$) and take into consideration the market rate of interest. Given these views about the likely profitability of holding the quota and their cost of borrowing capital, the potential dairy farmers offer a price just high enough so that after servicing of the loan they earn something above the normal rate of return obtainable in another occupation and in other use of their equity capital. Competition among potential dairy farmers assures that at the market price for a quota, earnings above normal are small and tend to zero.

Before we use these principles in the estimation of excess cost and revenue implicit in the actual prices for B.C. milk quotas, we need to discuss some other important issues raised by the existence of prices on quotas.

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Maximum Value of Quotas

The preceding theoretical analysis of the value of quotas leaves open the question whether there are any limits on the excess price and revenue which the Marketing Board can set. In principle, the price-raising activities of a Board are limited by the following three factors:

i) the elasticity of demand,
ii) the cost of entry into dairy farming and,
iii) the existence of countervailing political interests.

Firstly, the elasticity of the demand for milk enters as a constraint if the Board attempted to act like a monopolist and maximize profits for all farmers jointly. Under these conditions, the Board would set output such that marginal cost equals marginal revenue. To illustrate the output-price decision under these conditions, assume that the demand and supply curves in Figure 3 represent those of an "average" farmer, with the SS curve being equal to his marginal cost curve. Such an average farmer would maximize profits at the point where marginal revenue (MRMR) equals marginal cost (SS); output is at OQ_d; the price is at OP_j and the total excess profit (or *rent,* as it is known technically) is equal to $CBAP_j$. Elementary theory of the firm implies that entrepreneurs have a tendency to move to such a point of maximum rent, earning less than their highest net income at a price above or below OP_j. The geometric representation of the "average" farmer in Figure 3 can be assumed to reflect the collective of all dairy farmers by a simple expansion of the quantities measured along the horizontal axis.

While the price OP_j thus represents a theoretical maximum price charged by the B.C. Milk Board at any given moment in time, in the real world the demand curve for milk, and the associated marginal revenue curve, are shifting outward and to the right continuously, along with increases in population and income in the Vancouver area. Growth in demand does not necessarily lead to a shift in the industry's supply curve. Consequently, the growth in Vancouver's population and income causes a continuous increase in the profit-maximizing price of milk through time. Depending on the elasticities of the demand and supply curves over the relevant range, the increase in the profit-maximizing price of milk could be proportionately equal to, smaller or larger than, the increase in costs resulting from movements along

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the supply curve of the dairy industry.

A second constraint on the rent-creating activities of the B.C. Milk Board is the existence of provisions for new entry into the dairy industry, according to which farmers can obtain fresh milk quotas by producing and selling their output as the lower-priced industrial milk price for a certain length of time.[7] The difference between the cost of producing the industrial milk and the revenue received for it during this time represents an investment, the return to which is the rent obtainable through the ownership of the fresh milk quota at the end of the period. Farmers' decisions to obtain quotas, either through outright purchase or the investment in the production and sale of industrial milk, equalize the cost of acquiring quotas in both ways.

On the basis of this argument we may conclude that the existing rules of acquiring quotas through investment in industrial milk production set an upper limit on both the price for fresh milk and the value of the quotas. However, there is the added problem that if the rules of entry are very easy, then the Marketing Board may be forced into issuing so many quotas that rents become very small and that the very purpose for having the Board would be defeated. We, therefore, would expect the rules of entry to be set in such a manner that the required investment and maximum quota values permit the attainment of the objectives for which the Board has been created. We may, therefore, conclude that while entry rules provide a short-run ceiling on rents, (since they can be changed in the long run), other factors must determine the maximum value of rents.

The third constraint on the activities of marketing boards is a political one. Sam Peltzman (1976) has argued that their creation through the political process permits many different interest groups to influence the policies of the boards. Politicians, who have to face the electoral process, cannot afford to lose votes of consumers by permitting milk prices to become too high, while at the same time the votes, and financial contributions, of the milk producers set a lower limit on milk prices set by the Board. Through a theoretical analysis, which cannot be reproduced here, Peltzman concludes that the maximum price charged and producers' rent created by marketing boards are likely to be

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below those attained if the industry behaved like a perfect monopolist in the manner discussed above.

The main point of the preceding theoretical analysis is that the very existence of a quota system and the fact that quotas carry a value are evidence that the Marketing Board has raised prices above those necessary to keep farmers in the industry and earning a normal return on their work and investment. As a result of these policies, the initial holders of quotas earn returns above normal. These above normal rates of return may or may not be "fair", but they are likely to be below the maximum which would exist if the industry were run as a perfect monopoly.

Some Consequences of Quota Systems

Four other important aspects of quota systems bearing on the empirical studies to be undertaken are as follows. *First,* in the preceding analysis, emphasis was put on the fact that extraordinary profits accrue to farmers who were allocated the quota at the inception of the system. The sale of the quota represents a capitalization of this stream of extra profits which the farmers enjoy as a windfall capital gain. The purchasers of the quota have to pay lenders interest on the capital used to pay for the quota, or, if they use their own funds, they have an adjustment for forgone interest. At any rate, these costs of owning the quota eliminate all extra profits from the high Marketing Board prices for new farmers. Therefore, after all initial quota holders have cashed in their windfall profits, all current farmers are back to earning only "normal" returns. If such normal returns are deemed "unfair", then the Board has to raise the official price of the product to provide the current quota holders with extra profits considered to constitute a fair return. However, as we noted above, the rise in prices is constrained by the existence of a monopolistic maximum, the rules of entry through investment in production of industrial milk and the political power of consumers. Nevertheless, in a world of growing demand for milk from increased population and income, the elasticity of demand and political constraints may change sufficiently to permit increases in milk prices relative to cost of production and therefore in rent to producers for a long time before the limits have been reached.[8]

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Second, up to July 1975 the B.C. Milk Board quota holders were entitled to use them only if they had their production facilities within clearly-defined geographical regions, such as an area covering approximately one half of the Fraser Valley basin. Similarly, production regions existed in other parts of British Columbia and quotas were not transferable between them. These regions were defined at the foundation of the Board in 1956.

However, it is a basic fact that since 1956 the Vancouver metropolitan area population has grown very rapidly, causing both an *increase* in the demand for fresh milk (which was accommodated through increased quota allocations) and a *shrinkage* of agricultural land in the Board's control area. In the absence of the area border, these developments would have caused dairy farmers to migrate into areas further away from the metropolitan area of Vancouver, and the migration would have been facilitated by technical developments of the last twenty years such as pre-shipment homogenization and refrigerated tanker trucks which make possible the shipment of fresh milk over great distances. But because the use of the quotas was restricted to the control area, the Marketing Board regulations led to a net increase in the demand for land in this region. As a result, land prices rose more than they would have otherwise, producing another source of capital gains for dairy farmers in business at the time when the Board was put into effect. The increased value of the land, of course, was paid for by new farmers and entered their costs like that of the quotas.[9]

Third, in our analysis of the complications for price stabilization activities arising from the perishability of milk, we assumed that there was a free national and international market for manufactured dairy products which determined the value of industrial milk. This assumption is not entirely realistic for the reason that the simultaneous establishment of supply management schemes in several Canadian provinces, as well as in the United States, New Zealand, Australia and Western Europe, has led to an excess supply of manufactured dairy products. Most of the governments of these countries have not permitted prices of these products to fall but have, in effect, established controls on them alongside those for fresh milk. In doing so, they have re-

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stricted imports and either bought commodities, which were dumped or given away as foreign aid in Eastern Europe and developing countries, or they have introduced quota restrictions on industrial milk production. In Canada, the federal government introduced and administers the quotas for industrial milk since the tradeability of industrial dairy products requires a national approach to the problem of excess production. The federal programme is known as the **Market Share Quota System.** It has recently resulted in the creation of a new kind of quota which affects the average price received for milk and therefore the profitability of dairy farming and the implicit value of provincial quotas. In Part III, we will analyse these relationships empirically.

Fourth, even if milk prices set by the B.C. Milk Board were to result in only a stabilization of prices to consumers, the practical problems of determining such equilibrium prices through time are formidable, primarily because both demand and cost conditions are changing continuously and unpredictably. Since there are no practical methods available for taking account of all factors influencing demand and supply, a simplified method for determining the true equilibrium price has been adopted. This method involved the monthly calculation of an **Index of Cost** and other price developments. The components and weight of this Index are as follows:

Indices	Per cent Weight
(1) Wholesale Prices (Canada)	15
(2) Consumer Prices (Canada)	15
(3) Wages and Salaries (B.C.)	20
(4) Alfalfa Hay Prices (B.C.)	20
(5) 16% Dairy Feed (B.C.)	10
(6) Farm Labour Wages (B.C.)	10
(7) Prices of Farm Imports (Western Canada)	10

In the base period, this Index was 100 and it was applied to a base-period "accounting value" of, say $5, to obtain the initial accounting value equal to $5. With some modification, this accounting value determined the price for milk received by the farmer, say $6 per hundredweight of fresh milk. Now

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if in a later period the monthly Index added up to 150, its application to the base period accounting value makes the current value $7.50 and the milk price paid to farmers $9.[10]

This method for determining the price of milk paid to farmers tends to introduce an upward bias into the measure of production cost for two reasons. *First,* as the components of the Index shown above indicate, it is designed to reflect not only costs of inputs, but also wholesale and consumer prices and general wages and salaries. Therefore, B.C. milk prices would rise even if all of the inputs used by farmers, (including farm labour), had remained constant, but the general Consumer Price Index or wages and prices had risen. For the same reason, the milk prices would fall even if costs had remained constant although the Consumer Price Index or wages and prices had fallen. Historically, of course, productivity increases and shifts in the composition of output towards services have caused consumer prices and wages to rise faster than costs in manufacturing and agriculture. Presumably, the method of calculation was chosen in order to assure farmers a "fair" return, which keeps pace with inflation. However, in practice, such price increases have led to a greater excess of prices over cost of producing milk, which in turn causes increases in the market value of quota.

