MARKETING COOPERATIVES: A MODEL OF THE OUTPUT DECISIONS
OF THE CLOVERDALE LETTUCE AND VEGETABLE COOPERATIVE

by

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We accept this thesis as conforming to the required standard

THE UNIVERSITY OF BRITISH COLUMBIA

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Date Dec. 29, 1992
Marketing cooperatives play an important role in agricultural activities. Institutional support for cooperatives is based on the idea that, collectively, farmers can achieve benefits than, individually would be difficult to obtain. Head lettuce in the Lower Mainland region of British Columbia is marketed and distributed by a central selling agency which is organized as a producer cooperative. Members of the cooperative are subject to regulations, in the form of market quota allocations which control the quantity of head lettuce they can sell through their cooperative. This study describes and analyses the market structure of the head lettuce industry in British Columbia to ascertain and quantify the source of benefits to producers from cooperative marketing within a regulated marketing environment.

A model of the industry is constructed to characterize the market for head lettuce in B.C. The parameters which affect consumer demand and farm supply are estimated with econometric equations. A feature of supply is that current production decisions are influenced by the producer's market quota allocation which, in turn, is determined by the producer's past sales. The market quotas are believed to have constrained supply response and this is borne out by the empirical results which indicates a highly inelastic supply curve. The demand for head lettuce is also estimated to be inelastic. This result is not surprising since head lettuce is regarded as a basic commodity by consumers.

The estimated supply and demand elasticities are used to derive linear supply and demand curves at the cooperative and wholesale levels. These are used with the
observed 1990 price and quantity levels to calibrate a model of the B.C. head lettuce industry. A counterfactual model is then formulated to simulate a market with no controls on output. Given an inelastic wholesale demand, the simulation results indicate that for very small increases in cooperative output, large decreases in price occur. Consequently total revenues decline at every alternative assumption of supply increase. This result supports the hypothesis that output restrictions by the cooperative have the potential to increase members' output prices.

It is concluded that while the market quotas have in the past provided positive benefits to cooperative members, the quotas may now be hindering the process of adjustment to the loss of tariff protection and changing market conditions by making producers less price responsive.
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Finally, I would like to thank my family for their support over the years.
1.0 INTRODUCTION

Marketing cooperatives play an integral role in Canadian agriculture. Cooperative marketing of farm output is seen as a way for farmers to address market shortcomings and as a means of price enhancement. Three possible ways to raise farm price are apparent:

1. If the cooperative can market the farm product at a lower cost than existing non-cooperative firms, the margin separating farm and retail price can be reduced.

2. In agricultural markets where there are few buyers of the raw farm output, marketing sector firms may have market power over farmers. In this non-competitive setting farmers may be paid less than what the product is worth.

3. If a producer cooperative can raise the retail price of the products produced from the farm commodity, a higher farm price will result. This may be accomplished by improving the quality of the product or by restricting the flow of farm product to the market.

Any action that raises the farm price will raise farm income and make the farmer better off. Two additional potential benefits of cooperatives are the reduction of risk, and the provision of service in markets where no private marketing or processing firm is in operation.
1.1 Problem Statement

Cooperatives are a common feature in the agricultural sector in both developed and developing countries the world over. Governments actively encourage and support cooperatives through a number of policies including the enactment of enabling legislation, financial assistance and development assistance. Support for cooperatives rests largely on their perceived ability to bring about improvements in areas such as increasing market access and competition, lowering processing and marketing costs and utilizing economies of scale.

The Cloverdale Lettuce and Vegetable Cooperative is the producer organization responsible for marketing of lettuce and other vegetables produced in the Lower Mainland region of British Columbia. It is empowered by provincial legislation as the exclusive selling agency for head lettuce, celery and cauliflower. All producers of these crops are members of the Cooperative and are subject to market quotas which limit the amount of output producers may sell through the Cooperative. An added feature of the B.C. market is that imports enter freely subject to a seasonal tariff during the peak period of local production. Landed import prices are consistently higher than the price for locally grown products, suggesting the Cooperative has limited price setting ability. The source and extent of benefits to member-producers from this form of cooperative marketing is the focus of this study. An issue of particular interest is the role of the market quotas.
1.2 Objectives of the Study

The purpose of this paper is three-fold: the first is to discuss the theoretical basis for the welfare-improving qualities attributed to cooperatives. The theory will focus on agricultural marketing cooperatives and will be developed by examining the market conditions which give rise to the formation of cooperatives, the way in which cooperatives influence these conditions to the producers’ advantage, cooperative objectives and their implication on pricing and output behaviour. The theory will be applied to the case of the Cloverdale Lettuce and Vegetable Cooperative which operates under regulations which set it up as the sole seller of domestic lettuce but in a market structure which allows limited price setting ability. Since the primary motivation for farmers’ participation in a cooperative is to improve their well-being, the question of interest is, does the Cooperative provide a benefit to its members not obtainable otherwise.

The second purpose of the paper is to quantify the benefits of membership in the Cloverdale Lettuce and Vegetable Cooperative by developing a model of the B.C. lettuce industry. It is hypothesized that the inelastic demand which lettuce growers face gives rise to the imposition of output restrictions by the Cooperative as a way of preventing the large price decrease that will accompany an increase in supply. Furthermore, it is conjectured that farm supply has been effectively constrained by the market quotas and that supply would be more price responsive in the absence of these market quotas. Therefore, the third objective of this paper is to use the lettuce market model to simulate new equilibrium price and quantity outcomes under alternative assumptions of more
elastic supply.

1.3 Organization of the Study

Chapter 2 provides an overview of the structure of the B.C. fresh vegetable industry with an emphasis on the operations of the Cloverdale Lettuce and Vegetable Cooperative. Chapter 3 of the study begins with a definition of cooperatives and a general overview of cooperative organizations. This is followed by a discussion of the economic theory of cooperatives as developed within the literature. Chapter 4 discusses the estimation of supply and demand equations for the B.C. lettuce industry. Linear econometric equations are used to derive the relevant elasticities. These are used in Chapter 5 to obtain elasticities at the Cooperative and wholesale levels to develop a model of the B.C. lettuce market. A counterfactual example is then used to show potential changes in farm revenues by assuming alternative supply conditions to simulate a market in which the Cooperative does not use market quotas.
2.0 OVERVIEW OF THE B.C. FRESH VEGETABLE INDUSTRY

2.1 Description of Market Structure

The current marketing structure for fresh vegetables in British Columbia originated in the 1930's. Producer returns below the cost of production and ineffective attempts at voluntary price controls and cooperative selling convinced farmers that compulsory one-desk selling was essential if the industry were to survive. Petitioning by farm organizations to the provincial government to provide the necessary legislation resulted in the proclamation of the Natural Products Marketing (B.C.) Act in 1934. Under this Act, primary producers may petition the government to hold a plebiscite to indicate the wishes of growers to become involved in the collective marketing of their particular commodity. If a favourable ballot is returned the Act enables the establishment of a producer marketing board which is then empowered to regulate the marketing, packing and transporting of the specified product.¹

The B.C. Coast Vegetable Marketing Board and the Interior Vegetable Marketing Board, both established a year after the Act, were amalgamated in 1980 to form the B.C. Vegetable Marketing Commission (BCVMC). The BCVMC, operating under the Natural Products Marketing (B.C.) Act, is the organization currently responsible for the control and regulation of the production and marketing of vegetables in B.C. To date, fifteen fresh vegetables have been designated regulated commodities although the designation varies

¹Marketing boards in British Columbia, Province of British Columbia, Legislative Assembly, Select Standing Committee on Agriculture.
somewhat between the Lower Mainland, Vancouver Island and Interior regions. Table 1 provides a list of the regulated fresh field-grown crops and their status by region. These regulated crops represent approximately 59 percent of the value of fresh field-grown vegetable production in the province for the 1990 crop year.\textsuperscript{2} The major unregulated fresh vegetable crops include leaf-type lettuce, greenhouse peppers, broccoli, brussels sprouts, corn, beans and various Chinese vegetables.

Table 1: Fresh field-grown crops regulated by the B.C. Vegetable Marketing Commission.

<table>
<thead>
<tr>
<th>Product</th>
<th>Lower Mainland Share of BC Production</th>
<th>Vancouver Island Share of BC Production</th>
<th>Okanagan &amp; Interior Share of BC Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparagus</td>
<td>-</td>
<td>-</td>
<td>+ 69</td>
</tr>
<tr>
<td>Beets</td>
<td>+</td>
<td>+</td>
<td>+ 7</td>
</tr>
<tr>
<td>Cabbage - green</td>
<td>+</td>
<td>+</td>
<td>+ 14</td>
</tr>
<tr>
<td>- red</td>
<td>+</td>
<td>+</td>
<td>+ 6</td>
</tr>
<tr>
<td>Carrots</td>
<td>+</td>
<td>+</td>
<td>+ 10</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>+</td>
<td>+</td>
<td>+ 11</td>
</tr>
<tr>
<td>Celery</td>
<td>+</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Lettuce - head</td>
<td>+</td>
<td>+</td>
<td>&lt; .5</td>
</tr>
<tr>
<td>Onions - yellow</td>
<td>+</td>
<td>+</td>
<td>+ 17</td>
</tr>
<tr>
<td>Parsnips</td>
<td>+</td>
<td>+</td>
<td>+ 19</td>
</tr>
<tr>
<td>Potatoes</td>
<td>+</td>
<td>+</td>
<td>+ 34</td>
</tr>
<tr>
<td>Rutabagas</td>
<td>+</td>
<td>+</td>
<td>+ 12</td>
</tr>
</tbody>
</table>

\textsuperscript{2} = regulated crop required to be shipped through an agency of the Commission
\textsuperscript{-} = unregulated
\textsuperscript{*} = not shipped through agencies of the Commission

Source: BCHAF, B.C. vegetable marketing guide

All regulated vegetables must be sold at the farm level through agencies appointed by the BCVMC\textsuperscript{3} with a provision allowing these crops to be sold directly


\textsuperscript{3}Producers north of the 53rd parallel (Quesnel) are exempt from this requirement. However, this production represents only a tiny proportion of total fresh vegetable production in the province.
through farmer owned roadside stands which are established on the producer’s farm property or adjacent to it. The appointed agencies act as the single selling desk for specified crops, and, by the terms of the Act, are organized as producer cooperatives. The cooperatives coordinate marketing activities for producers including processing, distribution, storage and transportation services. Membership in the cooperative is a requirement for prospective producers of regulated crops unless growers plan to sell from on-farm outlets only.

The percentage of regulated field crops marketed through on-farm outlets is small and ranges from one percent (for head lettuce) to twenty percent (for beets). An exception is asparagus where approximately 90 percent of farm output is sold from on-farm outlets. The Lower Mainland accounts for about 60 percent of total production of regulated field crops with the Interior and Vancouver Island regions accounting for 20 and 19 percent respectively. Table 1 lists each region’s share of B.C. production for each of the regulated fresh field crops.

To control the amount of produce supplied the BCVMC has instituted a market quota system for regulated crops. The quota for an individual farmer for any particular year is based on his/her average sales over a period of three to five years depending on the commodity. A farmer’s market quota is not an absolute fixed amount but represents the proportion of the market to which the farmer is entitled, based on his/her historical sales. The market quota limits the amount that the farmer may sell through the agency/cooperative, however this quota does not limit the amount of the commodity that

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4 Nearly all asparagus production takes place in the interior of B.C. centred in the area around Armstrong and the northern Okanagan. Total provincial production in 1990 was 380,000 lb.
the farmer can produce. The cooperative calculates its selling price for the domestic product to be competitive with the landed price of imports. Given this selling price, product is sold on a share basis as long as market demand is there. If farmers have excess supply, e.g. more product than can be sold at the given selling price, the cooperative may attempt to sell all production at a lower price. Hence the BCVMC's marketing scheme does not have quotas in the strictest sense of the word. The quotas allows the agency to restrict the quantity of product going to the market if it wants to keep domestic product price as close as possible to the price of landed imports. Quotas have no formally established market value with a farmer's quota being established over a few years. New producers would typically receive a market quota allotment in the first year with the build-up of quota in subsequent years dependent on the producers' actual sales. In general, quotas are also obtainable by leasing or buying farms with existing quota.

Although the BCVMC has the power to set prices at the agency level for the products it regulates, in practice, the BCVMC is constrained by the landed import prices of commodities from other production areas. The United States, in particular California, is the major source of imported fresh vegetables for Western Canada and local market prices are based to a large extent on California costs and the size of its crops. There are no quantitative import barriers for fresh vegetables but seasonal tariffs are applied to imported crops during the peak period of local production. When sufficient volume of a commodity is available locally the BCVMC, on advice from the appropriate cooperative, makes a formal application to the Canadian Horticultural Council for application of the tariff. The tariff rate and the maximum duration of the tariff varies by commodity as does
the commencement date of tariff application. Table 2 summarizes the tariff rates, usual starting time and maximum allowable duration. At all other times during the year fresh vegetables enter duty free. Under the terms of the Canada-U.S. Trade Agreement, annual reductions in tariff rate, begun in 1989, will reduce the rate to zero over a ten year period. Tariffs on U.S. imports are charged according to the Most Favoured Nation (MFN) schedule, hence the current tariff rate for head lettuce, for example, is 9 percent ad valorem.

<table>
<thead>
<tr>
<th>Product</th>
<th>BP*</th>
<th>MFN**</th>
<th>Maximum period allowable</th>
<th>Usual period of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparagus</td>
<td>free</td>
<td>$.055/lb (but not less than 15% a.v.)</td>
<td>8 weeks</td>
<td>May 1 - June 26</td>
</tr>
<tr>
<td>Beets-topped</td>
<td>free</td>
<td>$.01/lb (but not less than 10% a.v.)</td>
<td>34 weeks</td>
<td>Jul 14 - Mar 10</td>
</tr>
<tr>
<td>Cabbage</td>
<td>free</td>
<td>$.0125/lb (but not less than 15% a.v.)</td>
<td>34 weeks</td>
<td>Jul 1 - Feb 24</td>
</tr>
<tr>
<td>Carrots</td>
<td>free</td>
<td>$.05/lb</td>
<td>20 weeks</td>
<td>Jul 10 - Mar 31</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>free</td>
<td>$.01/lb (but not less than 5% a.v.)</td>
<td>20 weeks</td>
<td>Jul 15 - Dec 2</td>
</tr>
<tr>
<td>Celery</td>
<td>free</td>
<td>$.02/lb (but not less than 15% a.v.)</td>
<td>18 weeks</td>
<td>Jul 15 - Nov 18</td>
</tr>
<tr>
<td>Lettuce-head</td>
<td>free</td>
<td>$.0125/lb (but not less than 15% a.v.)</td>
<td>16 weeks</td>
<td>Jun 24 - Oct 7</td>
</tr>
<tr>
<td>Onions</td>
<td>free</td>
<td>$.015/lb (but not less than 15% a.v.)</td>
<td>46 weeks</td>
<td>Aug 30 - Mar 28</td>
</tr>
<tr>
<td>Potatoes</td>
<td>$3.56/cwt All year</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*British Preferential a.v. = ad valorem
**Most Favoured Nation


The receipts for produce sold by the cooperative are pooled into product and, where applicable, grade pools and distributed to producers after operating expenses of
the cooperative have been deducted. Pool periods vary for different crops. The expenses cover all costs of services including overhead and administration incurred in the marketing, processing and distribution of the commodity. The deductions may be on a per unit or percentage basis and also vary between the different commodities. The deductions are made known to farmers usually at the beginning of the crop season. The cooperative’s board of directors decide whether any remaining funds at the end of the fiscal year are distributed to growers as patronage refunds or held in the cooperative.

2.2 Description of the Cloverdale Lettuce and Vegetable Cooperative

The petition by growers to regulate head lettuce and sell through a cooperative came about as a result of changing market conditions in the late 1960’s. By that time, a post-harvest vacuum cooling process had become standard practice for head lettuce in the California fresh vegetable industry. The process extends the shelf life and appearance of the product by removing the excess water that is a major cause of blemishes and rot. The local produce importers and wholesale trade were familiar with and preferred the vacuum cooled imported head lettuce and wanted to see the locally grown product processed in the same way. There was also an ongoing concern in the wholesale trade about the quality, mainly the variability in size, of the local head lettuce. Undersized deliveries could be rejected but due to transportation lags in obtaining imported lettuce the wholesaler would be short on supply unless an alternative local source could be quickly located. Prior to the establishment of the Cooperative, local
growers negotiated with the wholesale trade on a one-to-one basis for orders and prices. The local procurement system undoubtably involved higher costs for the wholesaler than dealing with a single produce broker in California who could supply all the produce desired through one transaction.

