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AN EXAMINATION OF THE LEVEL OF EFFICIENCY IN THE CANADIAN EGG INDUSTRY: THE CASE OF ONTARIO

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AN EXAMINATION OF THE LEVEL OF EFFICIENCY

IN THE CANADIAN EGG INDUSTRY:

THE CASE OF ONTARIO

BY

PATRICIA AGNES COWPER

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ABSTRACT

In 1973, the Canadian Egg Marketing Agency was formed under the National Farm Products Marketing Agencies Act (NFPMAA), and the agency introduced a national supply management program in the Canadian egg industry. Economic theory suggests that supply management may affect one concern of the NFPMAA, the level of efficiency in the industry.

There does not appear to have been any examination of the level of efficiency in the industry before and after regulation was introduced. In this study, an attempt was made to appraise technical efficiency in the Canadian egg industry since the introduction of the supply management program. On the basis of a budget model, Canadian production costs were compared before and after 1973 with those of a benchmark for efficient egg production, which was constructed for this study.

The results of the analysis suggest that the distribution of farm sizes in the Canadian egg industry has remained relatively stable since 1973 as a result of quota restrictions and the adequate returns available through the pricing formula. Consequently, the degree to which economies of scale are achieved has not improved visibly under supply management. In addition, since 1973 the use

of labour, investment and miscellaneous inputs has increased relative to the competitive benchmark. The apparent decrease in relative efficiency of input use is not inconsistent with the theoretical effects of supply management, through pricing and quota regulations.

Further study regarding the input markets and more detailed data concerning input use in the egg industries in Canada and in the benchmark area are necessary before firm conclusions may be made.

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CHAPTER I

INTRODUCTION

Background

Prior to the mid 1960's, the Canadian egg industry was not regulated, and egg prices were determined by the forces of supply and demand. There existed a large number of independent producers, each supplying a very small proportion of aggregate demand. A combination of seasonal variations in supply and demand, a lag in production response with respect to price changes and a demand curve which is relatively inelastic to price historically caused wide fluctuations in egg prices[1] (see Figure 1). The price fluctuations resulted in income instability in the egg industry. Improvements in technology which allowed production cost reductions, particularly in large scale operations, an increase in vertical integration in the industry and a growing concentration in retail markets resulted in a trend towards more specialization, larger operations and an increase in the exit rate of small producers.[2] During the 1960's, producers formed provincial

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[1] M. K. Loh, The Price Structure of the Shell-Egg Market in Ontario (Toronto: Parliament Buildings, Ontario Ministry of Agriculture and Food, Economics Branch, May 1973), pp. 9-11.

[2] Ibid., p. 2.

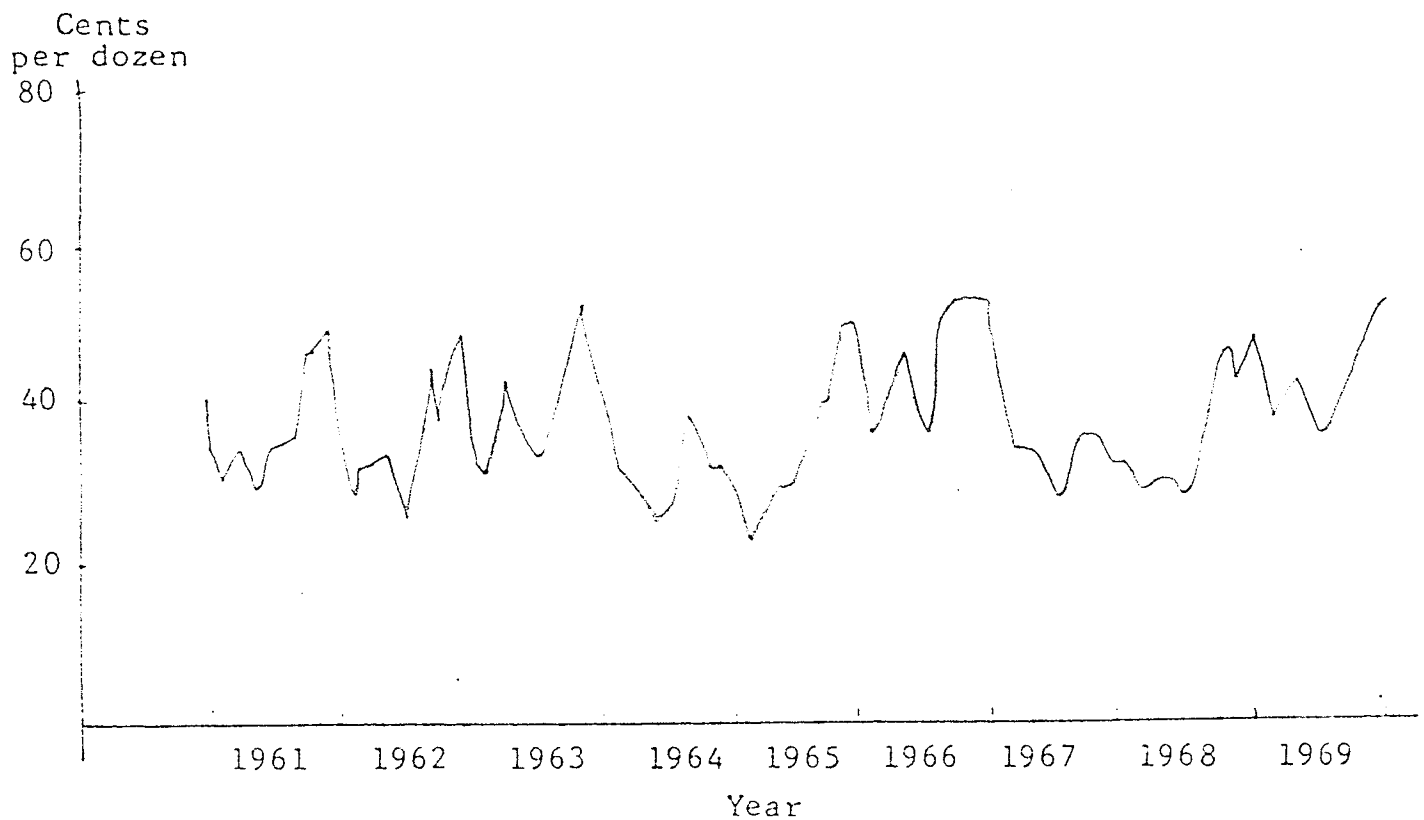

FIGURE 1: Egg Prices in Ontario Before Regulation (Grade A Large to producers at registered grading stations).

SOURCE: CDA, Poultry Market Review, Canada Department of Agriculture, "Poultry Market Review," 1961-1969.

marketing boards, stating their goals to be the preservation of existing farms, and price and income stabilization. The activities of the egg marketing boards, since their establishment, suggest that the raising of net returns was also a major goal.

Provincial marketing board attempts to stabilize provincial egg prices were unsuccessful due to the interprovincial movement of eggs and a periodic lack of coordination of provincial board policies. In 1970, the federal Minister of Agriculture, Mr. Olsen, stressed the producer desire for a "national approach to...marketing schemes, because of the limited effectiveness of segmented and uncoordinated provincial schemes."[3] He added that there was "good reason to provide for national leadership in this area having regard for the interests of the economy and the efficient use of resources devoted to agriculture in the various regions of Canada."[4]

As a result of producer pressure, the Farm Products Marketing Agencies Act (FPMAA) was passed in 1972, authorizing the establishment of national marketing agencies for

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[3]Canada, House of Commons Debates, Farm Products Marketing Agencies Bill, April 14, 1970, p. 5870.

[4]Canada, House of Commons Debates, Farm Products Marketing Agencies Bill, April 14, 1970, p. 5871.

farm products.[5] In 1973, the Canadian Egg Marketing Agency (CEMA) was established under the new act.[6]

The FPMAA requires that marketing agencies established under it must promote competition and efficiency. Specifically, agencies must "promote a strong, efficient and competitive production and marketing industry for the regulated product," and have "due regard to the interests of producers and consumers of the regulated product."[7] The Federal-Provincial Agreement regarding the marketing of eggs states that CEMA's pricing policy must not interfere with interprovincial trade,[8] and must "flexibly provide for orderly management of the market in light of current demand and supply conditions of the market, of import competition and of export opportunities."[9]

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[5]Canada, House of Commons, Farm Products Marketing Agencies Act, Chapter 65, January 12, 1972.

[6]Canada, Federal-Provincial Agreement, Comprehensive Marketing Program, Eggs, Schedule "C", October 1972.

[7]Canada, House of Commons, Farm Products Marketing Agencies Act, Chapter 65, January 12, 1972, p. 2055.

[8]Canada, Federal-Provincial Agreement, Comprehensive Marketing Program, Eggs, Schedule "A", 1972, p. 4.

[9]Canada, Federal-Provincial Agreement, Comprehensive Marketing Program, Eggs, Schedule "C", October 1972, p. 5.

According to economic theory, the fulfillment of the FPMAA stipulations quoted above will result in pricing efficiency, which results in the earning of normal returns on investment and in the efficient allocation of resources among products, technical efficiency, which implies that maximum output is produced given the available inputs and technology, and finally locational efficiency, which implies that the costs of obtaining inputs and distributing the final product[10] are minimized.[11]

The FPMAA allows a wide variety of programs and regulations to be adopted. The egg agency operates a supply management program. Under this program, prices are set according to a formula based on estimated average costs of production, and supply is controlled through quota regulations and import controls. The strict control of supply enables the established prices, which are intended to generate a 'reasonable' rate of return for producers, to be maintained.

The success of CEMA in achieving the short run producer goals of more stable and higher prices may be seen through an examination of farm gate price trends

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[10]The marketing costs which are added to farm-gate costs in determining the retail price are not discussed in this study.

[11]F. M. Scherer, Industrial Market Structure and Economic Performance (Chicago: Rand McNally and Co., 1973), pp. 12-15, pp. 400-411.

shown in Figure 2.[12] Before strict supply control was adopted by CEMA in mid-1975, prices fluctuated widely. In 1970, there was considerable expansion in the industry as producers anticipated high returns under the proposed national marketing plan, and increased production facilities in order to qualify for larger quotas.[13] As a result, production rose and prices fell. In 1973, the national egg marketing agency was established and the introduction of a cost of production pricing formula, together with rising feed costs, caused prices to rise.[14] Prices fell again in 1974, when U.S. prices followed their seasonal pattern and fell much below Canadian prices, resulting in an increase in imports into Canada.[15] The price fluctuations were dampened in mid-1975 when permanent import controls were added to quota regulations, effecting the supply

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[12] For a dissenting opinion regarding the degree of price stability achieved, see L. J. Martin and T. K. Warley, "The Role of Marketing Boards," Canadian Journal of Agricultural Economics, Proceedings (August 1978), pp. 878-883.

[13] M. M. Veeman and R. M. A. Loyns, "Agricultural Marketing Boards in Canada," 1977. (Mimeographed).

[14] Food Prices Review Board, Report on Egg Prices (Ottawa: Food Prices Review Board, January 1974), p. 23

[15] Food Prices Review Board, Report on Egg Prices II (Ottawa: Food Prices Review Board, August 1974), p. 25.

FIGURE 2: Egg Prices in Ontario Before and After Regulation (Grade A Large to producers at registered grading stations).

SOURCE: CDA, Poultry Market Review, Canada Department of Agriculture, "Poultry Market Review," 1961-1969.

control necessary to maintain a formula price.[16] Farm-gate prices have remained at a relatively high, stable level since that time.[17]

While the immediate objectives of producers have been achieved, the long run effects of the supply management program on efficiency, one economic goal stipulated in the FPMAA, are not clear. Economic theory suggests that technical, pricing and locational efficiency in the egg industry may have been affected by supply management.[18] For example, the CEMA pricing formula is based on a 48,000 bird operation, which has been judged too small to take advantage of all economies of scale.[19] As a result, producers operating at this size receive adequate returns not available in the long run under competition, excess profits may be earned by producers operating farms of a more efficient size, and the incentive to minimize costs among these relatively large producers may be lessened. In addition, the adoption of a quota policy by CEMA which

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[16] P. S. Ross & Partners, An Examination of Egg Production Costs in Canada (Ottawa: P. S. Ross & Partners, January 1975), p. 10.

[17] Producer income may still vary with changes in producer levies.

[18] For a detailed discussion of supporting theory, see below, Chapter 3.

[19] P. S. Ross & Partners, op. cit., p. 28.

restricts the level of production and prevents producers from expanding according to efficiency criteria effectively freezes the existing distribution of farm sizes. As a result, one source of increased efficiency over time, the achievement of economies of scale through the expansion of operations, is removed. Consequently, the level of efficiency may fall over time relative to that in a competitive industry.

Review of Related Studies

The Food Prices Review Board's Report on Egg Prices,[20] January 1974, and Report on Egg Prices II,[21] August 1974, provide background information regarding the egg industry in Canada. Demand characteristics, industry structure, price trends, production costs and pricing formulas are examined in these reports with particular emphasis on the early policies of CEMA during the period 1973-1974. Comparisons of U.S. and Canadian egg consumption patterns and price trends are also made. The reports discuss the problems encountered in the application of the national pricing formula, and suggest policy and program modifications. However, while the actual industry

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[20] Food Prices Review Board, Report on Egg Prices, op. cit.

[21] Food Prices Review Board, Report on Egg Prices II, op. cit.

problems are discussed and absolute monetary losses caused by the program estimated, the level of efficiency in the industry is not evaluated relative to that existing in a competitive industry.

The P. S. Ross & Partners Report to the Canadian Egg Marketing Agency,[22] January 1975, examines the egg production costs in Canada. The methodologies used in the study and production cost data, classified by flock size and region, are included. The P. S. Ross & Partners study Provincial Models of the Farm Gate Cost of Egg Production for Medium Size Producers[23] develops independent provincial production cost estimates for medium size producers. The model design and components are described and methods for maintaining the model are recommended. The 1977 P. S. Ross & Partners Update[24] outlines recent modifications in the model. These reports provide production cost data as required by the framework of the model. No attempt is made to assess the relative efficiency of the Canadian egg

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[22] P. S. Ross & Partners, op. cit.

[23] P. S. Ross & Partners, Provincial Models of the Farm-Gate Cost of Egg Production for Medium-Size Producers (Ottawa: P. S. Ross & Partners, July 1975).

[24] P. S. Ross & Partners, 1977 Update of the Provincial Models of the Farm-Gate Cost of Egg Production for Medium-Size Egg Producers (Ottawa: P. S. Ross & Partners, July 1977).

industry before and after the supply management program was introduced.

Material presented before the National Farm Products Marketing Council Hearings in 1976, regarding the CEMA pricing formula, describes the findings and experiences of egg producers, egg marketing boards, and consumers. No formal analysis of the level of efficiency in the industry was presented at the Hearings, however the material includes cost data and discussions of industry problems, and contributes to background information concerning the industry.

Problem Statement

Background information and preliminary theoretical observations suggest that the supply management program currently in operation in the Canadian egg industry may not be satisfying the FPMAA's economic objective of promoting an efficient egg industry in Canada. None of the studies reviewed generate information on which to base an evaluation of the Canadian egg industry with respect to the efficiency requirement of the FPMAA. Consequently, the level of efficiency in the industry is examined in this study. While pricing, technical and locational efficiencies are discussed in a theoretical context, because of time constraints the analysis has been confined to technical efficiency.

Objectives

In light of the hypothesis that the supply management program administered by CEMA may not promote efficiency in the Canadian egg industry, the objectives of this study were:

1. To determine the extent to which the FPMAA goal of technical efficiency has been achieved by CEMA by means of a comparison of Canadian production costs, both before and after the supply management program was introduced, with costs in an area considered to be efficient.
2. To determine, where possible, the specific sources of any differences found between costs in Canada and in the efficient area during the period examined, whether the sources are exogeneous (due to input prices, climate, etc.) or technical (arising from production techniques).

CHAPTER II

METHODOLOGY

The primary objective of this study was to determine whether the supply management program introduced in the Canadian egg industry in 1973 has had an impact on one concern of the FPMAA, the level of technical efficiency in the industry.[25] The level of technical efficiency was evaluated by means of a comparison of Canadian farm-gate production costs with the farm-gate production costs in an area which is considered to be efficient. The comparison was made both before and after supply management was introduced in Canada, with the pre-regulation comparison serving as a control comparison. Costs in the post regulation period were deflated by input price indexes in order to isolate the changes in costs over time which were due to either changes in the relative technologies used in the two areas, or to the operation of the supply management program.

The characteristics of the input markets over time were not examined in either area. To the extent that the

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[25]In this study, technical efficiency is defined as the degree to which costs are minimized, through scale economies and the use of available technologies and management skills, relative to the degree of cost minimization in an area considered to be efficient.

viable technologies in the two areas have not remained constant during the period being examined, it is not possible to conclude that changes in costs between the two areas over time not attributable to input prices were caused by the supply management program. Rather, the supply management program may be considered as one possible cause of any change in deflated costs found. Instances where several factors must be considered as possible sources of changes in costs are noted in the analysis.

In addition to the comparison of farm-gate production costs, the distribution of farm sizes over time in Canada was compared with that in an area considered to be efficient in order to determine whether the supply management program has affected farm size trends in Canada. Again, to the extent that the viable technologies have changed over time in the two areas relative to one another, the conclusion that any change in farm size trends is due to the regulation introduced in Canada must be qualified.

Selection of Areas to be Examined

The production cost data used to represent technically efficient egg production were taken from a competitive egg industry, since according to economic theory, costs are minimized under competition.[26] The criteria used for choosing an area which is to serve as an efficient

[26] See below, Related Theory, Chapter 3.

benchmark include an unregulated pricing system, and a competitive environment on both the demand side and the supply side of the market.

The state of California was chosen as the general area from which benchmark data would be collected, since prices in this area have historically cleared the market.[27] In other areas of the U.S., as a result of the decrease in the volume of eggs traded in terminal markets, prices established through exchange trading often have not followed actual changes in supply and demand.[28] Within California, San Diego county was selected as the source of benchmark data. San Diego county was first considered because detailed production cost data were available for the area. The assumption that the supply side of the San Diego county egg market is competitive is based on the fact that in the last ten years the number of egg producers declined from 500 to 75. This trend may be attributed to the exit of small producers and the expansion of large operations.[29] On the demand side, there are

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[27] U.S.D.A., Economic Research Service, Pricing Systems for Eggs, Marketing Research Report No. 850 (Washington, D.C.: U.S. Government Printing Office, 1969), p. 13.

[28] Ibid., pp. 4-13.

[29] Personal communication on August 2, 1979 with Robert Adolph, Farm Advisor, Cooperative Extension Service, University of California, San Diego, California.

approximately six buyers of eggs in the three counties in southern California, including San Diego county.[30] The degree of price competition in the area is determined by the extent to which interstate trade limits the scope for price manipulation. Imports may enter from the southern states, which supply approximately 40 percent of the eggs in the U.S., and eggs are presently exported from San Diego county to Arizona and Colorado.[31]

Canadian production cost data are based on egg operations in Ontario. It was assumed that any significant impact of the supply management program on egg production costs would be reflected in Ontario data, since Ontario is the leading egg producer in Canada. The province produced an average of 181.5 million dozen eggs, or 38.4 percent of Canadian production annually, between 1967 and 1971.[32]

Data Selection

Secondary data were collected from sources in Ontario and San Diego county as time constraints precluded the collection of primary data. Cost data for all inputs

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[30] Ibid.

[31] Ibid.

[32] Loh, op. cit., p. 3.

used in producing eggs up to the farm-gate level were collected and organized in budget format.[33]

Production cost figures for the control comparison were taken from the year 1971, as 1972 data in San Diego county were affected by an outbreak of Newcastle disease.[34] However, it has been estimated that in 1971 excess capacity existed in the Ontario egg industry as a result of producer expansion in anticipation of higher returns under the proposed national marketing program.[35] As a result, excess capital investment must be considered in the analysis of any changes in investment costs in Ontario since 1971.