Second, the weights of different inputs into the cost of production are fixed, assuming in fact that farmers do not substitute cheaper for more expensive inputs when relative prices change. However, it is well-known that such substitution possibilities exist and are used to lower true costs below those implied by an Index assuming fixed input co-efficients.

Both sources of upward bias implicit in the measurement of production costs of dairy farmers tend to be reflected in the value of quotas, since they lead to a widening of the gap between the price paid for milk and the true cost of producing it. In the following analysis, we have neither been able to measure these sources of bias nor use them to explain the level or changes in the value of quotas. This omission does not invalidate our estimates of the excess of price over cost of production and the implicit transfer of income from consumers to dairy farmers presented in Part IV below. These estimates are valid in the absence of any knowledge about the causes of the value of quotas. The

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empirical study of the determinants of quota values presented in the next part, on the other hand, could benefit from the availability of information on the size of the cost measurement biases just discussed. However, unfortunately we were not able to quantify these biases and can only remind readers to recall their existence in the interpretation of the results presented in Part III.

III. AN EMPIRICAL STUDY OF THE DETERMINATION OF QUOTA VALUES

The empirical testing of the basic properties developed in the preceding part of this paper is severely constrained by the availability of information on the value of Fraser Valley milk marketing quotas. While the B.C. Milk Board keeps records of ownership of quotas, it does not keep record of the price at which they were transferred. For this reason, we had to obtain information on the value of quotas from private live-stock auctioneers in the Fraser Valley who also act as brokers for milk marketing quotas. As a result of this fact, our data consist of a limited number of observations and we have no independent check on how representative our sample is and what proportion of all transactions it covers. However, because competition in the market for quotas is fairly strong, there is a good theoretical presumption that the sample data available to us approximate closely the true market value of the quotas during the period 1971-75.

The Basic Data

In Figures 4 and 5, we present graphically the basic data and some simple transformations of them on which our statistical analysis is based. Appendix D contains the numerical information underlying the graphs, along with descriptions of the sources of the data. All cost data were obtained from Annual Reports of the B.C. Milk Board.

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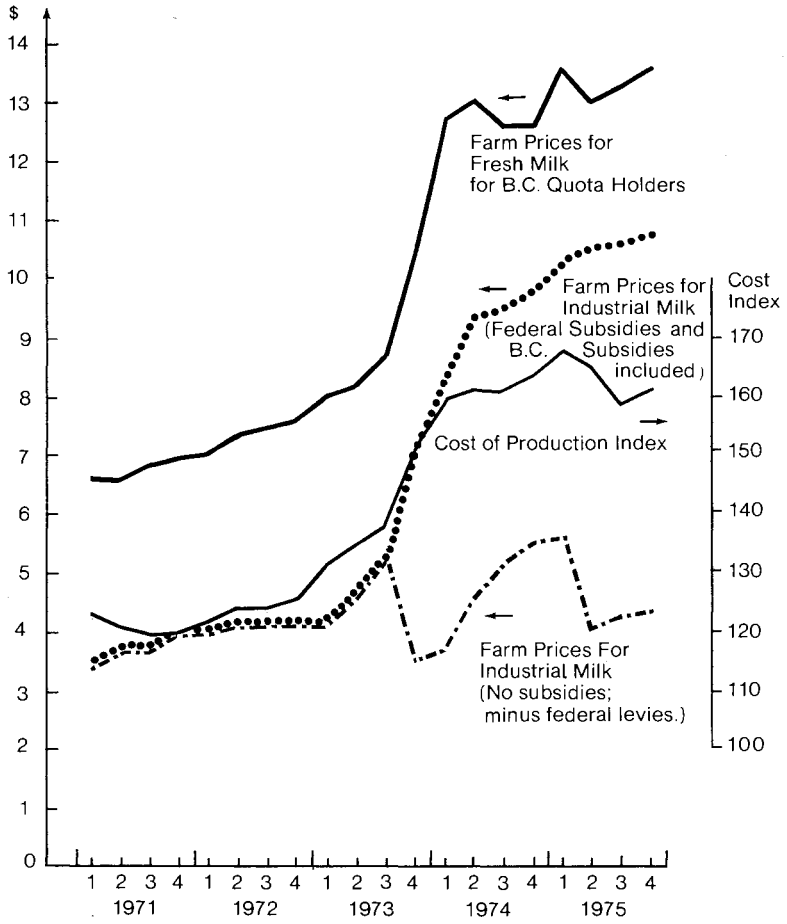
Figure 4—B.C. Milk Prices and Costs



The average quarterly prices paid for a hundredweight of milk by the B.C. Milk Marketing Board are measured on the left scale. The average of the quarterly Cost Index as calculated by the Marketing Board is shown on the right scale.

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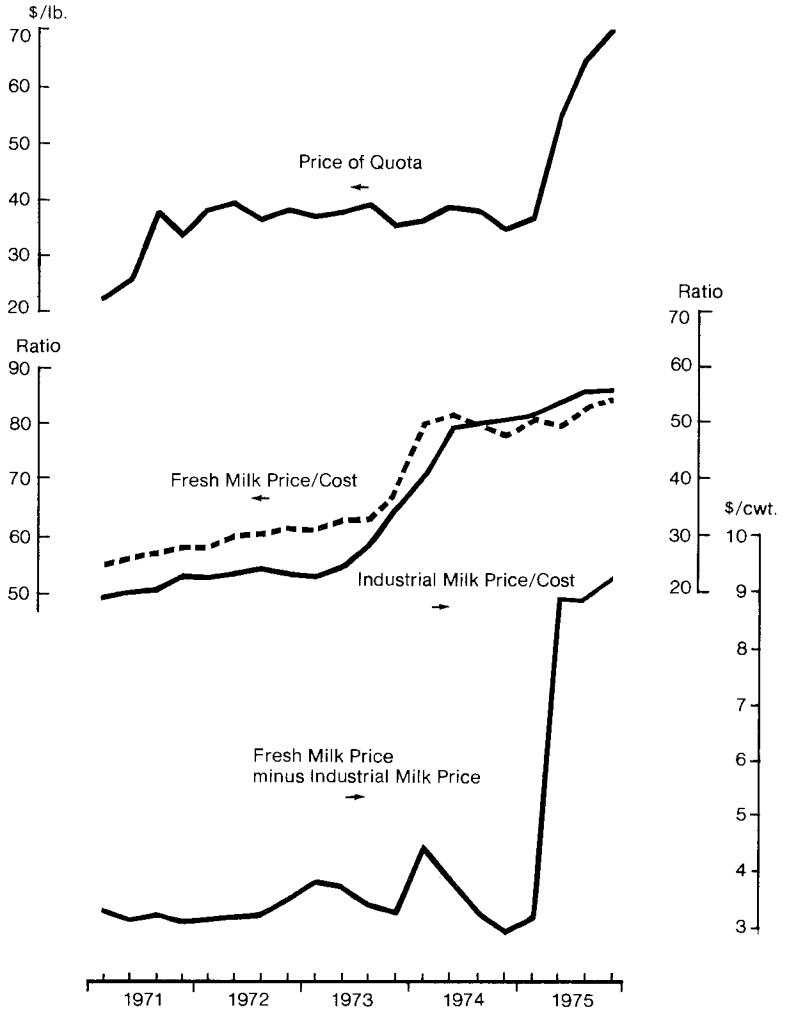
Figure 5—Comparison of Quota and Milk Prices



The top panel shows quarterly average prices of milk quota rights, entitling owners to deliver a pound of fresh milk per day at the official price. The centre panel shows the ratios of the indices of official price for fresh and industrial milk over the official Cost Index. The increase shown theoretically should raise the value of the quotas but because of institutional changes noted in the text it did so only after the sharp increase in the price of fresh minus industrial milk shown in the bottom panel. The industrial milk price shown in the bottom graph after the first quarter of 1975 is the UNSUBSIDIZED industrial milk price since new quota entitlements to federal industrial milk subsidies were not available after that time.