On the growers' part, there was an increasing concern about their lack of negotiating power in that wholesalers were often able to pay different prices to growers even when no quality differences were apparent. Discussions with producers in business at this time suggest that most farmers were aware of the range of prices within which local produce was selling, although exact prices were not shared except between close neighbours and friends. It was also difficult to know the quality of product shipped since farmers made their own deliveries to the wholesalers. Growers had no way of knowing whether the prices they received were comparable to prices of similar products the wholesalers imported from the U.S. For local farmers the cost of acquiring information on U.S. product prices, transportation and exchange rates on a regular basis is very high and unlikely to be justified by their small scale of operation. The lack of information was a distinct disadvantage for a grower in negotiating prices and a potential source of monopsony power for wholesalers. Coupled with this concern was the awareness that the quality of local lettuce had to keep pace with California imports if the local product were to maintain its market share. To achieve this, the issues of consistent quality and post-harvest processing had to be addressed.

Given these circumstances, both farmers and wholesale trade were receptive to a producer agency for marketing head lettuce. There was a general consensus amongst
all parties involved that an agency with regulatory powers was the only way to ensure participation by all growers. Regulated marketing through a single agency would: 1) ensure maximum through-put for the vacuum cooling equipment; 2) facilitate the inspection process to ensure that all product would be subject to the same quality standards; 3) give growers a collective voice in negotiating price; 4) eliminate price-cutting by individual producers, and; 5) ensure that market shares be allocated to growers who have historically served the local market and to control the growth of product supply to the market. Although lettuce growers had never organized before, a number of other field vegetables (see Table 1) were marketed in a similar way and the industry was familiar with the structure.

The Cloverdale Lettuce and Vegetable Cooperative was formed in 1969 and designated by the BCVMC as the exclusive marketing channel for head lettuce. At the time of its formation head lettuce was the only product marketed by the Cloverdale Cooperative. In subsequent years celery and cauliflower were added to the Commission's list of regulated crops and the Cooperative was designated the sole agency for their marketing. At present, in addition to the three regulated crops the Cooperative undertakes to market, on a contract basis, other fresh vegetables grown by its members. These include leaf type lettuces, hothouse peppers and a variety of Chinese and specialty vegetables.

Lettuce production expanded quickly after the formation of the Cooperative from 11.4 million lb. in 1969 to 16.2 million lb. just two years later, an increase of over 40 percent (see Figure 1). Although there are considerable year to year fluctuations.
production levels remained fairly constant through the 1970's and up to the mid-late 1980's. Since that time, output levels have declined somewhat. Changing consumer tastes and a substitution to a wider variety of fresh vegetables has contributed to this decline. Figure 1 also shows an upward trend in real producer prices since 1969. Part of the reason for this trend may be attributed to the decline, in real terms, of the marketing charges levied on members by the Cooperative.

Figure 1: B.C. head lettuce production and prices

Source: B.C.M.A.F.F. Production of vegetable crops together with an estimate of farm value.

Although local growers supported the petition to market head lettuce cooperatively, they were unwilling (or unable) to finance the purchase of the vacuum cooling equipment. To overcome this problem, the newly formed Cooperative contracted
with a private firm, West Coast Cooling, who would invest in the equipment and provide the vacuum cooling service. The Cooperative would provide marketing and other administrative services.

The Cooperative continues to contract out the vacuum service at annually negotiated rates.\(^5\) Services provided by the Cooperative itself for the marketing and processing of farm product are charged to members on a fixed per unit basis. The latter charges are established annually and vary among the different vegetables depending on the amount of processing performed by the Cooperative. For example, farm packed head lettuce carries a relatively low charge since it is farm packed and processing is limited to vacuum cooling. Cellophane wrapped lettuce, celery and cauliflower are delivered in bulk and are washed, trimmed, graded and packed in cartons and/or poly-wraps before distribution to the wholesale trade and therefore have a higher charge. Table 3 provides a breakdown of the Cooperative’s charges for selected products for 1991. In addition to those listed the charges may include additional levies for special programmes and promotional or lobbying activities undertaken by the Cooperative on behalf of its members.\(^6\) Packing materials are provided at cost to members and the Cooperative attempts to minimize the cost of these materials for members through bulk purchases, particularly shipping cartons which represent a substantial portion of total marketing costs.

Charges for inputs and services provided by the Cooperative are calculated to

\(^5\)The rates for vacuum cooling are set equal to rates charged by U.S. shippers on produce imported from California.

\(^6\)Proposals for special programmes are presented and voted on during general meetings of Cooperative members. Once a resolution has passed, any necessary levies are assessed on all members' output.
assure that total costs are covered. These charges are deducted from the Cooperative’s selling price to obtain the members’ net price per carton of product delivered to and sold by the Cooperative. To achieve an operating at cost position, excess service charges collected are redistributed back to members on the basis of patronage. Membership in the Cooperative is available for a nominal fee of one dollar, therefore members’ investment in the Cooperative is contributed only through these service charges which include amounts for servicing and repayment of financed capital investments.  

Table 3: Cooperative charges, 1991 crop (per carton basis)

<table>
<thead>
<tr>
<th></th>
<th>Head Lettuce (farm-pack)</th>
<th>Head Lettuce (cello)</th>
<th>Celery (farm-pack)</th>
<th>Celery (shed-pack)</th>
<th>Cauliflower (farm-pack)</th>
<th>Cauliflower (cello)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration</td>
<td>.60</td>
<td>.60</td>
<td>.60</td>
<td>.60</td>
<td>.60</td>
<td>.60</td>
</tr>
<tr>
<td>BCWMC Levy</td>
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*Vacuum cooling charges add $0.75 per carton on farm packed products

Source: B.C. Vegetable Marketing Commission

Membership in the Cooperative is necessary for growers who want to market lettuce, celery or cauliflower and is available to all producers. However, the amount of

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7 Although members have never been required to invest lump sums in the Cooperative, the original membership were required to sign promissory notes in order to secure the start-up bank loan. These notes were held by the bank until the loan was repaid. The original membership have made a greater contribution to the Cooperative but formalizing share or equity arrangement is difficult as some of these members are no longer farming. One suggestion has been to base members' equity in the Cooperative solely on the basis of total historic patronage, however a few original members have raised objections citing their greater contribution.
production a new producer can sell to the Cooperative is controlled via a market allocation or "quota" system. A new grower of lettuce is allowed to deliver 2000 cartons to the Cooperative during his/her first season of operation. In subsequent years a grower's market allocation is determined by a three year moving average of his/her annual sales. The grower's allocation is expressed as a percentage of total sales by the Cooperative over the same period. To illustrate, for the 3-year period 1988 to 1990, the Cooperative sold an average of 287,000 cartons of head lettuce per year. Assume a representative farmer's average annual sales are 15,000 cartons over the same period. This farmer's allocation or market quota for 1991 is the ratio of his/her average annual sales to the Cooperative's average annual sales. Therefore the farmer in this example would be entitled to supply 5.23 percent of all sales made by the Cooperative in 1991. However, if the farmer is unable to make his/her allocated delivery on any day, the missed delivery is not carried over to another time.

At the beginning of the production season, the Cooperative estimates sales for the coming year based on historical sales, and using the percentage allocations approximates the amount of product each grower could expect to sell. Actual sales depends on current market conditions and there is no guarantee that a grower will, in fact, be able to sell his/her "quota" amount. If current sales are lower than historic averages, then each member's current sales are also lower. At the same time a grower who plans production

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8 Discussions with people in the lettuce industry indicates that in the Cooperative's history, it is very rare that a new grower can supply this maximum allotment in the first year of production. Therefore the quotas should not pose a significant barrier to entry.

9 Based on production figures published by the B.C. Ministry of Agriculture, Fisheries and Food in Production of vegetable crops together with an estimate of farm values.
closely to historical quotas may miss out on sales if market conditions are favourable since "excess" demand is allocated to members on a proportional basis. In theory, the market allocation quota comes into effect only when supply exceeds demand. In practice, however, with product readily available from California and other U.S. sources, the quota is used to control local supply such that prices remain close to the level of U.S. imports.

A farmer who wished to increase the amount he/she markets must lease or buy farms with existing "quotas" or market allocations. Quotas are tied to a land base, therefore when a farm is sold the quota goes with the land. Similarly when land with quota is rented, the renter may have use of the quota. In a lease arrangement, the owner of the farm temporarily gives over his/her quota rights to the person leasing the farm. When the lease arrangement has ended, all the quota rights revert back to the owner, including any changes in the quota. The owner may then use the quota if he/she plans to farm that land himself/herself, or set up a new lease arrangement. While the land is leased the owner has no access to the quota. During the lease period, any increase (decrease) in quota is used by the renter (although the increase reverts back to the owner at the end of the lease period).

The farmer could also expand production beyond the predicted allocation and speculate that market demand will increase, thereby increasing the sales base from which future allocations are calculated. There are no quotas on production per se, and it should be emphasized the Cooperative is not required to accept all its members' farm output. The quota works by allocating current market sales among producers based on their
historical share of market sales, and by controlling the amount of new production entering the market.

To minimize discounts for lesser quality the Cooperative's manager is authorized to withhold a member's market allocation if the quality of that member's crop is deemed to be below current market standards. This allocation is distributed to the rest of the membership based on the market quota held by each individual. When allocations are missed due to substandard quality, to gaps in supply, or any other reason they are not held over for subsequent time periods.

An unintended consequence of the market allocation system is that it may contribute to supply volatility. Obviously, it provides an incentive to members to maintain a constant supply of quality produce since missed sales will result in lower annual sales and hence, smaller market allocations in future years. However, it may also be an incentive for members who miss sales early in the season to speculate by planning extra production for later in the season in an attempt to make up to their normal level of annual sales. Over the longer term however, this system is intended to shift market allocation initially held by unreliable, low-quality growers to those with consistent supplies of quality product.¹⁰

All the fresh vegetables marketed by the Cooperative are available in large quantities from other areas of supply, particularly from California. The Cooperative competes with these alternative sources and the price at which the Cooperative sells is largely determined by the landed import price of produce from these sources. Landed

¹⁰Discussions with Cooperative members/representatives. There is a general consensus that, over the years, the quality of head lettuce shipped by the Cooperative has improved as a result of this "weeding-out" process.
import prices are estimated weekly by the Cooperative. These are calculated by converted FOB prices (prices for graded and packed product at origin, e.g. Salinas, California) into Canadian dollar equivalent and adding seasonal tariffs, transportation costs, vacuum cooling charges, brokerage and handling charges. The Cooperative determines its selling prices so as to be competitive with the calculated landed import price.
Figure 2: Comparison of weekly wholesale-to-retail prices, 1985-90, Jun/Oct

Source: Agriculture Canada. Fruit, vegetable and honey crop and market report. Ottawa.
Data limitations do not allow a direct comparison of the Cooperative’s selling prices and landed import prices for head lettuce. However, by assuming that wholesalers mark-up domestic and imported lettuce in the same way, the wholesale price quotations for domestic and imported lettuce should reflect the cost at the wholesale level. A graph (Figure 2) of weekly wholesale-to-retail prices of domestic and imported lettuce for the period 1985 to 1990 shows that (except for a few observations) domestic prices are below those of imports.

In general, the landed import price is regarded by the Cooperative as the maximum it could sell its produce at. However, depending on current market conditions in both California and British Columbia, it is possible the Cooperative’s price could be higher, lower or the same although the first instance is rarer. Quality differences between the local and imported California product are the usual cause for discounts on the local product. If the supply of imported product is very weak, the Cooperative is better placed to price nearer to landed import levels. Conversely, during normal or strong supply conditions, Cooperative prices lag behind the landed import level after allowing for any quality differences. Throughout the production season the Cooperative’s manager carries out weekly inspections of member’s crops to determine the quality and quantity of produce available. A weekly bulletin is sent to the wholesale trade advising of quantities available and the selling price which is set after consideration of both local and California supply conditions. Quoted prices are still subject to change after the bulletin is issued. For example, if FOB California prices decreased, the Cooperative’s selling price

\footnote{Discussions with Cooperative members/representative.}
would follow accordingly. However, increases in the imported product price are rarely matched by the Cooperative (within the same week). This suggests the wholesalers have some market power over producers, even when acting collectively.

During periods when strong supply conditions prevail, maintaining price near the landed import price is more difficult if the Cooperative is to sell all its members' output. The Cooperative could enforce quota allocations so that only the quantity clearing the market at the current price is sold, or attempt to sell all the available product at a lower price. Conceptually, we may think of the Cooperative as manipulating its supply curve. Selling all members output would be equivalent to a rightward shift of the Cooperative's supply curve from its initial position where quota allocations are enforced and supply restricted. Given a downward sloping demand curve, more product will sell only at a lower price. The quota allocations allow the Cooperative to maintain supply at levels consistent with the calculated "target" price.

The discount necessary to move excess supply depends on the interactions of a number of factors. If the quality of the local product is consistently high amongst all growers, and if prices of California imports are firm (implying weaker supplies) then the discount to move all local produce will be small relative to the discount necessary when California prices are weak. Where possible, the Cooperative attempts to negotiate with wholesalers for special orders (e.g. supermarket "specials") such that the selling price is dropped only on the "special" orders with "normal" prices applying on other Cooperative sales. Since members receive the same price for their deliveries, discounting affects all members whether or not the individual member has excess supply. For example, if a few
growers have excess supply (e.g. more product than can be sold at a calculated market price competitive with import prices) and the Cooperative makes a decision to lower prices to move this "excess" output, then all product is affected unless the Cooperative has negotiated special sales prices. A member who does not have output in excess of his/her market quota would also receive the lower price. It is clear that given the CIF price, a major concern of the Cooperative will be to control supply by members to a level that would permit achieving this target CIF price.
3.0 COOPERATIVE PRINCIPLES AND ECONOMIC THEORY

3.1 Cooperative Principles

The preceding chapter described the operations of a cooperative organization, the Cloverdale Lettuce and Vegetable Cooperative, but with no attempt to relate cooperative principles to the organization's observed behaviour. This chapter will review the literature on cooperatives, and discuss how it may apply to the Cloverdale Lettuce Cooperative.

To better understand the effectiveness of cooperatives in a market-oriented economy, it will be useful to distinguish cooperatives from other types of business enterprises. The basic premise underlying any cooperative action is that through joint effort and mutual self-interest individuals may collectively achieve objectives unattainable by acting alone (Dunn, 1989). Although this premise could apply to other organizations a number of principles uniquely define the cooperative organization. The very earliest principles were established by a group of weavers in Rochdale, England who formed a purchasing cooperative in 1844. Many of their principles are accepted to this day (cited by Cotterill, 1987, p.174):

- open membership;
- one vote per member;
- provision of capital by members with limited return on investment;
- net margins returned to members on basis of patronage;
- market prices to be charged, cooperative savings or profits returned as patronage.
refunds to members;

- cooperative management to be under the control of membership-elected officers, and

- regular, comprehensive financial accounts made available to members.

Exceptions exist, for example, agricultural cooperatives restrict their membership to farmers and Staatz (1987a) notes that marketing cooperatives may restrict membership in the short run due to limitations of plant capacity, product quality control or other reasons. Many cooperatives obtain financing from commercial banks for investment and operating capital. Nevertheless, these principles remain the basis of modern agricultural cooperative associations.

A number of writers have catalogued three essential characteristics that set cooperatives apart from other types of business organization (Staatz, 1987a; Dunn, 1989; Barton, 1989):

1. The user-owner principle: Those who have capital invested in the cooperative are the majority users of its services.\(^{12}\)

2. The user-owner-control principle: Control of the cooperative is by those who use and own it. Furthermore, control is not proportional to equity investment. Voting power is limited on a one member/one vote basis, by patronage or some other form of restriction.

3. The user-owner-benefits principle: The benefits owners receive from capital

\(^{12}\)There are exceptions to this, for example, cooperatives may accept business from non-members as a way of using up excess plant capacity but these users have no say in cooperative decisions nor share in patronage refunds.
invested in the cooperative is allotted on the basis of their usage or patronage.

This principle is often stated as business or service-at-cost.

The above principles define the farmer cooperative: a user-owned and user-controlled business from which benefits are derived and distributed amongst owners on the basis of their usage.\(^{13}\)

In addition, an important characteristic of agricultural cooperatives is the element of vertical integration from the farm level. For several reasons (discussed in detail in the following section) it may be beneficial for producers to move into secondary production stages closer to the consumer. However, at the secondary processing stage the minimum size of plant needed to operate efficiently usually preclude individual farm producers expanding operations beyond primary production activities through vertical integration. Thus all cooperatives represent the joint action of a group of farm producers to integrate upstream (agricultural inputs supply cooperatives) and/or downstream (marketing and processing cooperatives).