Production cost data from the years 1975 to 1978 inclusive, were used for the comparison of Ontario and San Diego county production costs in the post-regulation period.

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[33]Similar technologies are used in egg production in San Diego county and in Ontario. The assumption that differences in disease problems in Ontario and in San Diego county are not great enough to invalidate the comparison is based on a personal communication with D. L. Campbell, Department of Animal Science, University of Manitoba, Winnipeg.

[34]U.S.D.A., Economic Research Service, Selected Topics Related to the Poultry and Egg Industries, ERS-664 (Washington, D.C.: U.S. Government Printing Office, 1977), p. 26.

[35]M. M. Veeman and R. M. A. Loyns, op. cit.

It was not possible to compare farms of the same size in the two areas being considered, and thereby remove the effects of scale on production costs, for the following reasons. San Diego county data were taken from cost studies of eleven to eighteen farms in San Diego county. The average size of these farms is greater than the average operation size in Ontario, and data based on farms larger than the average size of operation in Ontario were not available. At the same time, data from only the smaller farms studied in San Diego county would not provide a reliable base for an efficient benchmark, since economic theory suggests that in a competitive industry, a producer who fails to maintain an operation of at least the average size in the long run has objectives other than to minimize costs.

In consideration of these problems, San Diego county data were taken from the average data of all farms studied in the county. The farms studied varied from year to year, but in all cases were specialized egg producing operations. It was assumed that the monthly cost data provided by the contributing farms are based on efficient production techniques, and that any uncompetitive production practices of relatively small producers would not distort the average data significantly.

The San Diego county flock sizes range from 10,000 to 150,000 birds (average 47,000) in 1971 to 20,000 to

200,000 (average 79,000) in 1978. Ontario data are based on the production costs in a 20,000 bird operation, the average and predominant size of operation in the 10,000 to 50,000 bird operation category. Producers in this category supply approximately 50 percent of Canadian egg production and are representative of commercial egg producers in Ontario.[36]

The analysis was carried out on the basis of changes in differences in costs between farms in two areas. It was explained above that since conditions in input markets and therefore in viable technologies, are variable over time, changes in input markets as well as in the structure of the market being examined must be considered as possible sources of changes in the relative deflated production costs between the two areas over time. Due to the variable farm size in San Diego county data, economies of scale must be added as another possible source of changes in relative production costs. Given the data used in this analysis, it is not possible to determine the exact contribution of each possible factor affecting the level of technical efficiency.

A comparison of farm size distributions over time in San Diego county and Ontario was made using the available

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[36] P. S. Ross & Partners, July 1975, op. cit., p. 12.

data. While information was insufficient to warrant a detailed examination, hypotheses were formed on the basis of trends which appeared.

The basic steps, explained above, which have been followed in carrying out this study are shown in Figure 3 below.

FIGURE 3: Methodology

A	B
1. Design budget model. 2. Select cost data (areas, years, and operation sizes). 3. Fit data to model. 4. Estimate the production costs for the two areas and appropriate years. 5. Find the difference in costs between the two areas for each component in each year. Examine any trends or significant changes in relative input use or input prices. 6. Remove from the differences in costs between the base year and other years for each area the proportion caused by changing input prices. The result is the change in costs for each area not caused by input prices. 7. Find the difference in the values calculated in (6) between the two areas for each year. 8. Determine which components in the budget indicate major differences in (7). Attempt to isolate sources of changes in differences in costs not caused by input prices.	1. Assemble data for each area concerning size distributions over time. 2. Determine if there are any trends in size distribution in the two areas. 3. Examine any changes and/or differences in the trends and discuss factors in each area which might affect present and future trends.
↓	↓
If possible, conclude whether there has been a significant change in cost differences between the two areas since regulation was introduced in Canada.	Hypothesize regarding the future size trends in each area.

Conclude whether costs in Ontario, due to management and scale effects, have changed relative to costs in California since the introduction of the CEMA supply management program.

CHAPTER III

RELATED THEORY

The theoretical concepts upon which the analysis in this study is based were taken from the theory of production and cost, and the theory of the firm. Possible sources of differences in egg production costs between Ontario and San Diego county during the period examined emerge from the theoretical discussion.

Production Theory

Fixed and variable inputs are required to produce a particular good. Fixed inputs, which are not immediately variable, include buildings, major equipment and land, while variable inputs, which may be varied in use immediately with changes in market conditions, include raw and processed materials such as feed and some types of labour. The maximum output attainable from a given set of inputs is indicated by the production function.[37]

Given the law of diminishing returns, if the use of one variable input is increased while the use of all other inputs is held constant, total output will increase at an increasing rate, increase at a constant rate and eventually

[37] C. E. Ferguson, Microeconomic Theory (Homewood, Illinois: Richard D. Irwin, Inc., 1972), p. 134.

decrease. As illustrated in Figure 4, the assumption of diminishing returns implies that maximum physical output is producted at the point where the marginal product of an input equals zero.[38]

A production isoquant indicates the various quantities of two inputs which may be combined in order to produce a certain level of output. These isoquants are derived from the production surface. The slope of an isoquant represents the marginal rate of technical substitution of one input for another. The area of economical production lies inside the points on each isoquant where the marginal rate of technical substitution becomes positive; at this point more of one input is required to maintain production as additional amounts of another input are used, and consequently the cost of production rises.[39] The economical production area in input space is shown in Figure 5.

The optimal combination of inputs within the economical production area is determined by the ratio of input prices. The ratio of input prices is represented by the isocost curve, which indicates the various quantities of inputs which may be purchased given a certain budget and

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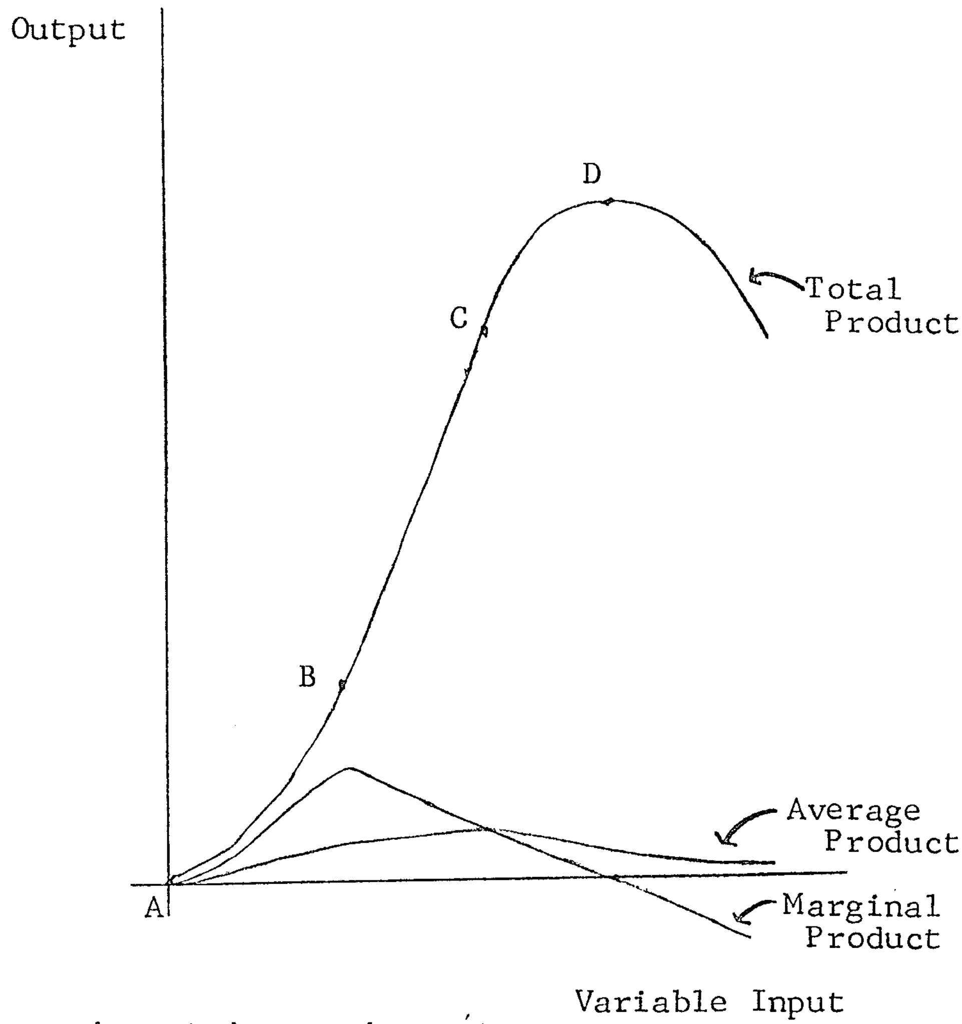
[38] Ibid., p. 150.

[39] J. M. Henderson and R. E. Quandt, Microeconomic Theory: A Mathematical Approach (New York: McGraw-Hill Book Co., 1971), p. 60.



AB - increasing at increasing rate

BD - increasing at decreasing rate

C - increasing at constant rate

D→ - decreasing

FIGURE 4: Diminishing Returns.

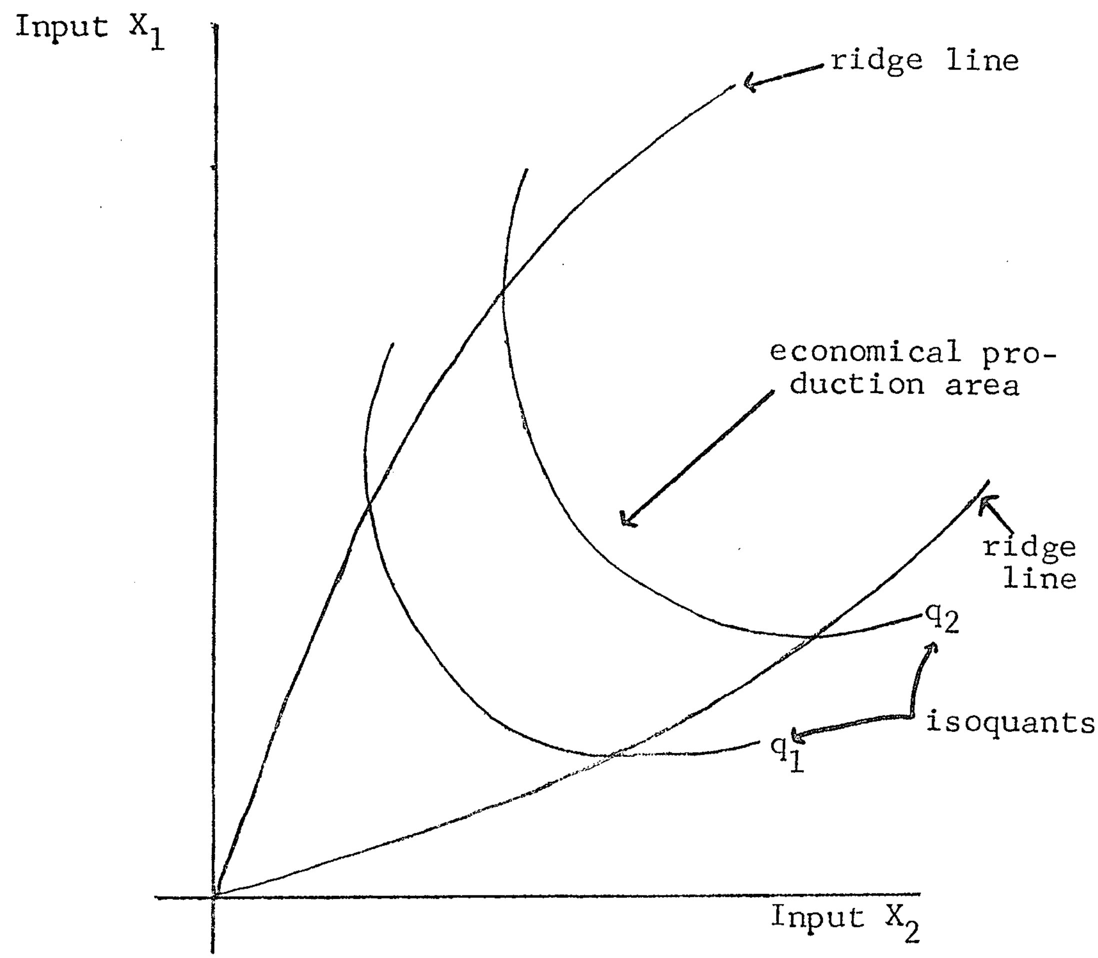


FIGURE 5: Economical Production Area in Input Space.

input prices. The shape of the isocost curve is determined by the competitiveness of the input market. In a perfectly competitive input market, prices do not vary with the volume of purchase, while an imperfectly competitive market results in prices which are a function of the volume purchased.[40] Figure 6 shows the maximum output attainable given a certain budget, in the case of a perfectly competitive input market.

If factor prices are held constant, and total expenditure is increased, the isocost curve moves away from the origin. The series of tangency points between the isocosts and the isoquants represents the expansion path of a firm. A straight expansion path implies constant returns to scale.[41] A hypothetical expansion path is shown in Figure 7.

Given a change in the factor price ratio, the input use ratio must be adjusted accordingly if optimal production is to be maintained. Because of indivisibility of inputs, inadequate information and lags in production response, instantaneous adjustment in input proportions

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[40] Sune Carlson, A Study on the Pure Theory of Production (New York: Sentry Press, 1974), p. 40.

[41] Ferguson, op. cit., p. 195.

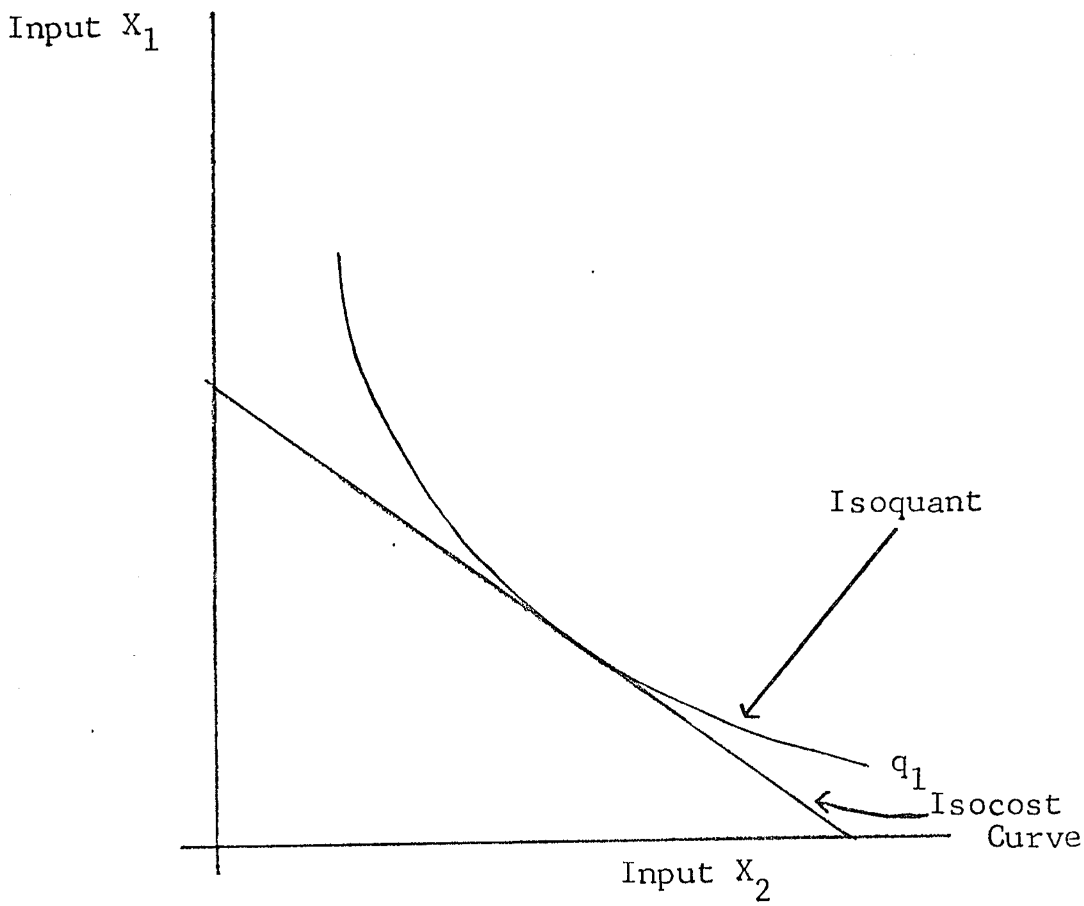

FIGURE 6: Isocost and Isoquant Curves in a Perfect Market.

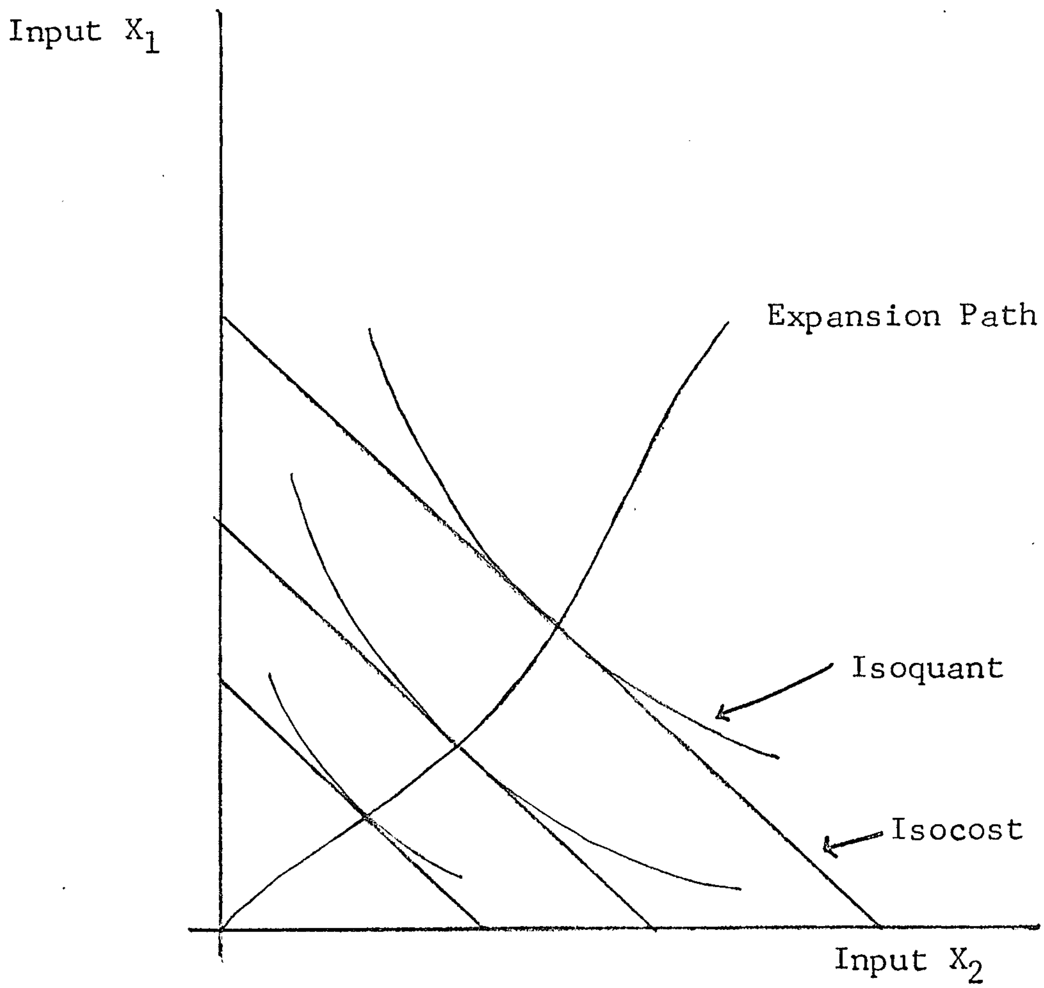

FIGURE 7: Expansion Path.

often does not occur. In this case, the maximum possible output for a given level of expenditure is not achieved.[42]

Cost Theory

Costs of production are a function of the amounts of inputs used and the prices of those inputs. Input use is determined by the level of technical efficiency, while input prices are a function of the structure of input markets, input availability and the scale of operation.[43]

This section begins with a discussion of the degree to which the scale of operation and level of managerial skill may affect input use and input prices. An examination of the extent to which the pricing system in an industry may affect the level of costs in an industry follows. The framework of this discussion is presented in Figure 8 below.