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Our theoretical analysis suggests the very simple empirical test that the value of the quotas should be an *increasing* function of the price of fresh milk received by quota holders and a *decreasing* function of the cost of producing this milk. However, there is an extremely high correlation between the prices for fresh milk and the Index of Production Cost.[11] This is, of course, as it should be, since according to the laws regulating the B.C. Milk Board, costs should determine prices paid to farmers. Thus, both time series show a moderate rise from the beginning of the period until the third quarter of 1973, then a sharp rise for two quarters and thereafter a leveling off. Yet, the apparent synchronous movement of these two series hides an important fact brought out by the calculation of the ratio of the prices for fresh milk over the Cost Index, which is plotted in the centre panel of Figure 5. As can be seen, this ratio increased slowly from the beginning of the period until the third quarter of 1973, then rose sharply for two quarters and thereafter remained nearly constant. In other words, until the beginning of 1974 the prices received for fresh milk by quota holders rose more rapidly than the cost of production.

According to our theoretical analysis, this development of the fresh milk price/cost of production ratio should have caused the value of market quotas to rise. However, as can be seen from Figure 5, the value of the quotas remained rather constant until the first quarter of 1975, when it rose sharply from about $35 to $69. The failure of the data to support the simple version of our theory is due to the existence of the following institutional setting.

B.C. dairy farmers are able to sell milk produced in excess of their fresh milk quotas as industrial milk, the price of which is determined by prices for industrial milk products plus a federal subsidy which is paid by the Canadian Dairy Commission but administered by the B.C. Milk Board. The price for industrial milk is posted by the Marketing Board and is available only to holders of the federal quotas. These federal quotas are designed to limit total Canadian output of industrial milk products and they are apportioned to individual provinces on the basis of some formula irrelevant to our analysis. Important for our analysis, however, is the fact that historically B.C. milk producers could

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obtain the federal quotas without any administrative difficulties and there was no value attached to them because the B.C. dairy industry had not exhausted the amount of quotas which it had been allocated under the federal plan.

In Figure 5, we plot the value of the ratio of the industrial milk price to the Cost Index. While the absolute value of this ratio is lower than that for fresh milk, the two run roughly parallel to each other, with a slight relative dip after the third quarter of 1972 for the industrial milk price ratio, (indicating decreased relative profitability of producing industrial milk). Thereafter, industrial became relatively more profitable than fresh milk production, as is evident from the relative position of the two ratios shown in Figure 5. The changes in the ratios of prices over cost after the third quarter of 1973, as seen in Figure 5, are due to the introduction of two new subsidy programmes, one by the B.C. and one by the federal government.

New Subsidy Programmes After 1973

In response to complaints about the lack of profitability of dairy farms and actual declines in the production of fresh milk, the NDP government of British Columbia in the third quarter of 1973 instituted the **Dairy Farm Income Assurance Programme,** supplementing existing provincial and federal programmes for the industry. The main features of this programme are that it is designed to resemble an insurance scheme, which, in principle, would make it self-supporting. Thus, every month, fixed and variable costs of dairy farm production are established in negotiations between B.C. Department of Agriculture officials and representatives of dairy farmers, drawing heavily on a model of an average dairy farm's production function with fixed input coefficients, a sample of which is attached as Appendix A.

Under the scheme, fresh milk producers receive a subsidy equal to the difference between the cost of producing milk and the price received by the farmer, *if* the former exceeds the latter. When costs fall *below* the price of milk, farmers pay one-third of the difference into the fund. During periods when costs exceed price, the money needed to pay

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the farmers is raised in equal proportions by:

- a payment from the provincial government's general revenue,
- a rise in retail price to the consumer and,
- a cash contribution by the farmers, who in effect are then receiving only two-thirds of the difference between the cost and price of milk.

A further provision of the programme is that the farmers' contributions cannot exceed $ .30 per hundredweight. The advances of the government and consumers paid into the fund during the periods of excess of cost over price are to be recouped during periods when costs are smaller than the price of milk, when farmers pay one-third of the difference into the fund[12] (in effect, repaying the money advanced by the government) and consumers' prices are reduced by one-third of the difference between the cost and price.

In principle, if the differences between costs and price are positive and negative by equal amounts and for equal lengths of time, the fund breaks even and requires no net payment from general government revenue. The consumers' price rise due to increased cost would be less and the fall due to lower costs smaller than, but average to, the same level as in the absence of the scheme. Similarly, the farmers' income would be stabilized but not raised on average.[13]

However, the operation of the scheme in practice has not been as planned. Since the programme's inception, costs of production have exceeded the price and farmers have been receiving a net subsidy from the provincial government. Consumer prices were not raised according to the legislation and the "insurance" fund has accumulated large deficits. Furthermore, without public explanation and therefore without any reference to legislative authorization, the British Columbia NDP government, in October 1974 and July 1975, by Cabinet Order, directed the Milk Board to make an arbitrary upward adjustment in the base period price which is multiplied by the Cost Index to derive the price of milk paid to farmers.[14] The net effect of these adjustments was increased retail prices for milk and increased payments to farmers. In effect, the "insurance" programme has turned out to be a pure subsidy programme to farmers.

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Almost simultaneously while introducing this provincial programme, the province joined a new Canadian Dairy Commission programme known as the **Market Share Quota System.** It had the two objectives of *increasing* the price received by holders of federal quotas and *discouraging* the production of industrial milk in excess of the Canadian-wide quota. The former problem was tackled by raising subsidies for industrial milk up to the quota quantities, while the latter led to the institution of a penalty levy on industrial milk sold in excess of the federal quota. At first, this levy was $1.50 per hundredweight until the first quarter of 1975, when continued excess accumulation of Canadian industrial milk products forced the federal government to raise the levy to $4.00 per hundredweight. The effect of this treatment by the federal government of milk produced in excess of quota was the creation of separate prices for quota and non-quota industrial milk after the third quarter of 1973. In Figure 5, we show these separate prices; it should be noted that the prices shown for fresh milk and industrial milk sold by the holders of B.C. and federal quotas also contain subsidies received under the B.C. Farm Income Assurance Programme.

The economically relevant main effect of the new provincial and federal subsidy programmes initiated in the third quarter of 1973 has been the increase in the ratio of both the fresh and industrial milk prices over the traditional Index of Cost, shown in Figure 5. The resultant increase in the profitability of milk production in British Columbia led to a rapid increase in output. At first, the provincial and federal subsidies were available to any farmers requesting them since federal quotas for industrial milk allocated to B.C. had not been exhausted. However, in the first quarter of 1975, the B.C. allocation of federal quotas ran out. Thereafter, the allocation of federal quotas was tied either to past deliveries of industrial milk or to the acquisition of provincial fresh milk quotas.

As a consequence of these developments, after the first quarter of 1975, federal quotas became scarce and therefore valuable. For any farmers who wished to acquire them and who had not had a record of past individual milk production, the only available method was to purchase B.C. Milk

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Board quotas. Consequently, after the first quarter of 1975, demand for provincial quotas increased, and as can be seen readily from Figure 5, their value rose sharply. These data therefore are consistent with the basic theoretical proposition that the value of milk quotas is an increasing function of the difference between the price of milk and the cost of producing it, though the direct relationship is obscured somewhat by the particular institutional arrangements linking the provincial and federal quota systems. In Appendix C, we present an econometric analysis of the relationship between quota values and the ratios of milk prices over cost of production. This analysis confirms the findings just discussed and evidenced by the graphs in Figure 5.

Summary and Conclusions

In this section we have presented information about prices, subsidies, costs and the value of marketing quotas to show that the value of the latter is an increasing function of the difference between the price and cost of producing milk. Because of the complicated nature of the Canadian and B.C. dairy industry subsidy programmes, and because of the limited period over which data are available, the theory could be tested only on one episode of change in the ratio of price over cost; this takes place in the third quarter of 1973 with the introduction of the federal Market Share Quota System and the B.C. Farm Income Assurance Programme.

These two subsidy programmes raised the prices paid farmers by more than the official Index of Cost. However, because the industrial milk price rose more relative to cost than did the fresh milk price, and because the industrial milk price could be obtained through the costless acquisition of a federal quota, the B.C. fresh milk quota did not rise in value until federal quotas became unavailable early in 1975. Thereafter, increased milk output could be sold only at an industrial milk price without subsidies and adjusted for a federal levy. Consequently, demand for B.C. market quotas increased and their value rose since their ownership provided access to the two subsidy programmes from the federal and provincial governments.

The formal econometric tests found in the Appendix confirmed the theoretical proposition that the value of quotas is an increasing function of the difference between the price received for milk and the cost of producing it.

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IV. THE COST OF THE B.C. MILK BOARD PROGRAMME

Economists distinguish two different types of costs associated with any government programmes interfering with the free operation of the market. The *first* of these is the cost of income transfers from consumers to producers. This cost, which is of greatest interest to the parties affected, is analytically the same as other transfer payments programmes operated by the government. It involves taking money away from one group of people and giving it to another in order to achieve some valuable social objective. These payments, by themselves, do not reduce the quantity of real resources available to society as a whole, except for those used up in the administration of the programme and in the political process of persuading politicians and the public that the subsidized group is indeed needy.

