FEED COSTS, POLICY AND DEVELOPMENT IN NOVA SCOTIA

by

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Abstract

The aim of this research is to evaluate the economic effects of transforming freight subsidies on feed grain shipments to Nova Scotia into equivalent output based payments to livestock and poultry producers. Changes in the long term federal policy of feed freight equalization (and recently other elements of the domestic feed grain policy) have negatively impacted upon the economic position of farms in the province. The purpose of the policy change considered here would be to alleviate the harmful consequences of reduced freight equalization and to facilitate adjustment. (Producers, farm organizations, regional politicians, and federal ministers have all stated this as a shared policy objective.) The analysis is also applicable to any planning or decision making with respect to minimizing the negative effects of any future termination of the program entirely.

A partial equilibrium static analysis is carried out at the individual subsector level to estimate the gains in producer welfare brought about by the removal of feed input price distortions. Static welfare gains are found to arise both from the utilization and the production of feed stuffs. The price elasticity of feed grain production in Nova Scotia is estimated as elastic in the intermediate term. A number of leakages of program benefits with the current system of payments are also found and assessed. Producers would realize corresponding benefit transfers as a result of the proposed change. The incremental public administration costs are estimated on the basis of current capacities and agencies in place. Such estimated costs are below the value of price efficiencies. The

additional presence of transfer benefits for producers further increase the cost effectiveness of addressing the unsatisfactory position of producers in this manner.

The implications which the policy change (and an undistorted input price environment) would have on the rates and directions of technical change in the agricultural industry are also considered. The induced innovation hypothesis is reviewed with related theories, models, and empirical research. A survey is made of the prospects for wide ranging, and frequently location specific, technical change which could over time reduce the industry's competitive disadvantage with respect to feed costs. Evidence of past induced technical change in the industry's production and utilization of feed inputs is reported.

The removal of feed input price distortions is seen as neither a necessary nor sufficient condition for the accelerated technical progress which would restore the industry's competitive position. However, it is argued to be a necessary condition for any public program to be cost effective in achieving this end or related targets. A sensitivity analysis is made of the induced technical change benefits which could be expected to arise if the policy were changed for the next fifteen years.

The proposed policy change is analyzed and found to be a low cost, high pay-off regional development project. It is found that it could significantly contribute to the alleviation of the serious problems which have arisen from the unplanned manner in which feed freight equalization was reduced in Nova Scotia.

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Chapter 1

Introduction

An important policy affecting the economics of livestock and, feed grain production in Nova Scotia has been Feed Freight Equalization or what is now termed the Feed Freight Assistance Program (FFA) of the Federal Government. FFA has subsidized either all or part of the cost of transporting prairie feed grains to other provinces since 1941 (and Ontario corn eastward since 1967). The investment decisions of farms and related businesses have been influenced in this period. The policy may have also affected regional agricultural technologies in regard to their directions and rates of change.

In the past decade there have been reductions in the real rates of assistance provided by FFA for shipments of feed grain into Nova Scotia. Feed costs as a result have risen relative to other livestock production areas in Canada and the U.S. These cost increases resulting from policy changes were unanticipated. They also occurred simultaneously with short term public incentives for livestock expansion which increased feed grain demand. Segments of the industry now face substantial farm attrition as a direct result of these policies.

One policy option that may address the immediate feed cost problems of the industry (and the need to accelerate adjustment and development) is the restructuring of the FFA Program from an input to an output based payment system. This was requested in 1982 by the

Nova Scotia Federation of Agriculture.[1] The Maritime Farmers Council[2] later called for a partial restoration of assistance to the historic (real) levels which prevailed in the past (1975-76) and a restructuring of the FFA Program from a freight/input to be a product/ouput basis. The disincentives for crop development and adjustment resulting from freight subsidies were a major concern. It was felt that FFA restructuring together with increased public technical support would result in the region moving steadily towards a position where the subsidy could be eventually eliminated with minimal negative consequences.[3]

1.1 Background

FFA today is a relatively minor element of the agricultural policy[4] of the Federal Government. It was at one time however, a major national program.[5] In 1976 following the development of corn

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1 Nova Scotia Federation of Agriculture, "The Domestic Feed Grain Policy and Nova Scotia Agriculture." Submission to the Technical Consultations on the Domestic Feed Grain Policy, Halifax, August 25, 1982.

2 Maritime Farmers Council. "Maritime Agriculture and Grain Transportation." Submission to the House of Commons Transport Committee, August, 1983.

3 Three 5 year programs were visualized with the goal of subsidy removal by the year 2000.

4 It is also considered by some to be an aberration to the current policy. For example see: Groenewegen, J.R. "Feed Grain Policy Objectives in Canada," Agriculture Canada, July 1982.
Canada Grains Council, "Domestic Feed Grain Policy Study, Report to the Advisory Committee," October, 1979.

5 Kerr, T. C., "An Economic Analysis of the Feed Freight Assistance Policy", Agriculture Economics Research Council of Canada, Ottawa, 1966, p. 139.

production in Southern Ontario and Western Quebec the geographic scope of the program was reduced such that only shipments to Northern Ontario, Eastern Quebec, the Atlantic Provinces, and British Columbia were eligible for assistance.[6] Since that time freight rate increases combined with only minor adjustments in the assistance rates have reduced the level of "price equalization" for Western feed grains in Eastern Canada and that of Ontario corn prices with the rest of Eastern Canada (see tables 1.1 and 1.2).

Feed grain price equalization has been of most importance to the Maritime Provinces.[7] The competitive basis for livestock feeders in Southern Ontario and Western Quebec had largely shifted to corn before the 1976 policy changes. During the 1970's Ontario moved from a net corn importing to a net exporting position. This transition resulted in Ontario corn prices falling relative to U.S. corn prices and this benefited feeders. Increasingly competitive U.S. corn supplies have also been a factor in offsetting the impact of feed grain policy changes in Quebec. Reductions in the Canadian tariff on corn were a factor in this improved market access. Lower protein feed ingredient prices and greater progress in increasing local feed grain production have further differentiated the Eastern Quebec situation compared with that of the Maritime Provinces.

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6 A more complete historical summary of the policy is outlined in appendix A.

7 Following a series of meeting across Canada in 1982 as part of the "technical consultations" for the Domestic Feed Grain Policy Review, Agriculture Canada officials reported that concerns about feed freight assistance were only expressed in the Maritimes.

Table 1.1

Rail Freight Rates, FFA Rates, and Private Cost of Feed Grain Shipments Ex. Thunder Bay and Chatham to Truro and Port Williams, NS 1973-84

($ per tonne as of July 31)

Year	Truro			Port Williams		
	Rail Freight Rate	FFA Rate	Private Cost	Rail Freight Rate	FFA Rate	Private Cost
			Western Grains Ex. Thunder Bay			
1973	11.46	10.36	1.10	14.33	12.57	1.76
1974	11.90	10.36	1.54	14.27	12.57	2.20
1975	17.86	10.36	7.50	21.38	12.57	8.81
1976	20.50	10.36	10.14	24.03	12.57	11.46
1977	22.48	10.40	12.08	26.00	12.60	13.40
1978	24.91	10.40	14.51	28.00	12.60	15.40
1979	28.22	10.40	17.82	31.31	12.60	18.71
1980	32.62	10.40	22.22	35.71	12.60	23.11
1981	36.81	10.40	26.41	39.90	12.60	27.30
1982	42.77	10.40	32.37	45.85	12.60	33.25
1983	45.41	10.40	35.01	48.49	12.60	35.89
1984	47.63	10.40	37.23	50.94	12.60	38.34
1985	50.27	12.40	37.87	53.58	15.60	37.98
			Ontario Corn Ex. Chatham			
1973	11.47	5.29	6.18	11.03	7.50	3.53
1974	11.91	5.29	6.62	11.47	7.50	3.97
1975	13.23	5.29	7.94	15.44	7.50	7.94
1976	16.54	5.29	11.25	19.40	7.50	11.90
1977	19.18	6.00	13.18	22.71	8.20	14.51
1978	20.73	6.00	14.73	24.48	8.20	16.28
1979	23.37	6.00	17.37	27.12	8.20	18.92
1980	27.12	6.00	21.12	30.87	8.20	22.67
1981	31.09	6.00	25.09	35.06	8.20	26.86
1982	35.94	6.00	29.94	39.91	8.20	31.71
1983	38.81	6.00	32.81	43.22	8.20	35.02
1984	40.79	6.00	34.79	45.42	8.20	37.22
1985	42.34	8.00	34.34	47.19	11.20	35.99
1986	44.98	8.00	36.98	50.05	11.20	38.85

Source: Atlantic Province Transportation Commission.

Table 1.2

Rail Freight Rates, FFA Rates, and Private Cost of Feed Grain Shipments Ex. Thunder Bay and Chatham to Truro and Port Williams, Nova Scotia 1973-84

(Constant 1971 Dollars per tonne as of July 31)

Year	Truro Rail Freight Rate	Truro FFA Rate	Truro Private Cost	Port Williams Rail Freight Rate	Port Williams FFA Rate	Port Williams Private Cost
			Western Grains Ex. Thunder Bay			
1973	10.00	9.04	0.96	12.50	10.97	1.53
1974	9.01	7.84	1.17	10.80	9.52	1.28
1975	12.21	7.08	5.13	14.61	8.59	6.02
1976	12.78	6.46	6.32	14.98	7.84	7.14
1977	13.05	6.04	7.01	15.09	7.31	7.78
1978	13.55	5.66	7.89	15.23	6.86	8.37
1979	13.92	5.13	8.79	15.45	6.22	9.23
1980	14.48	4.62	9.86	15.86	5.60	10.26
1981	14.77	4.18	10.59	16.02	5.06	10.96
1982	15.60	3.79	11.81	16.72	4.60	12.12
1983	15.66	3.59	12.07	16.72	4.34	12.38
1984	15.73	3.43	12.30	16.82	4.16	12.66
1985	15.84	3.91	11.93	16.89	4.92	11.97
			Ontario Corn Ex. Chatham			
1973	10.01	4.62	5.39	9.62	6.54	3.08
1974	9.02	4.00	5.02	8.68	5.68	3.00
1975	9.04	3.62	5.42	10.55	5.13	5.42
1976	10.31	3.30	7.01	12.09	4.68	7.41
1977	11.13	3.48	7.65	13.18	4.76	8.42
1978	11.04	3.19	7.85	13.04	4.46	8.58
1979	11.53	2.96	8.57	13.38	4.05	9.33
1980	12.04	2.66	9.38	13.71	3.64	10.07
1981	12.48	2.41	10.07	14.07	3.29	10.78
1982	13.11	2.19	10.92	14.56	2.99	11.57
1983	13.38	2.07	11.31	14.90	2.83	12.07
1984	13.98	1.98	12.00	15.58	2.71	12.87
1985	13.34	2.52	10.82	14.87	3.53	11.34

Farm prices received by Maritime livestock and poultry producers are at most slightly above Central Canada prices (chickens, eggs, turkey, fluid milk). For some commodities farm prices are essentially the same (hogs, industrial milk) and there are regional market circumstances for which farm prices are below the levels in Ontario and Quebec (particular classes of cattle, fowl, lambs). Dairy products, poultry and egg prices are not market determined although regional price differences are determined by transport and other transaction costs in the case of the later two commodities.

The reductions in feed grain price equalization combined with public incentives for substantial nonrumminant livestock expansion (hogs) and other economic developments have resulted in the Maritime Provinces accounting for an increasing share of eastern Canada feed expenditures. Furthermore, these are increasingly disproportional to livestock receipts (See table 1.3).

Farm feed expenditures in the particular case of Nova Scotia are the highest of any province relative to total farm operating expenses or to gross farm income. In 1984 provincial feed expenditures were $64.7 million accounting for 36% of total industry operating expenses. Increases in the comparative costs of the industry's largest purchased input has had serious consequences for agriculture in the province. Farm organizations have accordingly given this policy issue their highest priority. In recent years the Nova Scotia Federation of Agriculture has made more special trips to Ottawa on these matters than for all other issues combined.

A major political issue at this time involves the historic guarantee of feed grain price equalization. The Livestock Feed Assistance Act[8] ensures the "fair equalization of feed grain price in Eastern Canada".[9] Between 1976 and 1984 freight rates for feed grain shipments to the Maritimes increased by $30/tonne. This occurred for both Western grains and Ontario grains. The only adjustment in the FFA Program, however, was a $2-3/tonne increase in FFA rates made in 1984. Freight rate increases in 1985-86 have now more than offset the small 1984 increases in assistance rates.

A high level of price equalization with Thunder Bay was maintained by the policy until feed grain self-sufficiency was approached in Ontario and western Quebec. The policy statements in 1974[10] and 1976[11] which introduced the "New Feed Grain Policy" simply reaffirmed that FFA to the Maritimes (and other peripheral areas) would be maintained until these regions (like southern Ontario and western Quebec) achieved a high level of "feed grain self-sufficiency".

The increase in the private shipment cost of western feed grains has been roughly similar to all major livestock producing areas of Eastern Canada. However with increased Ontario corn production and lower relative corn prices (compared with U.S. markets) the cost of western feed grains is no longer an important factor to producers in Central Canada. Such offsetting developments

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8 Canada, Livestock Feed Assistance Act, R.S., c. L-9, Office Consolidation, August 1980.

9 The Act defines Eastern Canada as all that part of Canada east of Thunder Bay.

10 Minister of Agriculture. New Feed Grain Policy, Government of Canada Release, May 22, 1974 and Minister of Agriculture, New Feed Grain Policy to Begin on August 1, 1974, Government of Canada Release, July 26, 1974.

11 Minister of Agriculture. Minister responsible for the Canadian Wheat Board, Joint Announcement on Domestic Feed Grain Policy, May 31, 1976.

Table 1.3

Livestock Receipts and Feed Expenditures

Maritime Provinces and Eastern Canada 1976-83

	Livestock Receipts		Feed Expenditures		Maritimes/Eastern Canada	
	Maritimes	Eastern Canada	Maritimes	Eastern Canada	Livestock Receipts	Feed Expenditures
	- $ Million -				%	
1983	373.4	5,601.3	121.3	1,465.5	6.66	8.27
1982	380.0	5,813.2	112.9	1,440.4	6.53	7.83
1981	349.2	5,419.6	117.0	1,477.3	6.44	7.91
1980	306.7	4,876.9	97.2	1,294.3	6.28	7.50
1979	290.5	4,429.8	76.3	1,076.6	6.55	7.08
1978	245.6	3,802.5	62.8	920.5	6.45	6.82
1977	200.7	3,103.4	60.5	825.9	6.46	7.32

Source: Net Farm Income Cat. No. 21-202, Statistics Canada.

have not benefited or preserved the competitive position of Maritime feeders. In 1967 feed freight equalization had been extended to Ontario corn eastward.[12] This assistance has however, been reduced in the same manner (i.e., by rapid inflationary erosion) as the price equalization with Thunder Bay for western grain. The increased prairie-eastern price spreads for western grain may not be inconsistent with the spirit of the Livestock Feed Assistance Act. Maritime farm organizations have argued, however, that substantial price differences for eastern corn throughout the livestock production areas of Eastern Canada is contradictory with its principles.

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12 Canada, House of Commons. Debates, October 13, 1967, pp. 3065-3066.

Tychniewicz in 1976[13] interpreted the "New Feed Grain Policy" to mean that the position of Maritime livestock and poultry producers with respect to feed grain was secure. This view was widespread and impacted substantially upon agricultural planning in the region. Following the May 1976 Feed Grain Policy Statement, the Province of Nova Scotia signed the Agricultural Development Agreement with the Government of Canada (Department of Regional Economic Expansion). Programs implemented under this agreement encouraged expansion of the provincial hog sector.

The net cost of moving feed grain from Thunder Bay to Truro during the 1975-76 grain marketing year was $8/tonne. In 1983-84 this had increased to $36/tonne. In real terms (1971 dollars) the increase was from $5.43 to $12.12/tonne. Similar increases occurred in the cost of importing Ontario corn supplies (see tables 1.1 and 1.2). In the case of hogs, given an open North American pork market and common prices throughout Eastern Canada, the increases in feed grain transport costs have reduced the viability of these operations and substantial farm attrition is now expected[14]. Some other provincial commodity sectors operating within marketing plans with quotas and administered prices, have been able to partly compensate

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13 Tyrchniewicz, E.W. "Transportation Problems in Canadian Agriculture with Special Reference to Grain." Proceedings of the Canadian Agricultural Economics Society, 1976, pg. 29-30.

14 Maritime Farmers Council. Submission to the Honourable John Wise, Minister of Agriculture, Jan. 17, 1985.

for higher relative feed costs. Nevertheless, these producers (and related industries) are now vulnerable to structural market and institutional changes.

In the 10 years since the "New Feed Grain Policy" was introduced other changes in the region have also occurred. Since 1974 Nova Scotia grain production has increased from 32,000 to 63,400 tonnes. Unique and potentially high paying technological advances have been a feature of this expansion. The Province was the first in North America to commercially use intensive cereal management.[15] These new technologies are specific to the physical environment of the province with regard to high moisture growing conditions.[16] To a large degree such technological directions and advances have been initiated and carried out by the private sector.

The entire domestic feed grain policy as it relates to Maritime problems (and opportunities) and equity considerations is currently under review by the Federal Government. Changes in the overall policy to date have included the recent suspension of Canadian Wheat Board domestic sales of feed grain at corn competitive

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[15] The national farm publication Country Guide (November 1984) did a cover feature "Intensive Cereal Management Comes to Canada" which reported on progress in Nova Scotia. The quarterly publication of the Michigan State University Agricultural Experimental Station Futures (Vol. 3, No. 1, September 1984) reported on work underway in Michigan. This included the planning on a February 13, 1985 Crops Day with an anticipated audience of 1,500 farmers. The meeting was to feature a Nova Scotia grain farmer.

[16] The widespread use of grain varieties developed for prairie conditions was common in Nova Scotia despite the maritime climate until recently.

formula prices.[17] This has resulted in increased feed price spreads[18] in the Maritimes compared with Central Canada.

1.2 The Problem Statement

The reduction in the level of feed grain price equalization has affected the competitive position of specific sectors of the agricultural industry in Nova Scotia. This has been more serious then might otherwise have been the case because of the misdirection given to industry investment. High comparative feed costs are a major cause of financial problems in the hog sector. Segments of the industry operating within supply management programs do not face immediate prospects of business failures but are now vulnerable to institutional and structural changes in their product markets. These sectors have lost national market share as a direct result of their high comparative feed costs. Farm groups, regional politicians, and federal ministers have all stated that the position of these livestock and poultry producers with regard to feed costs and policy is unsatisfactory.

While seeking measures which would immediately reduce their high relative feed costs, farm groups have also sought a comprehensive medium term plan to reduce dependency on the subsidy. These two approaches can of course be conflicting. Furthermore, longer term action has frequently been discussed by farm groups and

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17 Minister responsible for the Canadian Wheat Board. Domestic Feed Grain Sales Suspended by Canadian Wheat Board, Government of Canada Release, December 11, 1984.

18 Maritime Farmers Council. Submission to Hon. John Wise, Minister of Agriculture, January 17, 1985.

public agencies in narrow terms restricted to measures to expand local grain production and frequently biased toward cash crop production.

In addressing the immediate feed cost problems of the industry and its movement to a position where the FFA Program could be discontinued with minimal (or less severe) consequences for livestock production and related businesses, the unintentional distortion effects of the FFA Program are a problem. In the short term the policy may distort input allocation decisions resulting in significant reduction in net benefits[19]. In the longer term the FFA Program may negatively impact upon the technical developments and other adjustments which could fundamentally address the feed cost situation of the industry over time. Efforts to direct and promote technical change in an artifically low feed cost environment may also become disorientated and misdirected.

1.3 Objectives of the Study

This thesis will analyze the economic effects of an initiative which would transform FFA in Nova Scotia from an input subsidy to an output based subsidy payment. (Details on the mechanics of such a transformation are given in appendix B.) The purpose of such a policy change would be to increase benefits to the industry in the short and intermediate terms and to orientate and accelerate adjustment and development so as to reduce the negative

[19] Output distortions resulting from the policy change evaluated here are less of a factor on the other hand because of the high proportion of livestock and poultry production covered by (supply management) production quotas.

effects of the reduction in feed grain price equilization and/or its eventual termination. The operational objectives of the study are:

1. To present theoretical concepts concerning input versus output subsidies and to relate these to aspects of the current and proposed policy and to the individual agricultural sectors which would be affected.
2. To measure the inefficiencies of feed input price distortions on the livestock and grain sectors of Nova Scotia and the price efficiency gains that could arise from the policy change.
3. To assess the implications of the proposed policy for technical change in the agricultural industry in Nova Scotia and to appraise the corresponding benefits which may arise from restructuring the FFA Program.
4. To measure the producer welfare gains resulting from the shift in feed assistance payment from an input to a product/output basis over a fifteen year period and to draw conclusions based upon these evaluations.

