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RESEARCH ARTICLE

EFFECT OF REGULATORY ENVIRONMENT ON THE EFFICIENCY OF AGRICULTURAL MARKETING CO-OPERATIVES IN CANADA

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ABSTRACT

In this study, we examine the efficiency of regulated (*poultry* and *eggs)* and non-regulated (*fruits and vegetables*) Agricultural Marketing Co-operatives using profit estimations. Time series data that spans from 1984 – 2001 was obtained from various institutions in Canada for the analysis. A Translog production function was specified and the analysis was carried across the above mentioned Agricultural Marketing Co-operatives. The empirical results reveal that, in general, these the co-operatives do not have equal economic efficiency; each co-operative has its own level of efficiency. This result also suggests that the co-operatives may be operating with different kinds of technologies within the same sub-sector and across various sub-sectors. These results imply that each co-operative has its own level of efficiency. Equal and absolute allocative efficiency were also tested and the results showed that the hypothesis of equal or absolute efficiency is rejected for the two groups of co-operatives. This means that that the allocative efficiency of the co-operatives is not equal and neither are they absolute. The elasticities of the regulated co-operative (*poultry* and *eggs)* were less elastic as compared to those for the non-regulated co-operative *(fruits and vegetables)*. Further, the results imply that the regulated co-operative did not exhibit any undue advantage over the non-regulated co-operative that might be attributed to supply management. The empirical results from the profit and efficiency estimations showed that the individual co-operatives are not technically or allocatively efficient. These results have policy implications regarding the management of co-operatives in the sense that supply-managed co-operatives may have to be more concerned about improving efficiency.

INTRODUCTION

Co-operatives play an important economic role in Canadian agriculture, as indicated by their substantial asset ownership and market share. The agribusiness co-operative sector is a significant element of Canadian business sectors in terms of cash receipts ($26.1 billion in 2002), assets (($16.8 billion in 2002), value-added ($1.2 billion in 2002), employment (83,000 people in 2002), and membership (5.1 million people in 2002) (Co-operatives Secretariat, 2004)). The Canadian Co-operatives also play a crucial role in farm supply and in the processing and marketing of grains and oilseeds, dairy products, poultry, fruits, vegetables, livestock, honey and maple products. It is clear that co-operatives have been very helpful to their members (Barton, 1989). Studies, have discussed the issue of regulations in the supply of certain products and how it affects their market (e.g.,Proulx *et al*., 1991). To the best of our knowledge, with the exception of one study by Janmaat (1994) on "Marketing co-operatives and supply management: a case study of the British Columbia Dairy Industry", no research has been done on the effects of regulatory restrictions on the performance of marketing co-operatives in Canada. According to Janmaat (1994), the principal effect of supply management restrictions is to guarantee that there are profits available to producers. Canadian processors have an interest in the outcome of supply management. The processors argue that supply management restrictions prevent them from achieving economies of scale (Funk and Rice, 1978). Secondly, quotas result in higher raw-material prices for processors, putting them at a competitive disadvantage in the world export markets (Schmitz *et al*., 2002). Proulx and Saint-Louis (1978) found evidence of a positive influence of supply management on farm-level productivity but expressed some reservations about the eventual implications of quota values which were beginning to emerge at that time. However, Richards (1996) concluded that farm productivity was lowered by supply management. Are these restrictions really making all the members of the co-operatives better off? The regulatory environment of supply management makes it more difficult for producers to expand due to the fixed quantity they are allocated to produce, thus reducing the size range of co-operative members. On the other hand, supply management guarantees a more secure return to small producers, reducing their reliance on the co-operative's

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patronage dividend (Janmaat, 1994). One question, therefore, is what are the economic impacts of the regulatory systems on the performance of the marketing co-operatives operating under supply management? Also, the supply management system accomplishes a number of objectives, in particular bringing stability to the industry. However, this stability comes at a cost which the entire economy pays. One theory is that co-operatives are created to deal with market failure, therefore if they are operating under supply management, are they acting as pro-competitive forces to improve market performance and producer welfare?

This study will contribute to the existing literature on supply management and also bridge a gap in the literature on the effects of supply management on the performance of marketing co-operatives. It will also provide policy implications on the management strategies of Agricultural Marketing Co-operatives. In this study, we examine the effect of supply management on the supply of produce by *poultry* and *eggs* producers. Supply management results in a change in farm price.With supply management, the administered cost of production-based farm price and supply are not directly related to the supply curve but are assumed to be related to processor demand (Duff and Goddard, 1997). At the farm level, processors pay the farm price. In supply-managed sub-sectors, the farm price processors pay is assumed to represent the marginal cost price and the static per unit quota value. The non-supply managed sub-sector (i.e. *fruits and vegetables*) do not have quota value, so the farm price paid by processors in these sector is assumed to be the marginal cost price. The objective of the study is to examine the efficiency of marketing co-operatives in a sub-sector that is supply managed and a sub-sector that is not.