Scale of Operation

Large scale operations in an industry may have lower per unit costs of production due to technical or pecuniary economies of scale. Technical economies arise from two main sources. First, given a large volume of

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[42] Ibid., pp. 196-204. This case is illustrated as point C in Figure 13 below.

[43] The proximity of input markets determines the level of transportation costs producers pay for inputs. Transportation costs are reflected in input prices.

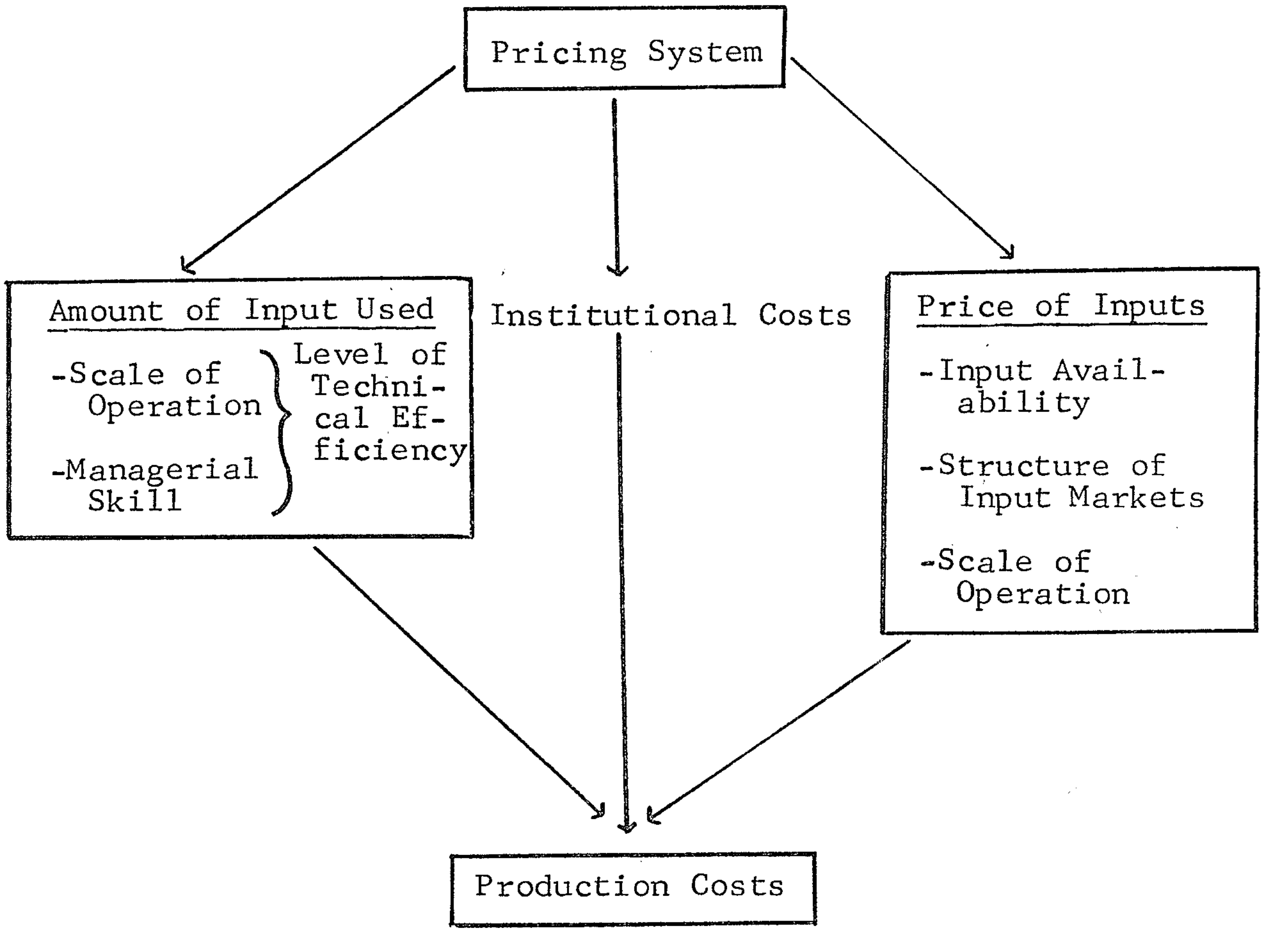

FIGURE 8: Framework of Discussion concerning the Determinants of Input Use and Input Prices.

output, it may be economically feasible to employ specialized machinery which completes one stage of production more quickly and effectively than smaller, all purpose machinery and labour. Second, replacements for machinery and repair costs represent a smaller proportion of total costs as production size increases. Pecuniary economies stem from pricing imperfections in input and output markets. Pecuniary economies include the volume discounts available to large producers from both input suppliers and firms transporting the final product, from premium prices often offered to large, reliable producers, and from the lower interest rates large producers may be able to obtain.[44]

There exist a number of factors which determine the extent to which scale economies may be achieved. The minimum scale at which economies are achieved in an entire operation is a function of the cost functions of all inputs; because of indivisibilities of inputs and varying operating capacities, it may not be possible to take advantage of all scale economies. Also, the decrease in per unit costs of each input may not continue indefinitely as output increases. For example, because the skills of the head manager/producer represent a fixed input, diminishing returns will eventually set in, as other inputs are increased. Marketing costs may also limit scale economies.

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[44] F. M. Scherer, Industrial Market Structure and Economic Performance (Chicago: Rand McNally and Co., 1973), pp. 72-79.

Factors including market size and opportunities, geographic distribution of customers, the rate structure of transportation costs, and the pricing system together with the elasticity of demand (i.e., the extent to which transportation costs may be passed on) determine the importance of locational considerations as a limiting factor to scale economies.

Managerial Input

Efficient resource allocation, in an aggregate sense, requires that producers operate on the expansion path. In other words, producers must minimize costs. The extent to which costs are minimized depends upon the level of producers' knowledge, skill and initiative, the degree of competitiveness in the industry, and the individual constraints under which producers operate. The constraints imposed by producers vary with individual aspirations, utility functions and financial conditions, and may affect the use of several inputs. If a constraint results in the use of less than optimal amounts of managerial input, producers will experience a relatively increasing lack of knowledge and skill, and as a result, will stray farther from the expansion path and optimal resource use.

Pricing System

a) Competitive System

The four basic conditions assumed to exist in a perfectly competitive market include a homogenous product, a large number of small producers and buyers, free entry and exit in the industry and perfect knowledge. In such a market, price is the mechanism which equates supply with demand and ensures that no excess profits are earned in the long run.[45]

Efficient price adjustment in a perfectly competitive market is illustrated in Figure 8. Assuming the quantity supplied does not change, if the demand level shifts up from DD to D'D', price will rise to P'. Profits will be earned in the industry and since the return to investment in this industry is greater than elsewhere, new firms will be attracted. As the competition increases and industry supply increases (SS to S'S'), price falls and individual firms will move toward their efficient level of production, q. As indicated in Figure 9, production costs are continually forced to the minimum level in the short run (minimum short run average cost) and thus towards minimum average cost in the long run.

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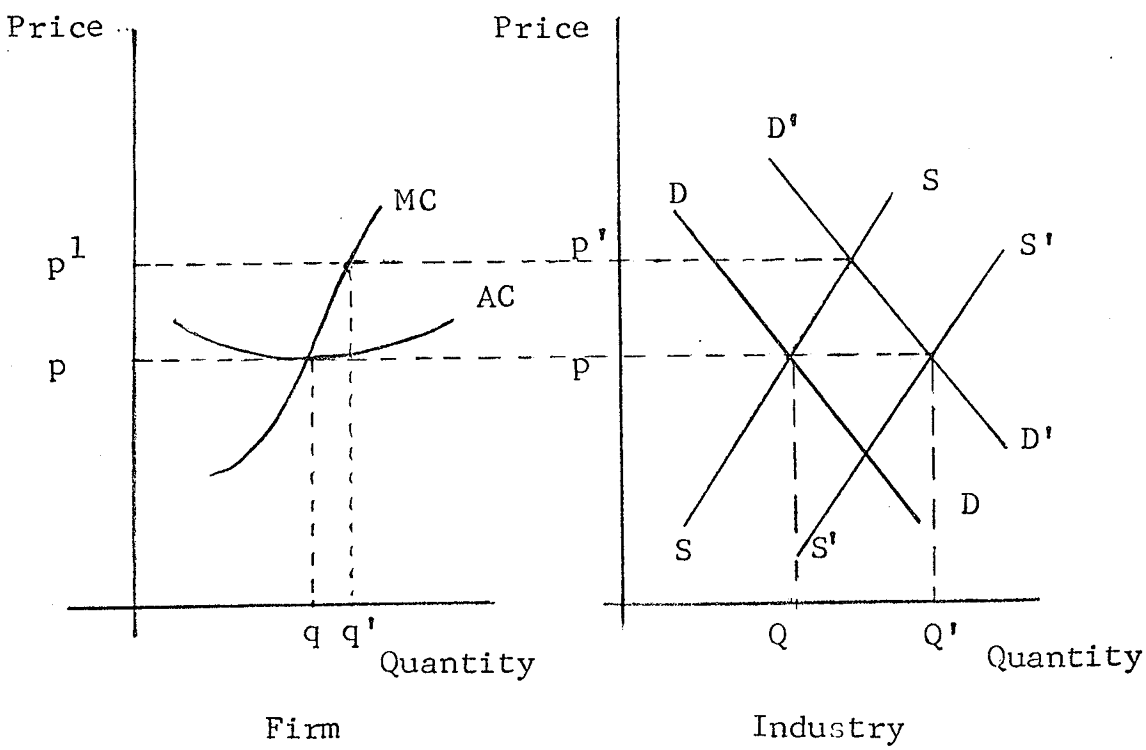
[45] Ibid., p. 12.



where:

AC = average cost

MC = marginal cost

S = supply

D = demand

FIGURE 9: Price Adjustment in Competitive Market.

b) Regulated Pricing System

The alternative to competitive pricing considered in this study is cost of production pricing, in which prices are determined on the basis of a cost of production formula. Formula pricing may be introduced in an attempt to increase the level and stability of producer income. While competitive pricing tends to result in cost minimization and the exploitation of scale economies,[46] formula pricing may affect both the average scale of operation in an industry and management behaviour, and in addition introduce additional costs into the industry.

i) Scale of Operation.

The market price in a competitive industry is based on marginal principles and theoretically results in efficient resource allocation.[47] Cost of production pricing, on the other hand, is intended to provide producers with 'adequate' returns.[48] Assuming decreasing returns to scale

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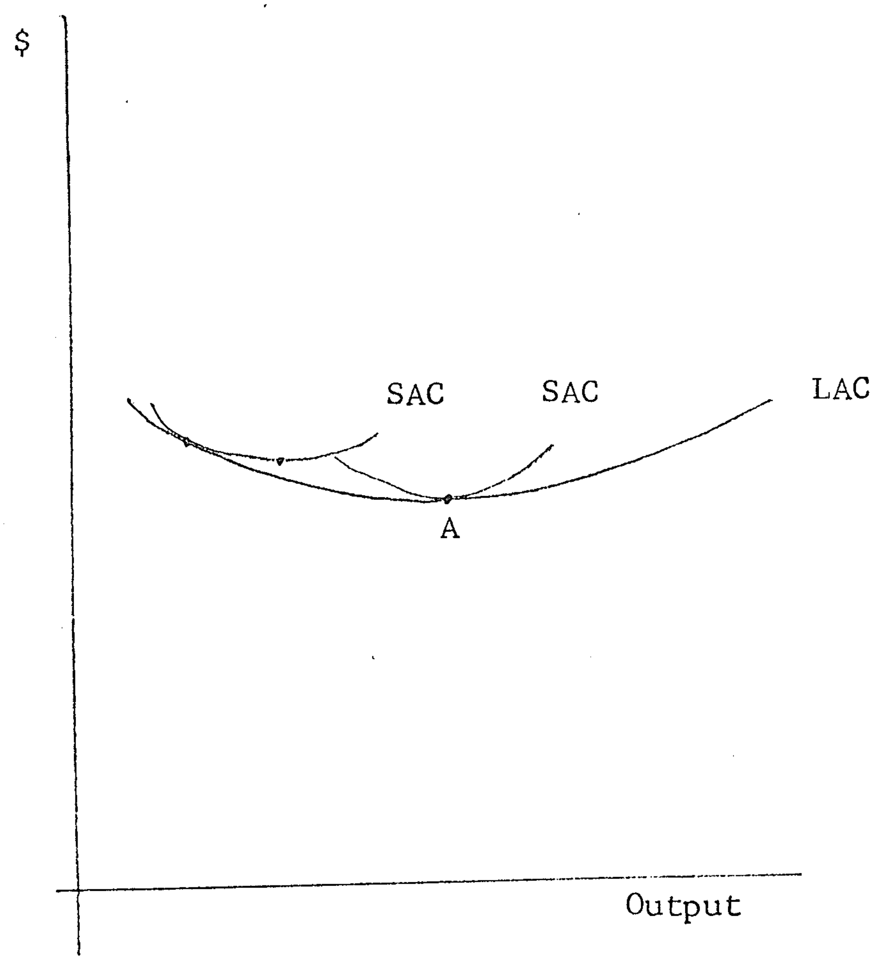
[46] In this study, scale economies refer to the lowering of total per unit costs of production as operation size increases. It is not assumed that all inputs are increased in proportion.

[47] The price fluctuations which result from the adjustment of supply and demand may cause planning difficulties for the producer, since perfect knowledge does not exist. As a result, inefficiencies may offset the advantages of competitive pricing to some extent.

[48] P. S. Ross & Partners, July 1975, op. cit., p. 27.



where:

LAC = long run average costs

SAC = short run average costs

A = point where minimum
SAC equals minimum LAC

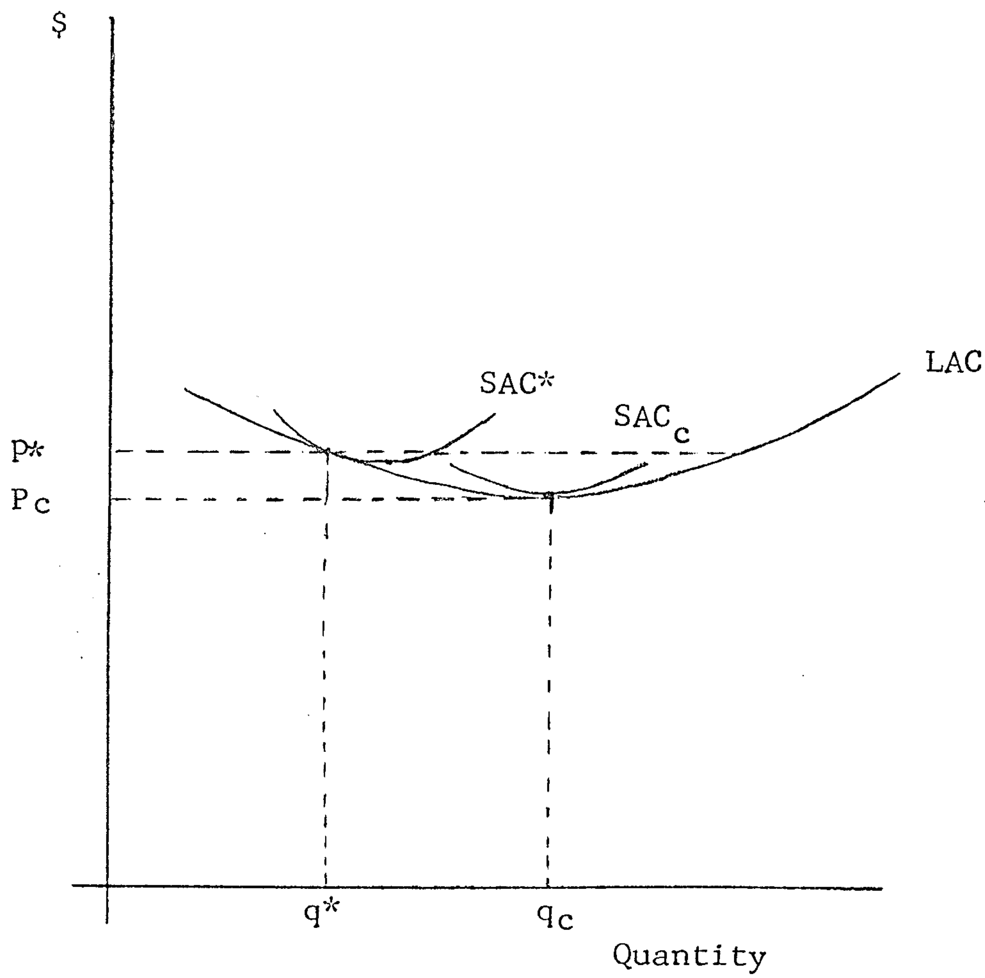
FIGURE 10: Long Run and Short Run Costs.

eventually set in, the prices under the two systems are equal only at the scale of operation where long run average costs are minimized and marginal cost equals average cost. If the formula price exceeds the competitive price, producers operating at a scale which is larger or smaller than the minimum cost scale may survive in the long run.

The costs of an inefficient scale of operation are compared with those of an operation in which costs are minimized in Figure 11. As long as the formula price, p*, exceeds the competitive price, Pc, the costs of firms between the sizes Q* and Qc are covered. Producers operating in this size range are not forced to reduce costs through expansion, as would be the case in a competitive market. P* is known as an umbrella price.

When a formula price is established in an industry, supply and demand are no longer equated through the price mechanism. The equilibrating mechanism may be replaced by the control of the level of production, the movement of product between markets, or the changing of the level of demand. Of these methods, production control is the most practical since shifting supply may be costly, and demand manipulation is not likely to be successful in the short run.