The *second cost* of such schemes as the B.C. Milk Board is one of great concern to economists. It involves outright welfare losses caused by the lowering of output and consumption brought about inevitably by the raising of the price of milk. This **social cost,** also known as the **loss of consumer surplus,** could be avoided in principle if the government made direct grants to dairy farmers from general revenue rather than raise the revenue through the increased price of milk.[15] All calculations which have been made in the past of such welfare costs reveal them to be quite small. Nevertheless, they are one important measure of the cost of the B.C. Milk Board operations and they will be presented below.

In the next section we turn to the analysis and measurement of the first type of costs, the income transfers from consumers to producers. All of our estimates must necessarily be rough and require that certain judgements be made. In situations where we were forced to make judgements, we tried to err on the side of understating our estimates of transfers on the grounds that any case against the B.C. Milk Board is stronger if it is shown that even conservative estimates imply large income transfers. In Appendices we provide estimates of transfers and costs under different assumptions for the convenience of readers who like to consider the implications of alternative assumptions.

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Some Basic Propositions About Income Transfers

We recall that in Figure 3 above, the excess of the price for fresh milk received over the cost of producing it is equal to P_jC per pound of fresh milk per day. A dairy farm producing OQ_d units of fresh milk per day receives a total amount of income above cost of production equal to the area $CBAP_j$ per day, or $CBAP_j$ x 360 per year.

This annual stream of net income over real production costs in practice is not observable directly. What we do know unambiguously, however, is the price which farmers have been willing to pay for the ownership of such a stream of income. According to well-known, basic principles of finance, the present value (PV) of a stream of annual income (Y) is given by the formula

$$PV = \frac{Y_1}{1 + r_1} + \frac{Y_2}{(1 + r_2)^2} \cdots + \frac{Y_n}{(1 + r_n)^n} + \frac{K}{(1 + r_n)^n} \quad (1)$$

where r is the interest rate and for discounting, the subscripts stand for the years in which the payments are received and the particular interest rates which are applicable, and K is the cash value of the quota at the end of the holding period. In this formula, only the value of PV can be observed and is known with certainty. The other elements of the equation are estimated implicitly (or explicity) by farmers and bankers who lend money to them for the purchase of the quota. In practice, considerable uncertainty surrounds the value of the quota at the end of the holding period since it is determined by a projection of trends of the type discussed here at some point in the future. Similarly uncertain is the magnitude of annual excess of receipts over real production costs and the discount rate applied to these future net receipts.

However, it is possible to obtain an estimate of the annual net receipt stream by making certain assumptions about the behaviour and motives of farmers buying the quotas. Thus it appears most reasonable to us that a farmer buying a quota will hold only very vague and uncertain views about the value of the quota in the future when he wishes to retire or leave the dairy business. This is so because he does not know when he will want to sell out and what will

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be the general economic conditions and government policies affecting the value of the quota at that time. Given these uncertainties, the perceived resale value of the quota typically is considered to be very low; in technical terms, it is discounted very heavily.

Given these considerations, it appears most reasonable to us to consider the resale value of the quota to be zero ($K=0$) and that the annual net receipts are equal ($Y_1=Y_2=\cdots=Y_n$) and perpetual ($n=\infty$). The former assumption is merely convenient, but the latter reflects the uncertainty about the expected length of the holding period. The perpetuity of the income stream may appear to bias upward the value of the right to it, but in fact an application of high discount rates consistent with the uncertainty surrounding the future of the programme very quickly reduces the present value of future payments to a negligible amount.

The discount rate applied to the stream of future net receipts influences the estimate of the capital value decisively. To err on the conservative side, we assume that the discount rate is equal to the interest rate on mortgages existing in 1975 when the quota value existed.[16] This rate was K per cent and is assumed to remain the same throughout the expected holding period ($r_1=r_2=\cdots r_n=.12$; $n=\infty$).

Under these assumptions, the present value of the stream of income is

$$PV = Y/r \qquad (2)$$

In this equation we know the value of PV from actual observation and r from the assumption that the discount rate is equal to the mortgage rate. By transformation of equation (2) we get

$$Y = PV.r \qquad (3)$$

This equation shows conveniently the implications of our set of assumptions about the expectations held by the buyer of a quota. In effect, he decides on the price he is willing to pay for focusing on the annual interest payments to service the loan he needed to take out from the bank to acquire the quota. He is thus assumed to believe much like a house-buyer who determines how big a house he can afford by relating the monthly mortgage payments to his current net income, giving only relatively minor weight to the resale value of the house or uncertain increases in his salary. Thus,

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if the quota costs $10,000 and the interest rate is 12 per cent, there is an annual interest cost of $1,200. It should be noted that such a payment schedule does not include an amortization of the loan, which in reality banks require. This fact may be considered to compensate at least in part for the perhaps unrealistic assumption that the farmer considers the value of the quota to be zero at the time of resale.

Readers who are dissatisfied with the realism of the assumptions underlying the following estimates are referred to Appendix E in which we analyse the implications of different sets of assumptions. However, before doing so, readers should consider the next section of the paper in which we relate the information about the value of the quota to actual costs of production to estimate the proportionate increased cost of production and the transfer of income from consumers to producers implicit in the market value of quotas and the preceding set of assumptions.

Income Transfers and Costs

The quotations on the price of quotas in Appendix D are in terms of the right to sell a pound of milk per day at the current official price.

In Appendix A of this paper we present data on the cost of producing milk—data assembled by the Mainland Dairymen's Association in connection with the B.C. Dairy Income Assurance Programme. The data cover April 1975 and take into account many kinds of variable and fixed costs of operating a dry lot operation involving 50 cows. The cost data omit interest payments on the quota.

As can be seen from the second column of the Appendix data, they concern the cost of producing a hundredweight of milk. In order to express the quota value analogously as per hundredweight, we have to engage in the following calculations, drawing mainly on data found in Appendix A. A cow produces about 13,600 pounds of milk per year, or an average of 37.78 pounds per day. During the winter months, daily output is about two-thirds of the annual average, or about 25 pounds per day.[17] The assumed 50 cow dairy farm therefore requires a quota for delivery of 1,250 pounds per day, which at $70 in the Spring of 1975

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comes to an investment of $87,500. This is the value of PV defined above for a 50 cow dairy farm. At that time, first mortgages on houses in the Vancouver area were issued at about 12 per cent. Assuming that the farmer could borrow the money at that rate, and using the equation produced above Y = PV.r, the annual interest cost for servicing the loan taken out to purchase the quota came to $10,500. With total annual fresh milk deliveries at two-thirds of the total (13,600 x 50 x 2/3 = 453,333 pounds or 4,533 hundredweights), the quota cost amounted to $2.32 per hundredweight for fresh milk delivered on average during the year.

According to the Mainland Dairy Association data in Appendix A variable costs were $10.85, fixed costs $2.30 and total cost $13.15 per hundredweight. The cost of servicing the loan for the quota and, according to our theory, the excess of receipts over cost of production, therefore, is equivalent roughly to all of the fixed cost and 18 per cent of the total cost of producing fresh milk.

In 1975, total fresh milk purchases at the Market Board's price in the Vancouver area were about 500 million pounds, or 5 million hundredweights. The amount of income transfers from consumers to producers (and through them to the lender of the capital with which the quota was purchased) came to $11.6 million. Given the roughness of our calculations and the biases implicit in the method of calculation, it is convenient to round the estimate to $12 million in 1975.

This $12 million income transfer from consumers to producers can be put into perspective by considering that in 1975 there were approximately 1,000 dairy farms in the Vancouver Mainland area, so that on average they received $12,000 each. There are, of course, many small farmers who received much less than $12,000 while some large operations received much more. Another way of looking at the amount is to consider that in 1975 the sale of all fresh milk products, consisting mainly of standard and low fat milk, but also including skim milk, sour cream, whipping cream, etc., came to about 160 million quarts. Assuming the average retail price of the milk to have been $ .60 a quart, the value of all sales amount to $96 million. The income transfers thus averaged about 12 per cent of the retail price of the milk. Still another way of putting the figures into perspective is

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to remember that the population of the Vancouver metropolitan area is about one million persons. Thus, the data imply an average expenditure of about $100 per person on fresh milk products, or $400 for a family of four, which is conservative since children consume more milk on average than adults. Such a family of four transfers $48 per annum to dairy farmers, or about one-twelfth of the annual federal allowances for two children.

Some Other Sources of Cost

The preceding analysis neglects two additional ways in which the operation of the B.C. Milk Board imposes costs on the B.C. public.

First, there are the administrative costs of the scheme. Civil servants have to be paid and administrative expenses met. According to the B.C. budget, these expenses in 1975 came to about $160 thousand. This expense is met from general tax revenue and therefore is borne by the population of the province in general. Furthermore, B.C. dairy farmers have to pay a certain levy, (the size of which is related to the quantity of milk produced), to the federal government in support of the Market Share Quota System for industrial milk. These payments in 1975 came to about $110 thousand.