Literature Review

Firm performance measures can be important in assessing how well a firm is doing and whether it will be able to continue in business. As multiple concepts of firm performance can be defined, it is logical that multiple measures of firm performance exist. The measure of performance of firms may be unique to every particular firm depending on the goals or objectives set by that firm. During the past two decades, both academics and practitioners have stressed the importance of a well functioning system of performance measurement in order for firms to thrive, or survive, in an increasingly competitive environment (Brimson, 1991; Johnson and Kaplan, 1987). Many studies have been done on firm performance in general but only a few on the efficiency of co-operatives in particular. The orthodox theory of the investor-owned firm assumes that the objective of the firm is to maximize profits, so it follows that performance measures have been developed based largely on this theory. Whatever a firm's objectives are, business performance measures provide an evaluation of the extent to which these objectives are being achieved (Jarvis *et al*., 1999). Grant (1991) noted in his study that all stakeholders have a shared interest: the survival of the firm. To survive, therefore, a firm needs to earn, in the long term, a rate of return that covers its cost of capital. As this is a financially oriented criterion, one can argue that in the end, the interest of every stakeholder is linked to the financial well-being of the firm. Co-operatives are often thought of as also providing a public good (Fulton, 1995). This includes their ability to correct for market failures by providing services which might not exist in a functioning market and also their commitment to participatory management and democratic governance. Therefore, a full evaluation of co-operative performance would require a method that is capable of also valuing these non-market dimensions. Sexton and Iskow (1993) pointed out that analysis of performance using financial ratios only, although popular, is not based on economic theory. Furthermore, they noted that co-operatives represent the vertical integration of the producers' firms; thus it is inappropriate to evaluate performance of the whole entity by examining data for only a portion of the entity. They went on to argue that a co-operative could be less profitable than an Investor Owned Firm (IOF) and still be desirable to a member, as long as the member's discounted stream of returns from the co-operative were greater than those from marketing the commodity directly or through an IOF (Sexton and Iskow, 1993). Profitability of an IOF may affect its ability to grow by both internal and external means. The more profitable the IOF is, the more rapidly it can grow from retained earnings. In addition, high profitability may be interpreted by potential investors as an indication that the future earnings of their investment will be high and safe. The IOF may be able to obtain capital on more favourable terms. However, in a short-run period it is reasonable to expect that the IOF may allocate part of its profits in investments to secure its establishment and growth in the market.

Therefore, either a positive or a negative relationship could be obtained between growth and profitability depending on the strategy of the firm and also whether it is a co-operative or an IOF. The case of the co-operative is different. A very fundamental co-operative principle is "operation at cost" (Caswell and Cotterill, 1988). Therefore, co-operatives are not expected to make profits, and if any revenues are realized over and above costs they are to be distributed to members as dividends according to patronage. The main source of funding for co-operatives is through debts and retained earnings. Co-operatives in their bid to retain earnings to finance their growth may be seen as not maximizing the welfare of their current members.

Porter and Scully (1987) further argue that co-operatives will exhibit allocative inefficiency because of horizon problems. That is because members benefit from co-operative investments only over their horizon as patrons, it is hypothesized that co-operatives will under-invest in long-term assets such as capital. Porter and Scully (1987) again argue that co-operatives often lack sufficient patronage to achieve the cost minimizing scale of operation and thus exhibit scale inefficiency. However, other arguments can also be raised to suggest that co-operatives will perform more efficiently than investor owned firms. These may be due to possible cost savings to internalizing transactions through vertical integration. Vertical integration eliminates the problem of technical inefficiency. Co-operatives provide mutual vertical integration for their members.

Theoretical framework and Methodology

Theoretical framework

Economic efficiency would be used to assess the performance of marketing co-operatives in this study. One of the fundamental decisions in measuring efficiency is the choice of concept to use. The two most important economic efficiency concepts that are based on production economic decision making are cost and profit efficiencies. Economic efficiency based on a profit function measures how close a co-operative is to producing the maximum possible profit given a particular level of input prices and output prices. Economic efficiency based on a cost function provides a measure of how close a co-operative's cost is to what a best-practice co-operative's cost would be for producing the same output bundle under the same conditions. The two approaches differ in terms of the fundamental objective function. The objective of the profit function approach is to maximize profits subject to a production function with input and output prices given. The objective of the cost function approach is to minimize costs subject to a production function with input and output prices given. The primary advantage of the profit function is that it allows for measurement of inefficiencies on the output side, as well as on the input side of the firm (Berger *et al*., 1993; Berger and Mester, 1997). Standard cost function approaches neglect output inefficiencies (Berger and Mester, 1997). The empirical results of profit efficiency measures depend on the approach that is used and on the assumptions imposed under a particular approach. In this study, the profit efficiency frontier was used in the estimation because to the best of our knowledge no previous empirical work has been done in the co-operative sector using the profit efficiency approach to assess performance and since the available data enable this.