The administration of quotas is one means of controlling the quantity produced in an industry. Under a quota scheme, total demand over a certain period of time is estimated and then divided over a certain period of time



where:

SAC = short run average cost

LAC = long run average cost

Pc = competitive price

q_c = quantity produced when costs are minimized

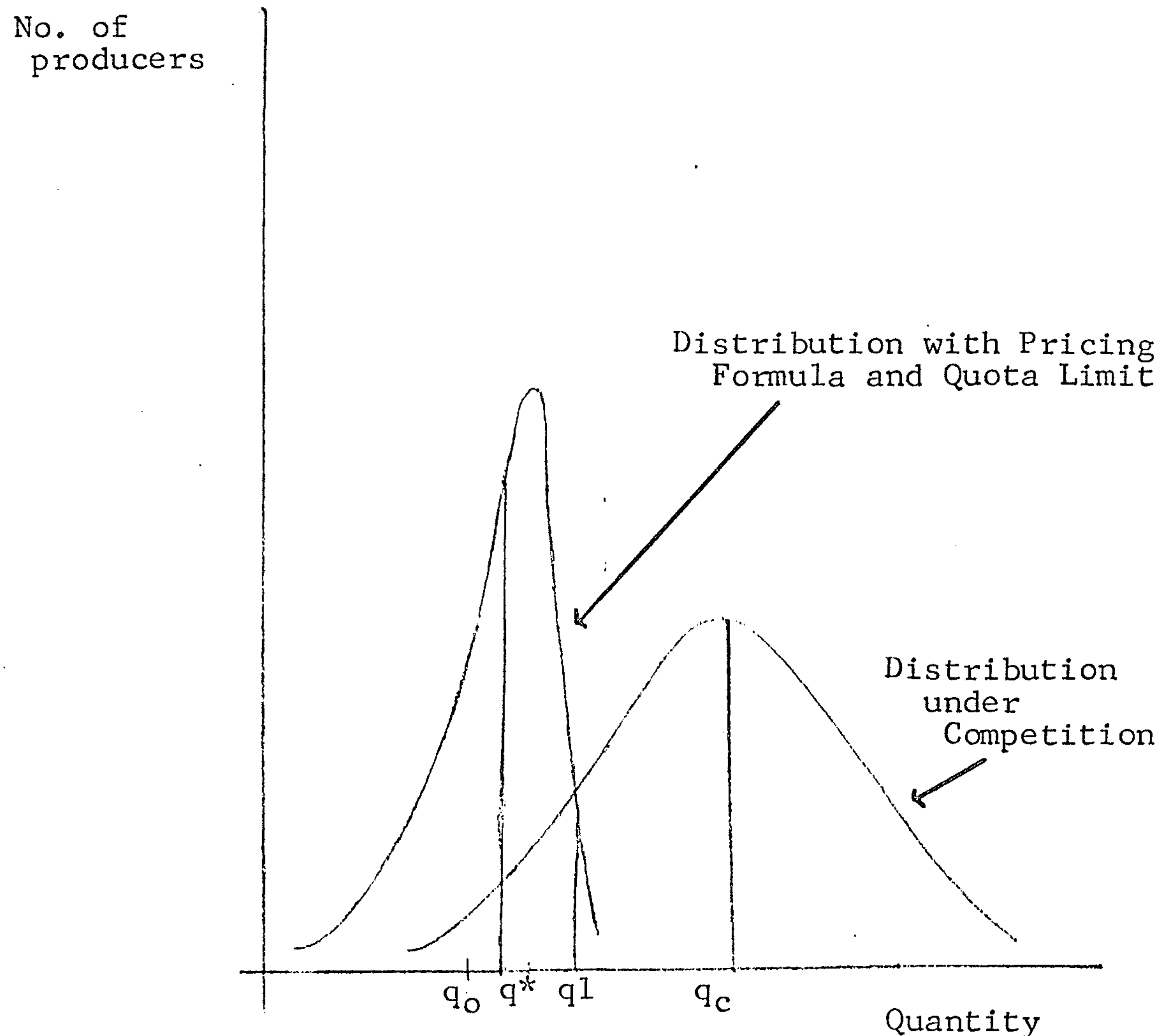
p^* = regulatory price

q^* = quantity produced by scale SAC*

FIGURE 11: Feasible Scales of Operation under Competition and under Regulation.

is estimated and then divided among producers according to established criteria. Quota regulations may have an impact on scale trends in an industry if there are quota size limits or restrictions regarding the transfer of quotas, such as the tying of quota rights to production facilities.

Feasible distributions of farm sizes in a competitive market and in an industry with a price formua and quota size limits are compared in Figure 12. The figure illustrates the distributions which could develop several years after pricing and quota regulations were introduced in one market. Assuming the average size of operation in both markets was approximately q_o, theory suggests that under competition the average size of operation would move to q_c, where costs are minimized. However, in a market in which prices are set with a view to adequately covering the costs of a firm operating at scale q^*, operations of the scale q^* would not be forced to expand. As a result, the average firm size would not be expected to increase to q_c, but rather to a size between q^* and the limit ql. The actual size would depend upon individual producer choice, and the extent to which quota of the desired size was available to expanding producers. Some farms of a greater size than the limit would exist if a grandfather clause in the quota regulations allowed producers to remain the size they were at the time the regulatory program was introduced.



where:

q^* = operation size upon which pricing formula is based

ql = size limit on quota expansion

q_c = size of operation where costs are minimized

q_o = approximate average size of operation in both markets, at time when both were unregulated

FIGURE 12: Feasible Size Distributions under Competition and under Pricing and Quota Regulations.

ii) Level of Management.

The level of management skill and degree of cost minimization prevailing in an industry may fall as a result of the introduction of formula pricing. Producers who have lower costs than in the size of operation upon which the price formula is based, due to location or scale, may maximize profits subject to constraints which would be unrealistic under a competitive pricing system. Operation under constraints may result in non-optimal resource use. Similarly, producers with relatively low costs do not have to adjust the use of inputs following changes in available technology and input prices as quickly as they would in an unregulated industry.[49] The failure to minimize costs, known as managerial slack or X-inefficiency, results in operation off the expansion path.

Two examples of inefficient input use are shown in Figure 13 below. The isoquant q_1 is known as an efficient unit isoquant, and represents the minimum quantities of the inputs X_1 and X_2 which can be used to produce the level of output q_1.[50] Points to the left of the isoquant are unattainable. Points to the right of the isoquant, such as B, represent excess input use. The point on the isoquant

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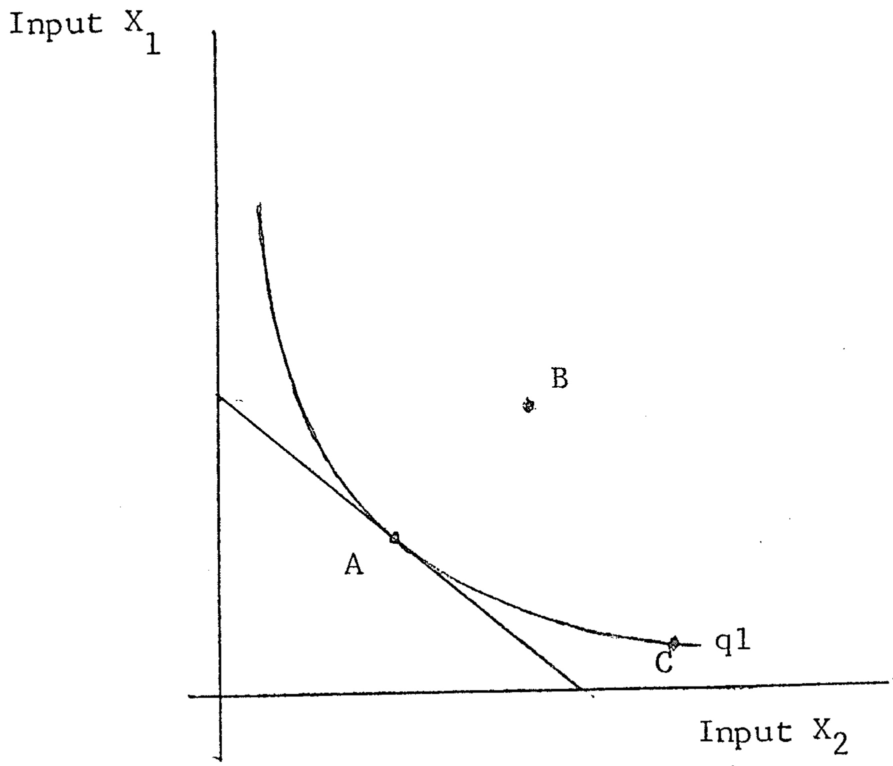
[49] Scherer, op. cit., p. 405.

[50] R. G. Bressler, Jr. and R. A. King, Markets, Prices, and Interregional Trade (New York: John Wiley & Sons, Inc., 1970), p. 403.



where:

q_1 = efficient unit isoquant

A = producer uses efficient combination of inputs and produces q_1

B = producer uses correct proportion of inputs, according to input prices, but only produces q_1, when it is possible to produce q_2 with the same amounts of X_1 and X_2

C = producer uses inefficient proportion of inputs to produce q_1. With the same level of expenditure, q_2 could be produced

FIGURE 13: Operation off the Expansion Path.

which is tangent to the isocost line indicates the least cost combination of inputs which may be used to produce q_1. Any other combination of inputs on the isoquant, such as that indicated by point C, is not proportional to the factor price ratio and requires a higher level of expenditure for the same level of output.

iii) Additional Costs.

Formula pricing, accompanied by quota regulation, may increase the level of operating costs in an industry through quota purchase and surplus removal costs, and through freezing the pattern of production.

Given an unrestricted quota market, if quota ownership generates higher returns than may be earned elsewhere, the anticipated net returns associated with the quota become capitalized into the present value of the production rights. Because quota rights are worth more to producers with lower costs, the more efficient producers can bid for quotas of the less efficient, and the pattern of production will closely resemble that in an unregulated industry. However, the addition of quota values to input costs will cause total costs in the industry to rise.[51]

The initial allocation of quotas is frequently based on historical production shares, as this is an objective

[51] M. M. Veeman, "Alternative Techniques of Quota Regulation by Marketing Board Actions," Market Regulation in Canada, Occasional Series #3 (Winnipeg: Department of Agricultural Economics, University of Manitoba, 1972), p. 61.

criterion. Unless there is an unrestricted quota market where quotas may shift according to relative production cost advantages following the initial allocation, or unless quota transfer policies strictly follow competitive criteria, the potential level of efficiency in the industry will not be achieved. In this case, the level of costs in the industry will increase, adding to the increase resulting from quota purchase costs. Quota transfer policies which may be enforced in order to achieve certain goals concerning the nature of enterprises in an industry, but which inhibit efficient quota reallocation and raise costs include the tying of quotas to production facilities, limits to quota expansion and the refusal to allocate quotas to firms involved in non-farm activities.

Quota regulation may not be successful in equating quantities supplied with quantities demanded at the formula price; in this case the market is not cleared and the quantity of product in the market must be adjusted to balance supply with demand if the formula price is to be maintained. A surplus removal program serves as the adjustment mechanism, moving product not sold at the formula price. Excess product is either diverted into secondary markets which are not regulated, or destroyed.

The costs of surplus removal include the dislocation of secondary markets caused by the dumping of the regulated product, losses due to low prices received in secondary markets,[52] losses associated with product destruction and the actual costs of product manipulation. Surplus removal costs must be weighed against the benefits of the regulation in order to determine the net impact of the program.

iv) Side Benefits of a Formula Pricing System.

The higher costs of formula pricing relative to competitive pricing may be offset to the extent that the organization which sets prices and quota regulations is able to achieve scale economies in certain areas and carry out activities which independent producers cannot economically perform. Such activities, including market development, research and information dissemination, may lower costs through increasing the volume of sales, improving production methods and increasing the rate of adoption of new technology.

The Integration of Theory with the Model

The theoretical sources of efficiency discussed above are related to the budget model used in this study in Table 1. The components of the budget model include feed, pullet, labour, depreciation, interest, and miscellaneous costs. The production factors determining the level of

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[52]The extent of these losses depends upon the elasticity of demand in the two markets, and the price in each market. See W. Scherer, op. cit., pp. 254-255.

TABLE 1

Relationship Between Budget Components and Sources of Efficiency

Component	Factor	Theoretical Source of Efficiency
FEED -		
feed conversion ratio	temperature, space/bird, wastage, bird weight, lighting	managerial skill
price	volume discounts	pecuniary scale economies location
PULLET -		
length of laying cycle	space/bird, lighting, disease, temperature, laying management	managerial skill
price	volume discounts	pecuniary scale economies location
LABOUR -		
hours	collection and feeding systems, training of labour	technical scale economies managerial skill
DEPRECIATION -		
investment in buildings and equipment	birds/cage, cages/house, degree of automation	technical scale economies
INTEREST -		
total investment	birds/cage, cages/house, degree of automation	technical scale economies
rate	cost of credit	pecuniary scale economies
MISCELLANEOUS -		
plant and administration	medication, energy, energy (automation	managerial skill technical scale economies
board fee	surplus removal, board administration costs	institutional characteristics of industry

each budget component are listed and these factors suggest possible areas in which efficiencies may be achieved. The sources of efficiency are identified in the table and discussed in more detail, in connection with egg production factors, in the following section.

The stages of production in which the efficiencies listed in Table 1 may be found are discussed below.

a) Economies of Scale in Egg Production

It has been estimated that significant economies of scale exist in operations with 48,000 birds or more.[53] Technical sources of scale economies include the type and arrangement of cages and the methods of feeding birds and collecting eggs. As the number of birds increases, larger cages may be used, resulting in less space per bird and lower investment costs in cages per bird. As the flock size increases, more cages are needed and houses may be used more intensively, reducing the amount of wasted space and lowering house investment costs per bird. Volume discounts for feed and pullets represent a major possible pecuniary scale economy, as feed and pullet costs constitute approximately 60 percent and 25 percent of total production

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[53] P. S. Ross & Partners, January 1975, op. cit., p. 28. The average cost curve in the egg industry may deviate slightly from the traditional U-shaped cost curve discussed in the theoretical section below. It is hypothesized that all economies of scale are achieved at a size greater than 48,000 birds, such as 60,000, and that diseconomies do not occur until a much larger scale is reached. The result is a cost curve with a flat bottom.

costs respectively.[54] Other pecuniary economies of scale arise from more and possibly less expensive sources of commercial credit, and premiums paid by large grading stations to large producers.

As explained in the theoretical section, the exploitation of these scale economies results in lower per unit costs of production.

b) The Role of Management in Egg Production

Genetic factors and management practices affect the level of production performance and thus the costs of production. The degree to which genetic factors determine the level of production performance of layers is indicated by heritability estimates, listed in Table 2.

It is evident from Table 2 that management practices are an important factor in determining the level of performance of layers. For example, the rate of egg production depends 25 percent on genetic factors, but 75 percent on management. Consequently, the rate of lay may vary significantly among operations, depending upon the quality of management.

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[54] M. O. North, Commercial Chicken Production Manual (Westport, Conn.: The AVI Publishing Co., Inc., 1972), pp. 287-288.

TABLE 2

Heritability Estimates

Production Factor	Percent Decided by Genetic Factors
Egg production	25
Adult body weight	55
Adult livability	10
Egg weight	55
Age at sexual maturity	25
Shell thickness	25
Blood spots	15
Albumen quality	25

SOURCE: North, op. cit., p. 375.

There are a number of factors controlled by producers which determine the outcome of the management share of production performance:[55]

i) The optimum space per bird is found through balancing offsetting factors. As the number of birds per cage increases, the investment per bird in housing and equipment falls. However, the resulting cost saving is offset due to the inverse relationship between egg production, livability, egg size and egg quality on one hand, and space per bird on the other.

ii) Lighting programs may increase the profitability of an operation since the degree of light intensity and the duration of lighting in laying areas affects the age at which laying begins and the number of eggs produced. However, the direct relationship between the degree of light intensity and the incidence of cannibalism must also be considered by producers.

iii) Feeding programs may vary and have an influence upon the level of feed wastage, the level of consumption and the average body weight of birds.

iv) The intake of water by layers must be regulated, since as water consumption rises, the wetness of manure increases and moisture problems in houses occur.

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[55]The following information regarding egg production practices and techniques is taken from M. O. North, Commercial Chicken Production Manual (Westport, Conn.: The AVI Publishing Co., Inc., 1972), pp. 254-289.

v) Birds must be protected in both cold and hot climates. Excessive heat may reduce feed intake below the optimum level, cause manure problems and may result in a high rate of mortality.

vi) Disease prevention through vaccination programs, fly control, etc. is crucial since the loss of birds results in the loss of the salvage value of the birds as well as the loss of the future income generated by birds.

vii) Procedures must be taken to control manure moisture levels and accumulation in order to minimize odours and fly breeding.

viii) The laying schedule chosen for birds will affect the profitability of an operation in three ways. First, the size of eggs varies directly with the age at which a pullet begins laying eggs, while the cost of pullets varies directly with the age of pullets. The cost of pullets must therefore be balanced against the size of the premium received for larger eggs. Second, the rate of lay increases rapidly during the first five or six weeks of production and then falls at a constant rate for the rest of the laying period. Producers must aim for a high peak of production if the potential volume of eggs is to be produced, since the rate of lay cannot be increased in the latter part of the cycle. Third, force moulting is a method of cutting off the first laying cycle and inducing a second cycle. The profitability of the procedure depends upon the rate of lay, feed consumption and egg size and quality in the second cycle, the costs of bringing birds to a second cycle, and the expected price of eggs.

ix) Egg breakage and consequent loss of income may be minimized by the careful handling of eggs, frequent egg collection, a well balanced feed ration, minimization of bird stress, cannibalism, fright and cage crowding, and the proper use of collection equipment.

x) Birds have a peck order and timid birds may fail to eat as a result of more aggressive leaders. In order to ensure that all birds produce to potential, producers must place feed and water in such a way that all birds will consume sufficient nutrients.

The failure of producers to consider these factors will result in poor production performance and excessive costs in varying degrees in several production factors, including the rate of lay, livability, the length of the laying period and egg quality.

c) The Effect of Location on Egg Product Costs

The location of a producer with respect to input and output markets affects the prices he must pay for inputs and the price he receives for his output. Because feed costs represent approximately 60 percent of total costs,[56] the transportation costs for feed are a

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[56]See Analysis, Chapter 5 below, p. 63.

significant factor in determining the costs of production. For example, if transportation costs for feed paid by a producer supplying a certain market exceed the costs of transporting the final product from an area closer to the feed source to the same market, a producer must find efficiencies elsewhere in the production process in order to remain competitive. The level of competition in an industry determines the extent to which producers in non-optimal locations are able to survive.

d) Institutional Characteristics and Egg Production Costs

The costs of the institutional system in the Canadian egg industry include surplus removal, administration and promotional costs. In order to determine the net institutional costs, the costs of a competitive system must be considered. For example, the costs of surplus removal and administration must be balanced against the costs of production cycles resulting from lagged producer response to egg prices. Similarly, the success of promotional expenditures in expanding the market must be compared with the estimated demand increase in the absence of marketing board activities. Theory suggests that given an increase in meat prices, an increase in the per capita demand for eggs could result from the substitution of eggs for meat as a source of protein.

The existence of any net cost to producers resulting from marketing board activities raises the level of production costs and lowers the level of efficiency in the industry.

CHAPTER IV

BUDGET MODEL

The examination of the level of technical efficiency in the egg industry over time in Ontario relative to San Diego county was carried out by means of a comparison of farm-gate production costs in the two areas. The comparison is based on a budget model. The budget components include the costs of feed, pullets, labour, depreciation, interest and miscellaneous expenditures. The components of the model are presented in Figure 14.

Explanation of Model Components

The model presented in Figure 14 was adjusted in order to fit Ontario and San Diego county data. The adjustments are presented in Figures 15 and 16, and are described briefly in the following discussion of model components. The exact methods of arriving at each of the figures used in calculating the components are described in Appendix Tables A-3 and A-4.

The cost of feed per dozen eggs produced is the product of the feed conversion ratio and the price of feed per pound. The feed conversion ratio represents the pounds of feed required to produce one dozen eggs. A conversion factor was added to San Diego county feed costs for the

FIGURE 14: Budget Model.

$$\text{Feed Cost} = (\text{Feed Conversion Ratio}) \times (\text{Feed Price/Pound})$$

$$+ \quad \text{Pullet Cost} = \left[\frac{(\text{Flock Size} \times \text{Pullet Price}) - (\text{Flock Size} \times \%\ \text{Salvage} \times \text{Salvage Price})}{\text{Flock Size} \times \text{Rate of Lay}^{a}} \right] \times \text{annualization factor}$$

$$+ \quad \text{Labour Cost} = \frac{(\text{Labour Hours/Bird/Year}) \times (\text{Labour Rate/Hour})}{\text{Rate of Lay}}$$

$$+ \quad \text{Depreciation Cost} = \frac{\text{Investment in Buildings and Equipment} \times \text{Depreciation Rate}}{\text{Rate of Lay}}$$

$$+ \quad \text{Interest Cost} = \frac{\text{Prime Loan Rate} \times \text{Total Investment/Bird}}{\text{Rate of Lay}}$$

$$+ \quad \text{Miscellaneous Cost} = (\text{Plant Costs} + \text{Administration} + \text{Marketing Board Fee})/\text{dozen}$$

= Cost of Producing One Dozen Eggs.