3.2 Implications of the Cooperative Principles

The cooperative principles described above result in a form of business organization with incentives and decisions different from those faced by investor-oriented

\(^{13}\) See LeVay (1983, p.3-6) for a review of some other definitions and characteristics of what constitutes a cooperative.
firms (IOFs). To the extent that stockholders influence a firm's decisions, it could be expected that the decisions of a firm will be different if its stockholders were major users of its services than if they were not (Staatz, 1987a). Some implications arising from cooperative principles and characteristics are discussed below.

The vertically integrated nature of the farm and cooperative imply that their owners have an incentive to jointly maximize the profits of the farm/cooperative system. As a result, cooperatives may give greater consideration to their member's fixed costs and have different pricing practices than that of IOFs. Members' fixed costs are likely to be more important in cooperative decisions than in an IOF because the market transforms the fixed costs of an IOF's customers or suppliers into variable costs for the IOF. Processing cooperatives, for example, often have a policy of accepting all farm product delivered by their members because of the need to account for the member's fixed on-farm costs. An IOF usually does not have to deal with its suppliers' fixed costs; they are transformed via the market into the raw product price paid by the IOF, which the IOF processor considers as a purely variable cost (Staatz, 1987a).

One of the most important consequences of owners being users of the firm's services is that pricing decisions are of vital interest to the owners since the income of member-farmers are more dependent on the individual prices charged or paid by the cooperative than on its overall profitability (Staatz, 1987a). In contrast, shareholders in

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14Firms other than cooperatives may be referred to as investor-owned or proprietary firms, and profit, private, ordinary or corporations. However, cooperatives are also private and investor owned organizations and they seek to increase profits or the economic well-being of their members. The distinction between the two organizational types is that cooperatives return net income on the basis of usage or patronage whereas other businesses return net income on the basis of investment. Thus the term investor-oriented makes the distinction clearer (Barton, 1989). Throughout this paper it is assumed that IOFs do not integrate backward into primary farm production activities.
an IOF are only interested in the "bottom line". Pricing decisions in a cooperative affect not only the firm's performance but have a direct effect on the member's willingness to patronize and invest in the organization. Furthermore, certain price pooling policies will affect the distribution of income amongst members. In multi-product cooperatives, the sensitivity of owner-users to price policies will limit the use of price-cutting or cross-subsidizing strategies to increase the cooperative's share of the output market.

The user-owner principle may also impose limitations on the potential for acquiring equity capital. Farmer cooperatives can only increase their equity base by applying to current members or through increasing membership (Staatz, 1987a). The latter option may not be viable due to the absolute limit of producers in the cooperative's area. The former may be difficult as ownership of the cooperative provides few direct financial benefits to the members since limited returns are paid on their equity and the interest does not reflect the profitability of the cooperative (Corman and Fulton, 1990). Furthermore, shares in cooperatives are not traded on secondary markets making it difficult to gain financially by selling the shares should they appreciate in value. Since returns from investment in the cooperative are low and benefits are achieved through usage, members have an incentive to use the cooperative but not to invest in it. In addition, the one-member/one-vote rule implies an individual member cannot increase his/her control over cooperative affairs by investing in the cooperative.

To alleviate this equity problem many cooperatives have adopted the practice of retaining a portion of earnings in an attempt to force members to invest in the organization. Although retained earnings are critical for the future performance of the
cooperative, such an investment also means members are deprived of an immediate benefit in the way of a cash patronage payment (Corman and Fulton, 1990).

The one-member/one-vote rule followed by most cooperatives is intended to provide all members with an equal say in cooperative affairs. A result of this rule is the possibility that a few producers who contribute a large part of the patronage may be dominated by a majority of small-scale patrons. The fact that the large producers may take their patronage elsewhere should ensure that their voices be heard. However, if the cooperative is the only firm in the market, no such outcome is assured and the decision making process could be contentious.

In summary we can review these implications with specific reference to the Cloverdale Lettuce and Vegetable Cooperative to define goals that may be implied from the observed behaviour of the Cooperative. Most pertinent to our topic of interest is that price and output decisions of the Cooperative need to reflect the interests of all its members. As a member controlled organization the Cooperative has an obligation both to members willing to accept lower prices in order to move their over-supply and to members who have, in a sense, controlled their production to minimize the need to discount on price. In periods of above normal supply, given the usual demand assumptions, all output will be sold only by lowering price below the landed FOB price. Since members receive the same price, some conflict is likely to arise between members with over-supply and those without. The existence of market quotas implies the Cooperative has discretion over the amount of farm output it accepts. If the Cooperative's objective is price maximization, (where price maximization is taken to be
achieving the price level of California imports) then the Cooperative must fully enforce the market quotas to ensure that over-supply does not push price downward. However, there is evidence the Cooperative does take into consideration members' supply conditions in determining its weekly selling price, and attempts to sell product on special terms to the wholesale trade. Therefore, a plausible assumption is that the Cooperative tries to strike a balance between maximizing price (as defined) and maximizing sales.

As the sole agency for marketing head lettuce, membership in the Cooperative is no longer voluntary but mandatory. Regulating the marketing of these crops serves to: 1) Coordinate pricing of farm output, 2) Facilitate application of grading standards, 3) Ensure the fixed costs of marketing and processing will be spread over the maximum amount of output available, and; 4) Ensure that investment capital is contributed by producers on the basis of their output and use of Cooperative services and facilities. On the other hand, individual producers may feel Cooperative goals do not coincide with their own but have no alternative except to continue marketing with the Cooperative. In the longer run, however, dissatisfied producers could switch to non-regulated crops, which would shrink the Cooperative's operations if no new producers enter the lettuce market.

While head lettuce production has declined slightly since the early 1980's (refer to Figure 1), it is uncertain whether this is due to a structural change in lettuce demand or to dissatisfied growers switching to other crops. However, it is certainly the case that during the 1980's growers did diversify into other (non-regulated) crops. Leaf lettuce production, for example, increased from about one million pounds annually in 1981 to
approximately ten million pounds by 1989.\(^{15}\) Since head lettuce production did not decline by a similar amount, the increase in leaf lettuce was probably a result of bringing new land into production.

3.3 Economic Theory of Cooperative Formation

An important characteristic of agricultural cooperatives is the element of integration from the farm level. The economic incentives for vertical integration via a marketing cooperative will be discussed by looking at the relationship between the amount that a marketing firm is able to pay for raw farm output and its selling price of the produce:

\[
\frac{r(R) = p(Y) - \frac{M}{k}}{1}
\]

where:

- \( r = \) maximum price paid by marketing firm for the raw farm output, \( R \), where \( r \) is a function of the amount of \( R \) purchased
- \( p = \) output price received by marketing firm for its final product, \( Y \), where \( p \) is a function of the amount of \( Y \) produced
- \( Y = \) final product, where \( Y = R/k \)
- \( M = \) marketing margin or cost, including normal profit, of labour, energy, capital and materials to market and process the raw product
- \( k = \) conversion factor for the number of units of raw farm product (\( R \)) needed to produce one unit of final product (\( Y \))

\(^{15}\) B.C. Ministry of Agriculture, Fisheries and Food. *Production of vegetable crops together with an estimate of farm value*. Victoria, B.C. various issues.
If the raw input and final output markets are competitive and the conversion factor is one, the above relationship becomes:

\[ r_f = p - M \]  \hspace{1cm} (2)

This relationship also shows how farm gate price is related to the Cooperative’s selling price and is an important component of the model developed in the subsequent sections.

In a competitive market firms function at the lowest cost possible to survive, thus the margin, \( M \) will be as low as possible. Competition amongst firms to secure supplies of raw farm product will bid up prices paid to farmers to the maximum indicated in equation (1). However, in markets where competitive forces are weak or lacking, the above relation shows three possibilities where integrating cooperatively could increase farmer’s welfare (Sexton and Iskow, 1988):

1. The cooperative may be able to lower the marketing margin, \( M \), thus increasing the raw product price, \( r_f \), paid to farmers.
2. The presence of a producer cooperative may prevent the exercise of monopsony power by downstream firm(s) with market power who may force farmers to accept a smaller price than \( r_f \) defined in equation (1).
3. The cooperative may be able to increase \( r_f \) by influencing \( p \). In the extreme case, the cooperative may act as a producer cartel and select output so as to maximize producers’ joint profit.

Each of these possibilities will be examined below. Additional conditions exist wherein cooperative action will benefit producers. One is that there are no firms in the market to perform the marketing functions, a second is that the cooperative may be able
to mitigate uncertainty, and a third is that cooperatives, when viewed as a public good, may have positive indirect effects on farmers. These will also be discussed in the following sections.

Marketing Margins

The scope for reducing margins and raising $r_f$ through cooperative vertical integration depends on two factors: 1) whether the cooperative can obtain lower prices on inputs used in the processing stage, and/or 2) the ability of the cooperative to perform more efficiently than other firms. These factors are equally relevant for IOFs, therefore the question is whether a marketing cooperative has any advantage in these two areas.

Since cooperatives operate in the same environment as IOFs, they are likely to face the same set of variable input prices. However, Sexton (1986) and Sexton and Iskow (1988) show the cost of capital is less for low tax firms, such as cooperatives, who can pass net income through to their members without paying tax on it. They note that while this tax advantage is available to any vertically integrated firm and is not, in itself, sufficient reason to form a cooperative, it does confer an advantage for a cooperative competing with non-vertically integrated IOFs.

Conducting exchanges within a vertically integrated enterprise can be more efficient than exchanges through markets if vertical integration reduces transactions costs. These include the costs of acquiring and analyzing information, decision-making, and negotiating and carrying a contract to fulfilment (Staatz, 1987b). In agricultural markets,

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16The references cited discuss U.S. cooperatives. Taxation of cooperatives in Canada is different. They are taxed at the corporate rate but allowed to deduct patronage dividends paid or credited, provided that a prior legal obligation existed to do so (Taylor, 1971).
transactions costs may be particularly high due to the existence of sunk costs or asset fixity at the farm level.

Asset fixity or sunk costs occur when the difference between asset acquisition price and its salvage value is high. The more specific an asset to a use the larger the sunk cost. When sunk costs are high, one firm may take advantage of another through opportunistic behaviour, for example, by reneging on contractual obligations.

Staatz (1987b) notes that the risk of opportunistic behaviour arising from asset fixity is a major factor for the prevalence of cooperatives in marketing fresh fruits and vegetables and milk. Producers of these commodities are particularly vulnerable to opportunism since the harvested product is a sunk asset with few resale opportunities because of its perishability. Vertical integration via a producer cooperative minimizes the potential for opportunism since producers have control of both primary and secondary activities. Hence a producer cooperative may indeed have lower transactions costs. A cooperative may be able to operate with lower margins and thus return a higher price to its producer members.

Avoidance of Market Power

If a commodity market is characterized by only one (few) buyer(s), farmers face monopsony (oligopsony) power and may gain by forming a cooperative to break or mitigate the monopsony. The cooperative in this circumstance seeks to achieve the size economies (reducing M, the per unit processing cost) usually implied by the presence of market power (Sexton, 1986). The avoidance of market power is the most familiar justification for cooperatives in a market-driven economy. With few buyers of the raw farm
product, competitive pressure that causes raw product price, \( r_f \), to be bid up are weak or lacking. In addition, monopsony or oligopsony power permits the exercise of price discrimination, that is, paying different prices to different producers for no cost justified reason.

The ability of cooperatives to counter market power depends on several issues. The first concerns costs and relates to the shape of the firm's cost curve. A cooperative entering an industry to counter buying power must be able to attract sufficient volume to be able to operate in the flat portion of the average cost curve. If this is not the case, then the cooperative's marketing margin, \( M \), will be higher than that of other firms and the price it is able to pay to its members may be less (Sexton and Iskow, 1988).

A second point to consider is that a bargaining association may be sufficient to prevent price discrimination and offset buying power. By playing processing firms off against one another and/or threatening to withhold the product by forming a cooperative to market and process the raw output themselves, a farmer's bargaining group may cause prices to be bid up. The bargaining association can achieve price enhancement goals without the financial commitments and concerns about achieving efficient scale relevant to formation of marketing cooperatives (Sexton and Iskow, 1988).

The third concern relates to entry into the marketing sector by a cooperative. Sexton and Sexton (1987) writes that price-cost deviations in an industry signal profitable entry opportunities for all firms, not just cooperatives, so that the presence of market power beyond the farm gate does not adequately explain a cooperative's presence. He suggests that differences in the determinants of the entry decision are the major
consideration. An IOF’s concern lies solely with behaviour in the post-entry market while a cooperative is most concerned with market characteristics if it does not get involved. Thus potential entry by a cooperative can be deterred by a limit price. However, invoking a limit price to deter entry requires an incumbent firm to pay farmers a sufficiently high price so that there is no incentive for cooperation formation. Price “wars” between the incumbent firm and the new entrant involve paying farmers more for their output. Limit prices that deter cooperative entry are conceptually similar to sustainable prices and therefore confer potential cooperatives with a powerful welfare enhancing role (Sexton and Sexton, 1987).

**Potential for Producer Cartels**

Formation of producer cartels to exercise market power yields maximum price benefits for farmers. As the sole seller of a commodity the cartel may exercise monopoly power by selecting the output level which will maximize profit. However, such cartels are subject to cheating by producers who collectively benefit from cartel power, but, because price usually exceeds marginal cost, individually have an incentive to supply more output. The conditions for successful producer cartel include: representation of a major proportion of producers’ output; the ability to restrict potential imports into the cartel’s market; the establishment and effective enforcement of a quota system to control output and/or a system to control the timely release of product to the market. Any of these conditions may be difficult to achieve. For example, production may be spread over such a wide geographic area that organization is very costly or perishability of the commodity may render market supply control impractical, therefore the scope for cartelization via
producer cooperatives is limited.

However, a producer cooperative may be able to achieve a degree of market power arising from cartelization if it controls the only processing and marketing facility within a particular region (Sexton, 1986). The great weakness of cartels is the lack of an effective means of enforcing output restrictions but if producers must sell through the cooperative, output control will likely be more feasible (assuming imports to the region can also be controlled). The existence of a single plant market suggest there may be barriers to entry at the processing/marketing stage due to substantial fixed costs and/or large volumes necessary to achieve the minimum efficient scale. Therefore, acquiring market power will probably be most feasible for cooperatives which handle commodities requiring capital intensive processing (implying presence of scale economies) and are storable. It would be least effective for perishable fresh fruits and vegetables which require minimal processing and must be sold quickly.

Reduction of Risk and Uncertainty

Assured access to upstream or downstream markets is an incentive for vertical integration common to all business. With the assumption farmers are risk adverse, Sexton and Iskow (1988) discuss two basic market risks: 1) Markets where prices are inflexible and markets do not clear and producers may be unable to sell all they want at the market price, and; 2) Markets where prices are flexible and large fluctuations in price increase the farmer’s exposure to income uncertainty. In the first instance a cooperative can alleviate the risk by strategically choosing membership so that the probability of marketing all its members’ output is high. Risk is thus shifted from members to producers
outside the cooperative. Alternatively, an open membership cooperative could provide a "home" for all farm output. Risk is pooled and the costs of sales rationing is spread over all producer-members to minimize their effect on individuals, for example a non-cooperative buyer may purchase all output from some farmers and none from others.

In the second instance fluctuations in market price expose farmers to price and income uncertainty. Contracting can help reduce this price risk but may lock trading partners into unfavourable prices due to uncertainty of market conditions at time of harvest. More flexibility is offered through contingency pricing as practised by producer cooperatives. Producers receive an interim payment for deliveries with final price received contingent on the cooperative earnings and market price at time of final sale. Staatz (1987b) suggests cooperatives may be more successful than IOFs in using contingent pricing because producer-members have access to the cooperative’s financial accounts and are less likely to believe the cooperative is withholding information or is using contingency pricing to act opportunistically towards them.

Risk due to price fluctuations may be diversified in multi-commodity cooperatives that allocate returns from a single price pool so that low prices in one commodity may be offset by high prices for another. In single commodity pools where prices may fluctuate weekly or even daily, pooling spreads price risk among member to minimize their effect for any one individual.
Cooperatives as Public Goods

In addition to the direct effects, Staatz (1987b) suggests that cooperatives may be viewed as a type of public good with positive indirect impact on the agricultural sector. First, cooperatives may play a role in bringing about a more socially desirable regional distribution of income. This claim rests on the argument the IOFs extract profits from rural communities and re-invests them in metropolitan areas. In contrast, cooperatives rebate net margins to its members who re-invest locally thus stimulating greater regional development. Second, cooperatives formed to compete directly with existing IOFs may improve economic efficiency by compelling the IOFs to expand output and increase their X-efficiency. Third, cooperatives may be more likely to encourage and invest in the development of new crops and production techniques. An IOF may be reluctant to engage in farm improvement activities because producers can potentially use their new skills to patronize competing firms. Unified ownership of farming and marketing activities reduces potential opportunism on the farmer’s part since their investment in the cooperative gives greater assurance of their continued patronage.