Economic efficiency of a firm can be conceptualized as comprising two main components (Farrell, 1957): first, technical efficiency which involves the firm's ability to obtain the maximum possible output from a given set of resources; second, allocative efficiency which concerns its ability to maximize profits, by equating the marginal revenue product with the marginal cost of inputs (Kalirajan, 1990). Common frontier efficiency estimation techniques are data envelopment analysis (DEA), free disposable hull analysis (FDH), the stochastic frontier approach (SFA), the thick frontier approach, and the distribution-free approach. DEA and FDH are non parametric methods, the rest are parametric. The non-parametric methods generally ignore prices and can, therefore, account only for technical inefficiency in using too many inputs or producing too few outputs (Sengupta, 1995; Murillo-Zamorano and Vega-Cervera, 2000). Another drawback is that the non-parametric methods usually do not allow for random error in the data, and assume away measurement error and luck as factors affecting outcomes. In effect, the non-parametric methods disentangle efficiency differences from random error by assuming that random error is zero (Mester, 2003).

Choice of Functional Form:

In specifying the estimation model, the translog functional form of the profit function is used in this study because of the flexibility it allows in estimating parameters. The use of the translog profit frontier has become increasingly popular since it is less restrictive than other functional forms such as the Cobb-Douglas and constant elasticity of substitution (CES) forms (Villezca-Becerra and Shumway, 1992; Estrada and Osorio, 2004).

The Translog Model

Following Holloway (1986), the general form of the normalized profit model under the translog specification is as follows:

$$In\pi^* = \beta_0 + \sum_i^n \beta_i * Inw_i^* + \frac{1}{2} * \sum_i^n \sum_j^n \beta_{ii} * Inw_i^* * Inw_i^* + \frac{1}{2} * \sum_i^n \sum_j^n \beta_{ij} * Inw_i^* * Inw_j^* \quad (1)$$

The expressions for actual normalized profits and actual shares of the variable inputs are presented as follows to be estimated for a co-operative in a perfectly competitive market.

$$In(\pi_a^{*j}) = In(A^j) + \beta_0 + \sum_i^n \beta_i * In(k_i^j * w_i^* / A^j) + \frac{1}{2} * \sum_i^n \sum_i^n \beta_{ij} * In(k_i^j * w_i^* / A^j) * In(k_j^j * w_j^* / A^j) - In\left\{1 + \sum_j^n ((1-k_i^j)/k_i^j) * \left[\beta_i + \sum_j^n \beta_{ij} * In(k_j^j * w_j^* / A^j)\right]\right\} \quad (2)$$

$$(D_i^* * w_i^*)/\pi_a^{*j} = -\left\{\beta_i + \sum_j^n \beta_{ij} * In(k_j^j * w_j^* / A^j)\right\} * \left\{1 + \sum_i^n ((1-k_i^j)/k_i^j) * \left[a_i + \sum_j^n \beta_{ij} * In(k_j^j * w_j^* / A^j)\right]\right\}^{-1} * (k_i^j)^{-1} \quad (3)$$

i = 1, 2……..n; j = 1, 2……..m;

where the superscript j denote each of the m groups of co-opeatives to be compared. The above equations are specified based on the objective function of an investor-owned firm. The objective of the investor-owned firm is to maximize profits. This equation will also hold for a co-operative operating in a perfectly competitive market. Therefore, for the co-operative, the profit model discussed above is given as;

$$In(\pi_a^{*j}) = In(A^j) + \beta_0 + \sum_i^n \beta_i * In(k_i^j * w_i^* / A^j) + \frac{1}{2} * \sum_i^n \sum_i^n \beta_{ij} * In(k_i^j * w_i^* / A^j) * In(k_j^j * w_j^* / A^j) - In\left\{1 + \sum_j^n ((1-k_i^j)/k_i^j) * \left[\beta_i + \sum_j^n \beta_{ij} * In(k_j^j * w_j^* / A^j)\right]\right\} \quad (4)$$

where

(π_a^{*j}) = profits of the co-operative.