[a] Rate of Lay represents the number of dozen eggs produced per bird per year.

FIGURE 15: Model Adjusted for Ontario.[a]

$$\text{Feed Cost} = (\text{Feed Conversion Ratio}) \times (\text{Feed Price per Pound})$$

$$+\ \text{Pullet Cost} = \frac{(\text{Flock Size} \times \text{Pullet Price}) - [\text{Flock Size} \times (1 - \text{Mortality Rate}) \times \text{Salvage Price}]}{\text{Flock Size} \times \text{Rate of Lay}^{b}} \times \text{Annualization Factor}$$

$$+\ \text{Labour Cost} = \frac{(\text{Labour Hours/Week/1,000 Birds}) \times (\text{Labour Rate}) \times \frac{52}{1{,}000}}{\text{Rate of Lay}}$$

$$+\ \text{Depreciation Cost} = \frac{(\text{Investment in Buildings \& Equipment}) \times (\text{Depreciation Rate})}{\text{Rate of Lay}}$$

$$+\ \text{Interest Cost} = \frac{(\text{Prime Loan Rate}) \times (\text{Total Investment per Bird})}{\text{Rate of Lay}}$$

\+ Miscellaneous Cost[c] =

1. Plant (for 1971, 1975, 1976)
$$\frac{(\text{Investment in Buildings \& Equipment}) \times \frac{\text{Plant Cost}}{\text{Investment in B \& E}}}{\text{Rate of Lay}}$$

2. Administration (Base Cost) x (Index)

3.[d] Marketing Board Fee (1971)
$$\frac{(\text{Rate}) \times (\%\ \text{Salvage}) \times (\text{Flock Size})}{(\text{Flock Size}) \times (\text{Rate of Lay})}$$

= Cost of Producing One Dozen Eggs.

[a]Calculations and sources of data for the elements making up each component are listed in Appendix Table A-3.

[b]Rate of Lay represents the number of dozen eggs produced per bird per year.

[c]Plant Costs for 1977, 1978 (Repairs & Maintenance Base) x (Index)
(Energy Base) x (Index)
(Other Base) x (Index)

[d]Marketing Board Fee for 1975, 1976-78 -- Standard Charge/Dozen

FIGURE 16: Model Adjusted for San Diego County.[a]

$$\text{Feed Cost} = \left[(\text{Feed Conversion Ratio}^{a}) \times (\text{Feed Price/Pound})\right] + \text{Conversion Factor}^{b}$$

$$+ \quad \text{Pullet Cost} = \frac{(\text{Flock Size} \times \text{Pullet Price}) - \left[\text{Flock Size} \times (1 - \text{mortality Rate}) \times \text{Salvage Price}\right]}{\text{Flock Size} \times \text{Rate of Lay}^{c}} \times \text{Annualization Factor}$$

$$\underline{\text{minus}} \quad \text{Conversion Factor}^{a}$$

$$+ \quad \text{Labour Cost} = \left[\frac{(\text{Labour Hours/Week/1,000 Birds}) \times (\text{Labour Rate}) \times \frac{52}{1{,}000}}{\text{Rate of Lay}}\right] + \text{Management Cost per dozen}$$

$$+ \quad \text{Depreciation Cost} = \frac{(\text{Investment in Buildings \& Equipment}) \times (\text{Depreciation Rate})}{\text{Rate of Lay}}$$

$$+ \quad \text{Interest Cost} = \frac{(\text{Prime Loan Rate}) \times (\text{Total Investment/Bird})}{\text{Rate of Lay}}$$

$$+ \quad \text{Miscellaneous Cost} = \text{Standard Cost for Plant and Administration}$$

= Cost of Producing One Dozen Eggs.

[a]Calculations and sources of data for the elements making up each component are listed in Appendix Table A-4.

[b]Data for San Diego county assumed pullets were added to the flock at 26 weeks of age for the years 1971, 1975-77, rather than at the usual age of 20 weeks. Consequently, an adjustment has been made for these years according to the method provided in the 1978 Poultry Egg Cost study. The adjustment affects the feed component positively, as birds must be fed from 20 weeks of age, and raises the feed conversion ratio. The pullet cost falls, as they are brought to the flock at a younger age.

[c]Rate of Lay represents the number of eggs produced per bird per year.

years 1971 and 1975-77 in order to adjust for the older age at which pullets were assumed to have been brought to the flock during these years.

The cost of pullets equals the net cost of the flock per dozen eggs produced. The cost of pullets is derived by multiplying the percent of flock size which is salvaged by the salvage price and this value is subtracted from the flock size multiplied by the price of pullets. The resulting net flock cost is multiplied by the number of weeks in the laying cycle and divided by fifty two weeks in order to determine the flock cost on an annual basis. In order to derive the cost per dozen eggs, this value is divided by the product of the flock size and the rate of lay per bird per year. In the San Diego model, a conversion factor is subtracted from the cost for the years 1971 and 1975-77 in order to adjust for the older age at which pullets were assumed to have been brought to the flock during these years.

The cost of labour per dozen eggs produced is calculated by dividing the product of the labour hours per bird per year and the labour rate per hour by the rate of lay. It is assumed that all help, including managerial help, is included in the labour component. Consequently, the management cost, which is presented as a separate item in the San Diego county studies, is added to the labour component in the San Diego county model.

The depreciation cost represents the devaluation of investment in buildings and equipment. Investment is based on a mix of historical and replacement costs, and therefore represents the costs of producers who are presently in the industry rather than the costs of entering the industry. The value of investment in buildings and equipment is multiplied by the depreciation rate, and this product is divided by the rate of lay, in order to derive the depreciation costs per dozen eggs produced.

The interest cost represents the cost of capital used in egg operations. In this model, a 100 percent debt situation is assumed and therefore, the interest component includes the opportunity cost of capital. The prime loan rate is multiplied by the total investment per bird, which includes fixed and working capital, and this product is divided by the rate of lay per bird per year in order to determine the interest costs per dozen eggs produced.

Miscellaneous costs include plant and administration costs in the San Diego county model and plant, administration and marketing board costs in the Ontario model. Plant costs include repairs, maintenance and energy, and administration costs cover taxes, insurance, medication, accounting and legal fees, and office supplies. Marketing board fees include all charges paid by producers to the regulatory bodies to cover surplus removal, administration and promotional expenses.

CHAPTER V

ANALYSIS

In this study, the level of technical efficiency in the Ontario egg industry was examined relative to that in San Diego county, the efficient benchmark, both before and after supply management was introduced in Canada. The study was carried out in an attempt to determine whether CEMA is fulfilling the FPMAA goal of achieving technical efficiency in the egg industry. The analysis was based on a comparison of deflated production costs in the two areas over time. Input use was examined in both areas and an attempt was made to identify the source of any changes in relative input use over time. Changes in input prices, the scale of operation, technology and pricing systems were considered as possible sources, but due to the fact that a detailed study of other factors which may affect relative input use, such as the tax structure in each area, relative energy requirements and the relative availability of credit was not made, it was not possible to identify the sources of cost changes with any degree of confidence. On the basis of the information collected it was possible only to suggest factors which may have contributed to changes in input costs and relative input use.

Numerical Analysis

The differences in input costs between Ontario and San Diego county for the years 1971 and 1975-78 were calculated and are presented, along with actual input costs, in Table 3.

In order to remove the increase in input costs resulting from input prices, input costs were deflated by input prices. The results of this process are presented in Table 4. For each component, the price index, which was calculated using 1971 as the base year, was multiplied by the 1971 input cost. This calculation is shown in row A in Table 4. This value was subtracted from the input cost in each year studied, and the resulting value (row B in Table 4) indicates the deflated change in cost for each input. In order to determine the size of deflated cost changes in Ontario relative to San Diego county, the change in cost not accounted for by input prices in San Diego county was subtracted from the corresponding figure for Ontario. The results of this calculation for each year studied are shown in row C, Table 4.

Results

a) Egg Production Costs

As indicated on page 68 in Table 3, total egg production costs have risen at different rates in San Diego county and in Ontario since 1971. The difference between San Diego county and Ontario costs rose sharply between 1971 and 1975, tapered off between 1975 and 1976 and fell slightly between 1976 and 1978, as illustrated in Figure 17. In an attempt to determine the source of the relative increase in Ontario production costs, the cost changes in each component in the budget were examined separately.

b) Feed

Total feed costs have increased greatly in both Ontario and San Diego county since 1971, as a result of an approximate doubling of feed prices in both areas during this time. In spite of this increase in feed prices, because of increases in other components of the budget, feed costs have remained a relatively constant proportion of total costs in Ontario, averaging 51 percent. In San Diego county, however, the sharp increase in feed costs between 1971 and 1975-78 resulted in an increase from 60 percent to 65 percent in the proportion of total costs constituted by feed (see Feed, Table 3).

As indicated in the feed B rows in Table 4, the change in Ontario feed costs not due to input prices is first positive, then negative and then positive, while in San Diego county the change steadily falls from positive to negative values. The difference between the deflated changes in feed costs in the two areas swings from positive to negative (see row C for feed, Table 4). As illustrated by Figure 18, there appears to be no trend in deflated changes in Ontario costs relative to those in San Diego county. The evidence is inconclusive, but suggests that

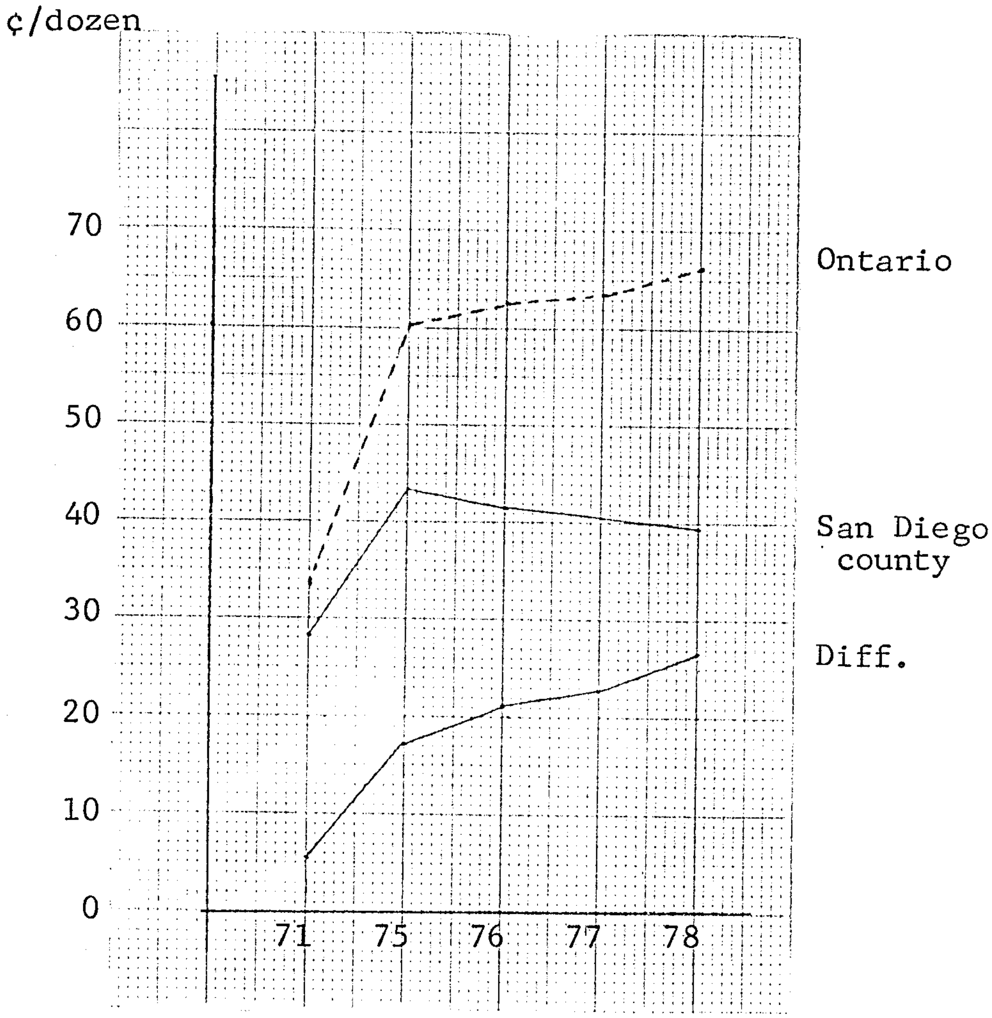


FIGURE 17: Total Production Costs, Ontario and San Diego County.

SOURCE: The figures upon which this graph is based are presented in Table 3.

TABLE 3

Costs of Production in Ontario and in San Diego County Presented by Budget Component, and the Differences[a] in Production Costs in the Two Areas for the Years 1971, and 1975-1978

Input	1971	% of Total Cost	1975	% of Total Cost	1976	% of Total Cost	1977	% of Total Cost	1978	% of Total Cost
FEED ($)										
-Total										
Ontario	.17	(50.4)	.3274	(54.1)	.3349	(53.2)	.3163	(49.7)	.3252	(49)
San Diego county	.1676	(59.4)	.3151	(72.6)	.297	(71.2)	.278	(68.3)	.257	(65.2)
Difference	.0024		.0123		.0379		.0383		.0502	
-Price per lb. ($)										
Ontario	.04		.0734		.0751		.0746		.0767	
San Diego county	.036		.0619		.0637		.0624		.0626	
Difference	.004		.0115		.0114		.0122		.0141	
-Quantity (feed conversion ration lbs./dozen eggs based on pullets bought at 20 weeks)										
Ontario	4.25		4.46		4.46		4.24		4.24	
San Diego county	4.66		5.09		4.71		4.46		4.4	
Difference	-.41		-.63		-.25		-.22		-.16	

(Continued)

TABLE 3 (Continued)

Input	1971	% of Total Cost	1975	% of Total Cost	1976	% of Total Cost	1977	% of Total Cost	1978	% of Total Cost
PULLETS										
-Total ($)										
Ontario	.0851	(25.3)	.1068	(17.7)	.1077	(17.1)	.1025	(16.1)	.1058	(16)
San Diego county	.0564	(20)	.051	(11.8)	.053	(12.7)	.06	(14.7)	.059	(15)
Difference	.0287		.0558		.0547		.0425		.0468	
-Price per Bird ($)										
Ontario	1.90		2.36		2.43		2.47		2.49	
San Diego county	1.23		1.08		1.14		1.38		1.27	
Difference	.67		1.28		1.29		1.09		1.22	
-Mortality Rate (% of flock)										
Ontario	.20		.189		.189		.188		.188	
San Diego county	.20		.13		.13		.13		.12	
Difference	0		.059		.059		.058		.068	
LABOUR										
-Total ($)										
Ontario	.0314	(9.3)	.0438	(7.2)	.0494	(7.9)	.0498	(7.2)	.0481	(7.3)
San Diego county	.017 / .01 } .027	(9.6)	.019 / .01 } .029	(6.7)	.02 / .01 } .03	(7.2)	.021 / .01 } .031	(7.6)	.023 / .01 } .033	(8.4)
Difference	.0044		.0148		.0194		.0188		.0151	

(Continued)

TABLE 3 (Continued)

Input	1971	% of Total Cost	1975	% of Total Cost	1976	% of Total Cost	1977	% of Total Cost	1978	% of Total Cost
-Price ($ per hr.)										
Ontario	2.61		4.00		4.51		4.634 } 4.022 } 4.4		4.878 } 4.204 } 4.63	
San Diego county	1.73		2.45		2.65		2.90		-	
Difference	.88		1.55		1.86		1.5		-	
-Quantity (hrs. per 1,000 Birds per week)										
Ontario	4		4		4		4		4	
San Diego county	3.86		2.89		2.88		2.85		-	
Difference	.14		1.11		1.12		1.15		-	
DEPRECIATION										
-Total ($)										
Ontario	.0142	(4.2)	.0188	(3.1)	.0207	(3.3)	.025	(3.9)	.027	(4.1)
San Diego county	.011	(3.9)	.013	(3)	.013	(3.1)	.012	(3)	.013	(3.3
Difference	.0032		.0058		.0077		.013		.014	
-Investment in Buildings & Equipment ($)										
Ontario	.19653		.26516		.29216		.33165		.3588	
San Diego county	.0734		.0867		.0867		.08		.086	
Difference	.12313		.17846		.20546		.25165		.2728	
-Interest ($)										
Ontario	.0184	(5.5)	.0339	(5.6)	.0392	(6.2)	.0361	(5.7)	.043	(6.5)
San Diego county	.0092	(3.3)	.0126	(2.9)	.011	(2.6)	.01	(2.5)	.02	(5.1)
Difference	.0092		.0213		.0282		.0261		.023	

(Continued)

TABLE 3 (Continued)

Input	1971	% of Total Cost	1975	% of Total Cost	1976	% of Total Cost	1977	% of Total Cost	1978	% of Total Cost
-Rate (%)										
Ontario	.0648		.0942		.1008		.085		.095	
San Diego county	.0567		.0773		.068		.0688		.0898	
Difference	.0081		.0169		.0328		.0162		.0052	
ISCELLANEOUS ($)										
Ontario	.01772	(5.3)	.0745	(12.3)	.0766	(12.2)	.1107	(17.4)	.114	(17.2)
San Diego county	.011	(3.9)	.013	(3)	.013	(3.1)	.016	(3.9)	.012	(3.1)
Difference	.00672		.0615		.0636		.0947		.102	
-Miscellaneous minus Mkt. Bd. Fee ($)										
Ontario	.0168	(5)	.0245	(4.05)	.0266	(4.2)	.0407	(6.4)	.044	(6.6)
San Diego county	.011	(3.9)	.013	(3)	.013	(3.1)	.016	(3.9)	.012	(3.1)
Difference	.0058		.0112		.0136		.0247		.032	
-Index of Misc. Input Prices										
Ontario	1.00		1.38		1.499		1.612		1.726	
San Diego county	1.00		.96296		1.07407		1.0463		-	
Difference	0		.41704		.42493		.5657		-	
OTAL										
Ontario	.337		.605		.629		.636		.663	
San Diego county	.282		.434		.417		.407		.394	
Difference	.055		.171		.212		.229		.269	

(Continued)

TABLE 3 (Continued)

[a]Difference always represents Ontario costs minus San Diego county costs.

SOURCE: The sources of the cost figures presented in this table are listed in Appendix Tables A-3 and A-4.