This analysis is relevant if the Federal Government attempts to minimize the cost of achieving regional development goals (as they relate to sustaining livestock production and feeding margins) or alternatively if the government attempted to maximize regional development objectives at any given expenditure level. Effects will be estimated for the current level of the subsidies as well as for a level $10/tonne higher corresponding closer to the increases requested by farm organizations and more consistent with the Livestock Feed Assistance Act.

1.4 Research Procedure

The research procedures which will address the specific objectives of the study are outlined below.

1. The relevant price theory with respect to the producer response to input price changes and the measurement of producer welfare is reviewed. Theoretical models are presented of the policy change at the aggregate level and for specific sub-sectors of the industry. The parameters required for a static partial equilibrium welfare analysis are identified.

2. A supply function for provincial grain production is estimated to obtain the price elasticity of supply for competitive local grain. Existing estimates of short term feed demand and livestock supply parameters and a range of long run elasticities are used to estimate price inefficiencies associated with the current policy. These are utilized for estimation purposes in accordance with the specified theoretical models.

3. Theory related to the influence of economic variables (prices) on technical change is reviewed. The current state and past changes in the province's agricultural technology is surveyed for evidence of relative prices having influenced directions and rates of change. Prospects for technologies which would make the industry less dependant on subsidies and imported feed grains are also considered. A sensitivity analysis is presented based on a range of rates of induced technical change and indicating implied industry benefits.

4. The net present value of estimates of producer welfare gains from transfers, the recovery of program benefits from price inefficiencies and from induced technical change resulting from the policy change over a fifteen year period are presented. These are also compared with estimates of the incremental public costs of changing the administration of the FFA Program.

1.5 Guide to Thesis

In the next chapter the theoretical basis for the partial equilibrium static welfare analysis is given. This analysis is subsequently undertaken in chapter 3. A number of industry transfer gains arising from the elimination of current program leakages are also estimated in chapter 3 as are the incremental public costs of the policy change. Chapter 4 considers the implications for technical change. Theory and past research are reviewed and applied to the consideration of the proposed policy. In chapter 5 the the quantitative results from the evaluation of the proposed change are presented. Finally in chapter 6, conclusions are stated and recommendations made.

Chapter 2

Theoretical Framework

This chapter will review theory which forms the basis for the partial equilibrium static welfare analysis undertaken in chapter 3. An aggregate model giving an overview of the policy change and its effects across the entire industry is presented. Disaggregated sections of the model representing the changes at the sub-sector level and used in the actual analysis are discussed. The required parameters are identified.

2.1 Derived Demand

The microeconomics of production and especially that of derived demand will form much of the foundation for this analysis. In review, the technical relationship between inputs and output can be expressed as a production function,

$$y = f\ (X_1,\ X_2\ .\ .\ .\ .\ .\ X_n) \qquad 2.1$$

Where y = output and X_1, X_2 . . . . X_n are the input quantities. The cost of producing output Y using the inputs X_1, X_2 . . . . X_n can be expressed as a cost function;

$$TC = FC + \quad W_i\ X_i \qquad 2.2$$

Where TC = total cost of production, FC = fixed costs which are invariant with regard to output level and W_i = price of input X_i. The profit function of the prices can then be expressed as,

$$P = P_yY - TC \qquad 2.3$$

Where P = profit, P_y = output price, Y = the level of output determined by 2.1 and TC = total cost given by 2.2.

A firm maximizes its profits when,

$$MR = MC = \frac{W_1}{MP_1} = \frac{W_2}{MP_2} \ldots\ldots\ldots = \frac{W_n}{MP_n} \qquad 2.4$$

Where MR and MC are marginal revenue and marginal cost and W_i and MP_i are the price and marginal product respectively of input i. For a firm or industry facing perfectly elastic demand for its output y, MR will equal product price P_y. (Perfectly elastic supply of inputs is assumed in 2.4 with the price of input i equal to its marginal cost per unit).

Equation 2.4 requires that,

$$W_i = (MR) \quad (MP_i)$$

or $$W_i = P_y \ (MP_i) \qquad 2.5$$

when P_y is given. The short run derived demand function for input X_i then becomes,

$$X_i^* = f\ (P_y, W_1, W_2 \ldots\ldots W_n) \quad i = 1 \ldots\ldots n \qquad 2.6$$

The substitution of the input demand function into the production function yields the optimal output as a function of input and output prices; i.e. the firm's supply function.

The total effect of a change in the price of an input upon its demand is composed of expansion and substitution effects. A lower price for X_i lowers the firm's marginal cost by a magnitude determined by its share of marginal cost and the price change. This, therefore, increases equilibrium output. The reduced price can also result in input substitution in favour of X_i. Unlike the substitution and income effects in consumer theory both of these effects will increase (decrease) the quantity demanded of the input as its price decreases (increases).

A condition which will occur in this analysis involves the production quotas in place for some livestock and poultry sectors. The difference between total revenue and total cost (profit) will then be maximized only if costs are minimized in maintaining the given production level. Profit maximization will then require the firm to,

$$\text{minimize} \quad TC = FC + W_i X_i \qquad 2.7$$

$$\text{subject to } f(X_1, X_2 \ldots\ldots X_n) = Y_o \qquad 2.8$$

The input demand functions of a profit maximizing firm then become,

$$X_i = X_i^* (Y_o, W_1, W_2 \ldots\ldots W_n) \quad i = 1 \ldots n \qquad 2.9$$

This equation, (2.9), is different from 2.6 in that demand is a function of output level (Y_o) and input prices instead of output price (P_y) and input prices. Changes in the demand for an input in response to a price change only arise from the substitution effect in this case.

2.2 The Effect of Input Subsidies on Input Choices

A conceptual model depicting the use of an input or output subsidy to achieve a given production from an industry using two substituable inputs is shown in figure 2.1. In the absence of a subsidy, the industry isocost position is ab. The desired output level is given as I_1. Total outlays required for this level of production, however, surpass returns. To induce a production level represented by isoquant I_1 the government could introduce an input subsidy on factor A. Measured in units of factor A the value of government subsidies required to achieve this production level is ae. Measured in units of factor B the public cost is fg. The price of factor B doesn't change so the new isocost line (with equivalent industry costs to ab) is now eb and the output level represented by I_1 is undertaken.

This input subsidy situation may be contrasted with an output subsidy case. An output subsidy would fall on all inputs equally and not change the least cost mix of inputs. In the diagram the new isocost line resulting from the introduction of an output subsidy is parellel to ab, i.e. the price ratio of factor A and factor B is not changed. In this case, production could be induced at the I_1 level by an output subsidy which measured in terms of units of factor B would cost the government ih. The distance along the factor B axis between the initial isocost and the tangency of the isoquant with the subsidized isocost indicates the value of the government subsidies. These are respectively fg and ih for the input and output subsidy cases. Subsidizing the input for the desired production causes an increase in the use of the subsidized input. A production subsidy would cost the government less. In the graphical representation ih is less than fg. If the government had resources equivalent to fg with which it wanted to maximize its regional objectives, it could introduce an output subsidy equivalent to ij. This option would induce a greater regional production represented by the isoquant I_2.

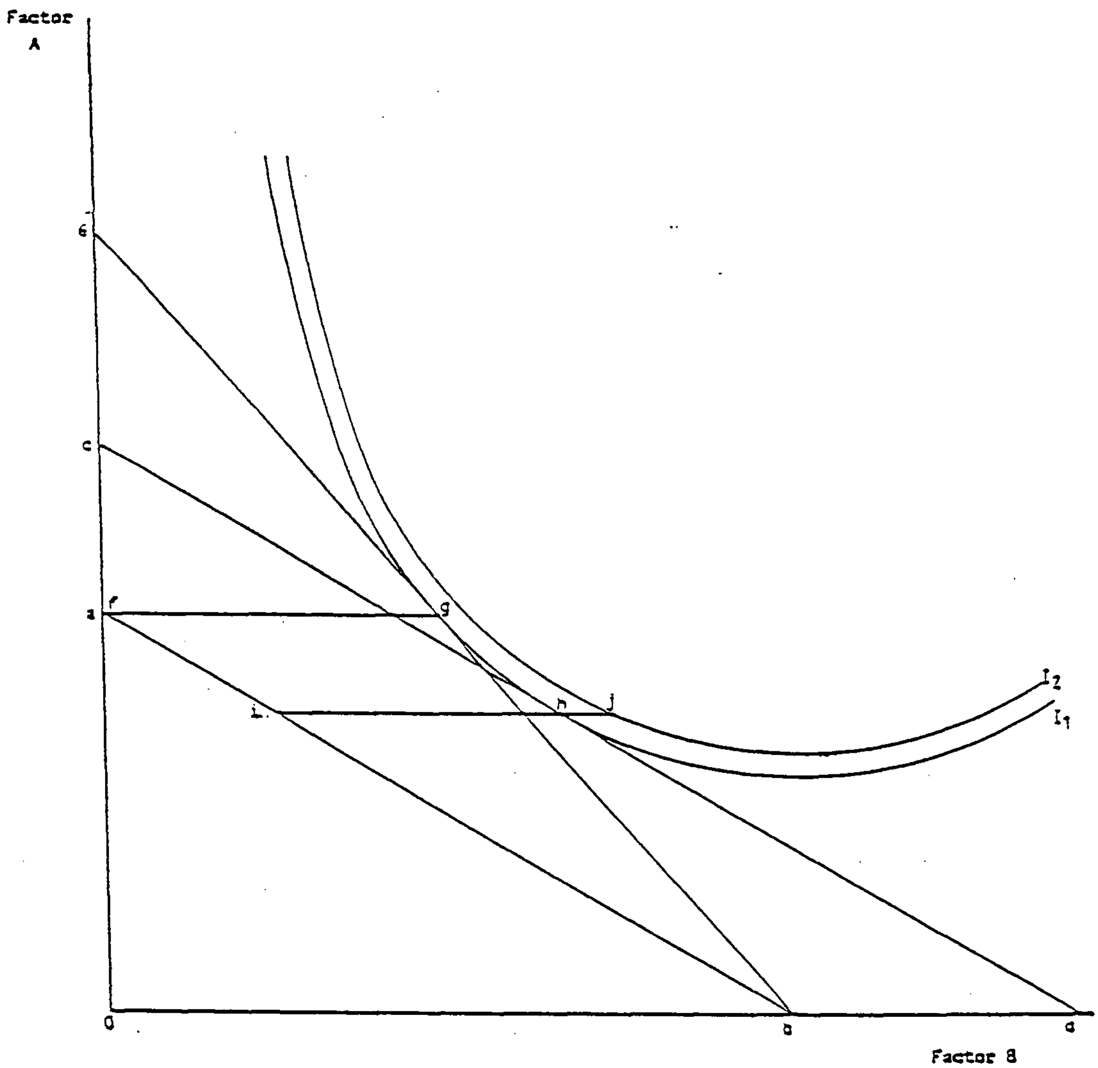

Figure 2.1 Production Isoquants and Factor Prices Showing the Effect of Input and Output Subsidies on Production

The welfare gain of utilizing an output versus an input subsidy depends largely on the degree to which factor/factor, output/output and input/output substitutions could occur. The more convex the isoquant the greater will be the factor/factor substitution effect in the event of changes in relative prices. If the subsidized input has a fixed coefficient in the production process, (L shaped isoquants) there are no gains to be made.

If the public objective in subsidizing production relates specifically to increasing output as opposed to the welfare of producers, a single (or more likely multiple) input subsidy can be cost-effective compared to an output subsidy. In the case of production with decreasing returns inputs are used more intensively at the margin. In such circumstances a subsidy on an input(s) will have a larger impact on marginal costs than on average costs. Consequently, a desired level of production can be achieved with a lower subsidy.

2.3 Measurement of Producer Welfare

In evaluating the welfare effects of restructuring the FFA Program as it applies in Nova Scotia, producer benefits will be of primary interest. Given the small size of agriculture in Nova Scotia compared with the provincial economy and with agriculture in North America, perfectly price elastic supply curves for variable inputs will be assumed for the partial equilibrium analysis.

In measuring producer benefits, the area above the industry supply curve and under price has frequently been used in partial equilibrium analysis. Marshall defined this as "producer's surplus."[1] Mishan[2] has argued that for policy purposes the long run supply curve of an industry is more relevant than the short run supply curve. The long run supply curve with all factors variable represents the lowest average cost for each industry output level. As such, he asserts that it includes all factor prices and all rents for a competitive industry and "the area above the rising industry supply curve carries no economic significance."

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1 Marchall, Alfred. Principles of Economics, 8th edition, MacMillan Company, 1948.

2 Mishan, E.J. "What is Producer's Surplus?" American Economic Review, 58, 1968, pp. 1269-82.

Supply curves of relevance for "producer surplus" are for the period in which "the output of the good in question can be increased only by adding to fixed-factors amounts of other factors that are imperfect substitutes for it but are perfectly elastic in supply with respect to their money price."[3]

Producer surplus is then the economic rent accruing to the fixed factors and Mishan makes the case that the money sum involved is better understood if it is referred to as economic rent. Mishan notes that "the term 'producer's surplus' is misleading and otiose". An advantage he adds, of the suggested terminology is that it obliges the analyst to identify the particular factor that is for some time period inelastic in supply and, therefore, rent earning to the factor owners. Economic rents are in this case identical with what Marshall called "quasi-rents" - the excess of gross receipts over total variable cost.

The question of whether producer welfare changes could be measured in either factor or output markets was first explored by

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3 Mishan, E. J. "What is Producer's Surplus?" American Economic Review, 58, 1968, p. 1275.

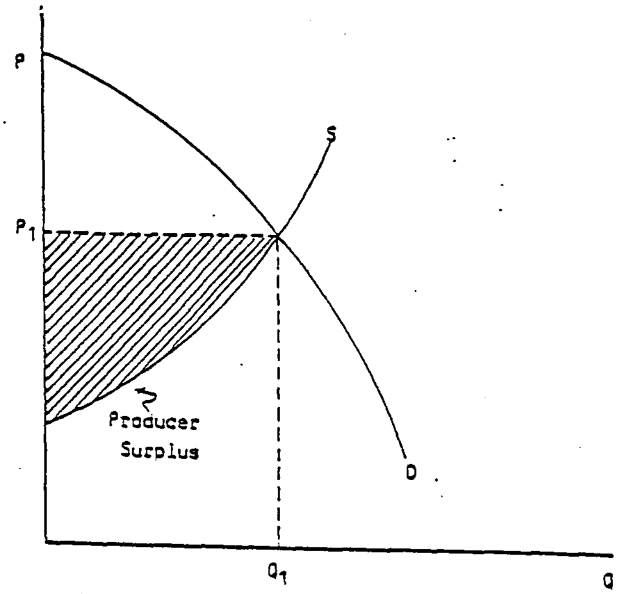

Fig 2.2 Producer Surplus Measured in the Product Market

Schmalensee[4] and by Wisecarver[5] who both concluded that except in the case of a technology with fixed coefficients measurement in the output market would understate the social cost of input market distortions. Subsequent work by Anderson[6] and Schmalensee[7] demonstrated errors in the earlier analysis. Schmalensee showed that producer welfare changes resulting from input price changes could be measured identically in either the input market involved or the output market. For a final goods industry with perfectly elastic

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4 Schmalensee, R. "Consumer's Surplus and Producer's Goods," American Economic Review 61, 1971, pp. 682-87.

5 Wisecarver, D. "The Social Costs of Input-Market Distortion," American Economic Review 64, 1974, pp. 359-72.

6 Anderson, J.E. "The Social Cost of Input Distortons: A Comment and a Generalization," American Economic Review 66, 1976, pp. 235-38.

7 Schmalensee, R. "Another Look at the Social Valuation of Input Price Changes," American Economic Review, 66, 1976, pp. 239-43.

supply of its inputs, even with non-zero quasi-rents, the consumer surplus in its input market is equal to the producer and consumer surpluses in its output market. The area underneath a derived demand curve for inputs used for producer welfare measurement assumes constant inputs and output prices. This is also true for the case of "producer surplus" measurement with respect to the supply curve (output market). The duality of surpluses in factor and product markets is reviewed extensively by Just, Hueth and Schmitz.[8]

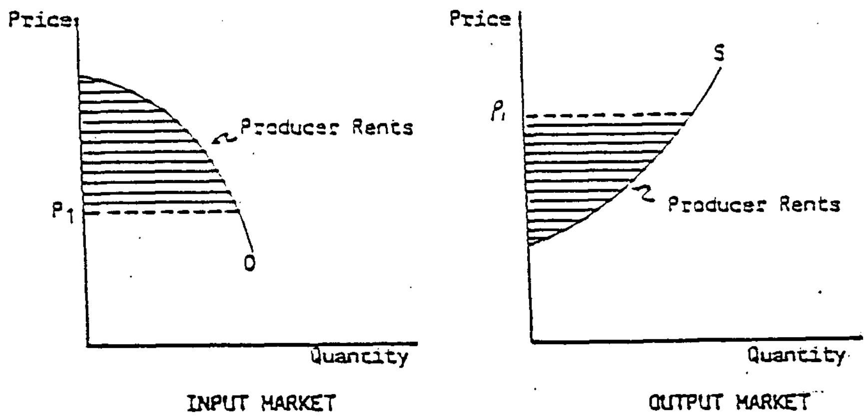

Figure 2.3 Producer Welfare Measurement in Input and Output Markets

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8 Just, R.E., D.L. Hueth and A. Schmitz. Applied Welfare Economics and Public Policy, Englewood Cliffs, N.J. Prentice - Hall Inc. 1982.

Just and Hueth[9] have examined the disaggregated welfare impacts on each affected market group in the case of a "multi-market framework". Their analysis showed that the area behind a general equilibrium demand curve in an intermediate market does not measure benefits to the purchasers in that market only but includes the sum of rents to producers selling in all higher markets plus final consumers surplus. Similarly the area behind the general equilibrium supply curve in an intermediate market measures not only rents for producers selling in that market but also the rents accruing to all producers selling in more basic markets plus initial resource supplier's surplus. In both multi-market structures it is assumed that no intervening market has perfectly elastic supply. Interpretation of the usual surplus triangles for market participants consequently changes with market level.

In the case of grain production in Nova Scotia the rents accruing to renting land owners are included above the supply curve (and under price), as may rents to custom combine service operators, lime suppliers, and local fertilizer blenders etc. Rents to purchasers of by-products would be reflected as well. Markets for straw have been a factor in the economics of Nova Scotia grain production. This demand for straw has a low price elasticity and

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9 Just, R.E. and D. L. Hueth. "Welfare Measures in a Multi-market Framework," American Economic Review 69, 1979, pp. 949-54.

consequently is a determinant of the upward sloping supply curve of local grain production.[10]

The area below the derived demand curve for mixed feeds manufactured by the feed industry in Nova Scotia similarly does not measure benefits to (feed purchasing) livestock and poultry producers only. It would also include the rents of processors, and consumers' surpluses. In the provincial markets for those livestock and poultry products where product supply is perfectly elastic (because of external supplies) there is no consumer surplus resulting from local production and this is reflected under the provincial demand curve for feeds. If the only source of eggs for example was within the province the demand curve for layer feeds would have a very high intercept. Since this is not the case the intercept reflects only the point where there are no rents remaining for provincial egg producers, egg grading operations, etc. Egg consumers may still enjoy surpluses in the complete absence of such rents or of any local egg production.

2.4 Theoretical Models of the Policy Change

An aggregate model illustrating the static effects of changes in the historic FFA policy in Nova Scotia at the aggregated sector level is shown in figure 2.4. The provincial derived demand and supply curves for feed grains are given by DD and SS respectively, while

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10 If higher grain prices resulted in increased grain production the benefits to strawberry growers from greater straw supplies (lower prices for their straw requirements) are part of the increased area under the grain supply curve.

P_1P_1 represents the supply curve for imported FFA grains. It is assumed that this supply is perfectly elastic. Initially provincial feed grain production is Q_1 and total utilization is Q_5. A subsidy equivalent to P_1P_2 is paid on imported feed grains. FFA grain utilization is represented by the differences between provincial production and utilization or Q_1Q_5. The public expenditures for the subsidy are abde. Complete removal of the subsidy would result in a loss of rents from livestock feeding equivalent to P_1efP_2. Rents accruing from local feed grain production, however, increase by P_1acP_2, leaving a net loss of producer welfare equivalent to acfe.

Mishan's recommendation is to identify the fixed factors to which lower rents accrue. In this case they would include physical assets (including those at the farm level and those of slaughtering plants and feed mills) livestock production quotas, and any rent accruing to specialized human capital skills.