Second, it has been argued theoretically, and shown empirically, that all interest groups in society, which have succeeded in obtaining a subsidy from the government, must continuously spend money on the maintenance of effective organization which can lobby with politicians and wage publicity campaigns to protect the rent they are obtaining.[18] It is, of course, extremely difficult to obtain an estimate of the amount of resources spent in this manner, since presumably even in the absence of the B.C. Milk Board dairy farmers would belong to an association doing research and serving as a clearing house for information relevant to running dairy farms. However, according to a recent U.S. study, the contributions made by U.S. dairy farmers to support their regional and national associations charged with lobbying for their interests amounts to about 25 per cent of the rent received from the government support programme.[19] In the absence of any estimates for Canada, it may be useful to consider the implications of such a magnitude for the B.C. Milk Board programme.

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Since, according to our estimates above, the rent accruing to B.C. dairy farmers in the Fraser Valley is about $12 million per year, the preceding analysis implies an additional expenditure of $3 million on lobbying and publicity. This appears to be high, but we should note that recent revelations in the United States have shown that corporations and industry associations are spending vast sums on lobbying and in support of political parties and candidates. Readers have to form their own judgement as to whether similar conditions prevail in Canada. The continued existence and prospective growth of marketing boards noted in the introduction to this study suggests that powerful influences are at work and overwhelming the efforts aimed at the elimination of these boards—efforts mounted by economists and consumer interest groups.

Whatever may be the true amount of money spent on lobbying and publicity by the B.C. dairy industry, this money is collected from the farmers and to them represents simply a cost which is associated with the ownership and value-maintenance of quotas. Prospective quota buyers incorporate estimates of these costs with the determination of how much they can afford to pay for the quota, given the true cost of producing milk and the supported price received for it. The value of the quota, therefore, is smaller than it would be if there were no such additional costs and the transfer payments implicit in the quota value analysed above represent an under-estimate of the true excess of milk price over cost. Due consideration of these costs, therefore, would lead us to conclude that a removal of the B.C. Milk Board programme would lower retail prices by 15, rather than by 12 per cent and eliminate transfers from consumers to producers of $15 million, rather than $12 million, under the assumption that these lobbying and publicity costs amount to 25 per cent of the rent.

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Economic and Welfare Implications

The preceding calculations present rough but suggestive estimates of the value of the resources transferred from consumers to producers of fresh milk in the Vancouver area. Such transfers may or may not be justifiable on social grounds. It could be argued, for example, that dairy farmers, like the unemployed or the invalid poor, deserve to receive benefits from the state on humanitarian grounds. Another ground for subsidising farmers is to assure self-sufficiency and independence from unreliable imports from the United States or other provinces. We shall now assume for the sake of argument that subsidies to B.C. dairy farmers are justifiable on these grounds. The economists' case against the B.C. Milk Marketing Board programme then rests on the fundamental premise that the subsidies should be paid directly as income supplements to farmers rather than through high support prices and quota restrictions on output. The direct income supplements have two distinct advantages over price support programmes:

- they eliminate economic inefficiency and,
- they assure that the subsidies go to the farmers whom they are intended to help.

We now discuss these advantages in turn.

The price support programme involves inefficiencies. The analysis and measurement of these inefficiencies are rather technical and complicated. Therefore, they are relegated to Appendix F. A simplified explanation of the inefficiencies, however, is as follows. The increase in consumer prices induced by the support programme causes the consumption of fewer milk products than would be the case at the low price which would prevail under free competition. The loss of welfare and the inefficiency of the support programme is due, therefore, to the *reduced* consumption of milk products and *increased* consumption of less preferred goods induced by the programme. By analogy, producers are foregoing some output under the quota system which they would have produced under free competition. The resources thus not employed in the production of milk are used in other industries where the social value of the output produced must be below that in the milk industry under competition.

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Typically, calculations of cost of inefficiency due to the distortion of free markets have resulted in estimates of low costs since the adjustments involve only marginal changes in consumption and use of resources. In the present study, our "best" estimates of efficiency costs come to about $175,000 out of a total of $12 million rent earned by milk producers.[20]

This estimate of the efficiency cost of the B.C. Milk Board quota system points clearly to the importance of the other resource costs mentioned above: the maintenance of a provincial and federal bureaucracy and the expenditures on lobbying, publicity and support of political parties and candidates. It is recalled that the budget of the B.C. Milk Board in recent years has been about $160 thousand; and the federal programme covered by B.C. contributions is $110 thousand. Because of the difficulties encountered in measuring the cost of political activity, we assume for the present analysis that it is zero. Under these assumptions, we conclude that society could save roughly $.5 million (175 + 160 + 110, rounded to 500) per year if it paid a direct income cash subsidy of $12 million annually to B.C. dairy farmers in the Fraser Valley instead of transferring this sum indirectly, through the maintenance of the high price of milk, to consumers.

The Recipients of the Subsidies

As we have mentioned already in the theoretical discussion of Part II, one of the most undesirable features of a price support programme is that it leads to a value of quotas representing the capital value of the implicit subsidy. As a result, any dairy farmer entering the business through the purchase of a quota in effect does not himself receive the benefits of the price support system. He has to service the loan which he had to take out to purchase the quota. (Or it represents interest on money he owned and used to purchase the quota, but which he could have invested to earn interest.)

The perverse effects of the price support programme on the welfare of dairy farmers may be illustrated dramatically as follows. Assume that all farmers who were in business at

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the inception of the support programme in 1956 sold their quotas in 1975, retired to Victoria and left their proceeds from the sale of the quotas in savings banks. The new farmers in 1975 annually transfer $12 million to the savings banks from whom they obtained the mortgage to purchase the quotas. The banks, after adjustment for profits, simply pay this interest to the former owners of the quotas. In other words, the sole beneficiaries of the milk price support programme are the lucky owners of quotas at the time the programme was instituted or at the time the support price relative to production costs was raised. The current generation of farmers receives no benefits whatever from the current subsidy implicit in the difference between the support price for, and cost of, producing milk.

In fact, however, the problems and inequities are even more serious than the preceding illustration suggests. Though no statistical details are available, it is well-known that dairy farms in the Vancouver region are of different sizes. Typically, the large farms are run very efficiently, employing large capital stocks and enjoying economies of scale, while there are many small family farms with high production costs, operating at less than optimum scale and capital use. The latter type of farm often stays in business only because the owner and his family implicitly accept a very low hourly wage rate for their labour. In effect, it is these farmers and their plight which typically in British Columbia and elsewhere persuades legislators to enact price support programmes. Yet, our analysis has shown that such small family farms, often started by young persons, have to buy quotas to enter the business. Any increases in the support price relative to cost is seen by such farmers as a just method of helping them. At the same time, however, such increases in support prices, relative to cost, benefit even more the efficient, larger-scale farmers who do not need the support in the first place. Because of the irrational distribution of the subsidies paid by consumers to dairy farmers, through high support prices, it would be much better to replace the existing programme with a direct income subsidy to needy farmers. Not only would society enjoy lower prices of fresh milk products and total output would be larger, but also the benefits would be certain to go only to those needing them.

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Summary and Conclusions

In this section, we have used information on the value of quotas, interest rates, production costs and retail value of fresh milk products to estimate the amount by which the price for fresh milk set by the B.C. Milk Board exceeds the cost of producing it in the Lower Fraser Valley. We found that the excess in 1975 was equal to about $2.32 per hundredweight, or equal to the fixed cost per hundredweight incurred by a 50 cow dairy farm, or equal to 18 per cent of the total cost of producing the milk. The implicit total value of transfers from consumers to producers in the Vancouver area came to $12 million in 1975, equivalent to $12,000 per dairy farm and $48 per family of four.

We have suggested that attempts to raise the income of poor dairy farmers through the support of milk prices *does not achieve its goal of helping those in greatest need.* The stream of the excess of price over production cost is capitalized in the value of quotas and leaves every newly-entering farmer where he would have been financially *without* the support programme. Only continuous raising of prices relative to cost helps new and poor farmers, but it benefits even more the large and efficient farmers. Furthermore, price support programmes and output restrictions lower the welfare of producers and consumers. For this reason, it would be both more efficient and equitable to replace the support of dairy farmers now supposedly taking place through high product prices by direct welfare support payments to needy farmers qualifying for them, like urban recipients of such support.

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V. SUMMARY AND CONCLUSIONS FOR POLICY

In this paper, we have shown theoretically that the stabilization of the price for fresh milk throughout the year does not have to lead to the establishment of a positive value for marketing quotas since excess production during the summer months can readily be transformed into industrial milk products and traded internationally or stored. We concluded from this theoretical analysis that the very existence of quotas with a cash value is evidence of output restrictions and an excess of price over cost of producing milk.