From the data, the profits of the co-operative are calculated by deducting the co-operative's expenses from its sales. The

variable inputs are labour, raw materials and capital. The price of output is the product price of the various products of the co-operative. For estimation, the above equation is expanded as follows:

$$In\pi = In(A) + \beta_0 + \beta_1[Ink_1 + InPL - InA] + \beta_2[Ink_2 + InPC - InA] + \beta_3[Ink_3 + InPR - InA]$$
$$+ \frac{1}{2}[\beta_{11}(Ink_1 + InPL - InA)*(Ink_1 + InPL - InA)] + \frac{1}{2}[\beta_{12}(Ink_1 + InPL - InA)*(Ink_2 + InPC - InA)]$$
$$+ \frac{1}{2}[\beta_{13}(Ink_1 + InPL - InA)*(Ink_3 + InPR - InA)] + \frac{1}{2}[\beta_{21}(Ink_2 + InPC - InA)*(Ink_1 + InPL - InA)]$$
$$+ \frac{1}{2}[\beta_{22}(Ink_2 + InPC - InA)*(Ink_2 + InPC - InA)] + \frac{1}{2}[\beta_{23}(Ink_2 + InPC - InA)*(Ink_3 + InPR - InA)]$$
$$+ \frac{1}{2}[\beta_{31}(Ink_3 + InPR - InA)*(Ink_1 + InPL - InA)] + \frac{1}{2}[\beta_{32}(Ink_3 + InPR - InA)*(Ink_2 + InPC - InA)]$$
$$+ \frac{1}{2}[\beta_{33}(Ink_3 + InPR - InA)*(Ink_3 + InPR - InA)]$$
$$- In\left[1 + \left[\frac{(1-k_1)}{k_1} + \frac{(1-k_2)}{k_2} + \frac{(1-k_1)}{k_3}\right]\right] * \begin{bmatrix}\beta_{11}(Ink_1 + InPL - InA) + \beta_{22}(Ink_2 + InPC - InA) \\ + \beta_{33}(Ink_3 + InPR - InA)\end{bmatrix} \quad (5)$$

where

π = normalized profit (ie profit divided by price of output)
PL = normalized price of labour
PR = normalized price of raw material
PC = normalized price of capital

Profit Maximization Function for Co-operatives

The system of equations that is used for the profit function and efficiency estimation are specified as follows;

The profit equation

$$In\pi = InA + \beta_0 + \beta_1 Ink_1 - \beta_1 InA + \beta_1 InPL$$
$$+ \beta_2 Ink_2 - \beta_2 InA + \beta_2 InPC$$
$$+ \beta_3 Ink_3 - \beta_3 InA + \beta_3 InPR$$
$$+ \frac{1}{2}\left[\beta_{11}(Ink_1^2 + 2Ink_1 * InPL - 2Ink_1 * InA + InPL^2 - 2InA * InPL + InA^2)\right]$$
$$+ \left[\begin{matrix}\beta_{12}(Ink_1 * Ink_2 + Ink_1 * InPC - Ink_1 * InA + InPL * Ink_2 + InPL * InPC - InPL * InA \\ - InA * Ink_2 - InA * InPC + InA^2)\end{matrix}\right]$$
$$+ \left[\begin{matrix}\beta_{13}(Ink_1 * Ink_3 + Ink_1 * InPR - Ink_1 * InA + InPL * Ink_3 + InPL * InPR - InPL * InA \\ - InA * Ink_3 - InA * InPR + InA^2)\end{matrix}\right]$$
$$+ \frac{1}{2}\left[\beta_{22}(Ink_2^2 + 2Ink_2 * InPC - 2Ink_2 * InA + InPC^2 - 2InA * InPC + InA^2)\right]$$
$$+ \left[\begin{matrix}\beta_{23}(Ink_2 * Ink_3 + Ink_2 * InPR - Ink_2 * InA + InPC * Ink_3 + InPC * InPR - InPC * InA \\ - InA * Ink_3 - InA * InPR + InA^2)\end{matrix}\right]$$
$$+ \frac{1}{2}\left[\beta_{33}(Ink_3^2 + 2Ink_3 * InPR - 2Ink_3 * InA + InPR^2 - 2InA * InPR + InA^2)\right]$$
$$- In\left[1 + \left[\frac{(1-k_1)}{k_1} + \frac{(1-k_2)}{k_2} + \frac{(1-k_1)}{k_3}\right]\right] * \begin{bmatrix}\beta_{11}(Ink_1 + InPL - InA) + \beta_{22}(Ink_2 + InPC - InA) \\ + \beta_{33}(Ink_3 + InPR - InA)\end{bmatrix} \quad (6)$$

Following Lau and Yotopolous (1972), the input demand equations are derived from the profit equation above as follows;

Share Equation for Labour

$$\frac{\partial In\pi}{\partial InPL} = \beta_1 + \beta_{11}(Ink_1 - InA + InPL) + \beta_{12}(Ink_2 - InA + InPC) + \beta_{13}(Ink_3 - InA + InPR)$$
$$- \beta_{11} * In\left[1 + \left[\frac{(1-k_1)}{k_1} + \frac{(1-k_2)}{k_2} + \frac{(1-k_1)}{k_3}\right]\right] \quad (7)$$