Most of the feed grain produced in Nova Scotia is utilized on the farms where it is produced. While there is a shift in the fixed factors to which rents accrue, the producer welfare benefits depicted as P_1acP_2 are largely received by grain growing livestock producers reducing their individual net welfare loss. Part of the producer welfare gains depicted by P_1acP_2, however, accrue to cash crop grain growers and many livestock feeders do not produce any of their feed grain requirements. In such cases transfers within the provincial agricultural industry are involved.

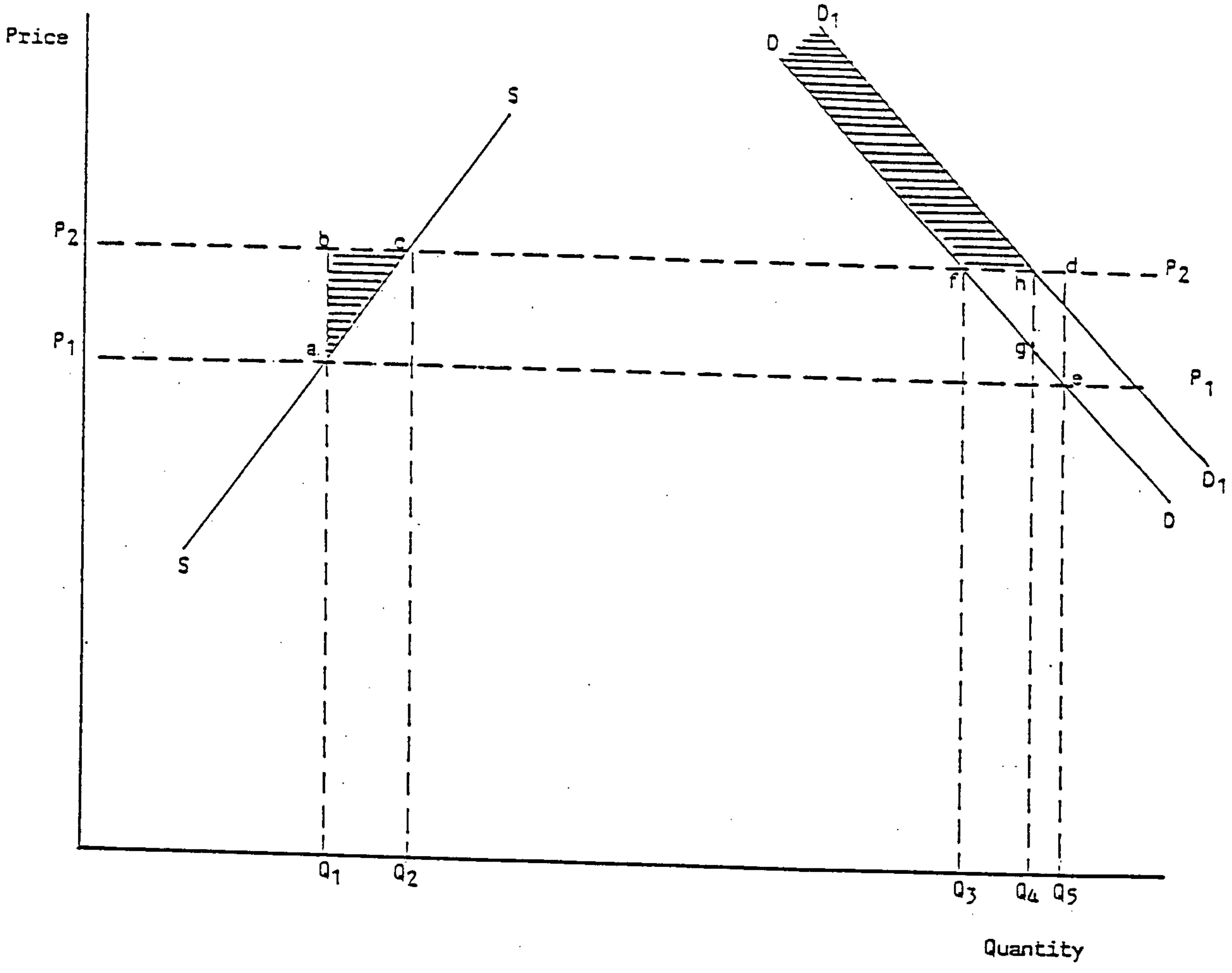

Figure 2.4 Supply of Local Feed Grains and Provincial Demand for Feed Grains

The policy change considered in this paper, i.e. the payment of the FFA benefit on livestock product, would result in a shift in the aggregate demand curve for feed grains. The new demand schedule is represented here by D^1D^1. The livestock product payments are shown as increasing feed grain demand by Q_3Q_4 compared to the situation if the subsidy were completely eliminated. Total feed grain use is shown as decreasing from quantity Q_5 to Q_4 as a result of the policy change and feed grain imports decrease from Q_1Q_5 to Q_2Q_4. While the public cost of the subsidy has been abde, net producer welfare benefits are only acfe. The triangle abc represents producer welfare benefits from the increased feed grain production with undistorted prices.

The shaded area between the two demand curves, above the new price P_2 and extending to the origin (not shown) represents producer welfare gains from the direct feed assistance paid on a product basis. The net change in producer welfare from the policy change is this area minus acfe. If feeding technologies involve fixed feed grain/product output ratios then there would be no efficiencies realized in livestock feeding. The subsidized input in such a case must be used in fixed proportion with other inputs hence the effects of the subsidy would be identical to an ouput based subsidy. Fixed proportions do not characterize the feeding technologies of agriculture in Nova Scotia. This is most apparent in the case of ruminant livestock production.

2.5 Disaggregated Sector Models

In the previous section an aggregate model showing the overall effects of the policy change was presented. For the purpose of estimation and to separate the implied effects on the different sectors of the industry it will be preferable to undertake the analysis on a disaggregated basis.

There are three different situations which will be encountered in the estimation of the welfare effects of the policy change. These involve the price effect on the local grain supply, the derived demand price efficiencies when livestock or poultry output is held constant, and changes in feed grain demand when livestock or poultry output is variable. The first of these was depicted on the left hand side of figure 2.4 and is shown in figure 2.5 (panel a). The removal of the subsidy P_1P_2 leads to an equivalent price increase for local grain. Production increases from Q_1 to Q_2. The resource cost of this increase in production is the area under the supply curve and between Q_1 and Q_2.

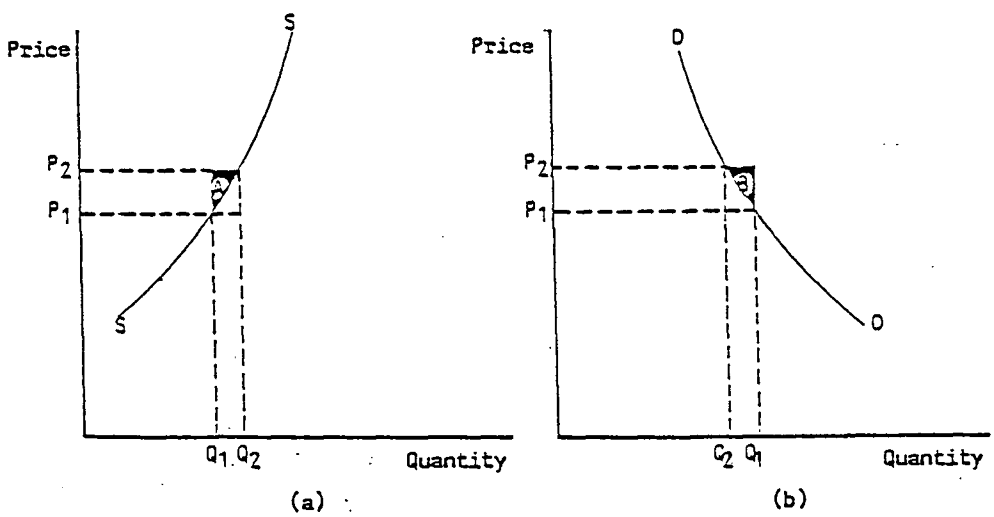

Figure 2.5 **Price Efficiency Gains Measured in Output-Product and Input Markets with Fixed Output**

The shaded triangle A represents the price efficiency gain. To estimate this gain requires the local price elasticity of grain supply, the price change, and the initial production level.

The second situation can be analyzed similarly on the basis of a movement along a "ceteris paribus" curve because of institutional constraints. In this case it is the derived demand curve for feed. Most of the feed grain utilized in Nova Scotia is by commodity sub-sectors having supply management and production quotas[11]. Feed grain price changes of the magnitude considered here would have no product output effect[12] in these sectors, all else being equal[13]. The slope of the relevant part of the demand curve for feed grain from such sectors is determined only by substitution opportunities. For this segment of the industry there would be no shift in the demand curve for feed grains. The parameter required for each commodity sector in this case is the fixed output price elasticity of feed grain demand.

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[11] In 1980 63% of feed was used in egg, pullet, chicken, turkey, and dairy production.

[12] This does not mean the subsidy could be ended without affecting the welfare nor perhaps endangering the survival of individual farm businesses. Many producers have recently purchased quota paying the capitalized value of expected future rents. This situation is analogous with the wealth redistribution (land values) consideration of the changes to prairie agriculture brought about be the Western Grain Transportation Act. (All livestock production quotas in Nova Scotia are owned however, by producers while a third of prairie farmland is rented.)

[13] All national commodity plans have provisions for shifting production consistent with comparative advantage.

The effect of the policy change is depicted in figure 2.5 (b). The increase in the price of feed grain is shown as decreasing quantity demanded from Q_1 to Q_2. The gain represented by the shaded triangle B occurs only from input substitution (and not from the curtailment of production levels for which the value of marginal product is less than marginal costs). For these two situations the parameters of the model can be interpreted readily in regard to the price efficiency benefits from the policy change. The gains to producer's welfare from direct payment of the feed assistance for different supply and (fixed output) demand elasticities are shown in table 2.1. For the changes considered linear approximations of the social cost triangles are used. The more inelastic are both the demand and local supply of feed grain with respect to own price the lower the gains to be realized from restructuring the subsidy program. No benefits are included in the illustrative example for economies in hog and beef cattle feeding.

The hog sector is the most important case where output would not necessarily be invariant with respect to the policies considered. The change in producers welfare from the restructuring of FFA in the case of hogs (and cattle) must be assessed both with respect to the product price and feed grain price changes. With the duality of producer welfare measurements in the input and output markets there are three options for this assessment. The entire welfare change could be measured in either the feed grain or the hog market. In the first case the parameters which are required are the price elasticities of feed grain demand with respect to feed grain and hog prices. This is depicted in Figure 2.6 (a). Removal of the FFA subsidy shifts the supply curve for hogs from SS to S'S' and production falls from Q_1 to Q_2. With the payment of the equivalent assistance on hogs directly, however, production increases from Q_2 to Q_3 consistent with the new S'S' supply schedule. The producer welfare gain is equal to area B minus area A.

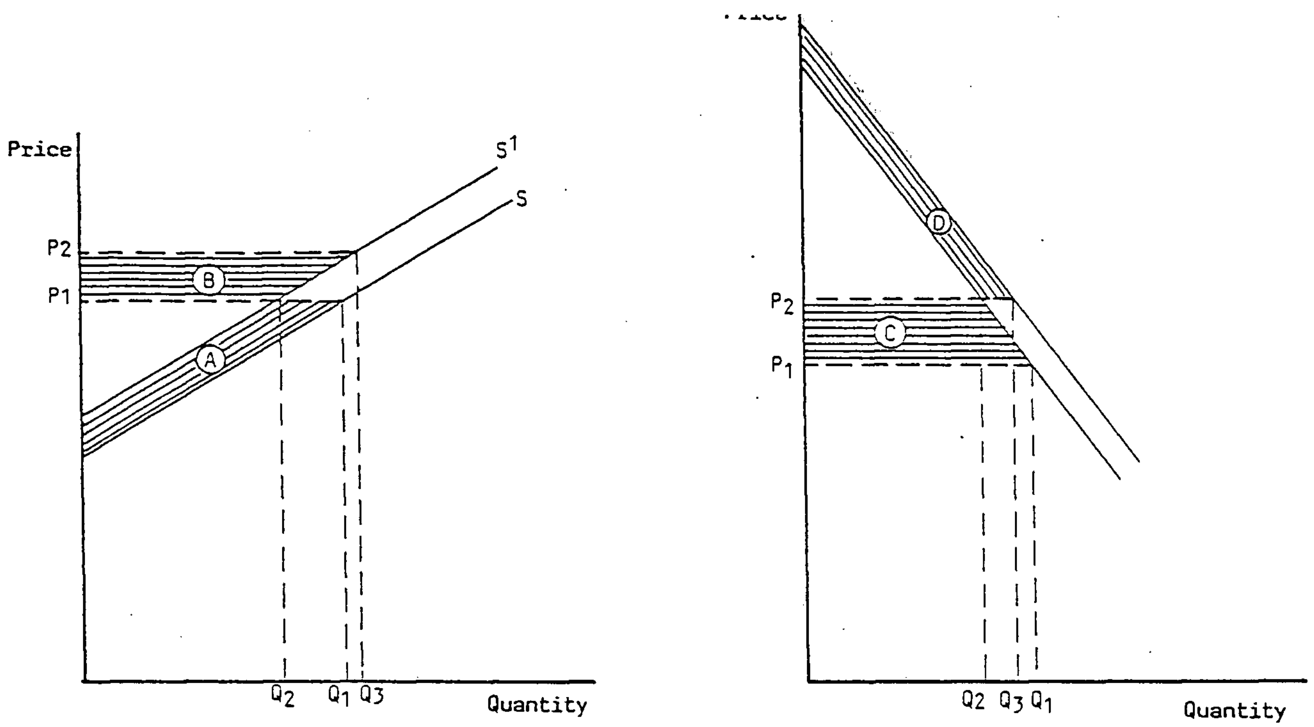
Table 2.1

Price Efficiency Benefits in Local Grain Production and Livestock Feeding (Supply Managed Sectors Only) From Restructuring FFA at Two Different Subsidy Levels

($000)

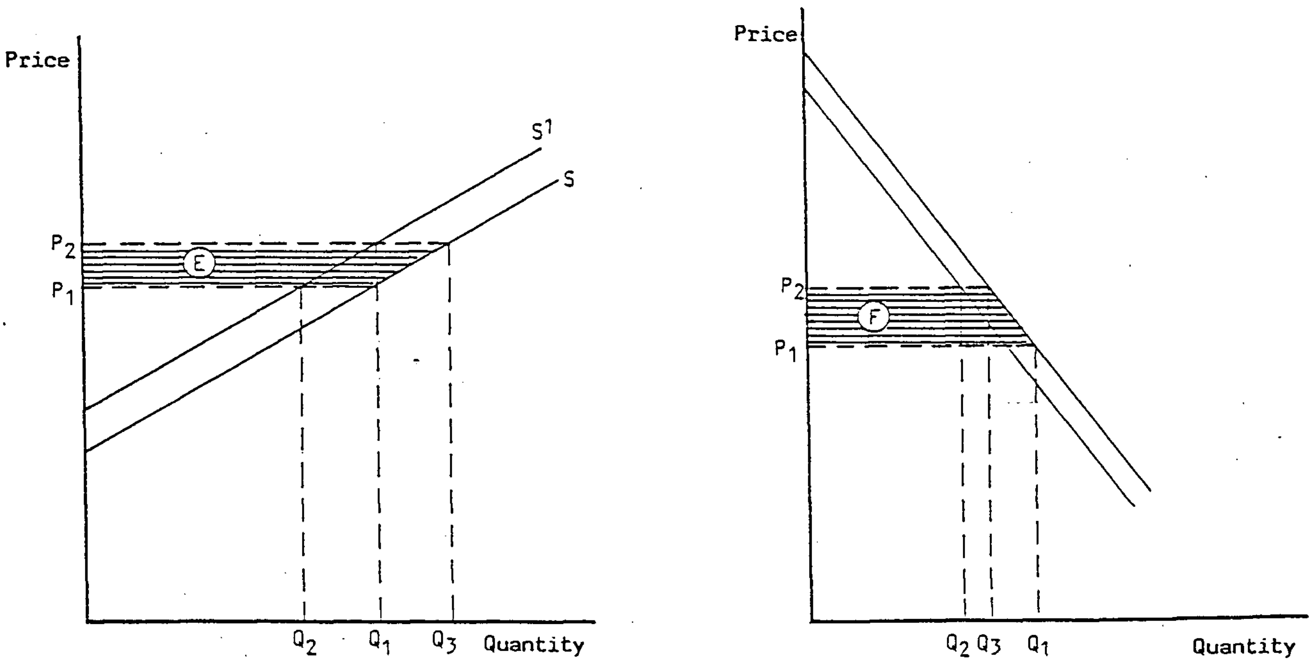
Price Elasticity of Feed Grain Demand (With Constant Output)	Price Elasticity of Local Feed Grain Supply		
	0.75	1.50	2.25
		Subsidy = $15/tonne	
-0.20	50	78	105
-0.40	73	101	128
-0.60	96	123	151
		Subsidy = $25/tonne	
-0.20	149	230	312
-0.40	216	297	379
-0.60	283	364	446

NOTE: Calculated on the basis of a feed grain price before the change of $168/tonne with local production of 55,000 tonnes and supply management sector grain utilization of 170,000 tonnes.



A. Producer Welfare Changes (B-A) Measured in Output Market

B. Producer Welfare Changes (D-C) Measured in Input Market



C. Producer Welfare Changes (E - F) Measured in Output and Input Markets

Figure 2.6 Three Models of Producer Welfare Changes

Source: Just, R. E., D. L. Hueth and A. Schmitz, Applied Welfare Economics and Public Policy, Englewood Cliffs, N. J. Prentice-Hall Inc. 1982, pp. 59-60.

Alternatively the hog supply own price elasticity and the hog supply elasticity with respect to feed grain prices can be used for estimation in the output market. In figure 2.6 (b) removal of the FFA subsidy increases the price of feed grain from P_1 to P_2 and this results in a drop of utilization from Q_1 to Q_2. With the implementation of equivalent payments on output the derived demand schedule shifts to the right from DD to D'D'. Feed grain demand accordingly increases from Q_2 to Q_3. The net change in producer welfare is area D minus area C.

In both these cases good estimates of the demand or supply schedule near the axis and of the intercepts are needed. (These positions are outside the range of observations in the case of this analysis.)

The third possibility involves sequentially evaluating producers welfare changes in the input and output markets. The own-price and cross-price elasticities of both demand and supply are required. In Part C of Figure 2.6 removal of the FFA subsidy results in demand falling from Q_1 to Q_2 and a loss of producer welfare equivalent to area F. In the output market the supply schedule shifts from SS to S'S' and production falls from Q_1 to Q_2. With the subsequent payment of the output subsidy of P_1P_2 production increases from Q_2 to Q_3 and producer welfare increases by area E. The net welfare gain is equal to E minus F. It does not matter for the purposes of measurement in which order the sequential price changes occur.

These models have not incorporated public administration costs, nor features of the restructuring related to benefit transfers from noncommercial feeders and others to producers. These tranfers result from leakages of program benefits from the beneficiary target group that arise from the current program structure. Estimates of the transfer of assistance from hobby horse owners and other nonagricultural feed grain user to commercial producers will be based in the analysis only on estimates of expenditure for these purposes now. Millfeeds of local origin are paid FFA subsidies as "milling in transit". These products are not, however, perfect substitutes for feed grains and the direct payment of assistance on product output would not result in fully equivalent millfeed price changes. There is, as a result, another small transfer to commercial feeders. The possibility of provincial imports of U.S. corn occuring as a result of the policy change introduces the prospects of transfers from Ontario corn growers. These matters are dealt with in chapter 3.

2.6 Some Related Studies

There are many published studies in the economic literature on the economic effects of various means of industry subsidization. Many of these are in the context of domestic support in the presence of foreign competition. Corden[14] has shown for the case where there is no monopoly power in trade that a production subsidy policy will be superior to a tariff policy in achieving a given production level at least cost in terms of the utility derived from goods and services.

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[14] Corden, W. M. "Tariffs, Subsidies, and the Terms of Trade," Economica (August 1957)

Bhagwati and Srinivasan[15] showed that subsidies were the optimal policy in the pursuit of such a non-economic objective with respect to the domestic production of importables. Superiority was demonstrated against a factor - subsidy policy. They similarly showed the superiority of a production subsidy in achieving non-economic objectives related to self-sufficiency. Bhagwati and Ramaswami[16] further argued that an optimum subsidy was necessarily superior to any tariff even in the presence of domestic distortions. They also discussed the non-economic aspects of such a policy choice.