In Part III of the paper we analyzed empirically the functional relationship between quota values and the ratio of milk price over an official Index of Production Costs. The lack of data on quota values before 1971 forced us to limit the analysis to the period since then and the operation of several types of provincial and federal support programmes for dairy farming had to be explained before the theoretically relevant statistical test could be formulated. The final results of our estimation show that the value of B.C. quotas increased after the ratio of milk price over cost of production had gone up, but only with a lag caused by the free availability of federal market quotas granting access to industrial milk prices, which had been raised even more than fresh milk prices. After due consideration of the institutional changes during the period, the empirical test supported the theoretical hypothesis.

The fourth part of the paper inferred from the value of the quota and a set of other, readily available information, the 1975 excess of price over the cost of producing a hundredweight of fresh milk on an average-sized farm. The estimates were that this excess amounted to 18 per cent of the total cost of production or the total fixed costs on a farm. The subsidy provided by the Vancouver public to dairy farmers on their purchase of fresh milk products was estimated to have been $12 million in 1975; $12,000 per farm; $48 per family of four and $0.07 per quart. All of these calculations are approximate and are based, in part, on imperfect information, though it is highly likely that further work would not alter them drastically.

We believe that these estimates are conservative because they do not reflect the cost of obtaining the quota

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system and of defending it against attacks from consumer protection groups and other groups representing the public interest. Political scientists and economists have suggested that these costs of lobbying, publicity and political contributions may be as high as 25 per cent of the transfers received. These payments by dairy farmers to their industrial organizations are a cost of being in the industry which would not exist in the absence of the government programme, but which lowers the market value of quotas and therefore biases downward our estimate of the excess of milk price over the cost of production implicit in the quota value.

We estimated that the efficiency cost of the B.C. Milk Board programme, as contrasted with the income transfer cost, amounts to about $.5 million per year.

One of the most important arguments against price support programmes for dairy farmers is that they are inequitable and inefficient. Quotas reflect the value of the excess of milk price over cost of production and farmers starting new in the business receive no benefits from the support programmes since they have to purchase the quotas. Consumers pay higher prices and farmers are forced into restricting output. All of these socially costly effects could be avoided if the dairy farm problem could be recognized for what it is, a problem of rural poverty, and treated as such through direct income supplements to poor farmers in an otherwise free market.

In conclusion, we should note that the estimates of costs presented here are incomplete since they neglect the effect of federal price support programmes for industrial milk. Since 1975, the federal quotas have also taken on a value and estimates of the excess of price over cost of production could be made. But the federal programme has resulted in added cost of a kind not encountered in the provincial fresh milk programme. The overall quantity of quotas allocated in Canada has led, in recent years, to such a large supply of milk that more industrial milk products were manufactured than were consumed by the Canadian public or could be exported profitably at prevailing world prices. The Canadian public, therefore, incurs not only the cost of subsidizing the excess production of industrial milk products with the consequence for quota values discussed

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in this paper, but also finances out of general tax revenue the storage, spoilage and ultimate sale at a loss of this excess production. An estimate of these costs of the federal dairy support programme has yet to be undertaken, but the policy implications of its results are clear and the same as for the B.C. provincial programme: abandon price support programmes in favour of free markets and support poor farmers with direct income supplements, treating them just like the urban recipients of welfare relief.

The Prohibition of the Sale of Quotas: Not a Solution

Several readers of the first draft of this paper have suggested to us that our analysis implies not that the B.C. Milk Board programme be abandoned, but that the only modification necessary would be that quotas be made non-transferable. Because this policy has such intuitive appeal, it may be useful to discuss its merits.

The most fundamental propositions about quotas developed above are that they are needed because at the government-set price for the milk, supply exceeds demand and the price exceeds the cost of production. The income transfers and efficiency costs are due to these facts. The value of the quotas is only a symptom of the underlying fundamental conditions.

Governments have in the past attempted to prevent individuals from appropriating the value of the rent implicit in commodity price support programmes by passing laws which prohibit the transfer of the quotas among farmers. Typically, under these conditions, market practices and institutions have developed to circumvent these rules. For example, if farmers are required to surrender their quotas to the marketing authority at zero value upon getting out of business, farmers are induced to prolong their stay in the business. Legal forms for leasing the quota simply, (or through attachment to cows or farm property), permit farmers to retain ownership and the benefits of the rent without actually operating the business. If the laws are tightened to prohibit leasing of quotas, the farmer may have to continue to live on his property, but he cannot be prevented from hiring a manager and retiring in practice.

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History abounds with examples of methods whereby the market and lawyers invent ways to circumvent prohibitions against the appropriation of the rent implicit in the quota right. Yet, it is conceivable in principle that legal requirements could be set so tightly and updated continuously, so that quotas are returned periodically to the Board at a zero cost. The question then arises how the Board allocates these obviously valuable rights to a stream of income to new owners. If it gives them away without cost, then strong incentives are created to bribe officials to allocate the quotas to particular persons. Alternatively, lucky new owners enjoy a windfall in income without having made a social contribution to deserve it. If the quotas are auctioned off, it would seem very inconsistent to insist that the buyers of these quotas return them to the Board later at a zero price and such a policy has little chance of being acceptable to farmers or the public.

The basic argument against making quotas non-transferable is that it does not eliminate the underlying income transfers and efficiency costs. Instead, by causing inconvenience to holders and the incurrence of real resource expenditures to circumvent the regulations, such a policy raises the efficiency costs of the entire programme. Attempts to reduce the value of quotas are like attempts to deal with a bad sore by covering it up with a band-aid. They merely hide the real problem.

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APPENDICES

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APPENDIX A
Components of the Cost of Production Index
MAINLAND DAIRYMEN'S ASSOCIATION
DAIRY INCOME ASSURANCE PROGRAMME—FRASER VALLEY
COST OF PRODUCTION AGREEMENT, APRIL, 1975.

	Per 100 lbs.
Grain—$133 per ton	$ 2.057
Hay—$84 per ton	3.891
Salt & minerals—$10 per cow	.074
Testing & Services—$4 per cow	.029
Veterinary & Breeding—$40 per cow	.294
Bedding—$12 per cow	.088
Dairy Supplies—$12 per cow	.088
Insurance—$10.45 per cow	.077
Hauling & Advertising (37¢ hauling—2¢ advertising)	.390
Interest on Investment per cow $700 @ 7 1/2%	.386
Cow replacement	1.287
Cow mortality	.154
Less Revenue—calves 5%	(.257)
—cull cows $210.10	(.372)
Labour	2.147
Cash Overhead	.516
Total Variable Costs	**10.85**
Depreciation—Barn & Dairy	.404
—Equipment	.348
Taxes—$1120	.165
Maintenance & Repairs—$767.05	.113
Legal & Accounting—$240	.035
Truck Costs—$900	.132
Operating Capital—$5000 @ 7 1/2%	.055
Interest on property investment	.654
Management (2%) of replacement costs	.393
Total Costs	**13.15**
Premium	**.20**
Net Producer Return	**$ 12.95**

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B.C.D.A. LOWER FRASER VALLEY – APRIL, 1975

Assumptions

1. Dry lot operation.
2. 50 cows.
3. Replacement rate 25% per year.
4. Mortality of cows 3%.
5. Calf sales 1/cow/year, $35.00.
6. Value of replacement cows @ $700.00.
7. Sale value of cull cows, Calgary—$16.70 × 13 − 15 ÷ 4 = $50.53.
8. Replacement cost/cow/year $175.00.
9. Milk produced per cow 13,600 lbs.
10. Weight of cow 1,300 lbs.
11. Grain required per cow including waste 4,207 lbs/year.
12. Cost of grain $133.00/ton.
13. Hay required per cow including waste 12,600 lbs/year.
14. Cost of hay $84.00 per ton.
15. Value of buildings $55,000.
16. Depreciation on buildings 5%.
17. Value of equipment $23,637.00.
18. Depreciation on equipment 10%.
19. Labour 1 man equivalent 2,920 hours.
20. Land 5 acres @ $4,000/acre = $20,000.00.
21. Value of cows $700 x 50 cows = $35,000.
22. Total investment $133,637 excluding quota.
23. Interest on investment 7 1/2% (50% only on equipment and buildings).
24. $5,000 operating capital accrues interest.
25. Repair, Maintenance and Hardware 15% of depreciation.

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APPENDIX B
The Problem of Moving Average Base Periods

In the text, the exposition of the method of calculating the price paid farmers was simplified by stating that the monthly cost index is applied to a fixed base period accounting value. In fact, however, this is not so. The accounting value which is multiplied by the index is a moving average of preceding accounting values. The use of such a base introduces a powerful upward bias into the measurement of costs, as can be seen from the following example:

(1) Year	(2) Accounting Value Base Period (dollars)	(3) Cost Index	(4) Accounting Value Simple Method (dollars)	(5) Accounting Value 2 Year Average (dollars)
1	5.00	100	5×100 = 5.00	100×.5 = 5.00
2	5.00	200	5×200 = 10.00	200×.5 = 10.00
3	5.00	200	5×200 = 10.00	200×.5× 5.00+10.00 = 15.00
4	5.00	200	5×200 = 10.00	200×.5×10.00=15.00 = 25.00
5	5.00	200	5×200 = 10.00	200×.5×15.00+25.00 = 40.00
6	5.00	200	5×200 = 10.00	200×.5×25.00+40.00 = 65.00

Under the simple method described in the text, a one-time doubling in the Cost Index leads to a doubling of the base period accounting value from $5 to $10, as can be seen from column (4). However, if in every period the accounting value is determined by multiplying the Cost Index by a moving average base period equal to the mean of the two preceding years, then the measure of cost increases explosively, as can be seen from column (5). Thus, in year 3 the accounting value is equal to the Index of 200 multiplied by one half of the sum of values in the preceding two years: .5 × (5.00 + 10.00), or $15.00.