Provision of Service

Farmers have often faced situations where no private firm is willing to serve the market. However, a cooperative, by recognizing the joint profitability of farm production and marketing, may be able to extract value from marketing where the benefits of doing so exceeds the cost (Sexton and Iskow, 1988). To illustrate this point, refer to Figure 3 below.17

17The following analysis is taken from Sexton and Iskow (1988).
The farm's supply curve is labelled S and indicates the minimum price they need to cover variable costs. The maximum a downstream firm could pay per unit for any given quantity of the raw farm product while covering all costs and a normal return on investment is given by the net average revenue product (NARP) curve. The net marginal revenue product (NMRP) curve shows how much each incremental unit of the farm product is worth.

Figure 3: Optimum behaviour for a marketing cooperative when no single price will cover costs.

As drawn, for all output levels the maximum a downstream firm could pay lies below the minimum farmers needs to cover variable costs, hence no firm could profitably serve the market. However, the NMRP curve does lie above the supply curve for some levels of production. Assuming farmers do form a cooperative, the optimal farm output will be $Q^*$, where the marginal cost of production is equal to the value of the marginal unit of raw product to the processor. Total net revenues from production and marketing the product is represented in the graph by the large dotted area minus the small cross-
hatched area. At the optimal output level $Q^*$, the cooperative must pay the producer $P_1$ for each unit. However, at $P_1$ the cooperative is not covering total costs. To recover this, it could then charge annual membership fees equal to the amount $(P_1 - P_2)Q^*$. It is this flexibility in pricing which enables a cooperative to profitably operate where an IOF could not. Farmers will benefit as long as the profit from growing the crop is greater than the membership fee, or producer surplus (area $acP_1$) is greater than membership fees (area $P_2bcP_1$).

3.4 Price and Output Decisions and Membership Policies

The previous section discussed how a producer cooperative could increase farmers' welfare by integrating into post-farm production activities. The following section will present a model (Pauly and Redisch, 1973) of a cooperative to illustrate how membership policies can alter equilibrium output and price positions. A closed membership policy is shown to have an effect on cooperative output analogous to the quota restrictions used by the Cloverdale Lettuce and Vegetable Cooperative.

To develop the discussion, a cooperative is assumed to produce one output ($Y$). Capital ($K$), labour ($L$), and the raw farm product ($R$) are used to produce $Y$ according to the cooperative's production function:

$$Y = R(K, L, R)$$

(3)

The raw produce, $R$, is supplied by member-farmers while the cooperative supplies labour and capital. Members have control of cooperative operations and ensure that services
provided to them are produced in such a way as to maximize their net return from the raw product they supply to the cooperative. Farmers supply the raw input according to their marginal cost schedules at or above their minimum average variable cost. For simplicity we may assume that farmers have constant marginal and average costs without seriously affecting the model's general results. This implies that the supply curve of \( R \) is horizontal at the price received by farmers.

The demand for the final product, \( Y \), can be written:

\[
Y = n(P_y) ; \quad \partial Y \partial P_y < 0
\]

where \( P_y \) is the price of the cooperative's output. By assuming a competitive output market, the cooperative faces the inverse demand curve:

\[
P_y = \bar{P}_y
\]

The price, \( P_c \), that the cooperative charges its members for services provided is given by: \( P_c Y = wL + cK \), where \( w \) is the wage rate of labour and \( c \), the user cost of capital. The cooperative operates to maximize the net incomes of its members and its objective is to maximize \((P_y Y - P_c Y)\) subject to the production function (3) and demand function (5) above. The difference between \((P_y Y - P_c Y)\) is the surplus amount after covering the cooperative's processing costs. This problem is identical to that of a profit maximizing firm although profit is the cooperative surplus which is distributed to members. The marginal conditions for optimal employment of labour and capital are the same, that is, the first order conditions for maximization yields the condition that marginal factor cost must equal the marginal value product for inputs. By assuming perfect competition in
input markets, marginal factor cost is merely the competitive market price of the input.

The amount of raw material supplied by member-farmers may be variable over time, or the cooperative could control deliveries by enforcing restrictive quotas on its members. The problem of the cooperative is to determine the optimal amount of product to process given its objective is to maximize the net income of its members. The ability to control the quantity of product processed depends on the cooperative’s membership policies. Equilibrium output results of three alternative policies are discussed: (1) closed membership; (2) open membership; and (3) a policy in which the cooperative accepts new members on a discriminatory basis.

3.4.1 Closed Membership

Although open membership policies were espoused by early cooperatives, many modern agricultural cooperatives have closed policies. The decision to admit new members is made by the existing members who, by assumption, have control over the cooperative’s operations. All members share in the residual income of the cooperative on the basis of their share of total output. If the objective of the cooperative is maximize the net return per unit of raw input (R) supplied by members, then members will be willing to add new members thereby increasing the amount of R, as long as the additional input of R causes the net return per unit of R to rise (or not fall).

Therefore, the objective function to be maximized by the cooperative is:

The necessary first order conditions (FOC) for a maximum are:
The third condition above (equation 9) states that the quantity of raw product processed by the cooperative is determined by equating the marginal revenue product of \( R \) with the net average revenue product of \( R \). Thus a closed cooperative will accept additional raw product from new members as long as its contribution to total revenues is greater than the average revenue per unit of \( R \) which members currently receive. Satisfying the third condition also implies that there are farmers willing to supply the raw output at the price offered by the cooperative, or in other words, the equilibrium value of \( P_r \) must be at least equal to the farmer's marginal cost of producing \( R \).

Figure 4 illustrates the long-run equilibrium position of a cooperative whose members are assumed to have constant marginal costs. Within the cooperative's processing activities capital, labour and other inputs take on short-run optimal values as the amount of raw product processed, \( R \), varies along the X-axis. The curve labelled
NARP (net average revenue product) indicates for each level of R the maximum net revenue per unit or price the cooperative can pay members for their output. Returns to scale in cooperative operations initially result in the upward sloping segment of the NARP curve but decreasing returns and diminishing marginal revenue eventually cause the curve to turn down. The maximum per unit net average revenue for the raw product, \( P_r^* \), is reached at the intersection of the net marginal revenue product (NMRP) and the NARP curves, where a closed membership cooperative would process \( R^* \) of raw product.

Figure 4: Equilibrium output positions of a cooperative under alternative membership policies.

Source: Pauly and Redisch (1973)

Pauly and Redisch (1973) make note of some seemingly paradoxical conclusions of this cooperative model in that supply response by the cooperative to changes in product and factor prices are opposite to that predicted by models of 'orthodox' firms. For example, an increase in the given price of output could result in lower output levels and smaller quantities of R supplied by members. This results because an increase in \( P_y \) produces a proportionate increase in the marginal revenue product of R, assuming the
K and L are held constant but the return per unit of R will rise more than proportionately. In terms of Figure 4, an increase in output price shifts both the NMRP and NARP curves upward but the extent of the shift in the NARP curve is greater so that the intersection of the two curves will now occur to the left of its current position and the maximum NARP would be attained at a smaller quantity of R.

3.4.2 Open Membership

The open cooperative does not restrict membership and accepts any amount of raw product by members subject to covering its processing costs. The equilibrium quantity of raw product processed is reached where the average net revenue per unit of R is equal to the member's marginal supply price. In Figure 4 this is the point labelled R_o. Alternatively a cooperative facing an upward sloping supply curve for R which intersects NARP curve to the left of its maximum will be in equilibrium at R_{oo} as shown in Figure 5. Such a cooperative will pursue an open membership policy as it would like to increase the quantity of R processed in order to move up the rising part of its NARP curve and increase per unit revenues for its members. A closed policy could then be adopted when the quantity of R processed reaches R*.

3.4.3 Discriminatory Policy

As the name implies, a discriminatory policy also requires that a cooperative be able to restrict its membership or control the amount of raw input supplied to it. Referring to Figure 4, the cooperative faces a horizontal supply curve for R and sets the quantity
it processes in the same way as would a profit maximizing firm. The quantity of product processed will increase until the NMRP of R is equal to the member's marginal supply price. Equilibrium quantity of product processed is $R_d$ and members receive a per unit return for $R_d$ equal to its marginal cost. However, members share in the profits of the cooperative according to their share of total patronage, or the amount $Y_r^+$ per unit of R supplied. Patronage refunds are essentially an adjustment to price to bring the cooperative to operation at cost.

Figure 5: Output equilibrium position of a cooperative with open membership policy.

To achieve an equilibrium at $(S = MC = NMRP)$ requires an initial assumption that farmers consider only the price received at delivery when making production decisions and regard patronage refunds as windfall gains (Cotterill, 1987). Failing that, the
discriminatory policy (or closed membership) requires multipart pricing schemes or quotas to preserve the optimum delivery levels of the raw product. If members are unable to distinguish between the market price paid and the patronage dividend, the cooperative may be forced to operate at the position where price paid is equal to the NARP. Note that the models of the discriminatory and open membership policy cooperatives do not exhibit the potentially perverse supply response present in the closed membership models. Increases in output price will lead to increases in output and the amount of R supplied by members.

The models discussed above provides a framework to evaluate the benefits of cooperative marketing. It turns out that benefits depend to a large extent on the membership policy of the cooperative. Membership policy may be viewed as analogous to a form of output control, indeed, even a closed membership cooperative would, in the longer run, have to institute some form of output restriction. Otherwise, *ceteris paribus*, in the long run members' supply curve could shift out as more farmers join the cooperative in response to the higher returns offered, and erode the benefits of cooperative marketing.

3.5 Basis for Formation of the Cloverdale Lettuce & Vegetable Cooperative

In this section, aspects of the economic theory of cooperative formation will be applied to the Cloverdale Lettuce and Vegetable Cooperative to establish the basis of benefits of the Cooperative to its members. Several elements would appear to have
relevance with respect to the Cloverdale Cooperative:

1. **Provision of Service.** One primary concern of lettuce growers was the need for a central standardized inspection service. This could have been provided by a government agency paid by a user fee or it is possible that a private firm could have undertaken this service as well as provide the post-harvest vacuum cooling process. However, such a function creates another market tier. Vertical integration on the part of farmers reduces the margin between retail and farm prices by returning profits from this marketing service to farmers as patronage refunds or as higher prices. An added advantage to a cooperative performing this function is that member-farmers are more likely to accept inspection process since they have a say in the conduct of cooperative business.

   Given the high initial investment cost of the vacuum cooling facility, some guarantees of maximum throughput were necessary to ensure that all operating costs could be recovered. Thus, a cooperative with a binding membership was thought to be a logical way of achieving this aim.

2. **Avoidance of Market Power.** *Ex post,* it is difficult to establish whether significant monopsony power was present before the Cooperative was formed. Although two or three wholesaler buyers dominated the market, there were numerous small wholesalers as well. However, the high cost of acquiring market information by individual farmers is an important factor in conferring market power to wholesalers. This information asymmetry permitted wholesalers to exercise price discrimination when dealing with domestic producers. A cooperative can achieve
a scale of marketing which greatly decreases information costs and thus put producers on a more even negotiating basis with wholesalers.

3. **Producer Cartels.** Although scale economies and enforcement of grading standards are cited as reasons necessitating compulsory membership in the Cooperative, the potential for output restriction as a means of raising prices must be admitted as another reason. This potential is given credibility through the existence of the market quota scheme supervised by the Cooperative. While the Cooperative has control over domestic production, imported lettuce is free to enter B.C. subject only to a seasonal tariff. Therefore the Cooperative's ability to restrict product to the market is severely hampered and, assuming the same product quality, any attempt to raise local lettuce price above landed import levels would eventually result in the loss of the entire market. However, the Cooperative can use the market quota system to restrict the supply of local lettuce reaching the market. By restricting supply the Cooperative's supply curve would be shifted to the left of where it would be if no market quota allocation were in place. The advantage for members to comply with the market quotas appears to stem from collectively holding local supply to a level which allows domestic prices to be set near those of the imported product.

The first two sources of cooperative benefits discussed above are difficult to quantify *ex post* due to the unavailability of data and non-market factors such as greater loyalty and trust by farmers to a member owned organization. It is possible however to
examine the basis and extent of benefits to members arising from the Cooperative's market quota scheme. The balance of this study will be concerned with the analysis of these benefits. The next chapter discusses the empirical estimation of supply and demand parameters which will be used in the last chapter to simulate a lettuce market model where it is assumed no market quotas are in place.
4.0 A MODEL OF THE B.C. LETTUCE INDUSTRY

The benefits of cooperative marketing were discussed in the previous chapter and, as noted, it is difficult to quantify certain benefits due to the unavailability of data. Of the possible benefits, benefits of the quota used by the Cloverdale Lettuce and Vegetable Cooperative to constrain supply may be examined by modelling the B.C. lettuce industry and simulating alternative supply parameters.

This section will discuss estimation of demand and supply parameters for head lettuce in B.C. These parameters will be used to calibrate a model of the B.C. lettuce industry under the current system of market quotas. This price and output equilibrium will be used as a reference point to compare changes in farmer’s revenues in the absence of the Cooperative’s marketing system. It is hypothesized that the Cooperative has altered the market structure to the benefit of its members by influencing producers’ supply elasticity and supply curve through the use of market quotas. The premise for the analysis is that supply has been restricted and rendered more inelastic. The lower output level which results enables the Cooperative to set higher prices than they would otherwise. For a higher price to lead to higher revenues, the demand curve must be inelastic. The demand for basic food commodities is considered quite inelastic, however demand for lettuce in B.C. will be estimated as part of the analysis. Price and output solutions under alternative supply assumptions will be used to calculate changes in farmer revenues if no market output controls existed.

Primary market demand and farm supply will be modelled by linear equations.
The derived wholesale demand and the derived supply by the Cooperative will be estimated by assuming a marketing margin relationship between the primary and wholesale/cooperative levels.

4.1 Price Determination in the B.C. Lettuce Market

Before proceeding to the discussion of demand and supply components, Figure 6 provides an overview of a proposed short-run model of the B.C. lettuce industry. An important assumption of the model is that the California lettuce industry strongly influences the price of the locally grown product. California is a major exporter of head lettuce to the rest of the U.S. and Canada, accounting for approximately 75 percent of all U.S. shipments in 1988\textsuperscript{18} and over 95 percent of B.C. imports of head lettuce.\textsuperscript{19} It is assumed that B.C. is a price-taker in the lettuce market since provincial consumption and production is very small relative to California’s production (total B.C. consumption is less than one percent of California production).

In the short run, and we may think of this as a one week period, the quantity of imported lettuce is fixed at the amount that wholesalers have purchased and is in transit to the B.C. market at this given time. The price that wholesalers pay for the imported lettuce, $P_{ci}$, is exogenous and is also fixed in this short run period (in the sense that the

\textsuperscript{18} U.S. Department of Agriculture, Agricultural Marketing Service. *Fresh fruits and vegetable shipments by commodities, states, and months, 1982*, FVAS-4 Calendar Year 1988.

price of the lettuce in transit has already been negotiated).

In Figure 6, panel (a), the wholesale demand curve for all lettuce is represented by the curve, $D_w$. Although not explicitly shown, this wholesale demand is derived from the retail demand for lettuce in B.C. Given the fixed quantity of imports, the Cooperative faces the residual demand curve of wholesalers, labelled $D_{w,r}$. The horizontal distance between the $D_w$ and $D_{w,r}$ curves represents the pre-committed quantity of imported lettuce purchased by the wholesalers, $Q_{Ca}$. In the usual trade model where B.C. is the price taker, the quantity of lettuce the Cooperative would supply is given by the intersection of the Cooperative supply curve, $S_{Coop}$, and the $P_{cif}$ price line.

Figure 6: Short-run model of price determination in the B.C. lettuce market
However, because the demand for domestic lettuce is a residual demand the quantity the Cooperative actually supplies, \( Q_{\text{Coop}} \), is given by the intersection of the Cooperative supply and the residual wholesale demand curves. We may think of there being an unobserved Cooperative supply curve that lies above the observed supply schedule, \( S_{\text{Coop}} \). The way to look at this relationship is that the Cooperative must give the wholesalers more lettuce at any given price to account for the lower quality, or conversely, take a lower price for the same quantity of lettuce. At the quantity, \( Q_{\text{Coop}} \), the price the Cooperative receives is \( P_{\text{Coop}} \), which is less than \( P_{\text{cif}} \). The difference between the cif price and the Cooperative's price may be decomposed into two parts. The distance between the Cooperative supply curve, \( S_{\text{Coop}} \), and the unobserved Cooperative supply curve represents the quality discount, which is assumed here to be constant at all quantities sold. The distance between the unobserved Cooperative supply curve and the \( P_{\text{cif}} \) price line represents the discount to sell the Cooperative's available supply.