Much of the applied published analysis with respect to input subsidies or taxes in agriculture pertains to fertilizer. Hsu[17] found that important economic gains could have been realized in Taiwan if the government had lowered the tax on fertilizer inputs and raised, if necessary, the tax on rice output instead. The favourable effects of such a shift were dependent on the fact that the value of fertilizer's marginal physical product was higher than the international fertilizer - rice price ratio. Barker and Hayami[18] demonstrated the possibility that to achieve self-sufficiency in food

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15 Bhagwati, J. and T. Srinivasan. "Optimal Intervention to Achieve Non-Economic Objectives", Review of Economic Studies 1969, pp. 27-38.

16 Bhagwati, J. and V. K. Ramaswami. "Domestic Distortion, Tariffs and the Theory of Optimum Subsidy," Journal of Political Economy. 71, 1963, pp. 44-50.

17 Hsu, Robert C. "First-Best and Second-Best Policies of Pricing on Imported Input: The Case of Fertilizer in Taiwan, 1950-1966," American Journal of Agricultural Economics. 1974, pp. 314-322.

18 Barker, Randolph and Yujiro Hayami. "Price Support Versus Input Subsidy for Food Self-Sufficiency in Devleoping Countries," American Journal of Agricultural Economics. Nov. 1976, pp. 617-628.

grains in the Philippines, a subsidy applied to modern inputs such as fertilizer being used below optimum could be more beneficial than supporting product prices. Nieuwoudt[19] similarly estimated that social gains generated by fertilizer subsidies in South Africa out weighed the social costs involved.

Parish and McLaren[20] compared a subsidy on a single input with an output subsidy as a means of stimulating output. They also explored the conditions under which the single imput subsidy is more cost effective and more socially efficient.

Without considering the walfare consequences for producers or others, Chambers[21] considered the least cost subsidy alternatives to achieve policy goals related solely to the economic survival of a particular class of farmers. It was shown that output subsidization alone will generally not involve least government expenditures or subsidies. If such a subsidy scheme is to be least cost it will require that any input that marginal firms use disproportionely receive higher or lower (as appropiate) encouragement.

In pertaining to regional objectives, similar to this study's orientation, Woodward[22] demonstrated using only weak assumptions that a given level of output could be induced at less cost to government in a high cost region (Nova Scotia) with a production

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19 Nieuwoudt, W.L. "Measures of Social Costs (or Benefits) of an Input Subsidy and the Value of Information," Journal of Agricultural Economics, 30, 1979, pp. 13-20.

20 Parish, R. and K. McLaren. "Relative Cost-Effectiveness of Imput and Output Subsidies," Australian Journal of Agricultural Economics 26, 1982, pp. 1-13.

21 Chambers, R. G. "Least Cost Subsidization Alternatives," American Journal of Agricultural Economics", 67, May 1985, pp. 252-256.

22 Woodward R.S. "Effective Location Subsidies: An Evaluation of DREE Industrial Incentives," Canadian Journal of Economics. VII, 1974, pp. 501-510.

subsidy compared with input subsidies for capital, labour, or transportation. Employment objectives were best achieved, however, with a labour subsidy. Existing DREE industrial incentives were found to create fewer jobs per firm and fewer jobs per dollar of incentives than alternative subsidies.

Feed Freight Assistance involved large public expenditures in the 1960's and early 1970's and impacted upon virtually all Canadian livestock production and a substantial portion of Canadian feed grain production. Consequently, it is not surprising that there were many studies of its effects. These are mostly of historical interest today. Kerr[23] used trade and location theory to predict the probable effects of the long term policy and compared these with historical developments. He concluded that the policy had disrupted the basic comparative advantage of livestock production regionally across Canada. This was most apparent in the case of hog and turkey production, two relatively "foot loose" sectors with respect to both input sources and market areas. The location of cattle production, particularly cow-calf operations, had been less influenced. In the case of poultry and egg production, he found that these highly market oriented sectors were not greatly affected with respect to location and that consumers in this case had benefited from the subsidy. In total however, he reported that the net benefits to Canadian agriculture and consumers were minimal.

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23 Kerr, T.C. An Economic Analysis of the Feed Freight Assistance Policy. Agricultural Economics Research Council of Canada, Ottawa, 1966.

The Kerr study was published before the Livestock Assistance Act establishing the Livestock Feed Board of Canada was introduced in Parliament. His recommendation regarding such an agency had been that its basic orientation should be towards rationalization over time and towards livestock industry productivity.

Wilson and Wood[24] analyzed the optimum location of livestock production in Canada using an inter-regional model. They too found that FFA had distorted the natural comparative advantage of livestock production in Canada. Poultry and hog production was found to be most affected. They concluded that net social welfare had been decreased by the policy.

In a background study prepared for the Federal Task Force on Agriculture, Heady et. al.[25] reported that the policy had a negative effect on the inter-regional distribution of grain and livestock production and regional comparative advantage. They presented a conceptional argument against attempting to increase income through an input subsidy (This applied to the widescale FFA policy as it

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24 Wilson, A.G. and A.W. Wood. "Regional Livestock Production and Feed Freight Assistance," Canadian Journal of Agricultural Economics. 17, 1969, pp 77-90.

25 Acres Research and Planning Ltd. "Final Report Problems Policies and Prospects for the Feed Grain Livestock Sector," (prepared by E. O. Heady, assisted by J. W. Knox, R. W. Crown, B. G. MacFarlane, and E. C. Baum), Toronto, May, 1969.

existed.) Other studies by Wilson and Darby,[26] and Gainer[27] reached similar conclusions with respect to the negative effects of the policy on hog and poultry production on the Prairies and the positive effects for B. C. and Eastern Canada.

Lerohl, MacEachern, and Vandermuelen[28] estimated the "multiplier effects" on prairie income from terminating FFA using different assumptions with respect to prairie price changes, lost domestic sales and assumed reductions in prairie grain production. The effect of the program on the location of livestock production was not considered.

Groenewegen[29] undertook an evaluation of the Maritime Farmers' Council's proposal to restructure FFA. Features of this proposal included the restoration of the 1976 real support level (which involved slightly over a doubling of funding), the long term continuation of such a program until the region achieved a high

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26 Wilson, G. W. and L. Darby "Transportation on the Prairies," Supporting Study No. 2, prepared for the Royal Commission on Consumer Problems and Inflation, 1968.

27 Gainer, W.D. et. al. "Economic Analysis of the Effect of Transport Rates on Products of the Industrial, Chemical, and Meat Packing Industry with Special Reference to Edmonton," Research Report prepared for the Canadian Transport Commission, Ottawa, June, 1977.

28 Lerohl, M. L., G. A. McEachern and H. Vandermeulen. "The Benefits and Burdens of Feed Grain Transportation Policy," Agricultural Economics Research Council of Canada, Ottawa, February, 1970.

29 Groenewegen J. "An Evaluation of the Maritime Farmers' Council's Proposal to Restructure Feed Freight Assistance," Livestock Feed Board of Canada and Agriculture Canada, February, 1984

level of feed grain self-sufficiency, and uniform product payments throughout the three provinces. The later feature would have resulted in substantial assistance "dilution" unfavourable to the current recipients, i.e. livestock producers purchasing all or most of their feed grains. Windfall gains would have been particularly common to livestock producers in Prince Edward Island where many farms produce all or most of their feed grains.

He reported that, even with a doubling of subsidy expenditures, no improvement in the position of totally grain purchasing livestock producers would be realized because of the payments being applied to all livestock production including that produced from local as well as imported grain. Assuming a 0.50 price elasticity of supply for local grain and using a price change of $11.96/tonne, Groenewegen also concluded that the regional grain supply response would not be significant in achieving the singular goal of feed grain "self-sufficiency."

While the "dilution" of benefits is a substantial problem with such a restructuring on a Maritime regional basis, Groenewegen greatly over-estimated this effect. His error in this regard was to consider only estimates of regional grain production and FFA shipments. He did not adjust for the much higher grain/output ratios when local grain[30] is fed (of which low energy oats is a high

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[30] Nova Scotia, for example, receives 58% of Maritime FFA payments while utilizing 38% of grain fed in the region (FFA shipments plus local production). Substantial unfavourable dilution could be expected with a cursory inspection of these numbers. The province, however, accounts for 47% of livestock and poultry sales. A detailed analysis of grain utilization by product and output confirms that 58/47 = 1.23 is the order of the interprovincial dilution against N.S. and not 58/38 = 1.53.

proportion) nor did he use the proposed use of commodity block funds and average FFA expenditures per unit of product output for each sector as the basis for the payments. This payment structure would have contained the "dilution" effect as calculated considerably (see appendix B).

The 0.5 regional grain supply elasticity used in the analysis was assumed and it was not clear whether this was meant to represent the short run or long run response. It was partly based, however, on the understanding that the economics of feed grain production for on-farm feeding ("home grown grain") would not change with the restructuring;

> "FFA does not disadvantage this on-farm production. It only disadvantages grain destined for the commercial market"[31]

This misunderstanding of the role of opportunity costs or shadow prices in influencing economic activity excluded the positive effects for the type of farming system which accounts for the bulk of Maritime grain production. Furthermore, this segment is seen by many as the most likely to develop. The use of a $11.96 price effect also did not adjust for the lower subsidy on corn and its small proportion of regional grain production. The weighted average price change (for

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[31] Groenewegen, J. An Evaluation of the Maritime Farmers Council's Proposal To Restructure Feed Freight Assistance, Agriculture Canada, Feb. 1984, p. 9.

the types of grains grown regionally) would have been $2.00 higher and this was subsequently increased by $2-3/tonne when changes were made to the assistance rates in September 1984.

The regional competitive disadvantage with respect to feed grains compared with Ontario was estimated and reported by Groenewegen as $2-4/tonne. This was determined based upon the landed cost of western grain only. The competitive position of producers in Ontario, however, is now clearly based on corn for which there is a current $37/tonne price advantage over the Maritimes. This important competitive consideration was overlooked by Groenewegen. The FFA Program officially recognized the importance of corn to comparative feed grain costs in eastern Canada in 1967 when the equalization policy was extended to include Ontario corn.[32]

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[32] Canada, House of Commons Debates, October, 13, 1967, pp. 30065-30066.

2.7 Summary

The payment of an input factor subsidy can be expected to lead to the misallocation of resources in the production process. Except in the case of an input used in fixed proportions producers would (assuming perfect information) be better off and public objectives, related to their welfare better realized, with an equivalent subsidy on output. The static welfare theory and empirical models required to investigate the effects of the transformation of the FFA subsidy from an input to an output based payment have been presented. This analysis is contained in chapter 3.

Chapter 3

Price Efficiencies, Transfers, and Costs

The following sections will deal with measuring the static welfare effects for producers of the proposed policy change. This will be done on a disaggregated industry basis. Existing estimates of the relevant supply and derived demand parameters in most cases will be utilized. When this is not possible or prudent econometric models are specified and estimated to yield the required parameters. In the case of longer term effects a sensitivity analysis is presented using a range of parameter values.

A brief general overview of the agricultural sector in Nova Scotia is given in section 3.1. Welfare gains resulting from the removal of the price distortion as it effects local grain production in the short, intermediate, and long runs are considered in section 3.2. Short run feeding efficiency gains from the removal of distortions in feed input prices for individual livestock subsectors are considered in section 3.3. A range of long run price elasticities of feed grain demand are also considered in this section together with their corresponding implications for producer welfare. The transfers and costs resulting from the proposed policy changes are considered in sections 3.4 and 3.5 respectively.

3.1 Overview of Agriculture in Nova Scotia

The gross value of agricultural production in Nova Scotia in 1984 was $253.2 million. Livestock and poultry products accounted for almost three-quarters of total farm sales. Dairying is the largest farm sector with milk and cream sales in 1984 totalling $73.9 million. Other major sectors include, horticulture ($39.1 million), poultry and eggs ($48.6 million), hogs ($31.5 million), cattle ($23.8 million), and fur ($9.2 million). Cash field crop production is limited largely to potatoes ($4.5 million), tobacco ($2.6 million), and grain ($2.3 million). Most grain is not produced by specialized grain farms and is generally utilized as "home grown" feed grain. In 1984 grain production was estimated at 60,000 tonnes.

The province imported 217,000 tonnes of feed grain during the 1983-84 grain marketing year. Farm feed expenditures in 1984 totalled $62.7 million and accounted for 35 percent of total operating expenses. This expenditure share was the highest of any province (excluding Newfoundland) in Canada. Grain input/output rates are higher than the national averages for milk, eggs, and hogs, while they may be lower for poultry.

At the time of the 1981 Census of Agriculture there were 1,000 specialized commercial[1] livestock and poultry farms in the province. The principle related secondary industries are the meat and poultry products industry with shipments valued at $70.3 million and employment of 523 in 1982 and the dairy products industry with

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[1] A commercial farm is defined here as having had agricultural product sales of $25,000 or more in 1980.

1982 shipments valued at $150.8 million and 1292 employees. The provincial feed industry made shipments valued at $61.9 million and had 201 employees in 1982.

An institutional aspect of the industry involves over two-thirds of livestock and poultry production being fixed under production quotas. This is a significant feature from the perspective of designing a subsidy program with minimal distortions.

3.2 Provincial Feed Grain Supply

When policies distort the producer price of a good the greater the elasticity of supply the greater will be the cost of the distortion.[2] There will, of course, be no deadweight loss if supply is perfectly inelastic with respect to price. In the case of grain prices and feed freight assistance in Nova Scotia both grain production and the current per unit price distortions are relatively small. Furthermore, it has been widely perceived that grain production in the Martimes Provinces is highly inelastic[3] with respect to price.

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2 Wallace, T.D. "Measures of Social Costs of Agricultural Programs," Journal of Farm Economics 44, 1962, pp. 580-94.

3 The only published source of these perceptions appears to be Sorflaten who conducted an analysis of factors which influenced Maritime feed grain acreages over the period 1942 to 1974. He did not report his numerical estimates but concluded:

> "the price of western feed grain...appeared to be a less significant explanatory variable. The relationship was consistently positive meaning that a high price of western feed grains one year would encourage local production the following year. Nevertheless, the magnitude of the relationship was so limited that any variation in western feed grain prices would exert no more than a minor influence."

Sorflaten, A. Feed Grain and Livestock Agriculture in the Maritimes Province, Canadian Livestock Feed Board, July 1977. p. 31.

A brief review of some of the circumstances which characterize grain production in Nova Scotia and producers response to price changes is presented below. A supply function is then hypothesized and estimated for the intermediate term to assess this component of the cost of FFA price distortions. Using the intermediate term elasticity as a lower bound, a range of long run supply elasticities and the corresponding costs (or benefits) which they imply are then considered.

Specialized grain farming operations account for only a small proportion of the grain grown in Nova Scotia. The bulk of the grain crop is also not grown for cash sales but is fed on the farms where it is produced. At the time of the 1981 Census of Agriculture 80% of the total grain acreage was reported by livestock farms. Another condition which is not typical of many of the regions for which grain supply functions have been estimated is the absence of any significant competitive cash crop. Over two thirds of the province's cropland is utilized for hay and fodder and this production is not normally marketed. Grain crops accounted for 12% of the improved agricultural land utilized in 1971 and 11% in 1981. In the short and intermediate terms any increase in grain acreage would arise primarily from a shift in use of land which would otherwise be in fodder production.[4]

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[4] This does not infer necessarily a decrease in fodder production as substantial yield increases are achievable with the greater use of lime, fertilizer, double cropping, reseeding etc.

In the longer term land currently not used for farm production could become available. Nowland, Dumanski, and Stewart[5] estimated that there are 2.9 million acres in the province moderately suitable or better for barley production. This estimate is over 6.5 times the total current agricultual land utilization and over 50 times the current grain acreage.[6]

Conditions which could be expected to limit the short term supply response to grain price increases include the availability of specialized planting and harvesting equipment and storage capacity. Conditions which could impose an upward sloping supply function in the longer term include the inelastic demand for straw, fixed manure supplies[7], and the supply of higher quality land.

Weather variability is an important influence on crop production in the province. The low degree to which current grain production technologies are specific to the region is a factor in the susceptibility to weather. This has direct implications for supply estimation. The production effects of weather preclude the use of output as a proxy variable for planned production (see table 3.1).

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5 Nowland, J.L., Dumanski, J. and Stewart, R.B. "National Resource Base," Part I of Production Base and Production Potential of the Eastern Grains Industry, Eastern Grain Production Seminar, Canada Grains Council, 1982.

6 Nowland et. al.'s estimates of the land supply of Nova Scotia capable of producing grain were the largest of any province's relative to current grain acreage. (In appendix E (p. 201) brief consideration is given to how the economics of technical change in a small region with unique conditions may impact upon this and other bio-physical assessments of the land resource).

7 The supply of commercial or chemical fertilizers is of course perfectly elastic.

3.2.1 Econometric Model of Grain Acreage

For the purposes of this policy evaluation an estimate of the supply response to grain price changes is required. The supply function for grain in Nova Scotia can be postulated as,

$$Qx^S = f\ (P_x,\ P_y,\ P_i,\ T,\ W).$$

Where, Qx^S = Total acreage planted to all grains,

P_x = Expected farm price of grain (+),

P_y = Price of competitive products (-),

P_i = Price of inputs (-),

T = Technology (+), and

W = Weather.

For the estimation, the 1967-84 period was selected to lessen the importance of the extensive structural and technological changes, which have occurred in the industry over the last three decades. (The estimated equation was based on 18 annual observations.) The total acreage of wheat, oats, barley, mixed grain, rye, and grain corn represented the planned producer supply. These cereals are close substitutes in production supporting the use of an aggregate supply function. The Statistics Canada estimated farm value of each of these crops was similarily totaled and the mean per tonne farm value for all grains was derived and used for the price variable.

The payments received by farmers from three short term subsidy programs was incorporated into the farm price variable. (see note under table 3.2). All price variables were deflated by the gross national expenditure implicit price index. A dummy variable was considered to represent the establishment of commercial grain marketing channels in the late 1970's. While this development has been associated with grain expansion the influence was through the higher prices returned to producers. In place of unobserved expected prices[8] a distributed three year lag of the actual prices was utilized. This distributed lag also incorporated the intermediate term constraints faced by producers in adjusting their crop production. It is assumed that the adjustment of cereal outputs to their optimum level may occur over a number of years because of the fixity of certain resources and other constraints.

Hay and silage corn production comprise two thirds of the cropland in Nova Scotia and these are the chief competitive crops. Since fodder prices are either not available or are unreliable, fodder acreage was used directly as a proxy measure in the estimation in lieu of the price of production substitutes.[9] A weighted composite of farm input price indexes for eastern Canada was used as a proxy for input prices[10] (see table 3.1).

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8 Grain production decisions must be based in part upon price, yield, and cost expectations before planting rather than the known value of these variables.

9 In similar circumstances Candler used fodder acreage directly in explaining wheat acreage in New Zealand. See: Heady, Baker, et. al., 1961, p 88.

10 The weights for this composite index were farm machinery 0.188, hired farm labour 0.053, mixed fertilizer 0.203, grain seed 0.115, custom work 0.206, lime 0.025, interest 0.097, and chemicals 0.113. These weights were obtained from the Nova Scotia Farm Management Advisory Manual. Eastern Canada farm input price indexes were used as reported by Statistics Canada, Farm Input Price Index, Cat. No. 62-004.

Table 3.1

Grain Acreage, Yields, Farm Price, Fodder Acreage, the Gross National Expenditure Implicit Price Index and a Weighted Grain Inputs Price Index

Nova Scotia 1967-84

	Grain Acreage[a]	Average Per Tonne Farm Value[b]	Hay & Silage Corn Acreage	Yield Per Acre (tonne) Current Year	Yield Per Acre (tonne) Prev. 3 Yr. Average	GNE Implicit Price Index	Weighted Grain Inputs Price Index[c]
1984	54,000	N.A.	182,500	1.17	1.05	303	307
1983	50,900	172	184,000	1.15	0.99	290	295
1982	47,995	150	185,000	1.01	0.94	274	298
1981	48,734	168	184,000	0.99	0.95	249	288
1980	42,491	184	185,300	0.97	0.90	225	253
1979	41,357	136	189,500	0.87	0.92	203	220
1978	36,997	113	193,000	1.00	0.83	184	192
1977	36,573	103	193,100	0.83	0.84	172	179
1976	37,093	106	193,500	0.93	0.74	160	170
1975	36,959	106	191,000	0.74	0.81	146	166
1974	37,686	100	184,000	0.85	0.79	132	149
1973	38,313	100	173,500	0.64	0.87	115	115
1972	39,440	59	163,000	0.94	0.86	105	102
1971	44,708	55	158,400	0.78	0.88	100	100
1970	46,368	55	159,600	0.88	0.81	97	100
1969	47,997	55	177,400	0.92	0.82	93	100
1968	47,426	61	191,900	0.85	0.76	89	98
1967	48,175	66	205,000	0.66	0.81	86	94
1966		65					

Source: Derived from Nova Scotia Department of Agriculture & Marketing. Agricultural Statistics, various editions and Statistics Canada. Farm Input Price Index, various editions, Ottawa: Statistics Canada.

a Includes wheat, oats, barley, rye, mixed grains and grain corn.

b Average per tonne values incorporate grants made as feed grain incentives as follows: 1965, $64,000, 1966 $137,000, 1967 $154,000, 1968 $135,000, 1969 $166,000, 1977 $190,000, 1978 $143,000, 1979 $226,000, 1980 $365,000, and 1983 $247,000.

c The weights for this composite input price index were farm machinery.188, hired farm labour .053, mixed fertilizer .203 grain seed .115, custom work .206, lime .025, interest .097, and chemicals .113.