TABLE 4

Results: Price Indexes for Budget Components Deflated Changes in Costs (Base 1971) for San Diego County and Ontario and the Differences[a] between the Deflated Changes in Costs in San Diego County and in Ontario for the Years 1971, and 1975-1978

Input	1971	1975	1976	1977	1978
Ontario Feed Price Index	1.00	1.835	1.8775	1.865	1.9175
A feed ($)	.17	.31195	.319175	.31705	.325975
B feed ($)	0	.01545	.015725	-.00075	.000775
San Diego county Feed Price Index	1.00	1.7194	1.7694	1.734	1.739
A feed ($)	.1674	.2878	.2962	.2903	.2911
B feed ($)	0	.0273	.0035	-.0122	-.0157
C feed ($)	0	-.01185	.01225	-.01145	.016475
Ontario Pullet Price Index	1.00	1.242	1.2789	1.3	1.3105
A pullet ($)	.0851	.1056942	.1088343	.11063	.1115235
B pullet ($)	0	.001106	-.0011343	-.00813	-.00572
San Diego county pullet Price Index	1.00	.878	.9268	1.12	1.03
A pullet ($)	.0564	.0495	.0523	.0631	.0581
B pullet ($)	0	.0015	.0007	-.0031	.0009
C pullet ($)	0	-.00039	-.0018	-.005	-.00662

(Continued)

TABLE 4 (Continued)

Input	1971	1975	1976	1977	1978
Ontario Labour Price Index	1.00	1.5326	1.728	1.686	1.774
A labour ($)	.0314	.0482304	.0542592	.0529404	.0557036
B labour ($)	0	-.00443	-.00486	-.00714	-.0076
San Diego county Labour Price Index	1.00	1.416	1.532	1.676	-
A labour ($)	.027	.0382	.0414	.0453	-
B labour ($)	0	-.0092	-.0114	-.0143	-
C labour ($)	0	.00477	.00654	.00716	-
Ontario Interest Rate Index	1.00	1.4537	1.556	1.3117	1.4661
A interest ($)	.0184	.026748	.0286304	.0241352	.0269762
B interest ($)	0	.007152	.01057	.011965	.016024
San Diego county Interest Rate Index	1.00	1.3633	1.1993	1.2134	1.5838
A interest ($)	.0092	.01254	.01103	.01032	.01457
B interest ($)	0	.00006	-.00003	-.00032	.00543
C interest ($)	0	.00709	.0106	.01229	.01059
Ontario Miscellaneous Index	1.00	1.38	1.499	1.612	1.726
A miscellaneous ($)	.01772	.0244536	.0265622	.0285646	.0305847
B miscellaneous ($)	0	.0501	.05004	.08214	.08342

(Continued)

TABLE 4 (Continued)

Input	1971	1975	1976	1977	1978
San Diego county Miscellaneous Index	1.00	.96296	1.07407	1.0463	-
A miscellaneous ($)	.0111	.01059	.01181	.01151	-
B miscellaneous ($)	0	.00241	.00119	.00449	-
C miscellaneous ($)	0	.04769	.04885	.07765	-
Ontario Miscellaneous Index minus Marketing Board Fee	1.00	1.38	1.499	1.612	1.726
A misc. minus fee ($)	.0168	.023184	.0251832	.0270816	.0289968
B misc. minus fee ($)	0	.00132	.00142	.01362	.015
San Diego county Miscellaneous Index minus Marketing Board Fee	1.00	.96296	1.07407	1.0463	-
A misc. minus fee ($)	.0111	.01059	.01181	.01151	-
B misc. minus fee ($)	0	.00241	.00119	.00449	-
C misc. minus fee ($)	0	.00079	.00023	.00913	-

Where:

A = [Total of Component (1971)] x (Price Index of Year in Question).

B = (Total of Component for Year in Question) - (A)
This value equals the deflated change in costs (i.e., the change in costs given no change in input prices).

(Continued)

TABLE 4 (Continued)

C = Difference between deflated changes in costs (row B), for Ontario and San Diego county.
This value indicates the degree to which deflated costs have increased in Ontario relative to San Diego county.

[a]Difference always represents Ontario costs minus San Diego county costs.

SOURCE: The sources of the figures used in this table are presented in Appendix Tables A-3 and A-4.

the regulation in Canada has not resulted in inefficiencies in feed use. This hypothesis is supported by the feed conversion ratios in the two areas. In Ontario, the feed conversion ratio rose after 1971, but has fallen since then, indicating that less feed is required to produce the same output. In San Diego county the feed conversion ratio has followed the same general trend which appears in Ontario, remaining above the Ontario feed conversion ratio by increasingly smaller amounts (see figure 19). It appears therefore, that San Diego county feed use is approaching the level of efficiency existing in Ontario. This trend may be due to the fact that cost pressures, which are caused by rising feed costs, are forcing San Diego county producers to alter management techniques.

c) Pullets

Pullet costs have followed an uneven, slow upward trend in both San Diego county and Ontario since 1971. In both areas, the percentage of total costs accounted for by pullets has fallen, indicating that pullet costs have risen at a slower rate than other input costs (see Pullets, Table 3).

As indicated in Table 3, the mortality rates have fallen more in San Diego county than in Ontario; new vaccines became available in both areas between 1971 and 1975, and thus the divergence in performance could be a

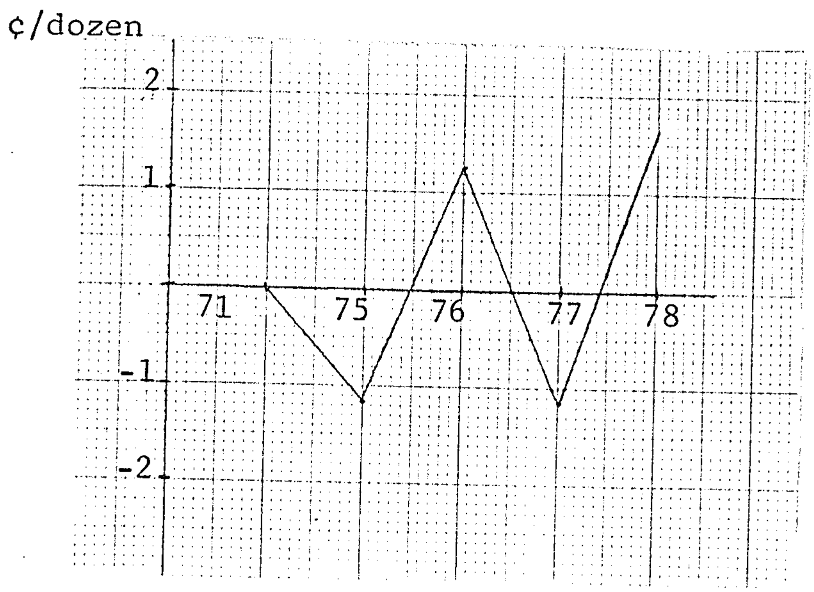


FIGURE 18: Differences between Deflated Changes in Feed Costs in Ontario and San Diego County.

SOURCE: The figures upon which this graph is based are presented in Table 4, row C, feed.

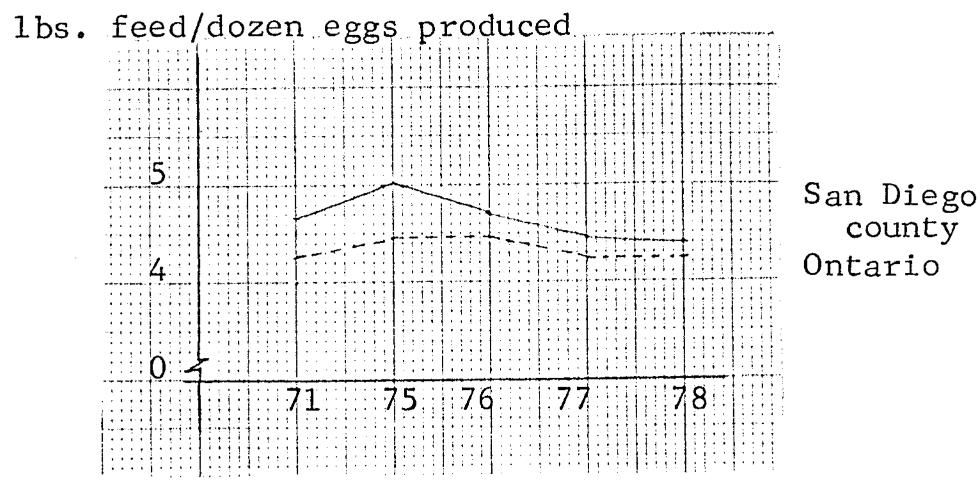


FIGURE 19: Feed Conversion Ratios Achieved in Ontario and in San Diego County (based on the addition of pullets to flock at 20 weeks of age).

SOURCE: The figures upon which this graph is based are presented in Table 3.

result of a change in the level of management and relative rates of adoption of technology following 1971.

The change in pullet costs not accounted for by pullet prices is negative in Ontario, while it fluctuates between negative and positive in San Diego county (see Pullets, row C). No firm conclusions regarding the efficiency of laying management in Ontario relative to that in San Diego county may be made at present. A detailed study of pullet placement techniques is necessary before any conclusions may be drawn.

d) Labour

Labour costs have risen in both San Diego county and Ontario since 1971, and costs in Ontario have risen at a more rapid rate than California costs. The percentage of total costs constituted by labour has not changed greatly over time in either area (see Labour, Table 3).

The change in labour costs not accounted for by rising wage rates is greater in San Diego county than in Ontario, and the difference is increasing. This trend is shown in Figure 20. The apparent relative lag in efficiency of Ontario producers with respect to labour use is consistent with the difference in the number of labour hours required for production in the two areas. While according to the available data the hours required in Ontario have remained constant, they have fallen overtime in San Diego county (see Figure 21). Economies of scale, efficient management

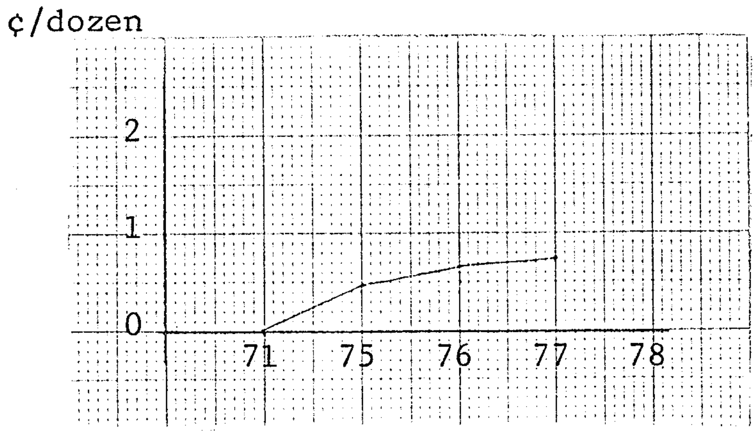


FIGURE 20: Differences between Deflated Labour Costs in Ontario and San Diego County.

SOURCE: The figures upon which this graph is based are presented in Table 4, row C, labour.

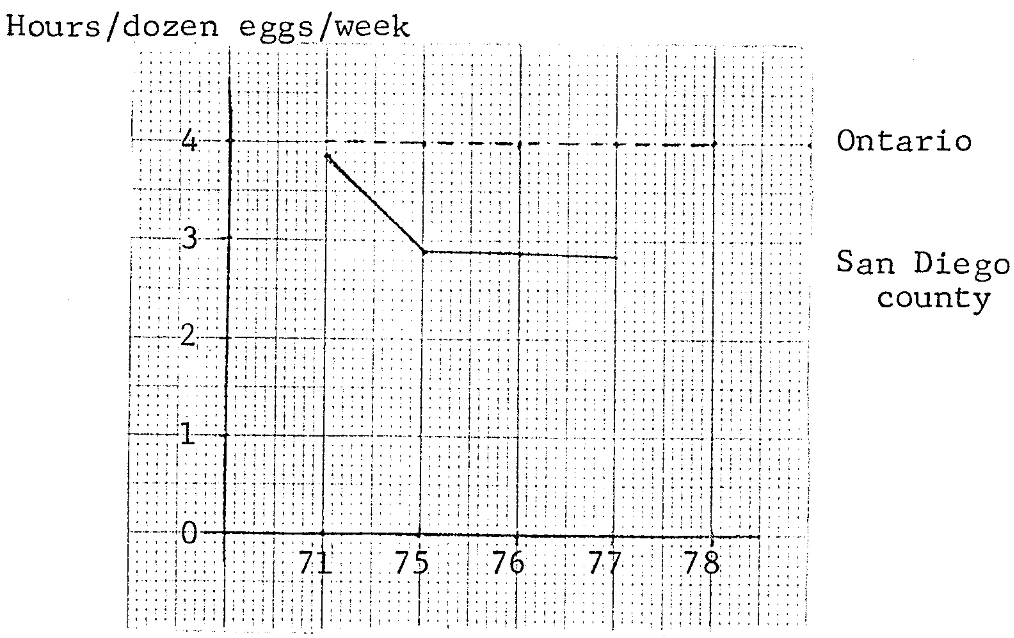


FIGURE 21: Number of Labour Hours Required to Produce Eggs in Ontario and in San Diego County.

SOURCE: The figures upon which this graph is based are presented in Table 3.

techniques and the use of new technologies could explain the fall in required hours in San Diego county. The labour requirements in Ontario suggest that producers in this area are not achieving these efficiencies. The validity of this hypothesis rests on the accuracy of the estimates of labour requirements.

e) Depreciation

Given constant depreciation rates in Ontario and in San Diego county, depreciation charges have risen in Ontario at a faster rate than in San Diego county since 1971 (see Depreciation, Table 3). This indicates that investment per bird has become increasingly higher in Ontario relative to San Diego county (see Figure 22). This pattern of investment costs is consistent with the hypothesis that scale economies are being achieved in California, lowering the per unit costs of production, and that the excess capacity present in the Ontario egg industry in 1971 has not disappeared.

f) Interest

Interest costs in Ontario and San Diego county have diverged and then come together since 1971 (see Interest, Table 3). The portion of the change in interest costs which is not attributable to changes in interest rates in Ontario relative to California rose between 1971 and 1977 and fell slightly in 1978, as shown in Figure 23. This trend indicates that total investment per bird has risen in Ontario relative to the U.S. in recent years. Interest cost

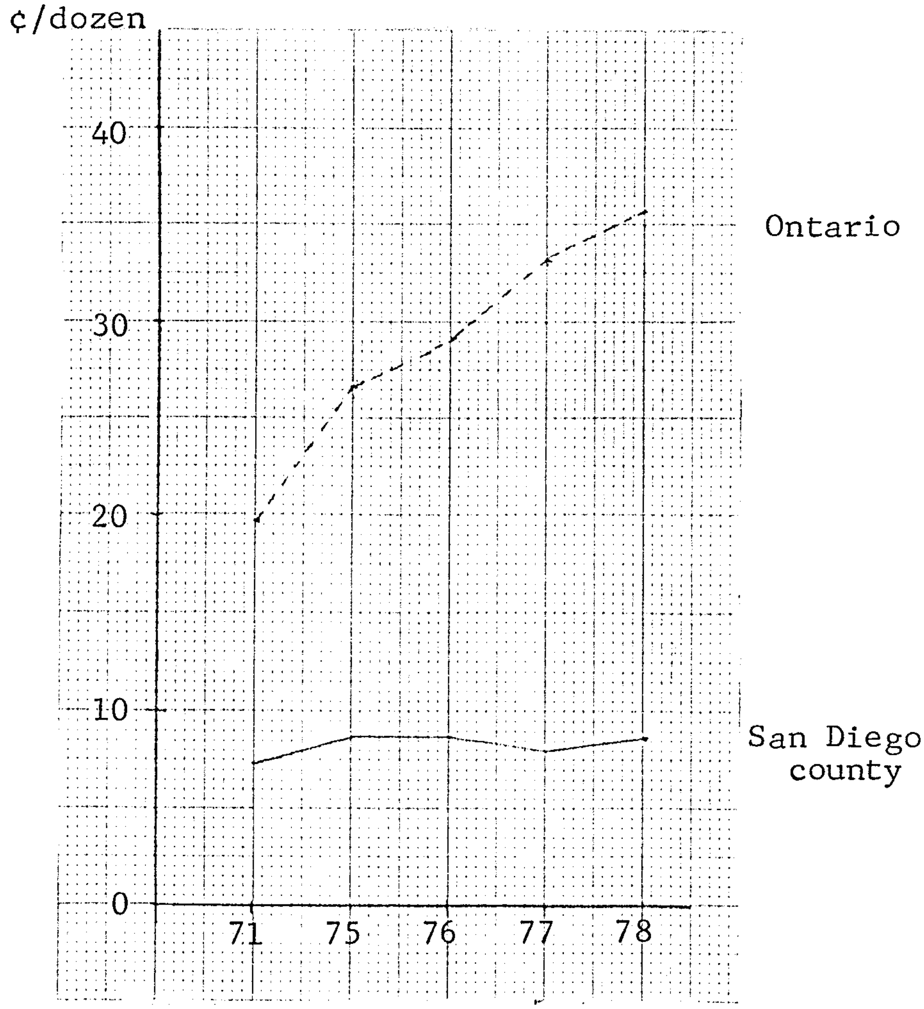


FIGURE 22: Investment per Dozen Eggs in Buildings and Equipment in San Diego County and Ontario.

SOURCE: The figures upon which this graph is based are presented in Table 3.

figures support the theory that economies of scale are being achieved in San Diego county relative to Ontario. However, the sources of investment cost changes in the two areas cannot be identified with certainty without examining factors such as the relative level of tax incentives for investment, and the relative availability of credit.

g) Miscellaneous

Plant, administration and marketing board costs rose at a significantly higher rate in Ontario than in San Diego county after 1971 (see Miscellaneous, Table 3). While these costs fluctuated between 3.1 percent and 3.9 percent of total cost in California, in Ontario they rose from 5.3 percent to 17.2 percent of total costs. A large portion of this increase is due to the marketing board fees in Ontario, ranging from $.00093 per dozen in 1971 to $.07 per dozen in 1978. The treatment of the marketing board fee as a production cost is open to debate. The fee presently consists of 4½¢ for surplus disposal, and 2½¢ for administration and promotion. It is difficult, without further study, to determine whether the explicit fee is less than or exceeds comparable, inexplicit costs in an unregulated industry. However, because the fee is unavoidable to producers and is passed on as a cost to consumers, a comparison of miscellaneous costs including the fee has been made in this study.

In order to deflate the miscellaneous costs in each area by input prices, miscellaneous price indexes for each

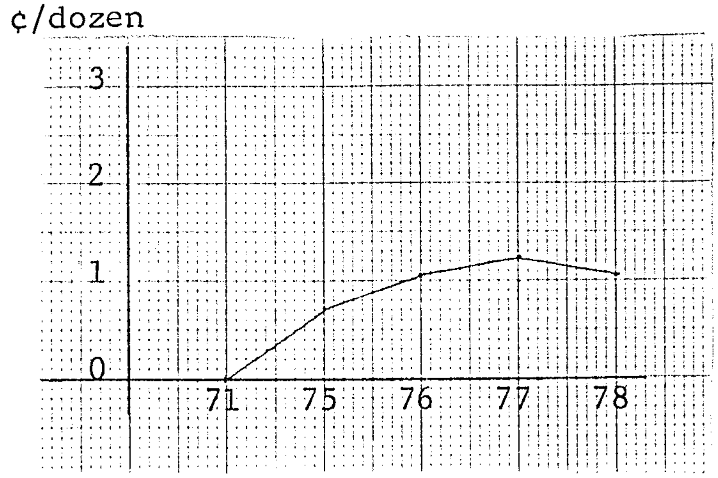


FIGURE 23: Difference between Deflated Interest Costs in Ontario and San Diego County.

SOURCE: The figures upon which this graph is based are presented in Table 4, row C, Interest.

country have been used. When the marketing board fees are included in miscellaneous costs, the change in costs not due to input prices rises at a significantly faster rate in Ontario than in California (see Miscellaneous, row C, Table 4). When marketing board fees are removed from Ontario miscellaneous costs, deflated miscellaneous costs still rise at a relatively faster rate in Ontario than in San Diego county. The two cases are shown in Figure 24. Assuming the indexes used accurately reflect the prices of the inputs included in the miscellaneous category and that relative energy requirements have not changed, it appears that a combination of board fees and the relatively inefficient use of miscellaneous inputs may have resulted in a change in the level of miscellaneous costs in Ontario relative to those in California. Further research into the effectiveness of board activities in Ontario and comparable activities in southern California is necessary before firm conclusions are made.

Grade A Conversion Factor

The CEMA pricing formula is assumed to represent the costs of producing medium sized eggs, and in order to determine the costs of producing other sizes of eggs, a conversion factor is added to the basic cost. The conversion factor is positive for large and extra large eggs, and negative for small, grade B and grade C eggs.