In the short run with the price and quantity of imports fixed, it is possible that the Cooperative could restrict its supply and move up the residual wholesale demand curve. In Figure 6, panel (b), the observed supply curve of the Cooperative has been pivoted leftward to \( S'_{\text{Coop}} \). There is a decrease in the quantity of lettuce supplied by the Cooperative to \( Q'_{\text{Coop}} \), for which they receive a higher price, \( P'_{\text{Coop}} \). The total discount needed to sell the available supply decreases, and the Cooperative selling price is closer to the cif price, \( P_{\text{cif}} \). The quantity of imports remains the same at \( Q_{\text{Ca}} \), but the total quantity of lettuce supplied to the B.C. market has decreased by the Cooperative's
A key question in our analysis is to quantify the price changes due to output restriction and how revenues will be affected. The next two sections will describe supply and demand models for head lettuce in B.C. Estimates of elasticities will be computed from the empirically estimated supply and demand equations. The elasticities will be used to calibrate the supply and demand model to estimate the equilibrium price and quantity position of the Cooperative. This equilibrium will then be used to compare alternative equilibria under an assumption of no Cooperative market quotas or output restriction.

4.2 Supply Model for B.C. Lettuce

Ideally a measure of the degree to which the Cooperative has altered supply response would require a supply elasticity for the period before and after cooperative formation. Due to data limitations only the post-Cooperative supply function can be estimated. Pre-Cooperative supply is hypothesized to be unrestricted and more elastic and plausible values will be assumed to estimate the supply curve in the absence of the Cooperative.

Estimation of the supply of lettuce at the farm level may be usefully approached by describing a behavioral model of farmers' production decisions. This behavioral model is useful for interpreting the coefficients of the empirical model and any restriction implied by the functional form chosen. The following model includes the major factors or variables related to output decisions:
Desired Output = f (Expected Price, Input Prices, Quota Effect, Expected Prices of Other Crops)

The desired farm output of lettuce for a given year is a function of the expected price of lettuce, the price of production inputs, the expected price of alternative crops and the market allocation quota.

In the empirical model, the dependent variable is measured as the current year's acreage planted to lettuce. Actual output sold may differ considerably from planned or desired output because of environmental factors beyond the farmer's control. The divergence may also occur as a result of unfavourable market conditions, for example, low cost imports from California driving prices down. The area actually planted to lettuce is, to a much greater degree, under the farmer's control and, thus, a better proxy of for planned output. As a proxy for planned output, acreage planted has two shortcomings. First, land is only one of many inputs in production and Behrman (1968) suggests that an index of all inputs to be devoted to the crop is preferable. Most non-land inputs are not unalterably committed to one crop at the beginning of the production season but have many substitution possibilities in response to market or environmental factors. Hence the measure of all inputs actually used on a crop may not correspond to the originally planned input use. Second, land is not a homogeneous factor. If land is sufficiently heterogeneous and if there are other inputs that constrain production, it is possible that a farmer may increase planned output of a specific crop by devoting less but better land to that crop. In the case of lettuce growing farms in the Lower Mainland, the quality of land is fairly homogeneous and acreage will be an appropriate proxy for planned output, given an expected yield based on a given fixed level of inputs.

To show the relationship between planned production and planted acre, we can
look at their respective elasticities:

\[ \frac{\partial Q^*}{\partial P} \cdot \frac{P}{Q^*} = \frac{\partial A}{\partial P} \cdot \frac{P}{A} + \frac{\partial Y^*}{\partial P} \cdot \frac{P}{Y^*} \]

\[ E_{Q^*,P} = E_{A,P} + E_{Y^*,P} \]

where \( Q^* \) is the planned output, \( P \) is the price of \( Q \), \( A \) the acreage planted to \( Q \), and \( Y^* \) the expected yield per unit of \( A \), for a given level of input use. The elasticity of interest is own price or \( E_{Q^*,P} \) whereas the elasticity obtained through empirical estimation is \( E_{A,P} \).

From the above it can be seen that the smaller is \( (\partial Y^*/\partial P \cdot P/Y^*) \), the closer is \( E_{A,P} \) an approximation for \( E_{Q^*,P} \). In developed country agriculture there are few physical barriers to acquiring or using more inputs, therefore changes in expected yields in response to output price changes may not always be presumed to be zero. However, a case may be argued for assuming \( E_{Y^*,P} \) to be close to zero in our model by noting that lettuce prices may fluctuate considerably from week to week. Thus an increase in output price at time \( t \), when inputs can be effectively used, does not imply the same price will prevail at time \( (t+1) \) when the crop is harvested. Under these circumstances, a farmer's yield expectations may be constant making the elasticity of acreage equivalent to the elasticity of planned output with respect to price.

Expected prices are formulated as a moving average of the price in the current period, the price in the previous period and the price two periods past. The choice of a three period moving average is somewhat arbitrary. However, it is sensible to assume a finite period of carry-over effects. Prices of fresh vegetables tend to show considerable year to year fluctuations and it would be unrealistic to assume farmers only consider last
year's prices when making output decisions for the current year. For example, high prices in the last period as a result of a poor crop due to inclement weather conditions would not be viewed by farmers as anything but a one-period anomaly. Therefore, historical average prices are more appropriate. The current year's price is included in the expected price because lettuce is planted on a continuous basis from early April to mid August. Although there is no assurance that prices received in the early part of the season will prevail, a farmer's planting decisions for the rest of the season are apt to be influenced by the observed trend of current prices.

To incorporate the effect of competing crops in the farmers' decision-making process, the price variable is expressed as the 3-year moving average price of head lettuce relative to the 3-year moving average price of leaf lettuce. The farms producing lettuce also produce other vegetables. Substitution possibilities among the various crops suggests that a price index of all farm output in the Lower Mainland would also be appropriate. Data limitations preclude the construction of such an index therefore the price of leaf lettuce alone will be used. Leaf lettuce is a good alternative crop since production techniques and type of inputs used are almost identical to those used in head lettuce production.

The quota effect on output decisions is measured by a 3-year moving average acreage. Since the Cooperative allocates market shares to members on the basis of historic share of sales, current planned output levels are likely to be strongly influenced by past production. The 3-year moving average used by the Cooperative to calculate members' market share is used in this model to capture the effect of the market quota
allocation.

The effect of input prices on desired output is measured by a share-weighted composite inputs price index. The index is composed of variable inputs whose level of usage may conceivably be altered in the course of the growing season in response to price signals.

4.2.1 Estimation of Supply Curve

The behavioral model described in the previous section translates directly into the single equation empirical supply equation that will be estimated. Choice of data to proxy the variables from the behavioral model was based on the theoretical considerations discussed and availability. The supply equation is estimated by:

\[ ACRE_t = \alpha + \beta_1 RP_t + \beta_2 INPUTS_t + \beta_3 MAVA_t + \mu_t \quad (11) \]
where:

\[
\text{ACRE}_t = \text{current year's acreage planted to lettuce}
\]

\[
\text{RP}_t = \text{3-yr. moving average price of head lettuce relative to the 3-yr moving average price of leaf lettuce, where the years are t, t-1, and t-2}
\]

\[
\text{INPUTS}_t = \text{share weighted price index of the variable inputs labour, fertilizer, pesticide and non-mortgage interest of the current year}
\]

\[
\text{MAVA}_t = \text{3-yr. moving average acreage planted to head lettuce, where the years are t-1, t-2 and t-3}
\]

The model hypothesizes that the acreage planted to head lettuce in period \( t \) is a linear function of the price of head lettuce relative to the price of an alternative crop, leaf lettuce, the price of inputs and past lettuce acreage. The output price variable is expected to be positively related to the dependent variable. Furthermore, the use of a relative index implies that as the price of head lettuce increases relative to the price of the substitute crop, then ceteris paribus, more acreage would be devoted to head lettuce. The inputs price index is expected to be inversely related to acreage. The measure of the quota effect (MAVA) should be positively correlated to current planted area. Assuming no major farm level structural changes it is expected farmers, at minimum, plan to maintain production to historical levels and, possibly, shift out their supply curves.

Estimation of a supply equation presupposes that firms engaged in production are assumed to obtain the largest possible profit given operational constraints. Market demand forces constrain the amount of product that may be sold (at a profitable price) and physical production requirements constrain the level of output that may be obtained. Under the profit maximization objective, firms supply output to the point where marginal
cost is equal to market price. The aggregate supply curve for the industry is the horizontal summation of the portions of the individual firm marginal cost curves that lie above minimum average variable cost. Hence the supply curve presumes that output is produced by the least cost combination of inputs at any given output price.

A major limitation of a linear supply curve is the implication of fixed marginal costs, in other words, the cost of production remains constant regardless of the output level. In many production systems this result is unrealistic, however by hypothesizing that the range of output levels under consideration is limited we may, with greater confidence, assume that input costs do remain constant within this range.

The empirical model contains an explanatory variable (MAVA) constructed from lagged values of the dependent variable. In our model, the MAVA variable is constructed as:

$$MAVA_t = \frac{1}{3} \sum_{i=1}^{3} ACRE_{t-i}$$

(12)

Although $ACRE_{t-i}$ depends on $\mu_{t-i}$ and all previous disturbances, it should not be correlated to the current error term $\mu_t$. Assuming that the current error term is not serially correlated, then the lagged regressor $ACRE_{t-i}$ will also be uncorrelated with the error term $\mu_t$ thereby satisfying an important OLS assumption that the explanatory variable is not correlated to the error term.

4.2.2 Supply Estimation Data
Primary data used to construct supply variables was taken from an annual publication of horticultural statistics issued by the BCMAFF, Farm Inputs Price Index, and Agriculture Economic Statistics. The following is a more detailed discussion of how the variables are constructed:

ACRE. In order to confine the supply estimation to producers belonging to the Cooperative, the values of ACRE are the acres planted to lettuce for the Lower Mainland Region only.

RP. Crop prices collected by the BCMAFF represent selling prices (per lb.) to wholesalers from the farm or by agencies. In the case of lettuce, the reported price is the Cooperative’s selling price. The farm gate price is calculated by subtracting the Cooperative’s charges which include administration fee, carton cost and vacuum cooling cost. A complete data set was not available for these charges. The administration fee was calculated from revenues reported in the Cooperative’s financial statements. Carton prices were not available for the period 1973 to 1987. To approximate this cost, a price index of corrugated boxes was used to compute a nominal price series. Data on vacuum cooling cost was also not available for the period 1973 to 1987. Approximating this cost is more problematic as there is no clear alternative 'product' for which time

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22 StatisticsCanada. Catalogue No. 21-603E.

series price data is available. However, anecdotal evidence suggests this cost tends to be very stable, for example, from 1988 to the present the cooling cost has remained at $0.75 per carton of product. Therefore, the missing data was interpolated from the observed endpoints. Since the vacuum cooling cost is only one component of total Cooperative charges, errors introduced by systematic patterns in the data should be diluted. The farm gate price of leaf lettuce was calculated in a similar manner. The administration fee was adjusted (down) to account for levies not applicable to leaf lettuce$^{24}$ and the carton cost was reduced to reflect its lighter construction. The relative price index is calculated as:

$$RP_t = \frac{1}{3} \sum_{t=0}^{2} \left( \frac{PL_t}{PLL_t} \right)$$

(13)

where PL is the price of head lettuce and PLL is the price of leaf lettuce. Using a relative price variable excludes other vegetable prices from the farmer's decision in planning lettuce production. Using other vegetable prices as explanatory variables assumes farmers can switch freely to these other crops in response to price increases. For Lower Mainland farmers this may not be the case since many other crops are also regulated (see Table 1) and require quota in order to deliver product to the designated cooperative. Leaf lettuce, however, is not regulated and farmers may grow as much as they think will be profitable.

**INPUTS.** The INPUTS index is constructed from the farm price indexes of four variable inputs: labour, fertilizer, pesticide and non-mortgage interest. The total index is simply the

$^{24}$ Leaf lettuce is not a regulated crop hence B.C. Vegetable Marketing Commission levies are not applicable.
sum of individual price indexes each weighted by its share of the total of these variable inputs. Shares are calculated from farm operating expense data for British Columbia.

**MAVA.** A 3-year moving average of past acreage planted.

### 4.2.3 Supply Estimation Results

The empirical model specified in Section 4.2.1 was estimated using the regression package SHAZAM. The supply equation was estimated using a linear functional form. The results are presented in Table 4. The model was initially estimated using ordinary least squares. All coefficients showed the expected relation to the dependent variable and were significant except for the relative price variable, RP. The adjusted $R^2$ value indicates the model is a reasonable fit of the data explaining 80 percent of the variation in the dependent variable.

Collinearity between the explanatory variables does not appear to be a serious problem as the correlation between regressors is less than 0.6 although with more than two explanatory variables, this is a less precise guide to detecting collinearity. However, auxiliary regressions indicate that the moving average acreage variable, MAVA is collinear with the other explanatory variables. Since this variable was included to account for what is believed to be an important factor in supply decisions, it would be incorrect to omit this variable. With a fairly high $R^2$ and significant t statistics multicollinearity does not pose a serious problem.

Although the model is specified on the assumption of non-correlation between the
explanatory variable(s) and the stochastic disturbance term, the Durbin-Watson statistic (2.694) lies in the interval of indecision as to whether there is negative autocorrelation. In cases where the estimated d value lies in the indecisive zone, the modified d test procedure can be used. Given that the critical value of \( d_u = 1.685 \), the modified d test indicates that the null hypothesis of \( \text{RHO} = 0 \) should be rejected, that statistically there is significant evidence of negative autocorrelation.

<table>
<thead>
<tr>
<th>Variable</th>
<th>OLS Estimated Coefficient</th>
<th>OLS Elasticity at Means</th>
<th>AUTO Estimated Coefficient</th>
<th>AUTO Elasticity at Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>RP</td>
<td>0.165 (1.401)</td>
<td>0.018</td>
<td>0.179 (2.174)**</td>
<td>0.020</td>
</tr>
<tr>
<td>INPUTS</td>
<td>-0.006 (5.284)**</td>
<td>-0.096</td>
<td>-0.006 (7.491)**</td>
<td>-0.099</td>
</tr>
<tr>
<td>MAVA</td>
<td>0.476 (3.040)**</td>
<td>0.478</td>
<td>0.480 (4.300)**</td>
<td>0.481</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>3.206 (3.500)**</td>
<td>0.601</td>
<td>3.200 (4.856)**</td>
<td>0.599</td>
</tr>
<tr>
<td>RHO</td>
<td>-0.383 (1.808)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td>2.694</td>
<td>2.367</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( R^2 ) (adj.)</td>
<td>0.801</td>
<td>0.831</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: 1. t-statistics in parenthesis 2. ** significant at 95% 3. Mean value of dependent variable: 5.3384

It is suspected that the source of autocorrelation probably lies with the average acreage variable since values of ACRE are likely to be correlated to each other and hence to the disturbance term. To check whether excluded variables was causing...
autocorrelation, a time trend was added to the regression. If the excluded variable affects the acreage planted, then the error term will reflect a systematic pattern. The new OLS regression had a Durbin-Watson statistic of 2.74 and, using the modified d test, the null hypothesis of no negative autocorrelation is rejected. In addition, the time trend variable itself was not statistically significant from zero and the adjusted $R^2$ suggests this model gave a poorer fit of the data. It should be noted that adding a time trend to test for excluded variables is limited to excluded variables that exhibit a linear pattern over time.

With time series data heteroscedasticity is not believed to be a problem and no diagnostics were carried out in this regard. On the basis on the modified DW test, the model was corrected for serial correlation of the residuals. With the correction, regression results improve with all variables statistically significant at 95 percent. The recalculated DW statistic still lies in the interval of indecision but the modified d test indicates the null hypothesis of no negative autocorrelation is just barely rejected suggesting that the problem is less serious.