To reflect the impact of technical change on production costs the deflated composite price index for crop inputs was divided by the three year moving average of per acre grain yields.

In the event of a curvilinear supply function the estimated equation may be regarded as a linear approximation.

The estimated supply function (see table 3.1) suggests the intermediate term (three years) price elasticity of total grain acreage in Nova Scotia over this period was 1.89 calculated at mean values. A $1/tonne price change (1971 dollars) was estimated to have a grain acreage response of 508 acres in the first year, and 410 and 416 acres respectively in years two and three. The estimated equation explained 79% of the total variation in grain acreage over the 18 year period. All coefficients had the expected signs and all variables were significant, using one-tailed t tests, at better than the 0.05 level. The level of significance for the lagged prices was in all cases greater than 0.025.

Yields for grain crops over the period averaged 0.9 tonne. Recently average yields have been over one tonne per acre. Based on the 1.06 tonne/acre average for the 1980-84 period a $1.00 (1971 dollars) change in the farm value of a tonne of grain can be associatd with an intermediate term change in local grain supply of 1,334 tonnes. This does not assume any positive relationship between expected value of the crop and subsequent yields although this may indeed be the case. High amounts of fertilizer, lime, and other inputs are required for grain production in Nova Scotia. Extended low yields in the early 1970's are often associated

Table 3.2

OLS Regression of Total Grain Acreage, Nova Scotia, 1967-84

		Constant	Fodder Acreage	CIPI/3YMAY	Distributed Lag P-1	Distributed Lag P-2	Distributed Lag P-3	R.SQ.
1.1	Coefficient	62,987	-.17	-57887	507.6	410.3	415.8	0.79
	(t-value)	(3.97)	(-2.03)	(-5.43)	(3.00)	(2.59)	(3.04)	df=9
Elasticity at Means			-.72	-1.66	.72	.58	.59	

Where,

Fodder Acreage = hay + silage corn acreage.

CIPI = a composite of real input price indexes weighted to reflect relative expenditure shares in Nova Scotia grain crop production costs.

3YMAY = the three year moving average of per acre grain yields.

P-1, P-2, P-3, = average per tonne farm value of provincial grain crop lagged for one, two, and three years respectively.

both with poor growing seasons and escalating input costs. Houck and Gallagher[11] have for example shown that taking acreage response estimates as approximations for total supply elasticity is to seriously underestimate the price responsiveness of corn production when fertilizer price is held constant. Input/output price ratios in the case of grain in Nova Scotia could also be expected to influence grain supply. Substantial weather variability, however, and the small time series sample made acreage preferable to production for estimating price responsiveness in this case. If in fact the elasticity of yields with respect to price is positive, then the estimated gains from the policy change made below are understated.

3.2.2 Interpretation For Policy Analysis

The elimination of freight subsidies for shipments of feed grains into FFA geographic Zones III to VI and the equivalent rate reductions into the higher zones would increase the farm price of feed grains in Nova Scotia by approximately $16/tonne[12]. Such a price increase could be expected to increase plantings in the intermediate term by 7,200 acres. Alternatively a $10 tonne increase in freight assistance could be expected to reduce grain crop production by 4,500 acres in the same period.

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11 Houck, J.P., and P.W. Gallagher. "The Price Responsiveness of U.S. Corn Yields." American Journal of Agricultural Economics. 58, 1976, pp. 731-734.

12 This estimate is a weighted average based on the composition of the provincial grain crop with respect to types of grain produced and the grain production distribution within the province with respect to freight subsidy zones.

The expected changes in production and producer welfare are depicted in figure 3.1. In Panel A, restructuring the subsidy results in a feed grain price increase equivalent to P_1P_2 and local production increases by Q_1Q_2. Since most feed grains are utilized as home grown feed on N.S. farms P_1abP_2 is largely a transfer between crop and livestock enterprises on the farms involved. The industry as a whole would however benefit by the triangle abc. This benefit would be worth an estimated $57,600 annually to those farms producing feed grain.

This gain is estimated from equation 3.1 and assumes a 1.0 tonne/acre crop yield.

$$\text{Welfare gain} = \tfrac{1}{2}\Delta P \Delta Q \qquad 3.1$$

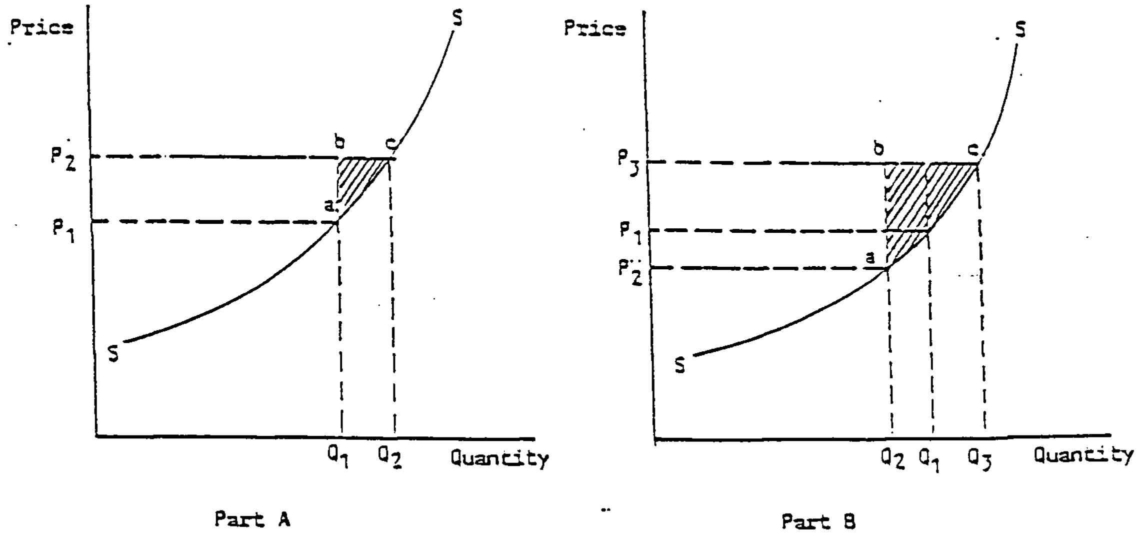

Figure 3.1 Price Efficiency Gains and Losses in Local Grain Production with Changes in Subsidy Administration and Level

Panel B of figure 3.1 shows the situation if the freight subsidy is increased by P_1P_2 which equates with \$10/tonne in the calculations below. Local production decreases from Q_1 to Q_2. Compared with the situation where producers could realize the same total subsidy expenditure but were free to secure their feed grain supplies at least cost, (i.e. were not exposed to input price distortions), producers are less well off by the triangle abc. At the end of the intermediate term of three years, this is estimated to represent \$152,300 annually.[13]

The recent introduction of partial compensating payments on some local feed grain production modifies the welfare gains from the proposed policy change. In the above analysis the FFA Program as it had existed for 43 years prior to September, 1984, has been used to calculate welfare gains. Under the new program some offsetting payments on local grain are made on product marketed through certain commercial channels and it is expected that less than 20% of all grain will qualify. The per tonne payments are equivalent (on a weighted average basis) to about 75% of the negative price distortion imposed upon local grain growers. Correspondingly, the gains from the change in administration of the subsidy now with respect to local feed grain production and price efficiencies are calculated to be approximately \$49,000 and \$129,500 respectively. These correspond with the situations discussed above with subsidy levels of \$16 and \$26/tonne, and weighted for the types of grain grown provincially and for the geographic distribution of grain production by FFA subsidy zones.

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[13] Based on equation 3.1, a \$26/tonne price change and a 11,715 acres change in grain production.

3.2.3 Long Run Supply and Price Efficencies

The longer term grain production response to the proposed policy change i.e., beyond 3 years is highly speculative. In this section the magnitude of the associated benefit of the longer term crop adjustment is estimated using a range of assumed long run price elasticities.

Published estimates of long run supply parameters for crops are frequently highly elastic and several times larger than those estimated for shorter periods (1, 2, or 3 years). In selecting low, medium, and high values for this assessment consideration was given to the estimates made for the intermediate term which served as a lower bound. In review, provincial grain acreage was found in section 3.2.1. to be price elastic in the intermediate term of three years. The estimated elasticity was 1.89.[14] Assuming a positive yield response to price, which appears likely, the corresponding supply (tonnage) elasticity for the same period would be higher.

For longer term responses the sustained nature of the price change is of relevance. The three year acreage response was discerned from the fluctuations in commodity market prices. The price change considered here would be of a permanent nature. Other factors to be considered include the resource and management bases. Grain acreage accounts for a relatively low percentage (11%) of the improved farmland in the province. Bio-physical evaluations furthermore report that the land base suitable for grain production

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[14] This proportional response is substantially above those estimated for major grain growing regions and reflects the relatively greater supply elasticity of grain growing resources in the province. Related to this, of course, is the small magnitude of the absolute change and the relatively small proportion of farm resources now committed to grain production in Nova Scotia.

Table 3.3

Change in Grain Production and Grain Producer Welfare Associated with Three Long Run Grain Supply Elasticities and Two Subsidy Levels Subsequent to FFA Policy Change

Price Elasticty of Grain Supply	Price Distortion Prior to Policy Change of $16/tonne: Change in Production (tonne)	Price Distortion Prior to Policy Change of $16/tonne: Change in Producer Welfare	Price Distortion Prior to Policy Change of $26/tonne: Change in Production (tonne)	Price Distortion Prior to Policy Change of $26/tonne: Change in Producer Welfare
2.50	+9,520	$+76,160	+16,460	$+213,980
3.25	+12,380	+99,040	+21,400	+278,200
4.00	+15,230	+121,840	+26,340	+342,420

NOTE: An initial feed grain price of $168 and $158/tonne is assumed for the $16/tonne and $26/tonne distortions cases respectively.

is 50 times the present grain acreage. Agronomists also report that yields with present technology can be increased substantially.

In table 3.3 the production and producer welfare implications of the selected range of long run price elasticities of supply are shown. These are interpreted both for the current level of FFA payments/price distortions and for a level corresponding with a $10/tonne increase in the subsidy.[15] At the present level of the subsidy the producer welfare gain is calculated at between $76,000 and $122,000 annually. With an increase in the subsidy rate of $10 tonne the difference in producer benefits from the program escalate to between $214,000 and $342,000.

3.3 Price Efficiencies in Feeding

The previous section considered the price efficiency implications of FFA policy alternatives with respect to the Nova Scotia's agricultural industry's own feed grain production. This section will consider price efficiencies in the utilization of feed grain inputs.

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15 Adjustments were made to account for the recent introduction of partially compensating FFA payments on some local grain production.

Many studies have estimated derived input demand elasticities for feed grains (Brandow[16], Ahalt and Egbert[17], and Egbert and Reultingear[18], and Meilke[19]). Frequently the aggregate demand for feed grain from all livestock and poultry production sectors has been considered. Richardson and Ray[20] and Gitu[21] have, however, reported separate elasticities for the different livestock and poultry sectors. Cost function studies for particular regions have also reported feed demand parameters for particular sectors (Hogue and Adelaja[22], Grisley and Gitu[23]).

Since the mix of livestock and poultry output in Nova Scotia is not the same as that for Canada, for the U.S. nor for any other region, the aggregate input demand elasticities that have been estimated for other locations may not be representative for the

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16 Brandow, G.E. "Interrelations Among Demands of Farm Products on Implications for Control of Market Supply." Pennsylvania Agricultural Experimental Station Bulletin. 680, 1961.

17 Ahalt, J.D. and A.C. Egbert, "The Demand for Feed Concentrate: A Statistical Analysis," Agricultural Economic Research. 17, April 1965, pp. 41-49.

18 Egbert A.C. and S. Reutlinger. "A Dynamic Long-Run Model of the Livestock-Feed Sector," Journal of Farm Economics 47,1965, pp. 1288-1305.

19 Meilke, K.D. "An Aggregate U.S. Feed Grain Model" Agricultural Economic Research 27, 1975, pp. 9-18.

20 Richardson, J.W. and D.E. Ray. "Demand for Feed Grain and Concentrates by Livestock Category." Western Journal of Agricultural Economics 3, 1978, pp. 23-30.

21 Gitu, K.W. "The Structure of Production and the Derived Demand for Inputs in the United States Livestock and Poultry Industries," Phd. Thesis, Pennsylvania State University, August, 1983.

22 Hogue, A. and A. Adelaja. "Factor Demand and Returns to Scale in Milk Production: Effects of Price, Substitution and Technology," Northeastern Journal of Agricultural and Resource Economics, 13, 1984, pp. 237-244.

23 Grisley A. and K.W. Gitu. "Production Structure of Dairy Farm," Northeastern Journal of Agricultural and Resource Economics 13, 1984, pp. 245-252.

province. Consequently, derived feed grain demand changes and associated economic gains are considered here on a sector by sector basis (i.e. dairy, poultry, hogs, cattle).

In the special cases of chicken, turkey, egg and dairy production, aggregate output in Nova Scotia is invariant with respect to the feed grain price changes considered in this analysis. The changes in the utilization of feed grain in response to price changes arise only from the input substitution effects in these sectors. This situation results from the supply management and production quota systems in place and these quota levels are invariant with respect to feed grain prices. Fixed output price elasticities will therefore be used to estimate the price efficiency gains for these segments of the industry.

In the hog and cattle sectors, where output is not restricted, changes in the derived demand for feed grain are composed of both output and substitution effects. Restructuring an input subsidy to an output basis, in such cases, will lead to both a shift and a movement along the derived demand curve for feed grains and the supply curve for livestock output. Invoking the duality between producer surpluses in factor and output markets the estimation of producer welfare changes can be based at convenience on either the feed grain or product (livestock) markets. This includes sequentially measuring the effect of multiple price changes (of both product output and feed grain inputs) using the supply curve in the product market and the demand curve in the feed grain market.

The relevant parameters for the measurement of producer welfare changes in livestock markets are the elasticity of supply with respect to feed grain prices and the elasticity of supply with respect to livestock prices. (There are published estimates of the hog supply function for the Maritime region). The parameters required for measurement of welfare changes in the feed grain market are the elasticity of demand with respect to feed grain price and the elasticity of derived feed grain demand with respect to product (hogs, cattle, etc.) prices.

In summary, estimates of product supply and derived input demand parameters are used below to analyze the producer welfare effects of the proposed policy change in dairy, poultry and egg, hog and cattle production in Nova Scotia. Short run estimates are first considered for the individual feeding sectors and then a range of long run effects corresponding both with the short run estimates and with any long run estimates available are considered.

3.3.1 Dairy Feeding

Dairy producers have a relatively wide range of adjustment possibilities in responding to feed grain price changes. Demand for feed grain in this sector consequently is more elastic than in other livestock feeding sectors. This situation may be explained by the ruminant capability of cattle versus the more restricted feeding requirements of nonruminant animals. Dairy feeding programs vary widely[24] depending on the relative costs of feed grains, concentrates, grain substitutes and various roughage feeds including pasture.

[24] The national average grain input per unit of milk output for 23 developed countries in 1973 ranged from 0.06 to 0.30 and averaged 0.16 for all OECD countries and Oceania. See, Regier, D.W. "Livestock and Derived Feed Demand in the World GOL Model," USDA Foreign Agricultural Economics Report No. 152, p. 31.

Compared with other areas of Canada, dairy production in Nova Scotia is characterized by higher utilization of feed grains. The 210 dairy farms participating in the Dairy Herd Analysis Service (NSDAM), in 1983, fed an average 2,363 kg of meal per cow, per year and had an average meal to milk ratio of 0.38. Individual farms ranged from a low of 683 kg of meal fed per cow to a high of 3,869. During the 1970-83 period the annual average milk (3.6 b.f.) to meal ratio ranged from 0.43 (1980) to 0.33 (1970). This range represents a 30% difference in the average annual utilization of this input per unit of output. (See table 3.4) The DHAS participating farms are believed to have higher productivities than the remaining 550 farms in the provincial dairy sector.

Faced with changes in dairy feed concentrate costs dairy producers can respond by varying their output and rates of hay and concentrate feeding. Many studies have shown that the optimum level of feeding is dependent on the relative prices of hay, concentrates, and milk, and that the marginal physical product of concentrates (hay) is increased with hay (concentrates) held constant at some level.[25]

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[25] See for example, Hoover L.M., P.L. Kelley, G.M. Ward, A.M. Feyerherm, and R. Chaddha. "Economic Relationship of Hay and Concentrate Consumption to Milk Production," Journal of Farm Economics Vol I, February, 1967, pp 64-78.

Heady E.O., N.L. Jacobson, J.P. Madden and A.E. Freeman. "Milk Production Function in Relation to Feed Inputs, Cow Characteristics and Environmental Conditions," Iowa Agricultural and Home Economics Experimental Station Bulletin 529, July 1964.

Heady E.O., J.A. Schnittker, N.L. Jacobson, and S. Bloom. "Milk Production Functions, Hay/Grain Substitution Rates and Economic Optimum in Dairy Cow Rations," Iowa Agricultural Experimental Station Research Bulletin. 444, October, 1956.

Young M.L. "Effects of Changing Milk and Feed Prices on Management Practices and Incomes, New York Dairy Farms 1974-78," Cornell University, Agricultural Economic Research 80-81, May 1980.

Table 3.4

Dairy Feed (14-16%) Prices, Annual Percent Change in Milk Production and Selected Dairy Herd Analysis Service Statistics 1970-83

	Dairy Feed[a] 14-16% ($/tonne)	Ratio Milk to Meal Fed (Kg Milk to Kg Meal) Actual	Ratio Milk to Meal Fed (Kg Milk to Kg Meal) Adj. 3.6% bf.	Ave. Meal Per Cow kg	%N.R. Meal	Roughage Ave. Rate[b]	Ave. Return Overfluid Milk[c] $/hl	Milk Production Per Cow Actual	Milk Production Per Cow Adj. 3.6% bf.	Production Change %[d]
1983	261	2.63	2.63	2,363	41	2.30	36.00	6,207	6,207	-3.9
1982	257	2.51	2.49	2,410	42	2.30	36.85	6,055	6,005	+0.6
1981	262	2.55	2.44	2,317	42	2.30	36.25	5,913	5,666	+1.4
1980	235	2.45	2.35	2,470	45	2.20	34.30	5,860	5,632	+3.7
1979	191	2.53	2.43	2,308	47	2.20	31.68	5,847	5,603	+5.1
1978	196	2,59	2,48	2,201	46	2.30	29.55	5,693	5,456	+7.2
1977	196	2.62	2.51	2,102	46	2.30	28.29	5,514	5,284	+2.5
1976	193	2.65	2.49	2,148	47	2.20	28.30	5,695	5,362	+6.5
1975	192	2.57	2.47	2.101	46	2.20	28.12	5,398	5,188	+7.4
1974	194	2.64	2.60	1.928	44	2.30	20.90	5,083	5,012	+2.0
1973	152	2.73	2.72	1,856	43	2.35	11.08	5,060	5,102	-1.1
1972	110	2.70	2.74	1,915	44	2.35	9.65	5,164	5,322	+5.8
1971	108	2.77	2.85	1,874	44	2.39	9.66	5,182	5,340	+4.9
1970	108	2.83	3.00	1,907	41	2.46	9.20	5,112	5,424	+1.5

Source: Various annual reports of the Dairy Herd Analysis Service, Livestock Services Branch, NSDAM.

a LFBC reported.

b Kg of roughage fed per 100 kg of body weight per day.

c Total market return for overfluid milk plus subsidies less levies paid.

d Annual change in milk shipments.