Share Equation for Capital

$$\frac{\partial In\pi}{\partial InPC} = \beta_2 + \beta_{22}(Ink_2 - InA + InPC) + \beta_{12}(Ink_1 - InA + InPL) + \beta_{23}(Ink_3 - InA + InPR)$$
$$- \beta_{22} * In\left[1 + \left[\frac{(1-k_1)}{k_1} + \frac{(1-k_2)}{k_2} + \frac{(1-k_1)}{k_3}\right]\right] \quad (8)$$

Share Equation for Raw Material

$$\frac{\partial In\pi}{\partial InPR} = \beta_3 + \beta_{33}(Ink_3 - InA + InPR) + \beta_{13}(Ink_1 - InA + InPL) + \beta_{23}(Ink_2 - InA + InPC)$$
$$- \beta_{33} * In\left[1 + \left[\frac{(1-k_1)}{k_1} + \frac{(1-k_2)}{k_2} + \frac{(1-k_1)}{k_3}\right]\right] \quad (9)$$

The endogenous variables are the actual normalized profits, π_a*, and the demand for the variable inputs; the exogenous variables are the normalized prices of the variable inputs (i.e. *PL, PC, PR*) and the quantity of variable inputs (X_i). The parameters to be estimated consist of those derived from the original translog system (β_0, β_i, β_{ij},). Other parameters to be estimated are the respective group specific efficiency parameters (A and k_i^i). Translog profit frontiers make use of logarithms in the dependent variables and thus do not handle cases of negative or zero unit profits. Yet it is not unreasonable to suppose that some co-operatives in some years lose money. To be able to deal with this problem, a constant scalar is added to the unit profit data in each sample such that unit profit of every co-operative is positive. As long as the cases of negative average co-operative profits are few (say, less than 5 percent), they are proportionately not very negative relative to average co-operative unit profit (so that the scalar is small relative to the mean), the resulting bias from a non-linear transformation of the data is judged to be of minor importance compared to the bias that would arise from using a less appropriate functional form or arbitrarily dropping the least efficient sample members (Battese and Coelli, 1988).

Description of the Data Set

Financial data from 1984 to 2001 were obtained from the Annual Survey of Agribusiness Co-operatives conducted by the Canadian Co-operatives Secretariat (CCS), Government of Canada. The financial data are an unbalanced panel data set consisting of 6085 observations of an average of about 312 supply and marketing co-operatives. The financial data contains information such as the cost of production, wages and salaries, number of full-time employees, volume of sales, costs of goods sold, long-term debt, number of members, assets, liabilities and others. Data for the GDP deflator, Herfindahl Indices, interest rate, raw material price indices and farm input price indices were gathered from Statistics Canada's CANSIM database for the period 1984 to 2001. Prices for chicken and eggs, fruits and vegetables were obtained from Statistics Canada's CANSIM database. The study focused on marketing co-operatives, with emphasis on the supply-managed co-operatives, that is, *poultry and egg* co-operatives). In the dataset for the co-opeartives of interest in this study, there are 9 poultry and egg co-operatives (two were used), 76 fruit and vegetable co-operatives (three were used). The individual co-

operatives used in the estimations are the co-operatives that have a number of observations more than sixteen; (that is, they provided data for more than sixteen years out of the eighteen-year span of the data set). Due to confidentiality reasons, the identity and origin of the co-operatives are not known and therefore they were identified by codes. The variables included in the profit and input demand functions equations were profit, price of inputs, price of output and marginal costs. Prices of capital and labour were input prices for all the co-operatives. For the poultry and eggs co-operatives, the raw material input prices used is the weighted average of the farm prices of chicken and eggs. The output price is the weighted average of the retail prices of chicken and eggs. For the fruit and vegetable co-operatives, the raw material input prices used are the weighted averages of farm prices of fruits and vegetables consumed regularly in Canada. The output price is the weighted average of the retail prices of fruits and vegetables. To maximize the welfare of co-operative members, the welfare maximization objective of co-operatives is assumed to be, to maximize profits plus producer surplus. To be able to achieve this, the conventional profit function should have a producer surplus component. Quantifying producer surplus and determining the functional form it should take proved to be a very difficult task. Therefore for the efficiency estimation, the assumption is made that the co-operative operates in a competitive environment and so maximizes profit like other investor-owned firms do. This assumption is substantiated by the Herfindahl indices which suggest less concentration in the industries in which the co-operatives operate. Thus, The Fruits and Vegetables Co-operative industry, and the Poultry and Eggs industry have average Herfindahl indices of 0.06 each over the period 1984 – 2001 (Statistics Canada, 2001).

Hypothesis Formulation

The hypotheses to be tested for the estimations are as follows. There is equal economic efficiency (i.e. both technical and allocative efficiency), allocative efficiency, absolute allocative efficiency between the co-operatives that are supply regulated (*poultry* and *eggs*) and the co-opeartives that are not supply regulated (*fruits and vegetables*). To be able to test these hypotheses, various restrictions were placed on the equations. Table 1 shows the restrictions that were imposed for the various hypotheses.