The elasticity with respect to price shows that for a 10 percent increase in the price of head lettuce relative to the price of leaf lettuce (where all prices are moving averages), acreage is increased by a mere 0.2 percent. Such a low elasticity measure implies that output, as measured by acreage, is not at all responsive to price. In agricultural sectors where physical factors are limiting, price insensitivity is more probable since there may be no viable alternative crops. However, this is not likely to be the case in the Lower Mainland where a wide range of crops can be grown and substitution possibilities high. Output response may also be limited by the level of management and
technical expertise of the farmer and/or rigidities in market structure. In an 'orderly' marketing scheme as for head lettuce, market shares are allocated on the basis of historical sales. Thus, unless farmers believe with great certainty that demand will increase substantially, they will use past sales as the main guide to planning output for the next period. The estimated coefficient of the quota variable (MAVA) is significant and indicates past sales do indeed have a strong effect on output. Furthermore, since future market shares are calculated on the basis of current sales, farmers may be reluctant to cut back on production in response to what may be perceived as a one-period decrease in price. It should be noted that many of the other crops grown by Cooperative members are subject to the same market sharing arrangement and increasing output of lettuce may jeopardize future market allocations of other crops. In the long run, of course, farmers could acquire more land if they believe price increases and/or demand shifts to be permanent. As a result of the market quotas, response in acreage with respect to price may be highly inelastic.

Other proxies for the price variable were tested, including the 3-year moving average price of lettuce deflated by the Farm Products Price Index (FPPI) for B.C. This did not yield comparable results possibly because the FPPI covers a wide range of agricultural products including livestock, dairy, fruit and grains. A regression was also estimated with the 3-year moving average prices of leaf lettuce and head lettuce separately, where both set of prices were deflated by the FPPI. The leaf lettuce variable was of the expected sign but with an insignificant t statistic.

Individual input price indexes were used in an early version of the model. The
estimated coefficients were of the correct sign but with insignificant t statistics. Since the overall test of significance (F test) indicated that the four inputs did have an influence on ACRE, a composite index was used to model this effect.

The INPUTS variable is highly significant and shows that for a 10 percent increase in the price of inputs there is a one percent decrease in output (acreage planted) implying an inelastic response. There are no guidelines, a priori, as to an expected elasticity measure. If the inputs included in the variable represent some minimum threshold level of inputs needed to produce the output then very little response could be expected with respect to price increases. On the other hand, lettuce is continuously planted through the season so there is scope for acreage response to lower input prices. In general, input prices are fairly stable (i.e. relative to output prices) and are often known or negotiated at the beginning of the production season.

It was hypothesized that past acreage would have a positive influence on current acreage and this is borne out by the estimated coefficient which is both of the expected sign and significant. For a 10 percent increase in the 3 year average acreage there will be approximately 5 percent increase in current acreage. Reinterpreting this variable as the market quota allocation effect, if farmers strictly adhered to past market allocations in planning output (i.e. quotas are very important in determining current output) then acreage in the current period would exactly equal the 3 year average acreage, and we would expect the coefficient of the MAVA variable to be unity as well as the elasticity value. On the other hand, if past quotas have no effect on current output decisions then this coefficient would be close to zero. The estimated MAVA coefficient lies midway
between the two extremes and suggests past quota allocations may have an impact in restraining current output. In fact, our results show that past quota allocations have a greater impact on current output than the price variable.

The conclusions regarding the quota effect are made on the assumption that the data for the ACRE variable has been correctly measured. It is possible that the actual acres planted may be under-represented due to reporting errors. Reported data equates acres harvested with acres planted and ideally we would like to have acres planted as the dependent variable and average acres harvested as an explanatory variable.

4.2.2 Validation of Supply Estimation

Overall the results of the regression equation indicates a fair fit of the data to the regression line. The model (corrected for autocorrelation) predicts 83 percent of the variation in the dependent variable, with all explanatory variables of the expected sign.

To examine the validity of the estimated model, we first plot the observed and predicted values (Figure 7). The observed values show considerable fluctuation from 1979 to 1981.²⁵ Although the model captures some of the turning points it does not pick up these large fluctuations, however the predicted values do follow the trend of the observed values during other periods when fluctuations are small. It is possible that over a larger sample the fit would improve.

A second test of the predictive ability of the model is to look at the deviations of

²⁵ The low acreage in 1981 was due, in the most part to heavy rains during early summer which flooded crops that would normally be harvested in August.
the predicted values from observed values, where the smaller the deviations the better is the fit of the model. The root mean square error (RMSE) value calculated is 0.193, or expressed as a percentage of the mean observed dependent value, is 3.62 percent. In other words, over the sample population the model predictions deviate by less than 4 percent from the observed mean value.

As a final test of the model, the supply equation was regressed omitting the last observation to provide a forecast. The predicted value is 5.1226 (512.26 acres) with a calculated residual of -0.0266. This deviation of the predicted from the final observed value represents less than one-half percent deviation from the mean value in this sample. These results suggest that the predictive ability of the model is acceptably accurate and we conclude it captures the major elements of the hypothesized behavioral model of farmer’s output planning process.
4.3 Demand Model for Lettuce in B.C.

4.3.1 Estimation of Demand Curve

The demand for lettuce will be estimated as a single linear equation. The commodity lettuce would appear to satisfy the conditions that allow our assumption of zero bias due to omitted variables as it represents a small proportion of expenditures on fresh vegetables and has few good substitutes. The quantity of lettuce is taken to be a function of its own price and income. The inclusion of substitutes or complements was considered but no single or group of fresh vegetables appeared to be appropriate. The selection problem is more acute in vegetables than in other food commodities as it is often difficult to determine if individual vegetables are substitutes or complements for each other. For example, head lettuce is often consumed in salads but may be served with or without other fresh vegetables. Other leafy type lettuces are believed to be weak substitutes for head lettuce which is consumed for its unique crunchy texture. A time trend is included to account for secular changes in demand. The demand equation is specified as:

\[ PCQL_t = \text{per capita consumption of head lettuce in period } t \text{ (lb.)} \]

\[ ^{26} \text{Estimating a demand equation presupposes the maximization of a representative consumer's utility function subject to the consumer's budget constraint. The first order conditions for a maximum yields a set of partial derivatives of the utility function with respect to each consumer commodity. These are solved to obtain a set of demand equations where the quantity demanded of a commodity demanded of a commodity is expressed in terms of its own price, other commodity prices and income. To satisfy the budget constraint, the sum of expenditures on all commodities must be equal to (or less than) total income (see Deaton and Muellbauer for discussion of restrictions on the set of demand equations). Invoking separability permits the estimation of subsystems of demand equations. In estimating single linear equation, omitted variables are assumed to be zero. The more closely related the omitted commodities are to the one of interest the larger the bias on the included commodities.} \]
$$PCQL_t = \alpha + \beta_1 MPL86_t + \beta_2 PCDI_t + \beta_3 T_t + \mu_t$$

(14)

$MPL86_t = \text{price index of lettuce}$

$PCDI_t = \text{per capita disposal income}$

$T_t = \text{time trend, from 1 to 23}$

Since our objective is to estimate market equilibrium in the period when local production is available, the time frame for the demand equation is limited to coincide with this period. The period from June to September represents the local season, although supplies are thin in the first week or so of June and limited supplies are still available in the early part of October. The delineation of this time period was necessitated by data limitations and by the need to approximate as closely as possible the period during which tariffs apply on imported lettuce.

The estimated coefficient of lettuce price is expected to be negative. Since lettuce is assumed to be a normal good, the estimated income coefficient is expected to be positive. *A priori* statements about trend variables are difficult to make since they often, as in the present case, may be accounting for other non-specified explanatory variables. The usual application of time trend is to mark shifts in demand over time due to change in tastes, and may be of either sign. In addition the trend variable could pick up the effects of other variables. If an omitted variable is a substitute, then the trend would be expected to have a negative coefficient.

4.3.2 Demand Estimation Data
Data for the demand model was taken from provincial reports of production statistics, Consumer Prices and Price Indexes, unloads reports, and Provincial Economic Accounts, Annual Estimates. The following section describes the variables used. All per capita values were obtained by dividing by the estimated B.C. population for the respective year.

PCQL. The quantity of lettuce consumed in B.C. for the period June to September is taken to be imports during this period and the total annual local production. There are some exports of B.C. grown lettuce to other provinces but the quantities are small relative to total production. The imports data are taken from weekly unloads reports compiled by Agriculture Canada based on surveys at wholesale points in Vancouver. Since the reports only account for the imports made by the wholesalers contacted, the unloads under-state imports. A monthly provincial import data series was not available for the years considered. Despite these problems, it is believed the B.C. per capita consumption as calculated for the period is more appropriate than national consumption figures.

MPL86. The price variable is approximated by the national price index for lettuce. Monthly indexes are available and this variable represents the median value for the four

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31 A discussion with Agriculture Canada representative indicates they are aware of the under-reporting and estimate the published figures to be approximately 20 percent less than actual imports. They did not offer an explanation for the chronic discrepancy.
month period under consideration. Average retail price data collected for various
Canadian cities is available for July, however prices tend to be at their lowest during this
month, therefore a median national 'summer' price is likely to be more representative.

**PCDI.** Provincial monthly per capital disposable income is not available and this variable
is constructed by simply dividing annual income by three, implicitly assuming the income
does not vary seasonally. The PCDI value was deflated by the median value of the
Vancouver consumer price index for the four month period June to September.

**TIME (T).** Time trend variable which increases by increments of 1 for each successive
observation.

4.3.3 Demand Estimation Results

Demand parameters were estimated using ordinary least squares technique. *A
priori* there is no theoretical basis to specify the functional form of the regression
equation. Double log forms are often used in demand studies but the selection is justified
by a better fit of the data rather that forehand knowledge. A double log form was tried
but rejected in favour of the simple linear form because of the implication of constant
elasticity associated with the log form. As with most perishable produce, the price of
head lettuce may fluctuate considerably over short time periods, or from a given time
period in one year to the same time period in the next year. Using a log form presumes
the own price elasticity would remain constant despite large changes in price. In a linear
relationship, the price level effect states that as prices increase, so does the absolute
value of own price elasticity. If the range of prices under consideration was small, a constant elasticity assumption is acceptable, but this is not the case with head lettuce.

The regression results are summarized in Table 5. All estimated coefficients show the expected relationship with the dependent variable and are statistically significant. The adjusted $R^2$ value of 0.67 suggests a satisfactory fit of the data considering the problems in specifying appropriate variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimated Coefficient</th>
<th>Elasticity at Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPL86</td>
<td>-0.314</td>
<td>-0.260</td>
</tr>
<tr>
<td></td>
<td>(1.750)*</td>
<td></td>
</tr>
<tr>
<td>PCDI</td>
<td>0.002</td>
<td>1.129</td>
</tr>
<tr>
<td></td>
<td>(3.037)**</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>-0.179</td>
<td>-0.331</td>
</tr>
<tr>
<td></td>
<td>(2.060)**</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>3.259</td>
<td>0.463</td>
</tr>
<tr>
<td></td>
<td>(1.657)</td>
<td></td>
</tr>
</tbody>
</table>

RHO       0.122
Durbin-Watson 1.593
$R^2$ (adj.) 0.674

Note: 1. t statistics in brackets 2. ** significant at 95% 3. * significant at 90% 4. Mean of the dependent variable: 7.033

A common problem in demand estimation is that price and income data series tend to be correlated to each other. It is natural that prices in an economy will move
together and there is often no satisfactory solution to the collinearity problem. In serious cases, the simplest means to correct the problem is to omit the variable causing the collinearity. However this introduces a new problem of specification bias. The correlation matrix of variables indicates high levels of correlation between regressors. The $R^2$ values obtained from auxiliary regressions of each explanatory variable on the other confirms high levels of collinearity. The time trend variable is often a source of collinearity and a regression was run omitting the time trend. The pairwise correlation between the two remaining regressors is in excess of 0.8 indicating the multicollinearity problem remains. The practical consequences of multicollinearity are large variances and standard errors of the estimators, however estimates remain unbiased and consistent. Since the standard errors in the model are small and all $t$ statistics are significant no remedial measures for collinearity are carried out.

Graphical analysis of calculated residuals did not indicate the presence of correlation between the disturbance terms and other explanatory variables. The calculated Durbin-Watson (DW) statistic is 1.59 and given the critical DW values with $k' = 3$ and $n = 22$, lies in the indecisive zone as to presence of positive autocorrelation. The modified DW test rejects the null hypothesis of no positive autocorrelation by a very small margin. On the basis of the residuals plot and the modified DW test, the problem of autocorrelation is assumed to be negligible and no remedial measures were carried out.

Demand elasticities as calculated at the mean value of the dependent variable are presented in Table 6 together with elasticities from other studies. Huang's (1985) results are estimated using a large scale demand system utilizing a constrained maximum
likelihood method with parameter restrictions derived from classical demand theory. Hammig and Mittelhammer (1980) utilized OLS and 2SLS to estimate a model of supply and demand in the U.S. lettuce industry. The model estimated by Curtin et al (1987) most resembles the author’s model but included price of tomatoes, potatoes as well as an index of other fresh vegetables. The latter two studies also imposed some parameter restrictions.

<table>
<thead>
<tr>
<th>Table 6: Demand elasticities for lettuce</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Own Price</td>
</tr>
<tr>
<td>Income</td>
</tr>
</tbody>
</table>

**Sources:**

The calculated own price elasticity is larger (in absolute terms) than elasticities from other studies, but like the others, lies in the inelastic range. Few true substitutes exist for head lettuce and, furthermore, lettuce may be regarded as a near staple commodity by consumers. The larger elasticity from our model may be a result of restricting the sample to account for summer consumption only. Increased availability of other fresh vegetables could account for slightly more elastic demand in the summer.
The calculated elasticity with respect to income from our model is much larger than the other income elasticities cited. Income elasticities for basic food items tend to be low in value, rarely being greater than unity except for highly prepared and luxury foods. Therefore, this figure must be interpreted with some caution.

There is no theoretical basis to predict either the sign or magnitude of the time trend variable. Growing consumer awareness of dietary needs would suggest that the demand curve would be shifting rightward over the period of estimation. However, increasing choices available in produce markets and more 'sophisticated' taste may be decreasing absolute consumption levels. The estimated coefficient is negative implying an overall reduction in head lettuce consumption. The time variable will also be picking up the effects of omitted explanatory variables that are related to the dependent variable. In this case, the time variable may be acting as a proxy for the price index of the unknown bundle of other fresh vegetables/foods which influence lettuce consumption.

4.3.4 Validation of Demand Model

Although the own price elasticity obtained from our model compares favourably with other results, the overall fit of the data is modest with only 67 percent of the variation in consumption explained by the regressors. However, the joint F test statistic rejects the null hypothesis that all explanatory variables are equal to zero and all coefficients were of the expected sign and all were significant.

The first measure of model validation is a graph of the observed and predicted
values. Figure 8 shows that while the predicted values follow the general trend of observed consumption, it smooths out the observed fluctuations. *A priori*, demand quantities of staple food commodities are expected to be rather stable over time. Data errors may account for the large observed fluctuations making prediction less precise.

![Figure 8: Observed and predicted values from econometric estimation of demand](image)

The second measure is to examine the root mean square error (RMSE) term calculated from the deviations of the observed and predicted values. The calculated RMSE value is 1.241. Dividing the RMSE by the mean of the dependent variable gives a measure that expresses the deviations of predicted from the mean as a percentage value. The calculated value is high, indicating the predicted values deviate by a substantial 17 percent from the observed mean.

To test the model's predictive ability, the demand equation was regressed omitting the last observation to obtain a forecast value of 4.574 for that observation with a residual
of -0.451. The deviation of the forecasted value from the observed mean is 2.194 percent and indicates a better prediction ability. The problem with the model's predictive ability appears to lie in the unusually high values observed in 1973 and the unusually low values in 1981. The latter value result from the exceptionally low output level due to poor weather in that year.

Although the predictive ability of the demand model is moderate, it is possible that this is a sample phenomenon and that over a larger sample the predicted values will approach the true ones. The results from the model are therefore considered acceptable for calculating derived elasticities.
5.0 ANALYSIS OF A COOPERATIVE WITH SUPPLY CONTROL

In this section the elasticities obtained from the empirical estimation of supply and demand will be used to calibrate a model of the B.C. lettuce market. The model is then used to show changes in total revenues by assuming an unrestricted supply curve that is hypothesized to exist in the absence of the market sharing quotas operated by the Cloverdale Lettuce and Vegetable Cooperative. Since the empirical estimation is based on retail and farm level data, the first part of this chapter will discuss the estimation of derived elasticities from primary level elasticities. This is followed by a discussion of the calibration of the supply and demand model using the derived elasticities. Both supply and demand will be modelled as linear curves. The third part reviews the implications of a cooperative with output control and simulates the effects of a marketing environment without such controls. This will be done by assuming an unrestricted farm supply curve within the calibrated model to look at changes in producer/member's welfare. Shifting or pivoting the supply curve will yield new supply elasticities. The final part of the chapter will provide a summary and conclusion of the analysis together with recommendations for further research.