Published production and cost function estimates for milk are considered to be characterized by (what are now) low productivity cows and by U.S. mid-west cropping conditions. (Hoover, Kelley, et. al., Heady, Jacobson, et. al., Heady, Schnittker, et. al.). Recently, however, a study by Hogue and Adelaja[26] estimated a translog cost function using pooled time series and cross section data from dairy farms in five northeastern U.S. states. Their estimates of the Allen partial elasticities of substitution for feed and other inputs and of the own-price elasticity of feed and cross-price elasticities of demand for other inputs with respect to feed prices, are shown in table 3.5.

Based on Hoque and Adelaja's fixed output own-price elasticity of demand for feed (-0.3160) the removal of freight assistance on feed grains in Nova Scotia could be expected to decrease the demand for dairy feeds in the short run by 1.36%.[27] With an initial utilization of 87,500 tonnes this implies that demand would fall by 1360 tonnes. This leads to a year one price efficiency gain of only $6900. If the freight subsidy were increased by $10/tonne (prior to the policy change) the welfare gain would be $20,200. Feed demand in this later case would fall by 2,104 tonne with the removal of the price distortion.

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[26] Hogue, A. and A. Adelaja. "Factor Demand and Returns to Scale in Milk Production: Effects of Price, Substitution and Technology," Northeastern Journal of Agricultural and Resource Economics. 13, 1984, pp 237-244.

[27] This assumes that feed grain prices are $168/tonne initially and increase to $182/tonne. Dairy feed prices increase from $260 to 271.20/tonne or by 4.3%.

Table 3.5
Estimated Own-Price and Cross Price Elasticities of Factor Demand with Respect to Feed Prices and Allen Partial Elasticities of Substitution for Feed in Milk Production

	Demand Elasticities With Respect to Feed Prices	Allen Partial Elasticities of Substitution for Feed
Feed	-0.3160	-0.8031
Labour	0.0640	0.0793
Utilities	-0.0259	-1.6207
Fuel Oil	0.0155	0.5523
Machinery	0.1299	1.9990
Capital	0.0704	0.2657
Other Inputs	-0.1950	-1.4105

Source: Hogue, A. and A. Adelaja: "Factor Demand and Returns to Scale in Milk Production: Effects of Price, Substitution and Technology," Notheastern Journal Agricultural and Resource Economics, 13 No. 2, October 1984, pp. 237-244.

Estimates in table 3.5 indicate that labour, fuel oil, machinery, and capital are all substitutes for purchased dairy feed.

There are currently 1,800 person years[28] of labour employed in dairy farm production in Nova Scotia. A 4.3% increase in dairy feed prices could, based on the 0.064 labour demand elasticity with respect to feed prices, be expected to directly create the equivalent of 5 person years of employment in dairy farming in the first year. Increasing the input subsidy by $10/tonne without restructuring the program would alternatively reduce employment in the sector by 4.4 person years in the short run. While these numbers are small if the incremental administration cost of restructuring the program are low

[28] Derived from Statistics Canada. 1981 Census of Canada, Agriculture, Nova Scotia, Ottawa, Cat. No. 96-904.

enough such employment gains could possibly be cost effective compared with other public measures to increase employment in the region.[29]

To test whether Hogue and Adelaja's estimates were representative of the magnitude of the derived demand response to price an estimate for the Nova Scotia industy was made.

The theoretical model explaining the derived demand for concentrates was postulated as,

$$Qx^D = f\ (P_c,\ P_m,\ P_r,\ T)$$

Where, Q_xD = amount of concentrates fed per cow,

P_c = price of dairy concentrates (-),

P_m = expected marginal price of milk (+),

P_r = price of roughage (+), and

T = technology.

The estimated empirical model varied from the postulated theoretical model as the measures of variables available were different from the "ideal" measurements. Published regional average prices for dairy concentrates (14-16% CP) were available. Roughages, however, are not marketed in quantity and dependable price series were not available. Furthermore the supply (and quality) of roughages, including pasture conditions on dariy farms in a given season, is largely predetermined and/or determined by weather.

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29 The Atlantic and East Grain and Flour Subsidy Program for which the principle objective is employment and economic activity in New Brunswick and Nova Scotia has been found to create employment at an estimated annual cost of $86,700 per job. Direct employment programs on the other hand can create employment at a cost in the $15 - 20,000 range per job. See: Canadian Transport Commission. Report on the Evaluation Study of the Atlantic and East Grain and Flour Subsidy Program, Ottawa, June, 1984.

Pasture conditions are included here. Grisley and Gitu[30] have for example reported that "treating farm-produced roughage feeds as variable inputs in a short-run feeding program may not be a realistic assumption in the milk production process." Halverson[31] similarly included forage supplies as predetermined for short run milk supply analysis.

An accurate measurement of the supply of roughage on dairy farms is not available. Therefore, the variable was either left out of the regression completely or was represented by the proxy variable of the reported roughage feeding rate of dairy cows. This later procedure, of course, clearly uses an endogenous variable and results in simultaneous equation bias in the estimates. Both options gave similar results in regard to the dairy feed elasticity demand possibly resulting from the short run dominance of external events over the control ability of producers with regard to roughage supplies.

To represent the expected marginal product return the calculated average per unit return from overfluid milk shipments adjusted for all levies and subsidies was used as an approximation.

To allow for technical change the genetic change in cows over the period was also represented by a proxy variable. This was the DHAS annual average (rolling herd) production per cow for farms

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[30] Grisley, A. and K. W. Gitu. "Production Structure of Dairy Farms," Northeastern Journal of Agricultual and resource Economics 13, 1984, pp. 245-252.

[31] See: Heady, E.O., C.B. Baker, H.G. Diesslin, E. Kehrberg, and S. Stanforth, Agricultural Supply Functions, Iowa State University Press, Ames, 1961, p. 84.

lagged one year. Bloom, Jacobson, McGilliard, Homeyer and Heady[32] have found that the genetic effect usually outweighted the effects of differences in feeding intensity, even when these differences were large.

Equations 1.1, 1.2, and 1.3 shown in table 3.6 explained 70.6%, 81.3%, and 83.5% of the annual variation in concentrate feeding rates over this period. The proxy variable for genetic change had the correct sign but was found not to be statistically significant and was omitted from equations 1.1. and 1.2. Calculated at their respective means a 1% change in dairy feed prices was estimated to result in a 0.337% to 0.394% change in concentrate feeding. These elasticities are not significantly different from the 0.3160 estimate reported by Hogue and Adelaja. It should be noted however, that for part of the estimated period, milk production in Nova Scotia was increasing to fill available market share quota (M.S.Q.) Therefore the demand changes resulting from decreasing feed prices would have been composed of both substitution and output effects during this time.

The major short term response which producers can make to higher dairy feed prices are adjustments in roughage feeding. The specifications used for the estimation of the price response in these results held this control variable constant or did not account for variations at all in roughage supplies. It is surprising that the

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32 Bloom, S., N.L. Jacobson, L.D. McGilliard, P.G. Homeyer and E.O. Heady. "Effects of Various Hay - Concentrate Ratios on Nutrient Utilization and Production Responses of Dairy Cows. Relationships Among Feeding Level, Predicted Producing Ability, and Milk Production," Journal of Dairy Science, 1957, pp 81-93.

Table 3.6

OLS Regression Equations of Concentrate Feeding
Per Milk Cow, DHAS Dairy Farms, Nova Scotia 1970-83

		Dependant Variable	Constant	RPDF	RROP	RGH	ROL Ave-1	R SQ.
(1.1)	Coefficient	Concentrate	2375.4	-7.464	+40.531			0.706
	(t-value)	Per Cow	(10.187)	(-3.819)	(3.921)			df=10
	Elasticity			-0.394	0.272			
(1.2)	Coefficient	Concentrate	5365.4	-6.306	+26.663	-0.631		0.813
	(t-value)	Per Cow	(3.604)	(-3.433)	(2.214)	(-2.064)		df=10
	Elasticity			-0.337	0.177	-1.400		
(1.3)	Coefficient	Concentrate	5499.7	-6.686	+23.629	-0.664	+0.020	0.835
	(t-value)	Per Cow	(3.713)	(-3.607)	(1.928)	(-2.180)	(1.087)	df=10
	Elasticity			-0.357	0.157	-1.472	0.050	

Note: Concentrates per cow = annual average kg. in meal fed per cow on DHAS herds.

RPDF = real annual average price of dairy feed (14-16% CP) ($ tonne)
RROF = real annual average farm returns from overfluid milk sales adjusted for all subsidies and levies ($/hl)
RGH = roughage rate X average body weight X 365
ROLAVE - 1 = overall rolling average production per cow lagged one year (used here as a proxy for genetic change)

estimated elasticity was so similar to the published estimates. A further specification problem included the aggregation of feed grains, and protein supplements as "dairy feed". This precluded one of the most immediate price efficiency adjustments which can be made by the industry.

The expected marginal returns from milk production did apparently influence concentrate feeding over the 1970-83 period. Higher milk returns resulting from the payment of feed assistance on a product (output) basis would not however be expected to effect any change in feeding practices at present. During part of the estimation period production was expanding to fill the provincial M.S.Q. This has now been achieved. Payments of feed assistance restricted to fluid milk and in-quota MSQ production furthermore would not affect marginal returns from over-quota production in any event.

Hogue and Adelaja used annual data in their study as was the case above. Large changes in the quantity of inputs demanded due to price changes in such a short period might not be expected. The policy and price changes under consideration would be long term and a one year period would be insufficient for all adjustments. The response of feed input utilization to price changes estimated above were fairly substantial despite substitution opportunities being restricted to the short term.

The implications for feed grain use and producer welfare from a range of long term price elasticities of derived feed grain demand are given in table 3.7. For comparison purposes in assessing the magnitude of the selected long run elasticities a study by Ferris et. al.[33] has estimated feed grain demand for a span of five years for manufactured feed in the United Kingdom. They reported a demand elasticity of -0.21 for year one, -0.33 for year two, -0.46 for year three, and -0.55 for year five. Longmire using aggregative programming analysis estimated a long run elasticity for feed grain demand in Britain of 1.9 which he compared to one-year elasticity estimates of between -0.29 and -0.50.[34]

The range of values selected for table 3.7 is considered conservative. They imply that the change in producer welfare that would result from an assistance policy which did not distort feed input prices is between $16,000 and $28,000. This applies to the existing subsidy level. With a $10/tonne increase in the subsidy rate the welfare "triangle" or opportunity cost for not undertaking the change would increase to between $51,100 and $89,000 annually.

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33 Ferris, J., T. Josling, B. Davey, P. Weightman, D. Lucey, L. O'Callaghan, and V. Sorenson. "Impact on U.S. Agricultural Trade of the Asccession of the U.K., Ireland, Denmark and Norway to the European Community," Research Report 11. Michigan State University. East Lansing Michigan: 1971.

34 Longmire, J.L. "Demand for Concentrate Feed in British Agriculture: An Aggregative Programming Approach," Journal of Agricultural Economics. 1980, pp. 163-173.

Table 3.7

Changes in Feed Grain Demand and Producer Welfare in Nova Scotia Dairy Sector Associated with Three Long-Run Demand Elasticities and Two Subsidy Levels Subsequent to FFA Policy Change

	Price Distortion Prior to Policy Change of $14/tonne		Price Distortion Prior to Policy Change of $24/tonne	
Elasticity of Feed Grain Demand	Change in Demand (tonne)	Change in Producer Welfare	Changes in Demand (tonne)	Changes in Producers Welfare
-0.40	-2310	$+16,170	-4270	$+51,240
-0.55	-3220	+22,540	-5880	+70,560
-0.70	-4060	+28,420	-7420	+89,040

Note: Based upon average initial feed grain demand of 87,500 tonne prices of $168 and $158/tonne. Price changes differ from those utilized for grain production effects because of compositional and locational differences.

3.3.2 Poultry and Egg Production

Gitu[35] has estimated the constant output elasticities of substitution between concentrates and feed grains, the own-price elasticities of demand for concentrates and feed grain and the cross-price elasticities of demand between the two, for turkey, broiler, and egg production on a quarterly basis for the U.S. The mean values are shown in table 3.7. The estimates of the elasticities of substitution between feed grain and concentrates were found to be above zero in all cases. Poultry and egg feeding technologies are not therefore characterized by fixed input proportions or fixed input-output coefficients. Protein concentrates and feed grain are substitutes (at normal price ratios).

Output in the case of Nova Scotia broiler, turkey, and egg production is not affected by changes in feed prices of the magnitude which would result from the policy change considered here. The own-price elasticities of demand for feed grain which indicates the proportionate change in the demand for feed grain resulting from a proportionate change in price when output and all other input prices are fixed, should consequently be used in calculating the welfare loss (gain) triangle. Price efficiency gains in these sectors will arise only from input substitution and not output effects.

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[35] Gitu, K.W. "The Structure of Production and the Derived Demand for Inputs in the United States Livestock and Poultry Industries," Ph.D. thesis, Pennsylvania State University, August 1983.

Table 3.8

Mean Values of Own-Price Elasticities of Demand for Concentrates and Feed Grains, Elasticites of Substitution, and Cross-Price Elasticities of Demand Between Concentrates and Feed Grains

	Turkey Production	Broiler Production	Egg Production
Elasticity of Substitution	0.0617	0.0587	0.0450
Own Price Elasticity (c)	-0.0346	-0.0402	-0.0350
Own Price Elasticity (f)	-0.1136	-0.0868	-0.0586
Cross Price Elasticity (cf)	0.0397	0.0238	0.0213
Cross Price Elasticity (fc)	0.0238	0.0350	0.0254

Source: Gitu, K.W. "The Structures of Production and the Derived Demand for Inputs in the United States Livestock and Poultry Industries," Ph.D Thesis, Pennsylvania State University, August 1983.

The own-price elasticity of demand for feed grain (with fixed output) in the case of broiler production was estimated at -0.09 by Gitu. Using a feed grain price of $170/tonne removal of the current FFA subsidies would increase the price of feed grain by $14/tonne or by 8.2%. This would decrease the demand for feed grain by 0.71%.

Based on annual feed grain utilization of 31,200 tonnes demand would fall by 222 tonnes and the welfare gain for producers from adjusting their feeding practices would be $1,554. (This assumes they received the same subsidy expenditure as before but paid on output.) For eggs and turkey production the short run welfare gain would be $1,197 and $287. Feed grain utilization for egg production is assumed at 35,600 tonnes initially and turkey feed utilization at 4,400 tonnes. The total welfare gain from poultry and egg producers minimizing costs consistent with the market value of feed grain at the current level of the subsidy in the short run is indicated at $3,038. If the FFA subsidy was increased by $10/tonne the corresponding efficiency gains would be $4,942 for broilers, for egg production $3,802, and for turkey production $912. The total efficiency gain for the poultry and egg sector from these short run adjustments would be $9,700.

The feed demand parameters estimated by Gitu for the poultry and egg sectors were quarterly elasticities. Only partial adjustment to price changes can occur over this short period. Substitution opportunities for feed grain in modern poultry production are, however, more restricted than in the case of other sectors and especially compared with ruminant livestock. The longer run implications for feed grain demand and producer welfare of the policy and price changes considered here (shown in table 3.9) are based on a range of low, medium, and high elasticities which reflect this circumstance.

At the present subsidy level the annual gains from the change in subsidy administration over the long run are implied at between $6200 and $14,500. Such gains given a $10/tonne increase in the subsidy level prior to the policy restructuring increase to between $19,500 and $45,400 annually.

Table 3.9

Change in Feed Grain Demand and Producer Welfare in Nova Scotia Poultry and Egg Sector Associated with Three Long Run Demand Elasticities and Two Subsidy Levels Subsequent to FFA Policy Change

Elasticity of Feed Grain Demand (with Fixed Output)	Price Distortion Prior to Policy Change of $14/tonne: Change in Demand (tonne)	Price Distortion Prior to Policy Change of $14/tonne: Change in Producer Welfare	Price Distortion Prior to Policy Change of $24/tonne: Changes in Demand (tonne)	Price Distortion Prior to Policy Change of $24/tonne: Changes in Producers Welfare
-0.15	-889	$+6,220	-1623	$+19,480
-0.25	-1483	+10,380	-2706	+32,470
-0.35	-2076	+14,530	-3788	+45,460

Note: Based upon average initial feed grain utilization of 70,000 tonne and prices of $168 and $158/tonne.

3.3.3 Hog Feeding

Nova Scotia hog producers have historically shared an open continental market with the remainder of the North American hog industry. Within this highly competitive sector they are currently faced with higher relative costs for their largest input (feed) and lower relative output prices. Lower relative hog prices have resulted primarily from Eastern Canada shifting from a net importing to a net exporting position for pork since the mid-1970's. The large scale hog expansion in the province of Quebec[36] was the major cause for the structural change in Eastern Canada's position in the North American pork market. While Nova Scotia and the Maritime Provinces are a net pork importing region, the local price for hogs is only equivalent to the Ontario price.

A more cost effective administration of the public resources committed to the sector could play a role in the sector's survival. The transformation of FFA from an input to an output subsidy could improve feeding margins for Nova Scotia hog producers. Whether or not there are substitutes for feed grain (and/or purchased feed grain) in hog production and if so to what degree substitution is economic at the new price ratios are important questions. If the feed grain/output (and/or purchased feed grain/output) relationships are invariant then the economic situation of producers would not be changed.

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[36] Hog marketings in the Province of Quebec increased from 2.3 million to 4.6 million between 1976 and 1984.

While there are numerous studies which have reported elasticities of supply for hogs with respect to own price and feed grain prices, for the U.S., Canada, and for particular regions, these can not be applied to the Nova Scotia case. The provincial industry's position, with respect to the utilization of purchased feed, is not common. It is estimated[37] that in 1980 "home grown" grain accounted for only 8% of the grain utilization in hog production in the province. Integrated hog-crop farms typically account for much larger proportions of the hog production in other regions. (Van Arsdall and Nelson[38] have reported that in 1980 nearly 90% of all grain used in farrow-to-finish and feeder pig finishing operations in the U.S. North Central region was produced on the same farm as the hogs.) Feed grain is an input in hog production (and largely a purchased input in N.S.) but it is frequently also a substitute for pork production in other regions. This is particularly noticeable at high grain prices.

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[37] Robinson, D. E. The Arithmetic of Restructuring FFA, Maritime Farmers Council Working Paper, November, 1982.

[38] Van Arsdall, R.N. and K.E. Nelson. U.S. Hog Industry USDA Economic Research Service, Agricultural Economic Report No. 511, June 1984, p. 27.

Given the high incidence of purchasing feed on Maritime hog farms, and the restricted substitution opportunities for feed grains it could be expected that the relative magnitude of estimates of the hog price and feed price elasticities of demand would reflect the revenue share of feed costs. (i.e. assuming largely fixed feed coefficients and feed costs equivalent to 50-60% of revenue, it could be expected that a 1% change in feed prices would have a similar output response as a 0.5-0.6% change in hog prices), In other regions with feed grain both an input and a competitive output such a relationship would not be expected a priori. There are many estimates in such cases of the hog supply elasticity with respect to feed grain prices which are higher than the own price elasticity for hog supply, for example Meilke.[39]

Existing regional estimates, however, do not show such relative responses to hog and feed price changes. Estimates by Chin, Pando, and West[40] and by Chin and Spearin[41] yield conflicting information on producer adjustment to changes in feed grain and hog prices and in both cases the grain price variable was statistically insignificant.

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[39] Meilke, K.D. "Another Look at the Hog-Corn Ratio," American Journal of Agricultural Economics. 59, 1977, pp 216-219.

[40] Chin, S.B., J.L. Pando, and D.A. West. National and Regional Hog Supply Functions, Agriculture Canada, Economics Branch Pub. No. 74115, September 1974.

[41] Chin, S.B. and M. Spearin. "An Analysis of Quarterly Provincial and Regional Hog Supply Functions," contained in Commodity Forecasting Models For Canadian Agriculture Vol. 1, coordinated by Z. A. Hassan and H. B. Huff Agriculture Canada, Publication No. 7812, 1978.

Chin, Pando, and West's estimates were based on the 1961-72 period using semi-annual data. They reported a 0.28 supply elasticity with respect to hog price and a -0.25 elasticity for the price of barley (used as a proxy for all feed inputs) for the Maritimes. The price of hogs was significant, however, only at the 10% level and the price of barley was not statistically significant. A $1/cwt increase in the price of hogs was estimated to increase marketing 18 months later by 1,376 hogs, while a $1/ton increase in the price of barley reduced marketing by 794 hogs in the same period. The relative magnitudes of the price coefficients combined with an average feed input per cwt of pork of approximately 0.30 ton infer that converting a $14/tonne feed freight subsidy to a $2.47/cwt product payment (current dollars) would reduce hog production in the short term.