Table 1: Test of Hypotheses and the Implied Parameter Restrictions

Hypothesis		Implied Restriction
Equal Efficiency **(EEE)**	Economic	$A^1 = A^2 = A^3$ $k_i^1 = k_i^2 = k_i^3$
Equal Efficiency **(ETE)**	Technical	$A^1 = A^2 = A^3$
Equal Efficiency **(EAE)**	Allocative	$k_i^1 = k_i^2 = k_i^3$
Absolute Efficiency **(AAE)**	Allocative	$k_i^1 = 1, k_i^2 = 1, k_i^3 = 1$

EMPIRICAL RESULTS

Estimates for the separate sub-sector regressions incorporating the restrictions to be tested were obtained for the two groups of co-operatives. Both unrestricted and restricted models were estimated for these two groups. The results of the estimations are presented in Tables 2 and 3. Looking at the estimation results, it is seen that most of the estimates are statistically significant at the 1% level of significance. The own price effects of most of the inputs had the expected negative sign and were significant. That is, as the input price increases, the quantity of input demanded and the profit of the co-operative decreases. Time trend was seen to have negative effect on profit across the two sub-sectors. This means that the profits of these co-operatives have been decreasing over time. For the poultry and eggs co-operatives, there were insignificant coefficients on the technical efficiency term. These were, however, labour and capital efficient with one of them being inefficient with raw material use. Two fruits and vegetable co-operatives were technically efficient, but on the whole, the fruits and vegetables co-operatives were allocatively inefficient.

The empirical results of the efficiency terms in Tables 2 and 3, suggest that both supply-managed and non supply-managed co-operatives are relatively technically inefficient. The results indicate that supply-managed co-operatives and the non supply-managed co-operatives have insignificant coefficients on their efficiency terms; they are not efficient. It may be concluded that supply management may not increase or improve the efficiency of co-operatives. Both supply-managed co-operatives and the non supply-managed co-operatives are not maximizing profits. This finding is somewhat consistent with the conclusion of Porter and Scully (1987) that non co-operatives firms were about 30% more economically efficient than co-operatives. What are some of the possible causes of these inefficiencies? These may potentially be explained by the existence of X-inefficiency, which in turn may be the result of bad management practices and distorted motivations (i.e. the principal-agent dilemma). Porter and Scully (1987) concluded from their studies that the source of co-operative inefficiency is not allocative inefficiencies, but rather caused by inherent weakeness in the structure of property rights within co-operatives. These results have implications for consumer. Thus, consumers may also be affected by inefficiency costs being transferred to them in the form of higher prices. The issue of inefficiencies in the regulated sub-sectors and the non-regulated sub-sectors therefore needs to be addressed for the benefit of producers and consumers alike.

Results of Hypothesis Testing

Four different restrictions were imposed on the unrestricted models to ascertain whether the individual co-operatives in the group had equal efficiency. The restrictions imposed were equal economic efficiency, equal technical efficiency, equal allocative efficiency and absolute allocative efficiency. The likelihood ratio test was used for testing the imposed restrictions. The results are prersented in Tables 4 to 5.

Table 2: Parameter Estimates of Unrestricted and Restricted Models for Poultry and Eggs Co-operatives

	Unrestricted Model	Restricted Model			
Param	UR	EEE	ETE	EAE	AAE
A^{11}	-2.87			9.41	12.91***
	(4.63)			(7.99)	(1.38)
k_l^{11}	7.23**		1.11		
	(3.56)		(1.16)		
k_c^{11}	0.12**		0.14		
	(0.05)		(0.48)		
k_r^{11}	-6.35*		0.68		
	(3.67)		(0.59)		
A^{12}	3.72	-2.92	-8.49	10.21	12.40***
	(13.64)	(38.12)	(15.77)	(7.89)	(1.08)
k_l^{12}	4.67**	9.15***	1.60	-0.32	
	(2.27)	(3.08)	(1.81)	(4.44)	
k_c^{12}	0.28*	0.18**	0.21**	1.34	
	(0.15)	(0.12)	(0.08)	(4.42)	
k_r^{12}	3.95*	8.33*	1.42	1.02	
	(2.09)	(2.2)	(1.05)	(1.10)	
b_{pl}	-1.64***	-2.15***	-0.22	-4.41*	-0.69**
	(0.62)	(0.71)	(1.07)	(2.25)	(0.31)
b_{pc}	-0.34***	-0.34***	-0.35**	-0.38**	0.16
	(0.10)	(0.10)	(0.15)	(0.16)	(0.12)
b_{pm}	-1.98	-2.45**	-0.11	-1.04*	-0.36**
	(1.68)	(1.15)	(0.10)	(0.56)	(0.16)
b_{plpl}	-0.28***	-0.18***	-0.29***	-0.08	-0.24***
	(0.05)	(0.04)	(0.07)	(0.05)	(0.05)
b_{plpc}	0.07	0.04***	0.02	0.04***	-0.20***
	(0.05)	(0.01)	(0.06)	(0.01)	(0.003)
b_{plpm}	0.21	0.18*	0.13**	0.12	0.05*
	(0.36)	(0.10)	(0.06)	(0.10)	(0.03)
b_{pcpc}	-0.03**	0.01	-0.04**	-0.02*	-0.05**
	(0.04)	(0.007)	(0.02)	(0.01)	(0.02)
b_{pcpm}	-0.11	-0.05	0.26**	0.24**	0.13
	(0.13)	(0.04)	(0.12)	(0.11)	(0.14)
b_{pmpm}	-0.10*	-0.09*	-0.43**	-0.15**	-0.19*
	(0.06)	(0.05)	(0.21)	(0.07)	(0.11)
Time	-0.02***	-0.10***	-0.01	-0.14***	-0.18***
trend	(0.008)	(0.01)	(0.02)	(0.03)	(0.06)
LLR	-1408.47	-1413.26	-1447.22	-1427.13	-1452.13