5.1 Derived Supply and Demand Elasticities

The own price elasticities calculated in the previous chapter represent supply and demand response at the farm gate and consumer levels respectively. For our purposes
the elasticities of interest are derived supply and derived demand elasticities or those at
the Cooperative level with respect to supply and the wholesale level with respect to
demand. The exact relationships between the two levels depends on how the primary
and derived curves are related. Since the two are separated by a schedule of marketing
margins, the relationship depends on how the marketing margin behaves. Tomek and
Robinson (1990) discuss three possibilities.

The first is where the marketing margin is a combination of absolute and
percentage mark-ups which in linear may be written:

\[ M = c + aP_p \]

\[ M = \text{margin between primary and wholesale} \]
\[ P_p = \text{price at primary level} \]

The mark-up structure implies that the constant portion \( c \) represents fixed costs while
the percentage portion \( a \) represents marginal costs of marketing each unit of output.
The elasticity relation between the primary and retail level is given by:

\[ \epsilon_d = \epsilon_p \left[ 1 - \frac{c}{(1-a)P_p} \right] \tag{15} \]

where:

\[ \epsilon_d = \text{derived level elasticity} \]
\[ \epsilon_p = \text{primary level elasticity} \]
\[ c = \text{constant, } 0 \leq c \]
\[ a = \text{proportion; } 0 \leq a < 1 \]
\[ P_p = \text{primary level price} \]

A second, and the simplest possibility in specifying a margin relationship is the
case of a fixed absolute amount, where the margin is a constant regardless of the amount
marketed. The primary and derived curves are parallel separated by a constant amount.
This specification is often not realistic but appears to fit the behaviour of the Cloverdale Lettuce and Vegetable Cooperative with respect to its mark-up above farm level prices. As discussed in Chapter 2, the Cooperative sets agency charges for marketing services annually. Furthermore, these charges are fixed to all members regardless of the level of output. Therefore, in our analysis a fixed margin will be assumed to characterize the relationship between primary (farm) level and Cooperative (derived) level supply. The relationship between elasticities at the two levels is given by:

\[ e_d = e_p \left( \frac{P_d}{P_p} \right) \]  

where \( P_d \) is the Cooperative (derived) level price and other notation as noted above. Given an empirically estimated primary elasticity value, it is possible to obtain the derived level elasticity. Since prices at the Cooperative level will always be higher than those at the farm level, the price ratio \( \frac{P_d}{P_p} \) is greater than one. Thus supply at the Cooperative level will be more elastic than supply at the farm level.

The third alternative is a fixed percentage marketing margin where the derived level prices are related to primary level prices by:

\[ P_d = aP_p \]

where \( 0 < a < 1 \). With the constant value \( c \) equal to zero, the right-hand side of the identity (8) reduces to one. Assuming a constant percentage margin regardless of the

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32 As discussed in Section 2.2, capital investments are financed through the service charges collected from members. Any surplus remaining at the end of the year after all outstanding receivables have been met is distributed back to members on the basis of their patronage. The surplus may be due to lower input prices negotiated after the service charge has been set, larger volumes which will reduce the fixed cost component of the service charge or other reasons. Patronage refunds represent a reduction in the service charge paid by members on every unit of product they market through the Cooperative. Information on the frequency and amount of patronage refunds is not available. Omitting patronage refunds from our calculations means that we may overstate the Cooperative margin in some years.
quantity marketed, the price elasticities at the two market levels will be the same for a given quantity marketed, or \( (\epsilon_d = \epsilon_p) \). Primarily due to a lack of data about marketing costs between the retail and wholesale levels, a constant percentage margin will be assumed on the demand side. One consequence of constant percentage margins is that as prices increase, the gap or margin between wholesale and retail prices increase. An examination of a graph of real retail and wholesale prices together with the margin provides some evidence for constant percentage margins. Figure 9 shows that along with the decline in the real retail price of lettuce, margins have also fallen while at the same time, the real wholesale price has remained stable. Thus the gap between retail and wholesale prices has indeed narrowed as retail prices have decreased.

*Figure 9: Relationship between real wholesale prices, real retail prices and margins*

5.2 Derived Supply and Demand Curves

In this section a model of the B.C. lettuce industry will be calibrated for the year 1990 using linear supply and demand curves calculated using the estimated elasticities.

On the demand side, the calibration of the wholesale demand for local lettuce begins with the consumer demand for all lettuce. In Figure 10, panel (b), the curve $D_r$ is the consumer demand for lettuce, where $D_r$ is calculated using the empirically estimated demand elasticity, the observed retail consumer price and observed consumption during the 1990 production season. Consumption is assumed to consist of domestic output and imports. $D_r$ has an elasticity of -0.26 through the point (17.66 M.Ib.; $0.59).

Also in panel (b) is the estimated wholesale demand for all lettuce, $D_w$, calculated by applying a proportional margin to consumer demand. The proportion is the ratio of the wholesale demand price ($0.22) to the retail price ($0.59) as discussed above. Using a proportional margin, the wholesale demand also has an elasticity of -0.26 through the point (17.66 M.Ib.; $0.22). This is shown as point B in the figure.

Having established the demand for all lettuce in panel (b), the residual wholesale demand for local lettuce, $D_{w,r}$, is derived by subtracting imports from total wholesale demand. In Figure 10, panel (a), the residual wholesale demand curve for local lettuce, $D_{w,r}$ lies below and is parallel to the total wholesale demand curve, $D_w$. The distance between the two curves represents the fixed quantity of imported lettuce. The residual wholesale demand curve for local lettuce is known to pass through the quantity 11.8 M.Ib. (the domestic production) at a price of $0.22 (the Cooperative selling price). Using this
point and the slope value from the equation of total wholesale demand, $D_{w,l}$, is calculated to have an intercept at the price $0.78$ and an elasticity of $-0.39$ at the point $(11.8 \text{ M.lb.; } 0.22)$.

**Figure 10: Model of B.C. lettuce market, 1990**

On the output side, the farm level supply curve has an assumed elasticity of $0.020$ at the 1990 production level of $11.8 \text{ M.lb.}$ and the 1990 average farm price of $0.15 \text{ per lb.}$ The absolute constant margin between Cooperative and farm level supply price is calculated as:
<table>
<thead>
<tr>
<th>Administration Fee</th>
<th>$0.81 / carton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carton Cost</td>
<td>1.45 / carton</td>
</tr>
<tr>
<td>Vacuum Cooling Cost</td>
<td>0.75 / carton</td>
</tr>
</tbody>
</table>

Based on an average of 43 lb. per carton, the margin of $0.07 per lb. yields a Cooperative supply price of $0.22 per lb. Using the elasticity relationship set out in the previous section the Cooperative supply curve has an estimated elasticity of 0.029 at an output quantity of 11.8 M.lb. at a price of $0.22 per lb., i.e. the point where the Cooperative supply curve intersects the residual wholesale demand curve of local lettuce. Prices received by member-farmers are determined by the farm level supply curve, which, as noted is $0.15 per lb. at a quantity of 11.8 M.lb. The Cooperative and farm supply curves are labelled $S_c$ and $S_f$ respectively in Figure 6, panel (a). The two curves are parallel, separated at every output level by the Cooperative’s fixed marketing margin.

5.3 Model Simulation

A working hypothesis of this paper is that cooperative marketing institutions provide positive benefits to its members. With respect to the Cloverdale Lettuce and Vegetable Cooperative, the issue of particular interest is whether this single desk selling cooperative, using a market allocation scheme, increases its member’s welfare (or total revenues) relative to an unregulated marketing environment.

The underpinnings of the Cooperative’s welfare improving role for members
depends on its ability to manipulate or restrict output by members in order to move up the market demand curve, which in this instance is the residual wholesale demand. The extreme case of output restriction is, of course, the monopolist seller who sets output equal to marginal revenue to maximize profits. This result assumes the monopolist operates on the elastic portion of the demand curve. In an analogous manner the benefits of the more limited output control of the Cooperative also depend on the wholesale demand elasticity. With an elastic demand, increasing output will cause price to decline by a smaller amount thereby increasing revenues. With an inelastic demand the consequences of increased output are not quite so salutary since price will fall by a greater amount causing total revenues to decrease. The more inelastic is demand the larger are the price decreases relative to output increases.

Given that the estimated demand curve for lettuce is inelastic, the purpose of output controls by the Cooperative must be seen as an effort to maximize revenues by preventing the large price decreases that would accompany a relatively small increase in output supply. It is hypothesized and supported by the estimated supply equation that the market quota allocation scheme used by the Cooperative has been a constraint on farm output response and that the supply curve is more inelastic than it would be in the absence of the constraining market quotas. Consistent with this hypothesis the results of the empirical estimation indicates that supply is indeed quite inelastic with respect to price.

To assess changes in revenue due to the Cooperative’s output control scheme, ideally we should have an estimate of supply elasticity both before and after formation of
the Cooperative. A pre-Cooperative supply elasticity is not available therefore it will be assumed that pre-Cooperative supply curve is more price responsive. For the simulation model we want to model a market supply to reflect the higher output levels assumed to be the case when market quotas did not exist. To simulate increased output the estimated supply curve will be pivoted rightward by adjusting its slope by discrete increments while keeping the intercept term constant. The flatter supply curve yields a new intersection with the residual wholesale demand curve at a higher output level and a lower price. In our simulation, the precise amount of discount from the cif price will not be explicitly addressed since data on the price wholesalers pay for the imported lettuce is not available. Only the change from the observed Cooperative price is modelled.

Higher output levels may also be simulated by shifting the supply curve rightward, however this assumes the new supply curve has the same slope and that the error term is the same at all levels of production. It should be noted that a more elastic supply may be simulated by rotating the observed supply curve through the observed equilibrium price and quantity point. This would give a more elastic supply at the observed point but will not show any impact on output in the current period. A multi-period simulation would be required, however this analysis will not be undertaken in this study.

The post-Cooperative supply curve is conjectured to be more inelastic although the extent of the change is unknown. The calculated elasticity of supply through the simulated price and quantity points will differ from the estimated supply elasticity since the latter is associated with a different point. Since supply will be more inelastic at lower prices (a consequence of assuming linear curves), the actual supply elasticity values at
the simulated points will be smaller. The large price decreases which result from a highly inelastic supply curve overwhelms the effect of the increase in the slope coefficient.

The corresponding derived supply curve may be viewed as the supply curve of the Cooperative, or any other type of marketing organization with no output restrictions. The marketing cost structure is assumed to be identical to the current structure. In actual fact, a non-cooperative marketing firm may very well have a different mark-up structure. Retaining an identical mark-up is a simplifying assumption which allows a more ready comparison with the current Cooperative marketing environment. Demand is assumed to be the same whether the Cooperative restricts output or not.

Figure 11 illustrates the conceptual model of supply and demand under alternative supply assumptions. The demand curve \(D_{w,t}\) is wholesale level residual demand for local lettuce, while the Cooperative and farm level supply curves are labelled \(S_c\) and \(S_f\) respectively. The alternative, more elastic supply curves are labelled \(S_{c'}\) and \(S_{f'}\), where \(S_{c'}\) is the derived supply of any marketing firm with no output controls. As drawn, demand is inelastic. The intersection of \(S_{c'}\) with the demand curve yields a new market equilibrium with an increase in output from \(Q\) to \(Q'\) and a large decrease in price from \(P_c\) to \(P_c'\).
Table 7 presents the changes in total revenues from incremental changes in the slope of the estimated farm supply curve that result in a flatter curve. At all price levels, the assumed supply is greater than that given by the base case observed supply. As expected, given the inelastic demand the new equilibrium points yield price decreases that greatly exceed the quantity increases. As a result total revenues decline with successively more elastic supply curves. At the farm level, with a one percent increase in the slope of farm supply, the new equilibrium output is 0.94 percent larger while the new equilibrium price has decreased by 3.5 percent resulting in a decline in farm revenues of 2.3 percent.
Table 7: Change in total revenues under alternative supply curve assumptions  
Wholesale demand elasticity: -0.26

<table>
<thead>
<tr>
<th>Change in Wholesale Demand</th>
<th>% Change in Farm Output</th>
<th>% Change in Farm Price</th>
<th>% Change in Coop. Price</th>
<th>% Change in Farm Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope</td>
<td>New Value (M.lb.)</td>
<td>Output ($/lb.)</td>
<td>Output ($/lb.)</td>
<td>Revenue ($M)</td>
</tr>
<tr>
<td>0.6495</td>
<td>11.800</td>
<td>0.150</td>
<td>0.220</td>
<td>1.770</td>
</tr>
<tr>
<td>Alternative Supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0%</td>
<td>0.6430</td>
<td>11.911</td>
<td>0.940</td>
<td>0.145</td>
</tr>
<tr>
<td>2.0%</td>
<td>0.6365</td>
<td>12.024</td>
<td>1.898</td>
<td>0.139</td>
</tr>
<tr>
<td>5.0%</td>
<td>0.6170</td>
<td>12.376</td>
<td>4.885</td>
<td>0.122</td>
</tr>
<tr>
<td>7.0%</td>
<td>0.6041</td>
<td>12.623</td>
<td>6.975</td>
<td>0.111</td>
</tr>
<tr>
<td>10.0%</td>
<td>0.5846</td>
<td>13.012</td>
<td>10.272</td>
<td>0.092</td>
</tr>
</tbody>
</table>

As discussed, the changes in total revenues depend as well on the behaviour of the wholesale demand curve. It may be recalled that a more elastic demand was estimated in this study than those from other studies (see Table 6). On the basis on these other elasticities, a value of -0.14 was used to derive an alternative demand equation to calculate changes in total revenues under an assumption of even more inelastic demand. Alternative supply assumptions are as before. Table 8 shows the equilibrium quantities and prices, and changes in total revenues using the new demand elasticity. As expected, a more inelastic demand results in larger decreases in price and smaller increases in quantity and consequently, larger declines in total revenue. The one percent increase in the supply curve slope value now increases output by a mere 0.88 percent while farm price and farm revenue fall by 6.2 and 5.4 percent respectively.
The results from the simulation of alternative supply and demand conditions suggests that the output restriction by the Cloverdale Lettuce and Vegetable Cooperative has been beneficial to its members. This conclusion hinges on our assumption that the Cooperative, by controlling market output, has constrained supply response on the part of its members resulting in lower output levels than would be the case in the absence of any market quotas. Given the inelastic nature of demand, farm prices fall dramatically for relatively small increases in output. Therefore, the Cooperative's efforts to control supply and members' willingness to comply with these market supply controls would appear to be entirely rational.

It is possible that supply response for lettuce would be unchanged even if no controls on output existed. The farms which grow lettuce also grow a variety of other fresh market vegetables. Physically, substitution possibilities amongst the different vegetables exist. However, many of these other crops are subject to the same market output regulations that apply to lettuce. Hence rigidities in production may arise as

<table>
<thead>
<tr>
<th>Change in Slope Value</th>
<th>New Slope Value</th>
<th>% Change in Output (M.lb.)</th>
<th>% Change in Farm Price ($/lb.)</th>
<th>% Change in Coop. Price ($/lb.)</th>
<th>% Change in Farm Revenue ($M)</th>
<th>% Change in Farm Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Supply</td>
<td></td>
<td>0.6495</td>
<td>11.800</td>
<td>0.150</td>
<td>0.220</td>
<td>1.770</td>
</tr>
<tr>
<td>Alternative Supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0%</td>
<td>0.6430</td>
<td>11.905</td>
<td>0.887</td>
<td>0.141</td>
<td>-6.210</td>
<td>-4.234</td>
</tr>
<tr>
<td>2.0%</td>
<td>0.6365</td>
<td>12.011</td>
<td>1.791</td>
<td>0.131</td>
<td>-12.513</td>
<td>-8.544</td>
</tr>
<tr>
<td>5.0%</td>
<td>0.6170</td>
<td>12.343</td>
<td>4.600</td>
<td>0.102</td>
<td>-32.194</td>
<td>-21.950</td>
</tr>
<tr>
<td>7.0%</td>
<td>0.6041</td>
<td>12.574</td>
<td>6.561</td>
<td>0.081</td>
<td>-45.916</td>
<td>-31.306</td>
</tr>
<tr>
<td>10.0%</td>
<td>0.5846</td>
<td>12.938</td>
<td>9.643</td>
<td>0.049</td>
<td>-67.492</td>
<td>-46.017</td>
</tr>
</tbody>
</table>
producers attempt to maintain market allocations for a number of crops. In the presence of output price volatility, production decisions may be motivated by protecting these market allocations.