Barley prices nevertheless explained a larger percentage of the variation in hog marketings than did the price of hogs. And the model as a whole explained a high proportion of the variation in marketings over the period. Commenting on the difference with the rest of Eastern Canada (where the price of hogs was the most influential economic factor effecting the level of hog marketings) Chin, Pando, and West suggested that hog producers in the Maritimes are more dependent on purchased feed and hence more affected by its price. The Maritime supply elasticity with respect to feed grain price at -0.25 was comparable to the estimates for Ontario (-0.29) and Quebec (-0.30).

Chin and Spearn also estimated a quarterly supply equation for the Atlantic Province for the 1966-77 period. Results showed a $1/cwt change in the price of pork increased marketing five quarters later by 166 hogs. A $1/ton change in the price of barley reduced marketing in the same period by 18 hogs. (While not reported these coefficients implied elasticites of supply calculated at mean values of 0.10 with respect to hog prices and -0.02 for barley.) Based on an average $14/tonne freight subsidy and an equivalent product payment of $2.47/cwt (current dollar) these estimates infer that hog production would increase in the short term with the change in the administration of FFA subsidies. The price of barley was again not statistically significant.

The Nova Scotia hog industry is currently faced with many uncertainties. Decisions such as with regard to stabilization policy and countervailing U.S. duties on Canadian live hogs and pork exports may be expected to greatly impact upon the province's hog production. In such circumstances estimates of the per hog feeding efficiency gains resulting from FFA restructuring are useful and avoid difficulties related to output level.

Gitu[42] reported a mean value for the constant output own-price elasticity for feed grain in hog production of -0.03 calculated on a quarterly basis. Assuming the feed grain input per hog is 292 kg this results in a 0.25% or 0.7 kg decrease in the use of this input in the quarter following a $14/tonne or 8.2% (initial price of $170) price increase. The efficiency saving would be 0.5¢ per hog. At current hog production levels this could represent only $1,250 in feeding efficiencies for the entire sector. These gains are for the short run of a single quarter.

If the freight subsidy were increasd by $10/tonne prior to the restructuring of the payment system the subsequent first quarter decrease in feed grain utilization per hog would be 1.3 kg. The efficiency saving would then be 1.6¢ per hog and at a production level of 250,000 hog would total $4000. Gitu had suggested in discussing his comparatively low elasticity values that only partial adjustment to price changes can occur in a single quarter. These efficiency estimates could, therefore, be considered as the lower bounds for such gains.

Given the very low values of Gitu's estimates reference was made to a second source. Boggess, Olson, and Heady[43] using Cobb-Douglas isoquants estimated that for live weight hogs grown from 60

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42 Gitu, K.W. "The Structures of Production and the Derived Demand for Inputs in the United States Livestock and Poultry Industries," Ph.D. Thesis. Pennsylvania State University, August 1983.

43 Boggess, W.G., K.D. Olson, and E.O. Heady, "Gain Isoquants and Production Functions for Swine" contained in Livestock Response Functions ed. E.O. Heady, and S. Bhide, Iowa State University Press, 1984, p. 267.

to 215 lbs the least cost ratio changed from 412 lbs of corn and 90 lbs of protein supplement to 424 lbs of corn and 83 lbs of protein supplement when the soya/corn price ratio changed from 1.75 to 2.00. Assuming initial soyameal and corn prices of $325 and $168 the soya/corn price ratio would change from 1.93 to 1.79 with the FFA restructuring. Interpolating Boggess et. al.'s estimates this would suggest all else being equal that feed grain demand on a per hog basis would fall by 6.7 lbs or by 3.0 kg. Using the equation 3.1 the price efficiency gains would be 2.1¢/hog and $5,250 for the total sector with production at 250,000 hogs. If the feed grain subsidy were increased by $10/tonne the efficiency saving would be 7.1¢/hog and $17,750 for the overall sector at the same aggregate output level.

While Gitu's quarterly estimates represented short term adjustments, those of Boggess, Olson and Heady were presented as complete responses. Other adjustments besides the substitution of soyameal to economize on more expensive feed grains may be possible in the long run. In Nova Scotia for example feed wastage in the hog sector has been estimated at 5-7% overall with a range on individual farms of between 2% and 10%.[44] In a sustained higher feed cost environment it may be expected that producers would allocate more resources to reducing this wastage then would otherwise be the case.

In table 3.10, the producer welfare implications of the policy change associated with three long run price and varying cross price elasticities of hog supply are shown. For each own price elasticity a cross elasticity of feed grain is given for which

[44] Communication with Donald Cox, Swine Supervisor, NSDAM.

Table 3.10

Change in Producer Welfare of NS Hog Sector
Subsequent to FFA Policy Changes with Varying Own and
Cross-Price Elasticities of Hog Supply and with Two Subsidy Levels

Own Price Elasticity of Hog Supply	Cross Price Elasticity of Hog Supply (With Respect to Feed Grain)	Change in Producer Welfare: Price Distortion Prior to Policy Change of $14/tonne	Change in Producer Welfare: Price Distortion Prior to Policy Change of $24/tonne
1.00	-0.357	—	—
	-0.355	$+5,700	$+9,800
	-0.353	+11,500	+19,700
	-0.351	+17,000	+29,500
1.50	-0.536	—	—
	-0.532	+7,600	+13,000
	-0.529	+13,400	+23,000
	-0.526	+19,100	+32,800
1.75	-0.625	—	—
	-0.620	+8,200	+14,000
	-0.617	+13,100	+22,500
	-0.614	+18,000	+30,900

NOTE: Calculated on the basis of feed grain price of $168/tonne, hog price of $81/cwt, production of 250,000 hogs and an initial average feed gain/hog output ratio of 0.292/tonne.

neither output nor producer welfare would change. If the negative supply response to the feed grain price change (increase) is below this level and is less than the positive output response from higher product returns in absolute terms, however, input substitution is implied and hog production and producer welfare would both be higher with an equivalent subsidy per unit of output. Consistent with the above discussion the conservative values selected imply very limited substitution opportunities even in the long run.

The annual economic gains implied for producers range from $5700 to $17,000 at the existing subsidy level. If the subsidy were to increase by $10/tonne then the implied gain from changing the basis of payments increases to a range of $9,800 to $32,800.

3.3.4 Beef Cattle Feeding

Excluding dairy cows, 72% of the cattle reported on farms in Nova Scotia at the time of the 1981 Census of Agriculture were on small, part-time, and hobby farms with total annual sales of agricultural products of less than $25,000. There are a few commercial cattle feeding operations but grass-fed beef and feeder cattle account for the bulk of the sector's output. In 1980 cattle operations utilized approximately 15,000 tonnes of purchased feed and the "home grown" grain production on these farms was approximately 8,400 tonnes.

Richardson and Ray[45] reported a price elasticity of demand for feed grain for cattle and calves of -0.95. Gitu[46] reported a constant output elasticity for fed beef of -0.63 and for non-fed beef of -1.79. Given the high proportion of Nova Scotia beef cattle on non-commercial farms and their relatively low expenditure share for feeds it could be expected that the feed grain demand in this sector would not be highly sensitive to price. Using a price elasticity of demand for constant output of 0.90 (which is half of the non-fed beef mean figure reported by Gitu) the elimination of the freight subsidy would be expected to reduce feed grain demand by 1730 tonne in this sector. The efficiency saving (ignoring any output effect) is indicated at $12,100. If the freight subsidy were increased by $10/tonne prior to the restructuring the saving would be $37,900.

Even in the special case of constant output and in the short run Gitu reported an elastic demand for feed grain for non-fed beef. For fed beef and non-fed beef combined, Richardson and Ray reported near unitary elasticity with output variable. With its output characterized to a large extent by grass fed (slaughter) beef and feeder cattle the response to grain prices in the Nova Scotia cattle sector could be expected to be more typical of estimates for the non-fed sector.

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45 Richardson, J.W. and E.E. Ray. "Demand for Feed Grain and Concentrates by Livestock," Western Journal of Agricultural Economics. 1, 1978, pp 23-30.

46 Gitu, K.W. "The Structure of Production and the Derived Demand for Inputs in the United States Livestock and Poultry Industries," Phd. Thesis, Pennsylvania State University, August 1983.

Table 3.11

Change in Producer Welfare of NS Cattle Sector
Subsequent to FFA Policy Changes with Varying Own and
Cross-Price Elasticities of Cattle Supply and with Two Subsidy Levels

Own Price Elasticity of Cattle Supply	Cross Price Elasticity of Cattle Supply (With Respect to Feed Grain)	Change in Producer Welfare: Price Distortion Prior to Policy Change of $14/tonne	Change in Producer Welfare: Price Distortion Prior to Policy Change of $24/tonne
1.50	-.1575	___	___
	-.1450	$16,700	$28,600
	-.1400	23,300	40,000
	-.1300	36,650	62,850
2.00	-0.2100	-----	-----
	-0.1950	15,000	25,700
	-0.1900	20,000	34,300
	-0.1800	30,000	51,400
2.50	-.2630	-----	-----
	-.2450	14,350	24,600
	-.2350	22,400	38,300
	-.2250	30,300	52,000

NOTE: Calculated on the basis of feed grain price of $168/tonne, initial cattle returns of $480/head and a feed grain/head output ratio of 0.3/tonne.

In table 3.4 the producer welfare gains from price efficiencies implied by a range of long run elasticities are given. Producer welfare is implied as increasing by between $14,350 and $36,650 with the assumed values and at the current subsidy level. At the higher subsidy level the welfare gain from an input price neutral assistance policy is indicated at between $24,600 and $62,850.

3.4 Transfers of Program Benefits

In addition to price efficiencies the effects of transforming FFA from an input subsidy to an output based payment system would include some transfers of program benefits. Such transfers include subsidies currently accruing to horse owners and other hobby farms, transfer benefits to local cash grain growers, transfer benefits arising from the "milling-in-transit" subsidies paid on local supplies of millfeeds, and the possibility that subsidies may occassionally be paid on feed grains which are exported in manufactured feed. Another transfer issue involves whether Ontario corn growers receive benefits which may be lost as a result of U.S. corn imports occurring into the province. In all of these instances the transfers would favour commercial farms in Nova Scotia and may be desirable.

This section considers such transfer issues and where possible the value of corresponding benefits to commercial agriculture are quantified. It is assumed that the expenditure committment (or lump-sum settlement) from which the new payments are made is based on past expenditures.

3.4.1 U.S. CORN

One concern about proposals to restructure FFA into an output payment system has been the possibility of U.S. corn imports occurring into the region. Groenewegen[47] expressed this as a potential problem but did not report any analysis in this regard. Livestock Feed Board officials have stressed that such a prospect would threaten the national interest.[48] The analysis in this section will consider the prospects for U.S. corn imports and the conditions under which such a trade may arise. The economic implications are then assessed.

No significant quantities of U.S. corn have entered the Maritime Provinces since the introduction of FFA in 1941. With the lower tariff on U.S. corn (resulting from the last GATT) increased imports into Quebec in the past decade have reduced the negative effects of reduced FFA in that province. With the substantial inflationary erosion of FFA in Nova Scotia the basis for such imports has improved and it is perceived that the removal of the freight subsidy applicable to Canadian product would result in imports displacing domestic grains in this market. This would also reduce the price incentive for local development created from any restructuring of the program.

The least cost origin of U.S. imports into Nova Scotia would be the eastern seaboard.[49] In the 1978-85 period the price

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[47] Groenewagen, J. An Evaluation of the Maritime Farmers' Council Proposal to Restructure Feed Freight Assistance, Livestock Feed Board of Canada and Agriculture Canada, February . 1984.

[48] Livestock Feed Board of Canada, Preliminary Observations Concerning the Maritime Farmers Council Proposal, Paper Presented to Feed Committee MFC, Amherst, Nova Scotia, July 26, 1983.

[49] Hill L.D., M.N. Leath, and S.W. Fuller. "Corn Movements in the United States," Illinois Bulletin 768, Agricultural Experimental Station College of Agriculture, University of Illinois at Urbana-Champaign and; Leath, M.N. , L.H. Meyer, L.D. Hill U.S. Corn Industry. USDA Economic Research Service, Agricultural Economics, Report No. 479, 1982.

difference between loaded U.S. corn at the Gulf ports and track prices in Truro (Chatham price carried forward) ranged from -$12.40 to $47.00.[50] Typically the price difference was $4-14/tonne (See figure 3.3). Based on current transportation costs of approximately $34-38/tonne[51] it is evident from the frequency distributions shown in figure 3.3 and figure 3.4 that the removal of the freight subsidy would not result in any steady corn movement from the U.S. It might, however, create opportunities in unusual market circumstances from time to time. The seasonal period which historically experienced the most favourable market situations for U.S. corn imports was June to September. These months are the tail end of the marketing season and the product involved would be "old corn". Martin, Groenewegen, and Pidgeon[52] similarly reported a high seasonal price basis for Ontario for the months of June to September.

The Halifax grain elevator does not have aeration equipment. This precludes the handling of new crop corn and increases the risk of larger shipments (longer periods in storage). The demand for corn during such market instances would furthermore be depressed depending on alternative western feed grain markets. Purchases of U.S. corn for utilization at the end of the season in Canada and especially

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50 See appendix C.

51 Including ocean shipping, inward and outward elevation, the tariff and land transport to mills.

52 Martin L, G.L. Groenewegen, E. Pidgeon. "Factors Affecting Corn Basis in Southwestern Ontario," American Journal of Agricultural Economics 62, 1980, pp. 107-112.

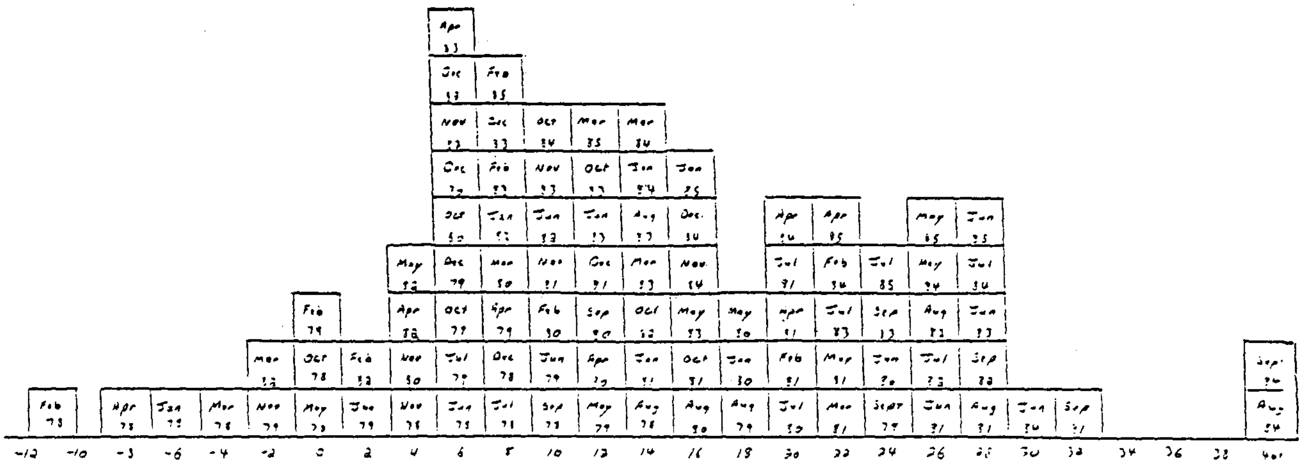

Figure 3.2 Frequency Distribution of Monthly Price Difference Between Ontario Corn (No. 2 C.E.) Landed at Truro and U.S. Corn. (No. 2 Yellow) Gulf Ports 1978-85. ($Can/tonne)

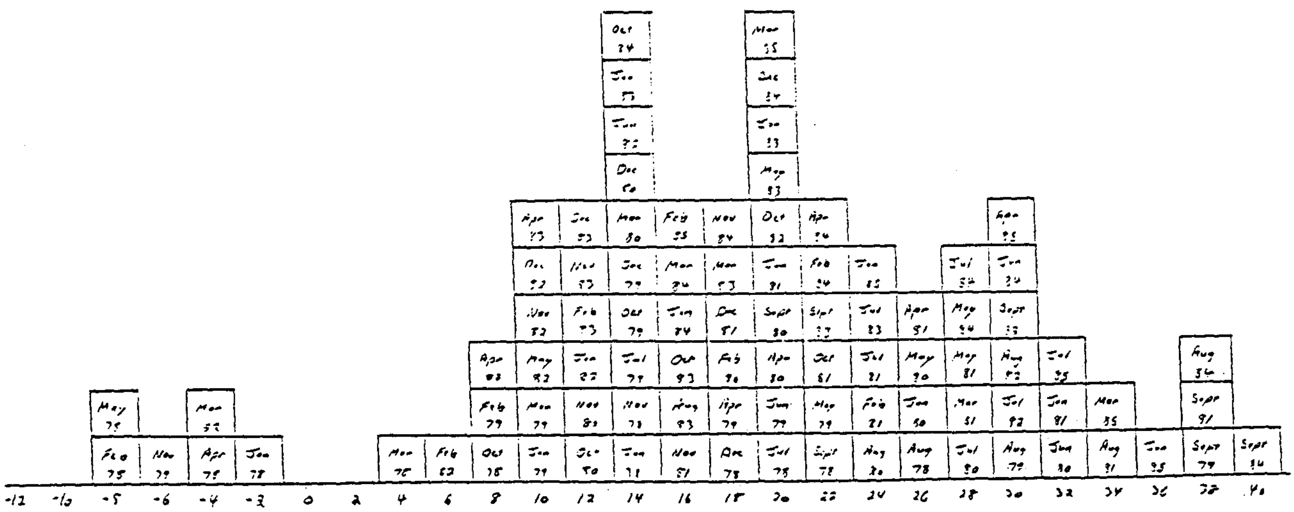

Figure 3.3 Frequency Distribution of Monthly Price Difference Between Ontario Corn (No. 2 C.E.) Landed at Truro and U.S. Corn (No. 2 Yellow) Gulf Ports with FFA Subsidy Removed[1] Expressed in Constant 1981 Dollars, 1978-85. ($Can/tonne)

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[1] It is assumed in calculating the price differences, in the absence of the FFA subsidy, that the removal of freight assistance would not have had an effect on rail freight rates.

spanning two marketing years also cannot usually be hedged very securely.[53]

Shipments of approximately 12,000 tonnes would seem the most probable and would represent 8-11 weeks each of total provincial usage at average corn utilization rates. Based on a $34-38/tonne (Gulf ports to feed mill) transport cost, historic price movements suggest that the removal of the $8-11/tonne subsidy on shipments of Ontario corn to principle milling locations, might create brief instances when the local trade could profitably import U.S. corn. The price savings appear small, however, and the risks significant.

The market conditions which give rise to the occasions of improved competitiveness for U.S. corn are important considerations for this analysis. The most significant grain market variable affecting the position of U.S. corn (against the alternative Ontario corn) on Nova Scotia markets is the price basis between U.S. and Canadian corn in southwestern Ontario.[54] The factors which are associated with changes in the Ontario corn price basis (against the dominant U.S. market) have been investigated by Martin, Groenewegen, and Pidgeon.[55] They report that the existence of an Ontario price premium reflects central Canada being in a net importing position for corn and that the degree of any price premium reflects the extent of

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53 Ibid, p. 111.

54 For an analysis of the variability of oceaning shipping rates for grain see: Brinkley, J.K. and B. Harrer. "Major Determinants of Ocean Freight Rates for Grains: An Econometric Analysis," American Journal of Agricultural Economics 63, 1981, pp. 47-57.

55 Martin L., G.L. Groenewegen, E Pidgeon. "Factors Affecting Corn Basis in Southwestern Ontario," American Journal of Agricultural Economics. 62, 1980, pp. 107-112.

corn imports from the U.S.[56] Similarly Martin and Hope[57] state "Basis has tended to strengthen during the summer in years when Eastern Canada's corn crop has been insufficient for local demand so that U.S. imported corn is required." Meilke and deGorter[58] have also analysed the Chatham-Chicago price relationship reporting "the (relative) Chatham corn price is a key indicator of the surplus-deficit position of eastern Canada".

The conditions in which Nova Scotia would import U.S. corn, therefore, involves a substantial price premium on Ontario corn and extensive imports of U.S. corn into eastern Ontario and Quebec. Accordingly, such Nova Scotia imports would not likely affect the Canadian trade balance with respect to grain. Supplies available for utilization in Central Canada would increase (as a result of N.S. purchases of U.S. corn) and would displace a comparable volume of U.S. corn imports which would otherwise take place (less advantageously) into Eastern Ontario and Quebec.[59]

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56 During the fifteen months shown in figure 3.3 as the most favourable for imports, total Canadian imports of U.S. corn averaged 97,500 tonnes per month.