In reality, the method used involves a ten-year moving average, so that the explosive nature of the Index during inflation is not as obvious as it is in the example above, but the principle remains.

Fortunately for the consumers of B.C. the bias in the determination of the accounting value just mentioned is offset by an analogous bias in the opposite direction in the construction of the Cost Index proper. Each component of the Index of Costs is deflated by a base period value which

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is a ten-year moving average, but because the actual value of the cost component, say wages and salaries, is divided by this moving average, the same forces which make the accounting value explode make the Index decrease when true costs are increasing.

We have not analysed whether the two biases are fully offsetting or whether on balance they favour consumers or producers, but experts in the construction of indices should be encouraged to undertake such an analysis and present recommendations for a review of the procedures used by the B.C. Milk Board.

We know of no reason why in the construction of indices base period values should be moving averages rather than fixed numbers.

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APPENDIX C
An Econometric Test of the Determinants of Quota Values

The determination of the quota value at the beginning of the period results from developments outside our range of observations. During the period covered, the main influence on the value of quotas appears to have been the difference in the price received for fresh and industrial milk. The validity of this proposition is intuitively drawn once we consider the possibility that if the industrial milk price were only marginally below (or the same as) the fresh milk price, the right to sell fresh milk would be worth nothing as long as the right to sell at the industrial milk price was obtainable freely. According to these considerations and given the free availability of federal industrial milk quotas until the end of 1974, the main determinant of B.C. quota values is the difference between fresh and industrial milk prices, the latter including federal and provincial subsidies until the end of 1974; thereafter excluding them. The time series of these milk-price differences is shown in the bottom of Figure 5. It is seen to be without a trend from the beginning of the period until the end of 1974, thereafter it rises sharply. The behaviour of the time series of quota values is almost identical, level until the end of 1974 then showing a sharp increase.

The visual impression of a correlation between the two time series is confirmed by a formal econometric test, the results of which are:

$$QV = \underset{(7.42)}{19.63} + \underset{(8.38)}{4.71}\,(FID) \qquad (1)$$

where QV is the value of B.C. Milk Board quota for fresh milk and FID is the fresh-industrial milk price difference described in the preceding paragraph. The t-values of the coefficients are given in parentheses and show that the estimates are statistically highly significant. The correlation coefficient (R^2) is .78, which for 20 observations is significantly different from zero. The Durbin-Watson statistic of 1.37 indicates the absence of any serious problems of serial correlation.

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APPENDIX D
Milk Prices, Quota Prices and Cost Data, Quarterly Averages

		Price of Marketing Quota ($/lb)	Farm Prices for Fresh Milk for BC Quota Holders Including BC Farm Income Assurance Programme Payments $/cwt.	Farm Prices for Industrial Milk Receiving Federal Subsidies and Provincial Subsidies $/cwt.	Farm Prices for Industrial Milk Without any Subsidies Adjusted for Federal Levies $/cwt.	Index of Cost of Production
1971	1	22.50	6.78	3.46	3.46	122.89
	2	25.00	6.75	3.71	3.71	120.56
	3	37.25	6.84	3.71	3.71	119.56
	4	34.08	6.99	3.95	3.95	119.84
1972	1	38.59	7.07	3.95	3.95	121.96
	2	39.12	7.34	4.09	4.09	124.31
	3	36.25	7.43	4.16	4.16	123.49
	4	37.22	7.66	4.16	4.16	125.88
1973	1	36.28	8.01	4.16	4.16	131.58
	2	37.77	8.29	4.56	4.56	133.98
	3	38.32	8.68	5.21	5.21	137.09
	4	34.81	10.39	7.15	3.50	152.61
1974	1	35.48	12.70	8.28	3.72	159.74
	2	38.63	13.03	9.23	4.47	160.95
	3	37.00	12.68	9.42	5.11	160.31
	4	34.15	12.68	9.73	5.48	163.48
1975	1	36.31	13.52	10.26	5.63	167.94
	2	54.29	13.03	10.44	4.07	165.76
	3	64.40	13.25	10.48	4.34	159.63
	4	69.87	13.58	10.76	4.35	161.65

Sources and Notes

1. The prices of marketing quotas were obtained from several Livestock Auctions in the Lower Fraser Valley. Quarterly data are simple arithmetic averages of observations during the period.
2. All prices for milk were obtained from *The Milk Board Annual Reports,* various issues, published by the Government of the Province of British Columbia.

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APPENDIX E Alternative Estimates of Transfers

Assuming, as in the text, that the quota is held in perpetuity and has a zero cash value at the end, the annual interest cost and cost per hundredweight at different discount rates is as follows:

(1) Discount Rate (Interest Rate)	(2) Annual Cost ($)	(3) Cost per Hundred-weight ($)	(4) Total Value of Transfers ($ million)
6	5,250	1.15	5.8
9	7,875	1.73	8.7
12	10,500	2.32	11.6
15	13,125	2.89	14.5
18	15,750	3.47	17.4
21	18,375	4.05	20.3

If it is assumed that the average farmer expects to hold the quota for n years, the value of the quota at the end of n years is expected to be k times its initial value of $87.50, the interest rate is r, then the equal annual payments Y are found with the help of the following equation:

$$87.5 = \frac{Y}{1+r} + \frac{Y}{(1+r)^2} + \ldots + \frac{Y}{(1+r)^n} + \frac{k.87.5}{(1+r)^n} \quad (2)$$

Thus, if $n = 5$, $k = 1$, $r = .05$, then

$$87.5 - 87.5/1.276 = 18.9 = \frac{Y}{1+r} + \frac{Y}{(1+r)^2} + \ldots \frac{Y}{(1+r)^n} \quad (3)$$

Y is found in a bond table to be 4.36.

This is the annual cost of servicing the loan taken out to pay the quota. The total value of transfers implicit in this figure is $4.8 million. It is found by multiplying Y by 1.1, consistently with the transformation between columns (2) and (4) above, where (4) = (2). 1.1 million.

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The following table gives the value of the transfers under different sets of combinations of k, n and r:

k = 1

n/r→ ↓	.07	.10	.13
5	6.8	9.6	12.5
10	6.8	9.6	12.5
15	6.8	9.6	12.5

k = .5

n/r→ ↓	0.7	.10	.13
5	19.3	21.5	23.7
10	12.0	14.2	16.4
15	9.6	11.9	14.3

k = 2

n/r→ ↓	.07	.10	.13
5	x	x	x
10	x	3.6	7.3
15	2.9	5.2	10.1

The estimates for k = 1 are the same for any year at a given interest rate because the present value of the capital sum declines at the same rate as does the discounted value of the annual net receipts. The cells marked with an x indicate conditions under which the growth in the capital value of the quota implies a net return exceeding the assumed interest cost. In the long-run under competition such conditions cannot exist.

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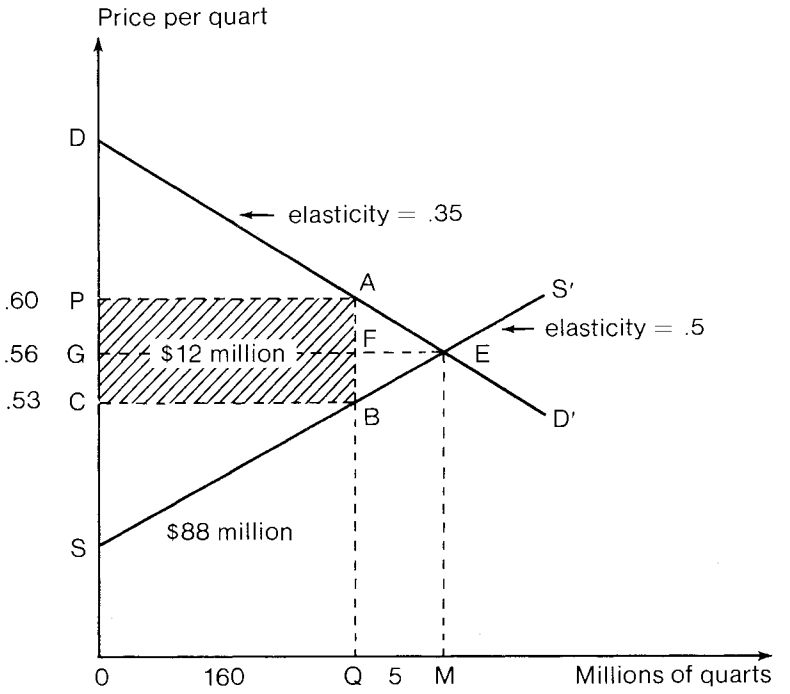
APPENDIX F Technical Estimate of Welfare Costs

To make the estimates of efficiency loses we draw on Figure 6, which reproduces all essentials of Figure 3. From basic price theoretic considerations it is well-known that under free competition with the milk product price at OG and the output at OM, total consumer satisfaction is equal to the area under the demand curve OMED. Of this amount, OMEG represents payment by consumers to producers. The area GED under the demand curve is equal to consumer surplus. Of the payment received by producers, the area SEG is producers' surplus while OMES measures the resources used up in producing the output.