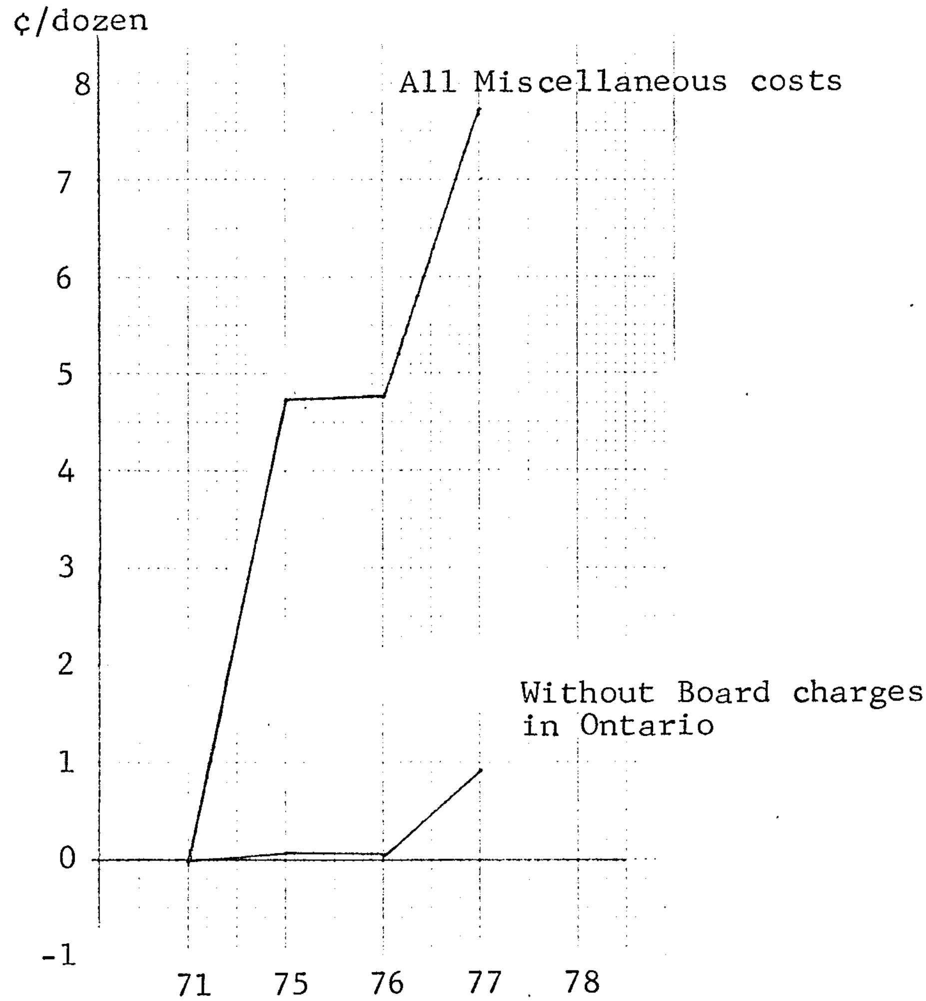


FIGURE 24: Difference between Deflated Miscellaneous Costs, With and Without Marketing Board Costs in Ontario and San Diego County.

SOURCE: The figures upon which this graph is based are presented in Table 4, row C, Miscellaneous.

The decision to use medium sized eggs as the base for the conversion factor is questionable since approximately 64 percent of eggs produced are large or extra large. The use of the conversion factor may result in either a positive or negative subsidy to producers, depending on the level and distribution of egg prices (see Table 5). The size of any premiums received increase with the volume of production, and therefore large, efficient producers may receive excess returns as a result of the conversion factor. Managerial slack may result.

Size of Operation

In San Diego county, the average size of operation has increased over time, from 13,000 birds per flock in 1961 to 79,000 birds per flock in 1978. This trend is shown in Figure 23. The trends in flock size distributions in California over time are shown in terms of two flock size breakdowns in Figures 24 and 25. It appears that the percentage of flock sizes under 10,000 birds is falling while the percentage of flock size over 10,000 is rising.

No series of data for average flock sizes was available for the Ontario egg industry. However, the flock size distributions over time were examined and compared with those in California. Since 1966, the percentage of flocks of under 5,000 birds has fallen, while the percentage of flocks over 5,000 has risen (see Figure 24). A more detailed breakdown for flocks in Ontario over 5,000 birds was

TABLE 5

Calculation of Premiums to Producers Resulting from Conversion Factor for Egg Size

Case #1 May 1975

Egg Size	Percentage of Total Production	[(Price)-(price of medium eggs)]	Weighted Premium (① x ②)	Sum of Premiums
Extra Large, grade A	20.2 } 63	7.7¢	1.5554¢	} Σ = 3.8666¢
Large, grade A	42.8	5.4¢	2.3112¢	
Medium, grade A	23.4	0	-	
Small, grade A	5.5	-14.2¢	.781¢	} Σ = 3.0734¢
PeeWee, grade A	.9	-35.2¢	.3168¢	
grade B	2.6	-16.8¢	.4368¢	
grade C	4.6	-33.6¢	1.5456¢	
Difference of Sums				+.7932¢

RESULT: .8¢/dozen premium.

Case #2 May 1976

Egg Size	Percentage of Total Production	[(Price)-(price of medium eggs)]	Weighted Premium (① x ②)	Sum of Premiums
Extra Large, grade A	22.5 } 65.8	6.4¢	1.44¢	} Σ = 3.085¢
Large, grade A	43.3	3.8¢	1.645¢	
Medium, grade A	21.2	0	-	
Small, grade A	5.6	-20.1¢	-1.126¢	} Σ = 3.881¢
PeeWee, grade A	.8	-49¢	- .392¢	
grade B	2.2	-21.8¢	- .48¢	
grade C	4.4	-42.8¢	-1.883¢	

(Continued)

TABLE 5 (Continued)

Egg Size	Percentage of Total Production	[(Price)-(price of medium eggs)]	Weighted Premium (① x ②)	Sum of Premiums
Difference of Sums				-.796¢
RESULT: -8¢/dozen loss.				
Case #3 May 1977				
Extra Large, grade A	20.1 } 64.9	8.6¢	1.7286¢	} Σ = 4.612¢
Large, grade A	44.8	6.5¢	2.912¢	
Medium, grade A	22.5	0	-	
Small, grade A	5.5	18.6¢	1.023¢	} Σ = 3.9559¢
PeeWee, grade A	1.01	50.4¢	.509¢	
grade B	1.81	25.35¢	.4589¢	
grade C	4.31	45.6¢	1.9659	
Difference of Sums				+.6561¢
RESULT: +.7¢/dozen premium.				

SOURCE: Canada Department of Agriculture, Markets Information Services and Poultry Division, "Poultry Market Report," May 1975, May 1976, and May 1977.

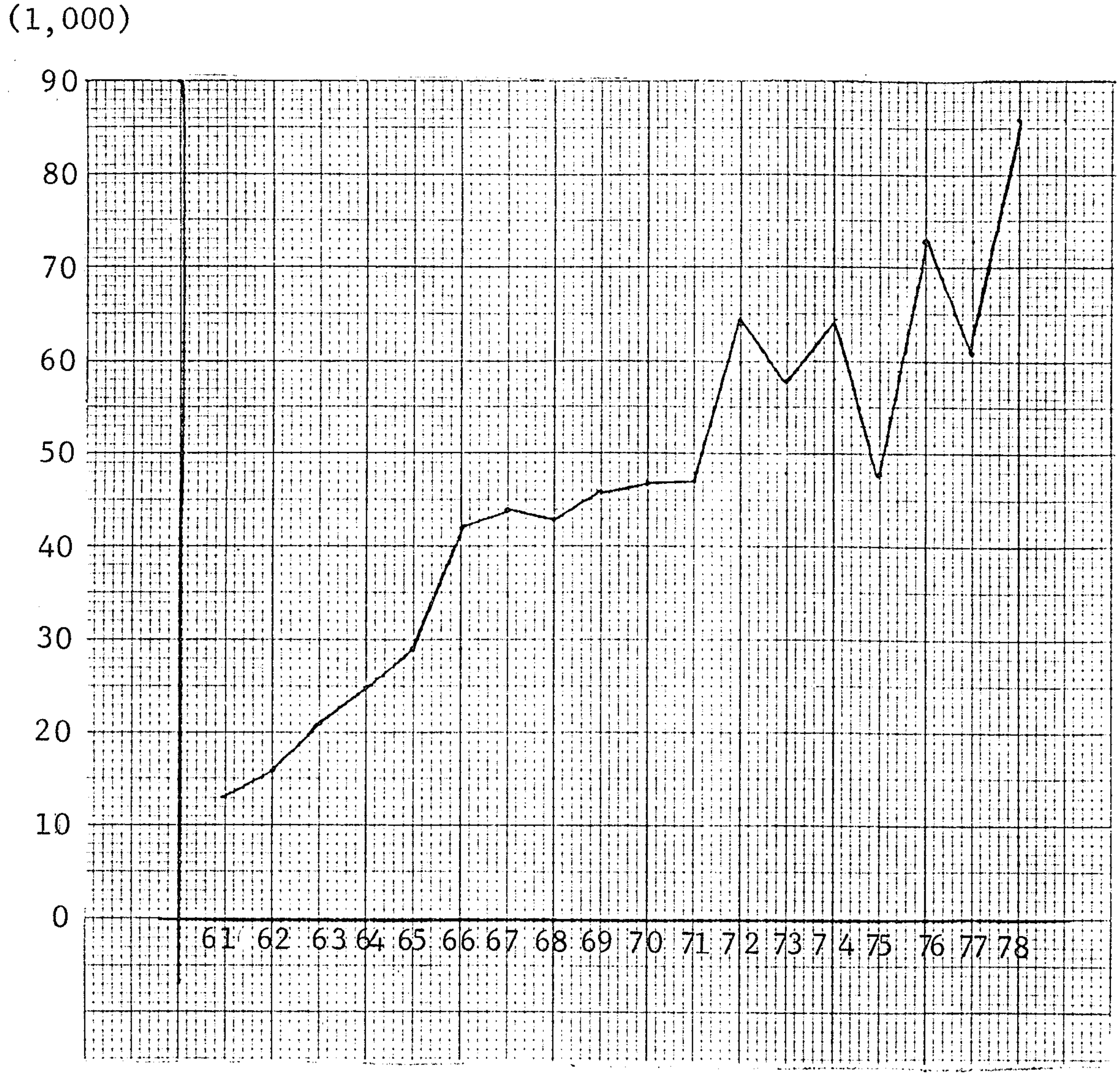
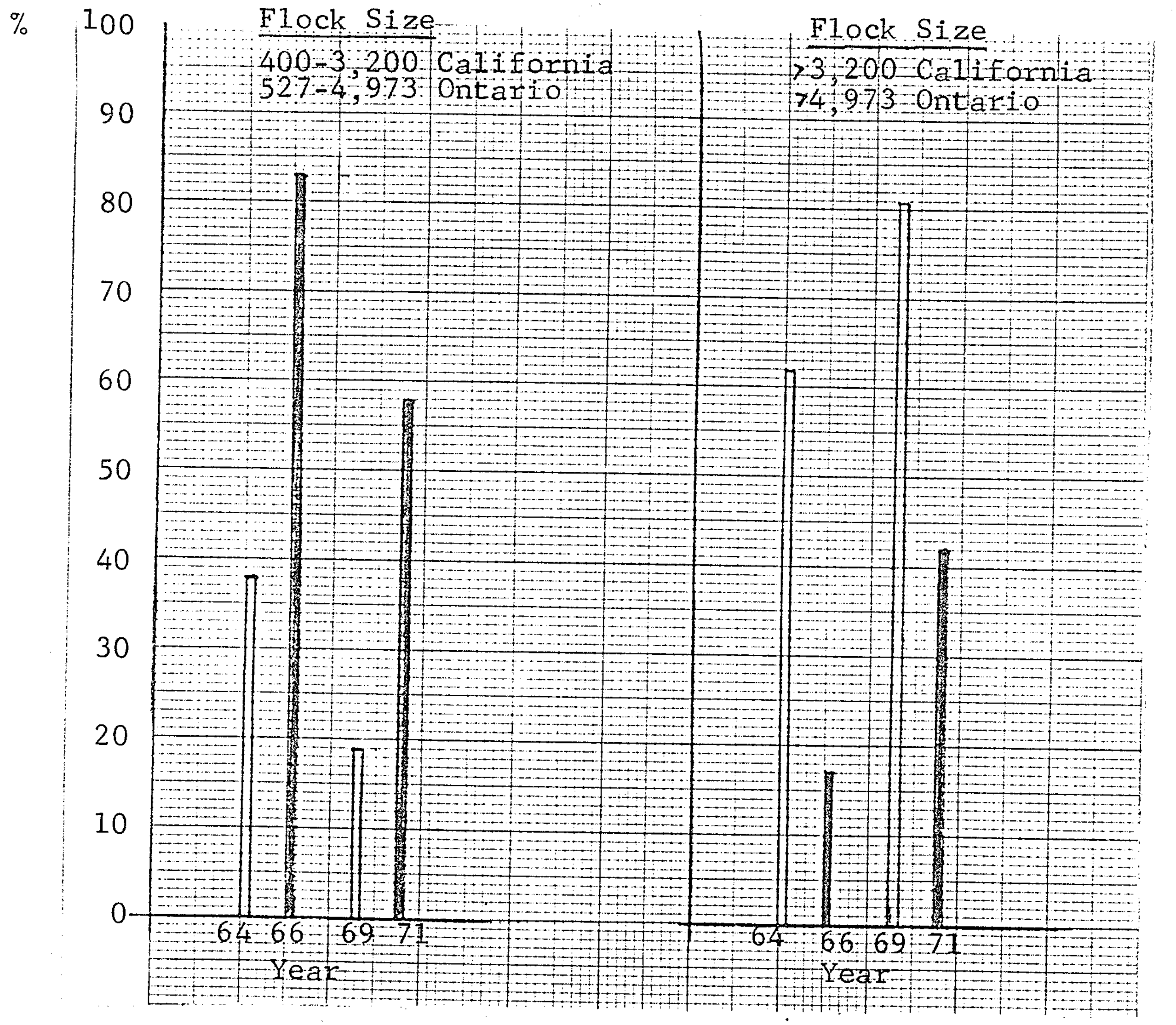


FIGURE 25: Average Flock Size, San Diego County, California 1961-78.

SOURCE: R. A. Adolph, "1978 Poultry Egg Cost Study," Co-operative Extension, University of California, San Diego, California.

FIGURE 26 : Comparison of Flock Size Distributions in Ontario and California. (Two way breakdown)

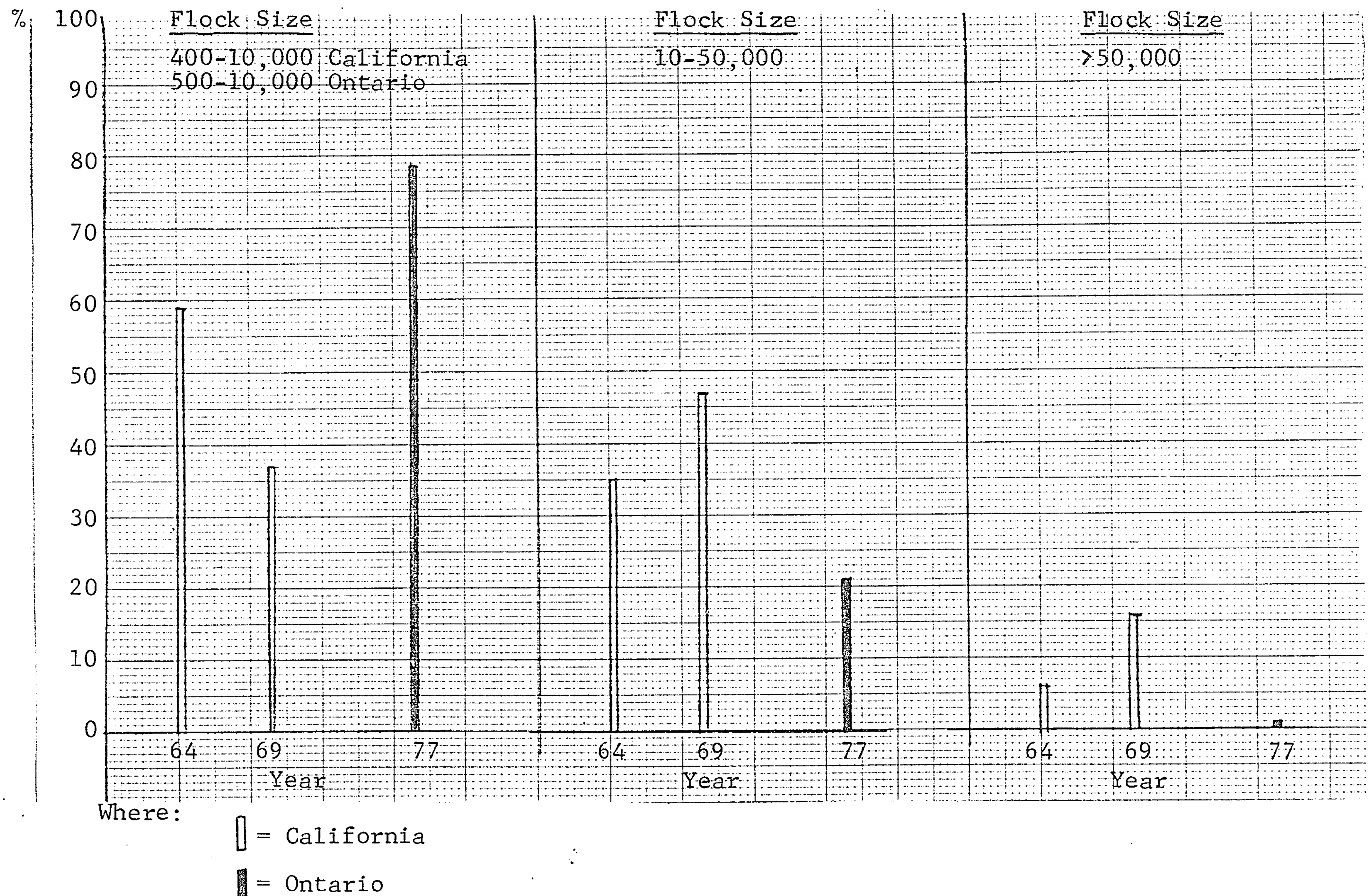


Where: ▯ = California

▮ = Ontario

SOURCE: Taken from figures presented in Appendix Table A-5.

FIGURE 27: Comparison of Flock Size Distributions in Ontario and California. (Three way breakdown)



Where:

= California

= Ontario

SOURCE: Taken from figures presented in Appendix Table A-5.

available only for 1977. The number of small flocks under 10,000 is much greater in Ontario than in California, while the number of flocks over 10,000 birds in Ontario is significantly less than in California (see Figure 25). Given a limit on flock expansion in Ontario of 25,000 birds, the upper half of the distribution will remain constant over time, and the difference between flock size distributions in California and Ontario will increase, assuming that present trends in California continue.

CHAPTER VI

SUMMARY, CONCLUSIONS AND LIMITATIONS

Summary

The difference between San Diego county and Ontario production costs in the control period was assumed to be the result of factors not associated with the introduction of regulation in Ontario, since the egg industries in both areas were assumed to be subject to competitive pressures at the time.[57]

There have been increases in production costs in Ontario relative to those in San Diego county since 1971 which are not accounted for by changes in input prices. The budget components which show an increase in deflated costs in Ontario relative to San Diego county include the labour, miscellaneous, interest and depreciation components. The precise sources of the increases in deflated investment, labour and miscellaneous costs per unit of output in Ontario relative to San Diego county could not be determined due to insufficient information. The level of investment may depend on the scale of operation, the level of

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[57] An exception to this assumption is the high level of investment costs in Ontario in 1971, which has been attributed to producer anticipation of the introduction of the supply management program.

managerial skill, the tax structure and the availability of credit. Labour use may depend on the scale of operation, the level of managerial skill, and available technology and labour. Deflated miscellaneous costs may depend on the scale of operation, the level of managerial skill and the institutional structure.