Table 3: Parameter Estimates of Unrestricted and Restricted Models for Fruits and Vegetables Co-operatives

	Unrestricted Model	Restricted Model			
Param	UR	EEE	ETE	EAE	AAE
A^{13}	31.26***			1.39	33.76***
	(9.26)			(10.42)	(2.26)
k_l^{13}	-2.18***		1.54***		
	(0.71)		(0.29)		
k_c^{13}	0.47***		-0.28		
	(0.20)		(1.33)		
k_r^{13}	2.71		1.04**		
	(1.98)		(0.54)		
A^{14}	10.02			1.39	17.82***
	(105.39)			(10.40)	(1.17)
k_l^{14}	0.23***		-9.29***		
	(0.07)		(3.33)		
k_c^{14}	-1.61**		-4.59***		
	(0.67)		(1.30)		
k_r^{14}	2.38		-2.76***		
	(2.31)		(0.78)		
A^{15}	18.73***	8.50	-3.45***	1.38	21.73***
	(6.17)	(10.27)	(0.42)	(10.38)	(1.35)
k_l^{15}	-5.49	0.03***	2.93**	-4.30	
	(5.55)	(0.001)	(1.24)	(3.40)	
k_c^{15}	2.37	2.06	-3.06***	-3.27	
	(4.79)	(3.70)	(0.40)	(2.67)	
k_r^{15}	4.12**	-0.03	1.39	-0.003	
	(1.89)	(10.34)	(1.15)	(0.002)	
b_{pl}	-0.61***	-2.07*	-0.70**	-2.24	-1.38***
	(0.15)	(1.14)	(0.34)	(1.82)	(0.09)
b_{pc}	-1.39***	-0.34**	-1.75***	-0.33**	-0.34**
	(0.39)	(0.15)	(0.16)	(0.16)	(0.12)
b_{pm}	-2.05*	-2.41**	-0.95*	-0.45**	-0.60**
	(1.23)	(1.22)	(0.41)	(0.22)	(0.30)
b_{plpl}	-0.32*	-0.12***	-0.12***	-1.16***	-0.05***
	(0.18)	(0.05)	(0.002)	(0.12)	(0.008)
b_{plpc}	-0.38***	-0.21***	-0.24***	-0.34***	-0.24***
	(0.09)	(0.06)	(0.02)	(0.09)	(0.02)
b_{plpm}	0.70	0.09**	-0.10**	0.06**	-0.15*
	(0.36)	(0.04)	(0.05)	(0.03)	(0.08)
b_{pcpc}	-0.47***	0.17***	-0.20***	-1.52***	-0.06***
	(0.17)	(0.06)	(0.02)	(0.07)	(0.01)
b_{pcpm}	0.85*	-0.38	0.45	0.57**	0.42**
	(0.45)	(0.20)	(0.36)	(0.20)	(0.20)
b_{pmpm}	-1.55**	-0.47***	-0.16*	-0.89**	-0.81**
	(0.78)	(0.13)	(0.10)	(0.36)	(0.39)
Time	-0.13***	-0.15***	0.38***	-0.07***	0.06***
trend	(0.01)	(0.01)	(0.01)	(0.01)	(0.002)
LLR	-1941.70	-1950.03	-1957.00	-1964.14	-1973.12