Figure 6—Estimating Efficiency Losses



The market demand and supply curves are DD' and SS' respectively. At the restricted output of OQ, price at OP, and cost at OC per unit of output, the value of rent accruing to producers is CBAP per time period. The dead-weight loss of consumer and producer surplus is BEA. The actual quantity, price and elasticities are explained in the text.

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Now consider the imposition of an output restriction to OQ and the setting of a price to consumers at OP. In the new equilibrium, consumer satisfaction comes to the area OQ AD with OQ AP paid to producers and PAD left as consumer surplus. From comparison of the two areas of consumer satisfaction, before and after the output restriction, we note that it is smaller in the latter case by the area QM EA, of which QMEF represents money not spent and therefore left over for acquiring goods yielding nearly equal satisfaction, and leaving only FEA as the unaccounted-for loss. This area is also known as representing the deadweight loss of consumer surplus. We should note that in the new equilibrium, of the money paid to producers by consumers, the area CBAP represents a rent, but because it causes consumer losses to be equal to producer gains, society as a whole is not worse off and there is no loss of efficiency resulting from this transfer of income.

Finally, we should note that producers also suffered a deadweight loss of surplus. The original surplus of SEG is reduced by CBEG and then increased by the subsidy payment from consumers equal to CBAP. This leaves the triangle BEF as the loss of producers' surplus. In total, therefore, the loss of consumers' and producers' surplus resulting from the output restriction is equal to the sum of the two triangles BEF + FEA.

It is possible to measure the magnitude of this area in terms of dollars from information available to us. We know that the distance OQ is a restricted output of 160 million quarts, selling at OP = $.60. Total sales volume therefore is OQAP = $100 million, of which CBAP = $12 million, all according to estimates presented in the preceding section of the paper. The $12 million rent is equivalent to $.07 per quart of milk, giving us the value of P = $.60 and C = $53.

The problem now is to estimate the distance QM representing the increased output which would result from free competition. This effect clearly depends on the elasticities of demand and supply. Drawing on some other studies,[21] we assume the long-run elasticities to be .35 for demand and .50 for supply.

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The mathematical derivation of the equilibrium point uses the information of the price and quantity at point A and the estimate of the elasticity of demand:

$$E_d = \frac{dQ}{Q} : \frac{dP}{P} \tag{4}$$

which can be written and evaluated as

$$\frac{dP}{dQ} = \frac{P}{E_d \cdot Q} = \frac{.60}{160 \times .35} = .01069 \tag{5}$$

The equation for the demand curve is

$$P = a - bQ \tag{6}$$

when a is the intercept OD and b is the slope of the demand curve, which is assumed to be constant and equal to that formed at point A. Rewriting equation (6) and using the information on the value of P and Q at point A we obtain

$$a = P + bQ = .6 + (.6 \times 160/160 \times .35) = 2.31 \tag{7}$$

Having an estimate for the intercept a and slope b in equation (7) we obtain the following expression for the demand curve

$$P = 2.31 - .01069\ Q_d \tag{8}$$

The equation for the supply curve can be derived in a logically analogous fashion

$$P = -.53 + .00663\ Q_s \tag{9}$$

Setting equal the two equations and solving for $Q_d + Q_s$ we find an equilibrium output of 165 million quarts and a price of \$.56.

With this information OG = 5 million quarts and OC = \$.56 it is now easy to find the area of the triangle BEF = (1/2) (QM×FB) = 1/2 × 5 million × \$.03 = \$75,000. By analogy FEA = (1/2) (QM×FA) = 1/2 × 5 million × \$.04 = \$100,000. The total efficiency loss therefore is equal to \$175,000 per year.

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Alternative assumptions about elasticities in various combinations produce the following estimates, showing that the results are not very sensitive to elasticities (in $ thousands).

Elasticity of supply	.40	.50	.60
Elasticity of demand			
— .20	167	158	161
— .30	207	196	200
— .50	235	224	235
— .60	235	224	235

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Notes

[1]For a survey of the issues and recent developments see Forbes *et al.*, (1974) and Veeman and Veeman (1974). Weiss (1971) provides an excellent introduction to the economic problems facing dairy farmers generally.

[2]Fresh drinking milk is technically known as "fluid" milk. In this paper we refer to it as "fresh" milk since milk sold for other purposes by farmers is also fluid.

[3]There exists a large and growing literature in international economics dealing with the problems of random shock to stability and commodity price and producer income stabilization efforts through international commodity agreements. For example, see Johnson (1967) and MacBean (1966).

[4]The determinants of quota values in agriculture have been discussed widely in the literature. See Aines (1964), Boxley and Anderson (1973), Schmid (1964), Schultz (1959) and Wilcox (1964).

[5]A history and an outline of existing B.C. Milk Board operations are found in Veeman and Veeman (1974) and Wreford (1974).

[6]In this study we had to obtain quota prices from unofficial sources since no official agency collects these data.

[7]These provisions are rather complicated in detail, but simple in principle, as explained in the text.

[8]A Statistics Canada survey of retail prices of milk in 14 Canadian and 56 U.S. cities revealed that the U.S. price was 47 cents and the Canadian price was 54 cents per quart in October 1975.

[9]Floyd (1965) discussed theoretically the distribution of the rent between increases in the value of land, labour and the factors of production, in addition to the quota. The distribution is determined by the elasticity of supply of the factor inputs together with the elasticity of substitution in the production function.

[10]In Appendix A to the paper we have placed a second list of costs entering into the determination of a subsidy to B.C. dairy farmers under a programme known as the B.C. Dairy Farm Income Assurance Programme. The nature of this programme will be explained below in Part III. The list of costs is interesting in that, in contrast with the one presented in the text, it reflects only true costs of production and not other price averages.

Appendix B exposes a curious bias inherent in the method of calculating accounting values. The analysis is rather technical but suggests the existence of a serious shortcoming in the operation of the B.C. Milk Board scheme.

[11]Note, however, the point made above that the Index reflects not only costs but also general inflation.

[12]There exists also a provision for farmers to make potentially large penalty payments if they wish to withdraw from the scheme before its

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scheduled expiry in 1979, though this provision appears not to have interfered with the attractiveness of the programme. See Wreford (1974).

[13]Industrial milk prices are stabilized through an analogous scheme. Producers are paid one-half of the difference between the variable, as opposed to total, cost of production and the Milk Board's formula price for excess milk. The other half of the difference is considered to be the producers' premium for enrolment in the programme.

[14]These facts were first brought to our attention by J. Forbes and substantiated by officials of the B.C. Milk Board.

[15]Assuming, as is usual, that raising the general revenue does not involve losses of consumer surplus.

[16]There is, in fact, a substantial risk associated with the holding of quotas. For example, we had learned that the price of quotas, which according to Appendix D was about $70 in the 4th quarter of 1975 had risen to over $90 in mid-1976. Subsequently it fell again to about $70 in November. Industry observers suggested that this drop arose from an increased availability of federal quotas, which was initiated allegedly just before the Quebec provincial elections in November, 1976. Quebec holds a very large proportion of the federal industrial milk quota and Quebec dairy farmers are known for the militancy of their demands for federal support. The explanation of the drop in quota values is consistent with our explanation of their rise in the period 1971-75. According to financial theory and evidence, assets which exhibit such large and unpredictable changes in value lead investors to apply high discount rates for risk to the expected (mean) value of the future stream of income flowing from the asset.

[17]This is an assumption and appears to be somewhat lower than the quantity estimated by considering seasonal differences in total milk delivery. However, our results are not particularly sensitive to this assumption and individual farmers' results may vary widely according to the breed of cows and kinds of feed used.

[18]In this context it is interesting to note that upon initial distribution of a first draft of this paper, we were contacted by several representatives of the B.C. dairy industry who had obtained a copy of the paper and wanted to discuss its contents with us. We were not surprised to learn that apparently the purpose of these meetings was essentially to enable the industry to prepare an effective strategy of defense to the arguments about income transfers and inefficiencies made in this paper in case it receives public attention. We await with some interest the "official" rebuttal to our analysis.

[19]This estimate was presented by Ippolilo and Masson (1976). A discussion of the need to invest in the initial creation and protection of the rent is found in Posner (1975) and Tullock (1967).

[20]Harberger (1954) has estimated the welfare cost of monopoly in the United States and found it to be very small, using the same analytical approach employed here.

[21]For estimates of demand and supply characteristics for milk see Rojko (1957) and Halversen (1958).

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