The sources of changes in input use which were explored theoretically in this study include the scale of operation, the level of managerial skill and the institutional structure. The scale of operation and managerial skill may affect input use through technical economies of scale and management decisions regarding production procedures, respectively.

The institutional structure may affect the level of managerial skill employed if it results in excess returns for some producers and if this environment results in managerial slack. Components of the pricing formula, including the choice of the operation size upon which it is based, and the conversion factor to Grade A large may result in 'above normal' returns to relatively low cost producers.

The institutional structure may affect the scale of operation through quota regulations, and through providing adequate returns for producers operating a certain scale of operation by means of a pricing formula. At present in Ontario, the average flock size is less than that which is estimated to be the minimum optimum size, while that in San Diego county exceeds the estimated minimum optimum size. One source of the considerable difference in average operation size in the two areas may be the variance in pricing systems, and their implications.

Conclusions

This study examined the level of technical efficiency in the Ontario egg industry relative to the egg industry in San Diego county, in an attempt to determine whether CEMA has fulfilled one aspect of the efficiency requirement of the FPMAA. As discussed in the theoretical section, the level of technical efficiency depends upon the scale of operation and the level of managerial skill, and these factors may be affected by the pricing system in the industry.

In the analysis, the level of technical efficiency in Ontario relative to San Diego county was examined by means of a comparison of deflated input costs, or input use. While differences in input use were discovered, the sources of the differences could not be established. An examination of input market conditions was not made, but is necessary in addition to the analysis carried out in this study in order to provide sufficient information for firm conclusions.

On the basis of this study it may be concluded that increases in the level of investment, use of miscellaneous inputs, and labour requirements in Ontario relative to San

Diego county since 1971 are not inconsistent with the theoretical effects of supply management, through its effect on the scale of operation and managerial skill. Information gathered in this study does not suggest that the relative use of feed and pullets has changed in Ontario.

The relatively inefficient scale of operation in Ontario is smaller than the estimated minimum scale at which economies of scale are achieved. The failure in Ontario to achieve the technical efficiencies associated with the scale of operation may be attributed in part to the effects of supply management on the scale of operation in the area, through the pricing formula and quota regulations.

Limitations

The analysis in this study rests on several assumptions. First, it was assumed that the P. S. Ross data accurately reflect the costs of production in a 20,000 bird operation in Ontario. However, the data are a combination of survey results and indexed values, and the results are only as accurate as the indexes and surveys. Second, it was assumed that the costs in the relatively small sample of California farms represent the average production costs of efficient farms in the area. Third, it was assumed that the efficient benchmark constructed on the basis of San Diego county data was adequate for the purposes of this study.

Because of the limited data, certain factors could not be analyzed. It was not possible to completely separate the effects of scale and management due to the use of different farm sizes in the comparison of production costs in Ontario and San Diego county. The extent to which pecuniary economies of scale were present, the effect of differing input market conditions on relative production costs in the two areas, and the extent to which quota values raised production costs in Ontario were not examined. In addition, the analysis was based only on a six year data series because the CEMA supply management program was introduced in 1973. As a result, the conclusions are limited and preliminary.

Suggestions for Further Research

On the basis of the findings of this study, it would appear that a detailed examination of production costs and scale trends in the Canadian egg industry relative to those in a benchmark area is warranted. Consequently, a collection of detailed production data in Canada and in a benchmark area is necessary. This data must include a careful breakdown of input prices, the actual quantities of inputs used and conditions in input markets. In addition, a careful examination of the implications of present policy in the egg industry is recommended in order to ensure that the long run effects of the regulation are both appreciated and desired.

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A P P E N D I X

TABLE A-1

Ontario Data ($ Canadian)

Component	1971	1975	1976	1977	1978
Rate of Lay/Year	17.3	19	19	20	20
Laying Period	60 weeks	55 weeks	55 weeks	55 weeks	55 weeks
Average Flock Size	20,000	20,000	20,000	20,000	20,000
Feed Conversion Ratio	4.25	4.46	4.46	4.24	4.24
Feed Price/Pound	.04	.0734	.0751	.0746	.0767
Pullet Price/Pullet	1.90	2.36	2.43	2.47	2.49
Salvage Price/Bird	.2514	.2631	.3265	.3718	.311
Mortality Rate	20%	18.9%	18.9%	18.8%	18.8%
Labour Rate	2.61	4.00	4.51	4.634 4.022 } 4.4	4.878 4.204 } 4.63
Manufacturing	3.47	5.18	5.87	6.47	6.90
Weight (Man)	.5	.5	.5	Paid .4; Imputed .2	Paid .4; Imputed .2
Farm	1.75	2.81	3.14	3.41	3.53
Weight (Farm)	.5	.5	.5	Paid .6; Imputed .8	Paid .6; Imputed .8
Labour Hours per Bird per Week	4	4	4	Paid 4 x .625 Imputed 4 x .375	Paid 4 x .625 Imputed 4 x .375

(Continued)

TABLE A-1 (Continued)

Component	1971	1975	1976	1977	1978
Depreciation Rate					
-Buildings	.05 x .5588	.05 x .58	.05 x .585	.05 x .4897	.05 x .4947
-Equipment	.10 x .4412	.10 x .42	.10 x .415	.10 x .5103	.10 x .5053
Investment/Bird					
-Buildings Base	2.922 (1975)	2.922 (1975)	2.922 (1975)	3.015 (1976)	3.015 (1976)
Index	100	153.5	170.7	183.9	201
-Equipment Base	2.116 (1975)	2.116 (1975)	2.116 (1975)	3.152 (1976)	3.152 (1976)
Index	100	140.7	153.1	164.4	176.1
Buildings & Equipment Total/Bird	3.40	5.038	5.551	6.633	7.176
Investment in					
-Land	.50	.50	.50	.50	.50
-Pullets and Feed	1.0066	1.2996	1.3374	1.3567	1.3701
-Total/Bird	4.91	6.84	7.39	8.49	9.05
Miscellaneous					
-Repairs & Maintenance	5.12% of Investment in Buildings and Equipment	5.12% of Investment in Buildings and Equipment	5.12% of Investment in Buildings and Equipment	Base .01078, June 76 Index 175.05	Base .01078, June 76 Index 188.05
-Energy				Base .00874 June 76 Index 175.85	Base .00874 June 76 Index 189.2
-Other				Base .0062 June 76 Index 156.5	Base .0062 June 76 Index 163.9

(Continued)

TABLE A-1 (Continued)

Component	1971	1975	1976	1977	1978
Administration					
-Base /Dozen	.0109 (1975)	.0109 (1975)	.0109 (1975)	.0123 (June '76)	.0123 (June '76)
-Index	100	162.6	172.9	180.1	197.4
Interest Rate	.0648	.0942	.1008	.085	.095
Market Board Fee					
-Rate	.02	N/A	N/A	N/A	N/A
-Total /Dozen	.00092	.05	.05	.07	.07

SOURCES: Sources of the figures in this table are listed in Appendix Table A-3.

TABLE A-2

San Diego County Data ($ U.S.)

Component	1971	1975	1976	1977	1978
Rate of Lay/Year	20.4	19.4	19.2	20.5	19
Laying Period[a]	varied	varied	varied	varied	varied
Average Flock Size	47,000	48,000	73,000	61,000	79,000
Feed Conversion Ratio (based on 26 weeks)	4.3	4.8	4.5	4.2	4.4
Feed Price/Pound	.036	.0619	.0637	.0624	.0626
Net Replacements Cost of Pullets/Dozen:					
Pullets	.027	.012	.031	.038	(Pullets & Feed) .062
Labour	.003	.003	.002	.002	.002
Miscellaneous	.003	.002	.035	.04	see Pullets
Feed	.0032	.044	.001	.001	.002
Depreciation	.001	.002	.001	.002	.002
Interest	.001	.002	.001	.002	.002
Management	.008	.003	.002	.003	-
Inventory	- .002	.007	-	- .005	- .003
Cull Credit	- .004	- .006	- .01	- .007	- .008
Total	.0069	.069	.066	.076	.059
Salvage Price/Bird	.14	.21	.32	.30	.32

(Continued)

TABLE A-2 (Continued)

Component	1971	1975	1976	1977	1978
Mortality Rate	20%	13%	13%	13%	12%
Labour Hours/Week per Bird	3.86	2.89	2.88	2.85	-
Labour Rate	1.73	2.45	2.65	2.90	-
Depreciation Rate on Buildings & Equipment	15%	15%	15%	15%	15%
Investment/Dozen: -Buildings & Equipment	.0734	.0867	.0867	.08	.086
-Total	.1625	.1625	.1625	.15	.225
Interest Rate	5.67%	7.73%	6.8%	6.88%	8.98%
Miscellaneous/Dozen	.011	.013	.013	.016	.012
Miscellaneous Index	108	104	116	113	not available
Management/Dozen	.01	.01	.01	.01	.01
Conversion for Pullet Cost	- .0126	- .018	- .013	- .016	N/A data based on 20 weeks
Conversion for Feed Cost	+ .0126	+ .018	+ .013	+ .016	N/A data based on 20 weeks

(Continued)

TABLE A-2 (Continued)

[a] All data are given on an annual basis.

SOURCE: Sources of the figures listed in this table are listed in Appendix Table A-4.

TABLE A-3

Sources of Ontario Data

Item	Year	Source
Rate of Lay per Year	1971	Ontario Royal Commission, adjusted to an annual basis (p. 27)
	1975-76	P.S. Ross, July 1975 (p. 14)
	1977-78	P.S. Ross, July 1977 (p. 19)
Laying Period	1971	Ontario Royal Commission (p. 29)
	1975-76	P.S. Ross, July 1975 (p. 14)
	1977-78	P.S. Ross, July 1977 (p. 22)
Average Flock Size	1971	Ontario Royal Commission (p. 25)
	1975-76	P.S. Ross, July 1975 (p. 12)
	1977-78	P.S. Ross, July 1977 (p. 14)
Feed Conversion Ratio	1971	Ontario Royal Commission (p. 27)--may be overstated slightly as this estimate is based on a flock size of 10,000
	1975-76	P.S. Ross, July 1975 (p. 19)
	1977-78	P.S. Ross, July 1977 (p. 23)
Feed Price per Pound	1971	Ontario Royal Commission (p. 27)
	1975-78	Quarterly prices quoted by CEMA. Prices are derived from Canadian Livestock Feed Board, "Weekly Wholesale Mixed Feed Prices Report," provincial average for 16% - 18% laying mash FOB mill door plus delivery charge. Yearly averages calculated. P.S. Ross, July 1975 (p. 19) and P.S. Ross, July 1977 (p. 24)

(Continued)

TABLE A-3 (Continued)

Item	Year	Source
Pullet Price per pullet	1971	Ontario Royal Commission (p. 27)
	1975-78	Quarterly prices quoted by CEMA. Average price of 20 week old pullets, delivered. Yearly averages calculated. P.S. Ross, July 1975 (p. 16) and P.S. Ross, July 1977 (p. 21)
Salvage Value per Bird	1971 & 1975-78	Computed according to P.S. Ross Methodology: $\left[\frac{\text{Pounds of Fowl}}{\text{No. of Fowl}}\right]$ x 1.333 x Price to Producer (Live Fowl under 5 lbs.) 1.333 is the eviscerated to live weight conversion factor. Quarterly figures are averaged to give yearly estimates. P.S. Ross, July 1975 (p. 17) and P.S. Ross, July 1977 (p. 21)
Mortality Rate	1971	Adjusted from 15% to 20% according to information presented in Ontario Royal Commission (p. 29)
	1975-76	P.S. Ross, July 1975 (p. 17)
	1977-78	P.S. Ross, July 1977 (p. 21)
Labour Hours per Week per 1,000 Birds	1971	Ontario Royal Commission (p. 27)
	1975-76	P.S. Ross, July 1975 (p. 20)
	1977-78	P.S. Ross, July 1977 (p. 25)
Labour Rate per Hour	1971, 1975, 1976	Average of the Average Yearly Ontario Manufacturing Hourly Wage (Statistics Canada 72-002) and the Average Ontario Wage for Farm Help without Board (Statistics Canada 21-003) P.S. Ross, July 1975 (p. 21)

(Continued)

TABLE A-3 (Continued)

Item	Year	Source
Labour Rate per Hour	1977-78	(.4 x Manufacturing Wage + .6 x Farm Wage) = paid. (.2 x Manufacturing Wage + .8 x Farm Wage) = imputed. Total = (paid wage x .625) + (imputed wage x .375) Computed according to P.S. Ross Methodology. P.S. Ross, July 1977 (p. 25)
Depreciation Rate	1971 & 1975-78	$\left[\text{Investment in Buildings} \times \frac{\text{Investment in Buildings}}{\text{Investment in Buildings \& Equipment}}\right]$ x (Depreciation Rate for Buildings) plus $\left[\text{Investment in Equipment} \times \frac{\text{Investment in Equipment}}{\text{Investment in Buildings \& Equipment}}\right]$ x (Depreciation Rate for Equipment) P.S. Ross, July 1975 (p. 16) P.S. Ross, July 1977 (p. 32)
Investment per Bird--	1975	Investment in B, Investment in E } Base Value P. S. Ross, July 1975 (p. 12)
Buildings (B) & Equipment (E)	1971, 1976	Indexed from Base Value according to the Annual Average of Building and Fencing Index, Canada (B) and the Annual Average of Farm Machinery and Motor Vehicles, Canada (E)
	1977	Investment in B, Investment in E } Base Value, P. S. Ross, July 1977, (p. 17)
	1978	Indexed from 1977 Base Value according to the same indexes as in 1971 and 1976

(Continued)

TABLE A-3 (Continued)

Item	Year	Source
Investment/ Bird Land	1971 & 1975-78	P. S. Ross, July 1975 (p. 14) P. S. Ross, July 1977 (p. 17)
Investment/ Bird Pullets & Feed		Pullets - (Price of Pullet) x ½ Feed - $\frac{\left[\text{Feed Conversion Ratio}\right] \times \left[\text{Price/lb.}\right] \times \left[\text{Rate of Lay}\right]}{52}$ P. S. Ross, July 1975 (p. 14) P. S. Ross, July 1977 (p. 19)
Interest Rate	1971 & 1975-78	Rate taken from Bank of Canada Review, Selected & International Interest Rates, including bank yields and interest arbitrage, Chartered Bank Lending Rate, Prime Business Loans, B14020
Plant	1971 & 1975-76	$\left[\frac{\text{Plant Cost}}{\text{Investment in B\&E}}\right]$ x Investment in B & E P. S. Ross, July 1975 (p. 22)
	1977-78	- (Repairs & Maintenance Base) x (Average of the Index for Building Repairs and the Index for Machinery and Motor Vehicles Operation) - (Energy Base) x (Average of the Index for Petroleum Products and the Index for Electricity) - ('Other' Base) x (Index for Small Tools) P. S. Ross, July 1977 (p. 29)
Administration	1975	Base Value. P. S. Ross, July 1975 (p.22)
	1971, 1976	Indexed from Base according to Total Farm Input Price Index, Canada
	1977	Base Value, P. S. Ross, July 1977 (p. 29)
	1978	Indexed from 1977 Base Value according to the same index as in 1971 and 1976

(Continued)

TABLE A-3 (Continued)

Item	Year	Source
Marketing Board Fee	1971	Rate on birds sold for salvage. Ontario Royal Commission (p. 27)
	1975, 1976	Standard Charge. P. S. Ross, July 1975, Appendix D
	1977-78	Standard Charge, National Farm Products Marketing Council Annual Report 1977-78 (p. 30)

TABLE A-4

Sources of San Diego County Data

Item	Year	Source
Rate of Lay per Year	1971, 1975,	1975 Poultry Egg Cost Study, San Diego County
	1976-78	1978 Poultry Egg Cost Study, San Diego County
Laying Period	1971 & 1975-78	All data provided is annual
Average Flock Size	1971 & 1975-78	1978 Poultry Egg Cost Study, San Diego County
Feed Conversion Ratio	1971, 1975	1975 Poultry Egg Cost Study, San Diego County
	1976-78	1978 Poultry Egg Cost Study, San Diego County
Feed Price per Pound	1971 & 1975-78	1978 Poultry Egg Cost Study, San Diego County
Pullet Price per pullet		Derived from information given in 1975 & 1978 Poultry Egg Cost Studies as follows: [(Flock size x pullet price) - (flock size x % salvaged x salvage price)] ÷ (flock size x rate of lay)
Salvage Value per Bird	1971 & 1975-78	1978 Poultry Egg Cost Study, San Diego County
Mortality Rate	1971 & 1975-78	1978 Poultry Egg Cost Study, San Diego County

(Continued)

TABLE A-4 (Continued)

Item	Year	Source
Labour Hours per Week per 1,000 Birds	1971 & 1975-78	Derived from assumed labour rate and total labour cost given in 1975 & 1978 Poultry Egg Cost Studies as follows: $\frac{\text{Wage x Hours/Bird/Year}}{\text{Rate of Lay}}$
Labour Rate per Hour	1971	USDA Agricultural Statistics 1978 Table 608
	1975-78	USDA Agricultural Statistics 1978 p. 433, Table 625 Defined as US Cash Wages Only (All hourly workers who are not receiving prerequisites
Management Cost per Dozen	1971,	1975 Poultry Egg Cost Study, San Diego County
	1976-78	1978 Poultry Egg Cost Study, San Diego County
Depreciation Rate	1971, 1975	1975 Poultry Egg Cost Study, San Diego County
	1976-78	1978 Poultry Egg Cost Study, San Diego County
Investment in Buildings & Equipment	1971 & 1975-78	Derived from information given in 1975 & 1978 Poultry Egg Cost Studies as follows: $\frac{\text{Depreciation Rate}}{100} = \frac{\text{Depreciation Charge}}{\text{Investment in Buildings \& Equipment}}$
Total Investment (Land, Stock, B & E)	1971 & 1975-78	Derived from information given in 1975 & 1978 Poultry Egg Cost Studies as follows: $\frac{\text{Interest Rate Assumed}}{100} = \frac{\text{Interest Charge}}{\text{Total Investment}}$

(Continued)

TABLE A-4 (Continued)

Item	Year	Source
Interest Rate	1971 & 1975-78	Rate taken from Bank of Canada Review, Selected and International Interest Rates, including bond yields and interest arbitrage, Prime Rate Charged by Banks B54404
Miscellaneous	1971, 1975	1975 Poultry Egg Cost Study, San Diego County
	1976-78	1978 Poultry Egg Cost Study, San Diego County
Miscellaneous Index	1971, 1975-78	USDA Agricultural Statistics 1978, Table 635, p. 441

TABLE A-5

A Comparison of Farm Size Distributions in Ontario and California

Size of Farm (# of Birds)	California 1964	Ontario 1966	California 1969	Ontario 1971	California 1977	Ontario 1977
400 - 3,200 527 - 4,973	524 (38%)	168 (83%)	172 (19%)	1,031 (58%)	N/A	N/A
>3,200 >4,973	885 (62%)	334 (17%)	737 (81%)	76 (42%)	N/A	N/A
400 - 10,000 500 - 10,000	1,252 (59%)	N/A	429 (37%)	N/A	N/A	789 (78.5%)
10 - 50,000	759 (35%)	N/A	553 (47%)	N/A	N/A	209 (21%)
>50,000	126 (6%)	N/A	184 (16%)	N/A	N/A	6 (.5%)

SOURCES: 1964 California Census of Agriculture, Section 1, p. 35.

1969 California Census of Agriculture, Section 1, p. 48.

Minister of Supply and Services Canada 1978, National Farm Products Marketing Council, Annual Report, 1977-78, p. 63.