The possibility that producers faced monopsony power before the formation of the Cooperative was discussed in Section 3.5. To show the effect of monopsony power we need to calculate the marginal outlay (MO) curve facing the monopsonist wholesaler. The quantity demanded by the monopsonist buyer is determined by the intersection of the MO curve with the demand curve. The price is then determined according to the farmer's supply curve. Because our estimated supply curve is highly inelastic the intersection of the calculated MO curve and the estimated wholesale demand curve yields a negative supply price. It is possible that even with the Cooperative wholesalers are able to exercise some residual monopsony power. In other words, the observed supply quantity and price is not on the supply curve where it intersects the wholesale demand curve but below that point. This could explain the negative supply price in our simulated monopsony scenario.

The final simulation undertaken in our analysis is to examine the changes in total revenue from the sale of head lettuce when the quantity of lettuce imported is increased. As in the earlier analysis this increased quantity is assumed fixed at the amount in transit in the current period. In terms of Figure 6, an increase in the imported quantity has the effect of shifting the residual wholesale demand curve for local lettuce in panel (a) downward. Recall that the horizontal distance between this curve and the total wholesale demand represents the quantity of imported lettuce. An increase in the quantity of
imports, given that total demand remains unchanged will increase the horizontal distance and shift the residual wholesale demand curve downward. The Cooperative and farm supply curves are assumed to remain unchanged.

For the simulation the quantity of imported head lettuce is increased by small increments to show the change in domestic product price, output quantity and farm revenue. Table 9 shows the results of the simulation as well as the percent change from the base case when the import quantity is 5.863 M.lb. (1990).

A one percent increase in the quantity of imported lettuce leads to a very small decrease in the quantity of domestic output (less than one-half percent). However, since the domestic supply curve is highly inelastic this small change in quantity results in a 1.2 percent decline in farm price. Total revenues from the sale of head lettuce fall by 1.7 percent due to the lower price and reduction in output. From the table it can be seen that the decline in farm price rather than the reduction in output is the source of the large decreases in revenues.

The results from this simulation suggests that in the short-run domestic producers are at considerable risk as a result of increases in imported lettuce. This may have been the situation for domestic producers during 1991 and early 1992 seasons when head lettuce imports increased. Given an almost vertical supply curve, the downward shift in the wholesale demand for local lettuce would cause domestic prices to decline rapidly.
Table 9: Change in total revenues when imports increase (downward shift in wholesale demand curve for local lettuce).

<table>
<thead>
<tr>
<th>Change in Imports (%)</th>
<th>New Farm/Coop. Qty. (M.lb.)</th>
<th>Output (M.lb.)</th>
<th>Change in Price ($/lb.)</th>
<th>Change in Farm Output ($M)</th>
<th>Change in Farm Revenue (M.lb.)</th>
<th>Total Con-summ'tn</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base Import Quantity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.8630</td>
<td>11.800</td>
<td>0.150</td>
<td>1.770</td>
<td></td>
<td></td>
<td>17.663</td>
</tr>
<tr>
<td><strong>Increased Import Quantity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0%</td>
<td>5.9216</td>
<td>11.796</td>
<td>-0.034</td>
<td>0.147</td>
<td>-1.770</td>
<td>1.739</td>
</tr>
<tr>
<td>2.0%</td>
<td>5.9803</td>
<td>11.793</td>
<td>-0.068</td>
<td>0.165</td>
<td>-3.603</td>
<td>1.707</td>
</tr>
<tr>
<td>5.0%</td>
<td>6.1561</td>
<td>11.780</td>
<td>-0.170</td>
<td>0.137</td>
<td>-9.524</td>
<td>1.613</td>
</tr>
<tr>
<td>7.0%</td>
<td>6.2734</td>
<td>11.772</td>
<td>-0.239</td>
<td>0.132</td>
<td>-13.861</td>
<td>1.551</td>
</tr>
<tr>
<td>10.0%</td>
<td>6.4493</td>
<td>11.760</td>
<td>-0.342</td>
<td>0.124</td>
<td>-21.052</td>
<td>1.457</td>
</tr>
<tr>
<td>12.0%</td>
<td>6.5666</td>
<td>11.752</td>
<td>-0.410</td>
<td>0.119</td>
<td>-26.373</td>
<td>1.395</td>
</tr>
<tr>
<td>15.0%</td>
<td>6.7425</td>
<td>11.740</td>
<td>-0.513</td>
<td>0.111</td>
<td>-35.294</td>
<td>1.302</td>
</tr>
<tr>
<td>17.0%</td>
<td>6.8597</td>
<td>11.732</td>
<td>-0.582</td>
<td>0.106</td>
<td>-41.975</td>
<td>1.240</td>
</tr>
<tr>
<td>20.0%</td>
<td>7.0356</td>
<td>11.720</td>
<td>-0.685</td>
<td>0.098</td>
<td>-53.333</td>
<td>1.146</td>
</tr>
</tbody>
</table>

Although the members of the Cooperative have been benefitting from higher prices due to restricting supply, a longer run effect of the market quota scheme is that it may also have reduced flexibility to price changes. As discussed above, with an inelastic supply curve, price and not quantity does most of the adjusting to changes in demand. With the tariff protection form domestic head lettuce being reduced annually, it is possible that the quantity of head lettuce imported will continue to increase. It should be noted that the exchange rate is also an important component in the wholesaler's calculation of the landed import price. The drop in the Canadian dollar relative to the U.S. dollar in the latter part of the 1992 season undoubtedly afforded the Cooperative an extra degree of protection from U.S. imports.
5.4 Summary and Conclusions

Marketing cooperatives play an important role in agricultural activities. Support for cooperatives is based on the idea that, collectively, farmers can achieve a beneficial market outcome that, individually, would be very difficult. Price related benefits dominate the rationale for cooperative formation although risk reduction is important in some areas of agriculture. The most commonly stated ways a cooperative may influence price include: 1) reducing the margin between farm and retail prices; 2) counterbalancing market power of the marketing sector firms, and; 3) increasing consumer price through cooperative marketing either by restricting the quantity of farm product to the market or improving the quality (physical or otherwise) of the farm product.

The lettuce industry in the Lower Mainland of B.C. is organized into a producer cooperative with exclusive marketing powers over all locally grown product (except for direct retail sales at the farm gate). The Cloverdale Lettuce and Vegetable Cooperative is also empowered to operate a market sharing scheme amongst its members. Although physical production quotas are not a part of the scheme, the quantity of lettuce member-farmers are permitted to sell is based on a three-year moving average of historical sales. The Cooperative determines a selling price competitive with the landed price of imported California lettuce. As a "large country" exporter, the landed price of California lettuce is seen to be a ceiling for domestic lettuce prices. The quantity of domestic lettuce sold is determined by market demand together with the Cooperative's selling price and is allocated to members on the basis of their market shares.
A major objective of this study is to determine how and whether this system of cooperative marketing benefits member-farmers. Restricting farm output to the market is the classical way of raising prices, as epitomized by the monopolist seller. It is hypothesized that the Cloverdale Cooperative practices a limited form of output restriction as a means to prevent the oversupply which, given an inelastic demand curve, would result in rapid decreases in price and total revenues.

In order to achieve this objective and test our hypothesis a supply and demand model of the B.C. lettuce market is constructed. Supply and demand elasticities are estimated with econometric equations using farm level and consumer level data respectively. The estimated elasticities are used to formulate linear farm supply and consumer demand equations using price and quantity observations for the year 1990. A proportional marketing margin is assumed to derive the wholesale level demand for lettuce. The supply curve for the Cooperative is derived by adding its fixed marketing charges to the farm supply curve. The model shows that the B.C. lettuce market is characterized by inelastic demand and even more inelastic supply.

To simulate a market with no controls on output, a counterfactual model is constructed where it is assumed that the supply curve lies to the right of its present position. With no clear idea of what a non-restricted supply schedule should be, a range of alternative assumptions were tested. The results show that for very small increases in output (from imposing a flatter supply curve), large decreases in price occur. Consequently total revenues decline at every alternative supply assumption.

This result supports the hypothesis that the objective of the Cooperative's output
restrictions is to prevent oversupply and the slide down the demand curve. The benefits to members are the potential losses in total revenues. A key factor in the analysis is the demand parameter. The more inelastic is demand the greater is the decrease in price and total revenues. This is clearly shown in a second counterfactual model where a more inelastic demand is tested with the original set of supply assumptions. The same slope change in supply here more than doubles the loss in total revenues with the more elastic demand.

Regulated marketing by the Cloverdale Lettuce and Vegetable Cooperative would appear to be a response to the typical supply and demand characteristics of the market for many agriculture food commodities. The relatively price-inelastic demand for basic fresh vegetables, including head lettuce leads to a situation where, for a given demand curve, increases in supply resulting from short-run favourable environmental growing conditions or longer run technological improvements, cause total revenues from the sale of the product to decrease. Total revenues can be expected to increase from reductions in supply, thus planned output restriction is a way of controlling the output fluctuations which cause price and income variability.

Although the Cooperative is the sole marketing agency for domestic lettuce it cannot act as a monopoly seller since imports are not restricted. The maximum to which the Cooperative may sell its product at is limited by the cost of transporting lettuce from California plus the tariff protection. In the short run when the quantity and price of imports is fixed, the Cooperative faces the residual wholesale demand curve and may control the quantity of local product so as to keep domestic prices close to the level of
imports. For quality reasons, namely the longer storage life of California lettuce, domestic lettuce is priced, at best, slightly below that of imports. Total revenues are increased as a result of keeping domestic production at levels which yield this price.

While maintaining higher price levels for producers, output restrictions have welfare implications. If, as has been hypothesized, the observed farm supply curve has been constrained by the market quota allocations, then the "true" supply curve may involve a pivotal shift to the right. The area between the "true" and observed restricted supply curves below the demand curve represent a welfare loss due to allocative inefficiency. The sources of these efficiency losses have been suggested to arise from cost increases due to underutilization of existing productive capacity, non-captured economies of scale and "x-efficiency" costs (Veeman, 1982). In the case of the B.C. lettuce industry it is difficult to establish whether allocative inefficiency is significant. Resources which may have been utilized in lettuce production may have merely been transferred to other uses (i.e. other vegetable crops grown by lettuce producers). Non-captured economies of scale in lettuce production may be a more valid source of allocative inefficiency, however crop diversification reduces farm income variability and hence the risk premium a farmer may require for specialization to a single farm output.

There is no clear way of assessing these welfare losses since, ex post, there is no way to measure what "true" supply would be if the market quota allocations had never been instated. Indeed, it is possible the "true" supply may not differ from what is currently observed. However, the quota scheme which regulates the marketing of many vegetables in B.C. remains a source of allocative inefficiency. The need for quota to
begin production and the incentive to maintain earned quota both render the farmer less responsive to price changes and delays the process of allocating resources to other crops. As shown in the simulation, an increase in the quantity of imports shifts the residual wholesale demand curve downward, but it is the price decrease rather than quantity reduction which causes the decrease in revenues. In addition, the market quota scheme may also inhibit farmers from experimenting with new crops. As a result, the B.C. fresh vegetable industry may be in a less favourable position to respond to changing market conditions.

The Cloverdale Lettuce and Vegetable Cooperative illustrates some of the benefits of marketing through a central producer-owned selling agency. Members benefit from scale economies for purchase of shipping cartons and materials; in the processing and marketing of output and in the acquisition of market information. Standard grading of lettuce as well as post-harvest vacuum cooling have helped to bring the quality of the local product in line with that of imported lettuce. These services may not have been provided otherwise, or, at a higher cost to producers. More importantly, prices are kept as high as possible through member compliance with their market quotas. Members have also benefitted from the lobbying activities of the Cooperative. For example, in June (1992) the federal government temporarily increased the duty on U.S. head lettuce entering Western Canada from the current 9 percent to 15 percent to protect producers from low import prices.\textsuperscript{34} This benefit may have been received without the Cooperative but a coherent and united producer group undoubtably has some influence.

The Cooperative and members view the marketing scheme as a system of delivery to the marketplace to meet demand and to affect production to prevent short-term market surpluses. In addition, it prevents new growers and growers wanting to increase production from "jumping into the market when it is already being supplied by existing (quota holding) growers". For current members the market quota scheme ensures their right to their earned market and guarantees them a share in any future market growth. From a societal welfare point of view, such marketing schemes act as a barrier to entry for potentially more efficient producers. Furthermore, the scheme reduces the ability of efficient producers to expand and may reduce the opportunity for innovative farmers to explore new markets.

Such a scheme requires the cooperation and support of participants, specifically, members must be committed to selling all their output through the Cooperative. Since head lettuce does not require processing growers can easily sell their output illegally through non-Cooperative channels. Anecdotal evidence suggests these side sales are fairly common but volumes are small relative to total sales. One reason for this may be the difficulty in concealing production in field grown crops, especially within a small group of producers such as the Cloverdale Cooperative. A second reason may be that side sales are made at a discount from the Cooperative's price, therefore growers may engage in these sales mostly when their production exceeds their allocated market share. To discourage illegal sales, the Cooperative will withhold a member's market allocation for one or more days when transgressions are detected. Since market quotas in future years

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are dependent on current sales, there is an incentive for producers to protect their market quota.

At present, it appears producer compliance with the Cooperative’s output controls is successfully achieved, however, producers of head lettuce have no alternative but to market through the Cooperative. This raises the possibility that some growers, for example, low cost producers willing to supply more output at all price levels could be better served by a different marketing structure. One option for producers limited by their market quotas is production of non-regulated vegetables. Members may choose whether to market these through the Cooperative and benefit from scale economies in the purchase of inputs and marketing of output, or seek new market opportunities on their own. For many small scale farms, the advantages of being within a large marketing institution may likely be greater than individual endeavour to market farm output.

It is concluded that the Cloverdale Lettuce and Vegetable Cooperative has been effective in providing benefits to its members. As a unified group marketing through a central selling agency, members benefit from economies of scale in input purchase, marketing and distribution, the lobbying activities of the Cooperative and potential price increase by collectively controlling domestic output to the market. The phasing out of tariff protection and the possibility of more aggressive marketing by U.S. exporters may well increase the volume of imported lettuce to the B.C. market in the future. Given a highly inelastic supply curve which results from the rigidity of the market quotas, the B.C. lettuce industry may be slow to respond to increased competition from U.S. imports.

Two unintentional consequences of the market quota system have an adverse
effect on the industry’s response to changes in market conditions. First, the quotas may be keeping less cost efficient producers in the industry at the expense of more efficient producers. Secondly, the quotas may reduce the flexibility of producers to switch to alternative crops. To address these issues, changes to the market quota scheme for regulated fresh vegetables will be needed. For example, the 3-year period on which current quota allocations are calculated could be modified to induce greater flexibility. This would lessen the carry-over effects of past output on current farm production decisions.

For the lettuce industry to survive in the face of increasing competition from U.S. imports, the marketing scheme will have to be changed to that the most efficient producers are not constrained by their historic market shares to expand production. This would inevitably require changes or retirement of the market quota scheme. The future role of the Cooperative will be less concerned with output control, and focused on the provision of low-cost processing services, product development and more innovative marketing.
REFERENCES


Statistics Canada. Agriculture economic statistics. Catalogue No. 21-603E.


Fresh fruits and vegetable shipments by commodities, states, and months 1989. FVAS Calendar Year 1988.

APPENDIX: Data Tables

Table 1: Lettuce quantities and prices and leaf lettuce price

<table>
<thead>
<tr>
<th>Year</th>
<th>Head Lettuce Acres</th>
<th>Head Lettuce Domestic Production (lb.)</th>
<th>Head Lettuce Imports* (lb.)</th>
<th>Head Lettuce Cooperative Price ($/lb.)</th>
<th>Leaf Lettuce Cooperative Price ($/lb.)</th>
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* Imports for period June to September of the respective year


Table 2: Cooperative charges for head lettuce and leaf lettuce

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<th>Administration Charge ($/ctn)</th>
<th>Carton Cost ($/ctn)</th>
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* Per lb. charges calculated by using 43 lb. per carton for head lettuce
** Per lb. charges calculated by using 34 lb. per carton for leaf lettuce
*** Vacuum cooling costs are the same for both head lettuce and leaf lettuce.

Source: See Section 4.2.2 for a description of this data
Table 3: Total farm expenses (British Columbia)

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<th>Year</th>
<th>Total Labour Wage ($,000)</th>
<th>Total Fertilizer &amp; Lime ($,000)</th>
<th>Total Pesticide ($,000)</th>
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Source: Statistics Canada. Catalogue No. 21-603E.
Table 4: Farm price indexes (Western Canada)*

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* For all indexes, 1986 = 100
** Farm product price index for vegetables


Statistics Canada. Catalogue No. 21-603E.
Table 5: Other price indexes*

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<th>Year</th>
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* For all indexes, 1986 = 100
** Median value for July to September


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