Table 4: Hypothesis Testing Results for Poultry and Eggs Co-operatives

Hypothesis	Restriction	Log. Likelihood	X^2			Decision
			Cal.	Critical		
				5%	1%	
UR		-1408.47				
EEE	4	-1413.26	9.58	9.49	13.28	Reject at 5%
ETE	1	-1447.22	77.50	3.84	6.64	Reject H_0
EAE	3	-1427.13	37.32	7.82	11.35	Reject H_0
AAE	3	-1452.13	50.00	7.82	11.35	Reject H_0

Critical = the critical values from the chi-square distribution table

Table 5: Hypothesis Testing Results for Fruits and Vegetables Co-operatives

Hypothesis	Restriction	Log. Likelihood	X^2			Decision
			Cal.	Critical		
				5%	1%	
UR		-1941.70				
EEE	4	-1950.03	16.66	9.49	13.28	Reject H_0
ETE	1	-1957.00	30.60	3.84	6.64	Reject H_0
EAE	3	-1964.14	44.88	7.82	11.35	Reject H_0
AAE	3	-1973.12	17.96	7.82	11.35	Reject H_0

Critical = the critical values from the chi-square distribution table

The results obtained from the tests in Tables 4 to 5 showed that on the whole, the hypothesis that there is equal economic efficiency among the individual co-operatives is rejected. This implies that the co-operatives do not have equal economic efficiency; each co-operative has its own level of efficiency. This result also suggests that the co-operatives may be operating with different kinds of technologies within the same sub-sector and across various sub-sectors. Equal and absolute allocative efficiency were also tested and the results showed that the hypotheses of equal or absolute efficiency are rejected for the two groups of co-operatives. This means that the allocative efficiency of these co-operatives are not equal, and neither are they absolute. The elasticities of the regulated co-operative were less elastic as compared to those for the non-regulated co-operative. The regulated co-operatives did not exhibit any undue advantage over the non-regulated co-operatives that might be attributed to supply management. Hypotheses testing for equal economic efficiency, technical efficiency and allocative efficiency were all rejected for supply-managed and non-supply managed co-operatives alike.

Conclusions

In this study, we examine the efficiency of regulated (*poultry* and *eggs)* and non-regulated (*fruits and vegetables*) Agricultural Marketing Co-operatives using profit estimations. Time series data that spans from 1984 – 2001 was obtained from various institutions in Canada for the analysis. A Translog production function was specified and the analysis was carried across then above mentioned Agricultural Marketing Co-operatives. The empirical results reveal that, in general, the co-operatives do not have equal economic efficiency; each co-operative has its own level of efficiency. This result also suggests that the co-operatives may be operating with different kinds of technologies within the same sub-sector and across various sub-sectors.

The elasticities of the regulated co-operatives were less elastic as compared to those for the non-regulated co-operatives. The regulated co-operatives did not exhibit any undue advantage over the non-regulated co-operatives that might be attributed to supply management. Hypotheses testing for equal economic efficiency, technical efficiency and allocative efficiency were all rejected for supply-managed and non-supply managed co-operatives alike. Supply-managed co-operatives are not performing any better than the non supply-managed co-operatives. These results have some policy implications for the management of Agricultural Marketing Co-opeartives.

Non supply-managed co-operatives have also been found to be inefficient like the supply-managed co-operatives. There is an issue of inefficiencies in the operation of co-operatives: supply-managed and non supply-managed co-operative alike. Attaining economic efficiency in supply-managed sub-sectors may be difficult due to the rigid nature in which provincial quota is allocated. The quota allocated to provinces is fairly fixed which does not take into consideration growth in provinces. Co-operative managers should be educated on efficiency measures that they can practice to make the co-operatives more efficient and be able to maximize profits. Supply-managed co-operatives may have to be more concerned about improving efficiency since it is seen from the simulation results that increased efficiency results in a significant increase in the profit of co-operatives in the supply-managed sub-sectors. These results have implications for consumer. Thus, consumers may also be affected by inefficiency costs being transferred to them in the form of higher prices. The issue of inefficiencies in the regulated sectors and the non-regulated sectors therefore needs to be addressed for the benefit of producers and consumers alike.

While the above conclusions are justified on the basis of rigorous theoretical and empirical techniques, the study possesses a few limitations. The estimations carried out in this study were carried out on individual co-operative level. However, due to lack of sufficient data for most individual co-operatives, the co-operatives with less sufficient data points were left out of the estimation, thus reducing the number of co-operatives estimated. The geographical locations, for instance, of these co-operatives are not known and therefore much could not be said about their behaviours relative to where they are located in the country.

In light of the above limitations, a number of potentially fruitful areas of future research are proposed. Since this study carried out estimations on individual co-operative level, it may be helpful to carry out analysis of the various sectors as a whole in future research for comparison. Also, with regards to the efficiency estimation, future work can be done to determine the reason why the co-operatives are inefficient and find solutions to eradicate or reduce these inefficiencies.

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