57 Martin, L., and D.G. Hope. "An Analysis of Strategies For Pricing Corn in Ontario", University of Guelph, Agricultural Economics and Extension Education April 1983, p 13.

58 Meilke, K.D. and H. deGorter, "A Quarterly Econometric Model of the Feed Grain Industry," Commodity Forecasting Models for Canadian Agriculture. Vol. I. ed. Z. Hassan and H.B. Huff, No. 7812 Economics Branch, Agriculture Canada 15-42, 1978, pp 13-42.

59 It is also significant that in 14 out of the 21 months shown in figure 3.3 as the most favourable for purchases of U.S. corn that the Canadian Wheat Board sold feed grain to the domestic market at formula prices which were under market prices. This practice was based on the Corn Competitive Pricing Component of the Domestic Feed Grain Policy.

There are consequently no apparent reasons to be concerned with costs being imposed on other Canadian producers as a result of the improved position for U.S. corn imports in the Nova Scotia market resulting from the restructuring plan. In the circumstances in which these imports might occur it is possible this trade would be of net benefit to the Canadian economy.[60] Given the remote possibility of U.S. corn shipments into Nova Scotia, however, no industry benefits are assigned.

3.4.2 Other Effects for Ontario and Western Grain Growers

The achievement of "feed grain self-sufficiency" is frequently presented as the answer to the feed cost problems of agriculture in the Maritime Provinces.[61] While the policy change considered here could be a cost-effective component of a program, to achieve such a policy goal it would be unlikely to result in this achievement all else being equal. The strategy of restructuring FFA is to give greater inducement to a wide range of developments which would help to reduce the negative effect of reduced and/or terminated subsidies. The policy could be economically worthwile even though grain continued to be shipped into the province.

60 While it is outside the scope of consideration for this analysis the variable cost of freight shipments of Canadian corn would be an important consideration of the effect on the total economy. The Halifax Elevator's variable costs compared with its revenue would be an offsetting factor as would the economics of the rail or truck shipments of grain from Halifax to the mills and the revenue to the Government from the tariff. The benefit to Nova Scotia livestock feeders would of course be unambiguously positive.

61 Many of the adjustment programs which have resulted from such an orientation have been biased towards cash crop grain expansion (compared with home-fed grain grown on livestock farms) and have generally overlooked lagging feed productivity rates and grain substitutes such as quality forage and potato wastes.

Nevertheless, if the policy change were to result in the complete curtailment of import feed grain demand this would represent only 0.3 percent of current national grain production. Since feed grain prices are set in a world market the decrease in demand from Nova Scotia would have no discernible effect on prices in other parts of Canada.

It is possible that the additional economic inducements provided for the commercial development of intensive cereal management (ICM) technologies in the province (see appendix E, p. 192) could result in significant benefits for other Canadian grain growers. Researchers and growers in other regions have already received technical information and insights from the Nova Scotia experience.

3.4.3 Provincial Cash Crop Grain Supplies

Marketings of local feed grain in Nova Scotia are approximately 12,000 tonnes annually. The remaining locally grown feed grain supplies representing more than three quarters of total production is utilized on the farms where it is grown. The market value of local grain is reduced by the amount of the FFA subsidy and removal of this freight assistance would accordingly result in cash grain growers receiving prices consistent with the full alternate cost of importing grain. If freight subsidy expenditures were simply reallocated on livestock output, these payments would not compensate livestock producers for the benefit they previously received from the negative distortion to local feed grain prices.[62] The restructuring of the historic FFA Program would have consequently involved a transfer from livestock producers to cash grain growers of roughly $187,500.[63]

A recent modification to the FFA Program[64] has, however, made commercially marketed local grain eligible for partially compensating FFA subsidies. The new payment scheme on locally produced grain marketed through commercial channels provides for full FFA subsidy compensation in the case of grain corn. For barley, rye, wheat, and oats the payment is $4.40/tonne less than what is paid as freight assistance on the competitive imported grains. Consequently if these current program expenditures were included with the current freight subsidies in calculating the new producer product payments the previous benefit to feeders from the reduced price of local grain would be largely preserved (and cash grain growers would be able to market their grain at undistorted market prices). The transfer arising from livestock producers to cash barley, oats, rye, and feed wheat producers would then be approximately $44,000[65] annually.

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62 Faced with a similar "dilution" problem for western grain growers concerning changes in the method of payment of the "Crow Benefit" Gilson, (1982) recommended that the Federal Government cover part of the difference.

63 Based on an average price reducing subsidy of $15/tonne. This is calculated on a weighted basis to account for the types of grain grown and the location of grain production in the province with respect to geographic subsidy zones.

64 Livestock Feed Board of Canada, Revisions of Feed Freight Assistance Rates and Ammendment to the Regulations. Release, August 28, 1984.

65 Calculated on the basis of 10,000 tonne of local barley, mixed grain, rye, wheat and oats increasing in cost to feeders by $4.40/tonne net of redirected compensating payments.

The restructuring plan would also eliminate the diseconomies inherent with the expected dislocation of grain movement which may result from the restriction of compensation payments to marketed grain.

3.4.3 Transfers from Hobby and Non-Commercial Farms

Benefits from FFA as currently administered also accrue to hobby farm operators. Hobby horse owners are the most significant such group. The 1980-82 "Province of Nova Scotia Equine Survey"[66] estimated the provincial horse population at 12,700. Whole grain purchases for horses were reported at $3.4 million and mixed feeds at $1.1 million annually. Assuming average retail prices for whole grain of $220/tonne and for mixed feeds of $270/tonne (and 85% grain composition in the mixed feeds) then the annual grain consumption is indicated at 19,700 tonnes. This level of horse feed sales was, however, believed to be high. This assessment was supported by feed trade personnel.

A more conservative estimate of hobby horse grain utilization is 15,000 tonnes. Product payments in lieu of freight subsidies would therefore involve a transfer of approximately $225,000 annually in favour of commercial producers. If FFA subsidies were increased by $10/tonne this transfer from hobby horse owners to commercial farms would increase to $375,000. There are some horses in the

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[66] Animal Science Department. "Province of Nova Scotia Equine Survey", Nova Scotia Agricultural College, Truro, 1983.

province used in commercial primary production, principally the yarding of logs. Feed subsidies would not be significant to the annual cost and returns associated with this activity.

There are also a large number of other small and hobby farms who based upon past program experiences would not claim direct feed assistance in lieu of the indirect FFA subsidies from which they currently benefit. In 1981 there were 1704 farms in Nova Scotia with gross agricultural product sales under $5,000 who reported feed expenditures (1213 of these had sales of less than $2,500).[67] These farms would qualify in total for approximately $68,000 at the current subsidy level based upon their product sales. If the subsidy were to increase by $10/tonne equivalent they would qualify for approximately $113,000. Assuming 700 of the 1,704 farms did not submit claims this would involve a transfer of $28,000 at the current subsidy level and $46,000 at the higher level.[68]

The product sales of these farms are disproportionaly small relative to their feed expenditures. The census farms with sales under $2,500 reported 2.6% of total farm sales in 1981 but a higher 3.5% of feed expenditures. Consequently even if they claimed all of the payments that their livestock output would qualify, their level of subsidy would still be reduced. The difference in this regard would largely be the result of horses and this part of the transfer has been considered above.

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67 Statistics Canada, <u>1981 Census of Canada, Agriculture Nova Scotia</u>, Cat. No. 96-904, Ottawa: Statistics Canada.

68 These levels of nonparticipation are considered understated. Such levels were used in estimating administrative expenses (see p. 110) so as not to error in underestimating such incremental costs of the program change.

3.4.4 Exported Feed

There are significant amounts of manufactured feeds exported from the province to off-shore markets. In 1983 Nova Scotia laden exports of ground cereals, by-product feeds, complete feeds, and feed concentrates totalled 2,230 tonnes valued at $1.1 million. Any under reimbursement of FFA subsidies paid on feed grains shipped into the province and sold externally increases FFA expenditures without benefit to provincial feeders. Restructuring of the payments based on historic program expenditures would avoid such leakages of benefits.

3.4.5 Millfeeds

One aspect of the current FFA Program is the payment of a "milling-in-transit" subsidy on the local production of millfeeds (mainly bran and shorts) which are by-products from flour milling. There is one flour mill in Nova Scotia located in Halifax and in 1983-84 within province sales of millfeeds totalled 10,000 tonnes. This product receives the western product freight assistance rate applicable to which ever FFA zone the millfeed shipments are utilized. Milling-in-transit payments are intended to compensate mills for the lower market value of their byproducts caused by the subsidization of competitive (imported) feed grains.

Other FFA grains, i.e. wheat, oats, barley, corn, and screenings, are not however, perfect substitutes for millfeeds. These mill by-products are commonly included in rations for very specific reasons. They are highly palatable, have high fat content and are twice as bulky as oats. The relatively high protein of bran and shorts is of better quality than that of corn or of entire wheat grains, although not as good as soyameal or fish meal. Especially in the case of bran, medicinal properties related to laxative effects are important elements in their demand. These feeds are often associated with particular uses such as for farrowing sows and gilts.

Since the demand for millfeeds is not based solely on their relative costs compared with other FFA grains, removal of Feed Freight Assistance would not result necessarily in increases in millfeed prices fully equal to the recovered "milling-in-transit" payments. The "milling-in-transit" payments may overcompensate for the price depressing effect FFA subsidies have on the millfeeds market.

The reported composite price of millfeeds at Halifax was regressed on the local cost of western wheat, oats, barley, Ontario corn, and soyameal and on the millfeeds proportion of FFA product utilization over the 1978-83 period.[69] The volume of millfeeds relative to the aggregate demand for feed inputs was included to account for situations where millfeed extended normal usage and had to be more price competitive.

The resulting equation (See table 3.12) explained 88% of the variation in millfeed prices. T-ratios were low for the less perfect substitutes feed ingredients and for the highly collinear variables generally.

A $12.40 tonne increase in the cost of western wheat, oats, and barley together with a $8.00/tonne increase for corn (soyameal

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69 See appendix D for data.

Table 3.12

OLS Regression of Millfeed Prices on FFA Grain Prices and Shipments Share

	Intercept	P.Wheat	P.Oats	P.Corn	P.Soya	P.Bar	ProMF	R^2
Coefficiant	29.408	+0.114	+0.266	+0.031	+0.015	+.359	-35.912	.88
(t-value)	(3.17)	(0.78)	(1.89)	(0.28)	(0.37)	(3.48)	(-1.39)	df=79

Note: - P wheat, P oats, P corn, P soya, P bar = Monthly origin prices respectively for wheat, oats, corn, soyameal, and barley plus the net transport cost to Nova Scotia.

ProMF = Millfeeds as a proportion of total monthly FFA product Shipments.

costs would not increase), was associated with a $9.41/tonne increase in the price of millfeeds. Low availability of millfeeds relative to the general utilization of feed ingredients or aggregate demand for feed grain resulted in higher prices reflecting the unique features of the demand for this product. This variable was not, however, statistically significant.

It should be noted that the current cost of FFA grains receivable in 6 to 8 weeks time have been used here in forming prices for millfeed products immediately available. Feed mills, generally price their inventories at current replacement values and these form the immediate competitive environment for local ingredients.

Based upon these estimates livestock producers would benefit by a transfer of $29,900 under FFA restructuring. This amount is currently accruing to the provincial flour mill as over compensation for the negative effects of FFA on their market returns from milling by-products.

3.4.6 Intrasector Transfers

Using average FFA grain utilization per unit of output in each livestock sector ie. hogs, dairy, poultry, as the basis for the product payments eliminates any intersector transfer of benefits. The grain grown currently on dairy and cattle farms would not affect payments in the poultry and egg sectors where little grain is grown, etc.[70] This in effect recognizes that there are different degrees

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70 Groenowegen (1984) did not adjust for such considerations.

of complementarities between types of livestock production and grain production. In addition to differences in the amounts of home grown grain produced relative to livestock output, within a given sector, the differences in total grain (purchased and grown) input/output ratios would also create intrasector transfers. In the case of nonruminant production these would mainly reflect feeding efficiencies, i.e. differences in feed to product conversions. Numerous factors such as the quality of forage would create a wider range of differences in the dairy sector.

The degree of transfers within each livestock sector would directly correspond with the demonstrated and potential ability of that sector to adjust to higher grain prices. Intrasector transfers will be greatest in sectors (such as dairy) where one group of farms have significantly lessened its utilization of imported/subsidized grain while another group in the same sector have not. Such low level transfers which are partly offset by price efficiencies and transfer gains have been accepted by producers in their requests for restructuring.

3.5 Costs

The higher costs which apply against the benefits and any desirable transfers from the FFA restructuring in Nova Scotia involve administration and the delayed delivery of assistance to program beneficiaries. The higher administration costs associated with the change in the method of payment represent a depletion of the real resources of the federal government. These of course must be compared against the expected efficiency gains to be realized by producers. The interest expenses involved with the greater short term financing requirement of farms are, on the other hand, in the nature of a transfer from the perspective of the overall economy or total income of Canadians. These incremental costs which would result from the policy change are estimated in sections 3.5.1. and 3.5.2.

3.5.1 Administration Costs

The extra administration associated with restructuring of the FFA Program, arising from the increase in the number of claimants, is the major cost which must be weighted against the welfare gains (and with any expected regional development benefits). If a new administrative infrastructure had to be put in place such costs could be prohibitive. Given the administrative capacities, structures, and agencies in place, however, marginal costs could be very low.

The reported administrative expenses of the Agricultural Stabilization Board (ASB) are shown in table 3.19. Payments made to producers and the number of claimants over the 1976-83 period are included. This agency might not be the least cost option for the administration of the new payments.[71] It has, however, been used for numerous commodity deficiency payments and a wide variety of special payments. This later group has recently included payments to western grain producers to compensate for Canadian Wheat Board sales of feed grains under the Domestic Feed Grain Policy, payments related to the Grains Embargo Conpensation Program, the 1980-81

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[71] The Livestock Feed Board may also be able to accommodate this program at low marginal costs. FFA claims have trended downward while the real cost of administration has remained at past levels.

Weaner Pig Program, the Fodder and Livestock Transportation Assistance Program, and feed purchase assistance paid in Manitoba as the result of flooding.

It is evident from the variability of the data in table 3.13 that there are rapid average cost reductions per claimant as the number of claims increase. (In 1981-82 claims paid increased by 132% while expenses increased only 44%. In the next year claimants were reduced to only 17% of the 1981-82 level, while expenses only fell to 73% of the year before level.) Of special consideration to the proposed Nova Scotia payment system, is the multi-year nature of these payments. The ASB can not normally plan on such a degree of regularity. Their other payments are never as routine as this from year to year and there may be economies to this feature. Also, over 90% of the Nova Scotia payments would apply to products marketed through marketing boards or commissions. This could greatly simplify audits, policing, and other aspects of administration compared to other commodity sectors where payments have been made.

A regression of the reported administration expenses of the ASB expressed in 1982 dollars on the number of claimants estimated the marginal cost per claimant at $12.95.[72] This was for the 1976-83 period shown in table 3.13.

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[72] The equation explained 96% of the annual variation in administration costs while the number of claims variable was significant at .001.

Table 3.13

Administration Expenses and Program Activity
Agricultural Stabilization Board 1976-83

Year	Administration Expenses	Deficiency and Other Payments	Number of Claimants	Number of Payment Programs
		-$000-		
1982-83	1,317[a]	6,136[b]	10,966[b]	10[b]
1981-82	1,792[c]	146,023[b]	63,358[b]	9[b]
1980-81	1,246[d]	51,444[e]	27,272[e]	10[e]
1979-80	990[f]	30,798	17,388	9
1978-79	1,043[f]	47,068	28,117	13
1976-77	882[g]	31,239[h]	33,531[h]	12[h]

Source: Annual Reports of the Agricultural Stabilization Board.

a Administration expenses of the Agricultural Products Board in the amount of $76,206 have been excluded. Costs however, include administration of the agreement between the Canadian Wheat Board and Agriculture Canada to compensate western grain producers for C.W.B. sales of feed grain under the Domestic Feed Grain Policy.

b Includes Grain Embargo Compensation Program.

c Agricultural Products Board expenses of $50,384 have been excluded.

d Agricultural Products Board expenses of $25,543 have been excluded.

e Includes Weaner Pig Program and the Fodder and Livestock Transportation Assistance Program.

f Includes expenses of the Agricultural Products Board.

g Includes expenses related to the payment of consumer subsidies on skim milk powder, services provided to the Canadian Dairy Commission "without charge", and the operation of the Agricultural Products Board.

h Includes the feed purchase assistance paid in Manitoba as the result of flooding.

In the 1981 Census of Agriculture 3,701 farms in Nova Scotia reported feed expenditures. Included were 1,213 farms with gross sales of agricultural products under $2,500 and another 491 with farm sales of between $2,500 and $4,999. Total feed expenditures for those two classifications were $1,442,240 and $836,529 respectively. Based on current FFA expenditures the first group would be eligible for approximately $32,000 in direct feed assistance and the second group $36,000. With a $10/tonne increase in subsidy levels these figures would increase to $53,000 and $60,000. With such low eligible payments, it could be expected that a substantial number of these producers would not submit claims. This has been the experience with deficiency payments and other programs.

Assuming that producers were able to submit claims for direct feed assistance at six month intervals and that 3,000 farms made claims, the ASB would process 6,000 claims annually. With marginal costs in the vicinity of $15 per claim, the administration costs for the term restructuring would be $90,000 annually. This cost would be reduced by 50% if annual payments were made. Livestock Feed Board administrative expenses have shown no tendency to fall as FFA claims have fallen (see table 3.20). Consequently, no significant saving can be expected from their reduction in claim processing based upon past experiences. The recent extension of off setting FFA subsidies to locally marketed grain has, however, increased administration costs of the current FFA Program.

Table 3.14

Administrative and Program Expenses and FFA Shipments, Livestock Feed Board of Canada, 1973-83

Year Ending Mar. 31	Program Expenses FFA	Other Programs	Admin. Expenses	FFA Shipments[a]	Ratio Admin. to Program Expenses
		-$000-		-'000 tonnes-	
1984	15,154	498	1,356	2,143	0.09
1983	13,800	535	1,209	1,720	0.08
1982	14,769	1,236	1,075	1,943	0.07
1981	15,309	1,211	984	2,068	0.06
1980	15,244	1,017	878	2,247	0.05
1979	14,042	17	873	2,287	0.06
1978	11,036	-	800	1,782	0.07
1977	11,977	-	718	1,694	0.06
1976	20,055	-	686	2,207	0.03
1975	20,479	-	669	2,578	0.03
1974	22,273	822	542	2,624	0.02
1973	20,950	-	502	2,808	0.02

Source: Livestock Feed Board of Canada, Annual Report of the Livestock Feed Board of Canada, Various Editions, Montreal.

a Marketing year ending July 31.

Consequently it will be assumed that Livestock Feed Board expenses would be reduced by $10,000 annually. This is beleived to be a conservative estimate. Even when the LFBC annual report is available it will be difficult to discern the extra cost of the new program from the initial experience.

Based on biannual payments the incremental administration costs are then estimated at $80,000 and for annual payments $35,000. For comparison the Committee of Inquiry on Crow Benefit Payment[73] estimated the administration of the (partly indexed) $658.6 million Crow Benefit in Western Canada would cost an extra $600,000 under their recommended Grain Transportation Refund system as compared with payment to the Railways directly. The incremental cost of an acreage based payment of the Crow Benefit was estimated at $850,000.

3.5.3 Interest Costs (Private)

Based on a $3.2 million program, semi-annual payments and a 14% opportunity cost to producers, the average three month delay (from the date of feed payments to the receipt of direct assistance) would cost producers $112,000 annually. In the case of a $5.3 million program, (corresponding with a $10/tonne increase in the subsidy) these costs would increase to $185,000. Based on a 11% opportunity cost to the government, however, there would be corresponding public savings of $58,000 and $146,000 respectively. Such savings on the part of the government, if not applied to producer payments, would dissipate the increased public administration costs. It will be assumed here that the savings to the government of the delay in payments will be applied to the

[73] See: The Report of the Committee of Inquiry on Crow Benefit Payment March 1985, Cat. No. T22-66/1985E Canadian Government Publishing Centre, p. 111.

payment fund.[74] The increased financing cost of producers will be reduced to $23,000 and $39,000 respectively for the two program expenditure levels.

3.6 Summary

The supply function for local feed grain (acreage) was estimated and the response to price was found to be elastic even in the short and intermediate terms. Numerous studies have reported feed grain demand (even at constant output and for nonruminant livestock and poultry production) to vary with respect to price. Significant leakages of benefits to others (as opposed to those taken to be the target group or intended beneficiaries, i.e. commercial feeders) were also found to result from the current input subsidy payment system.

The price efficiencies and benefit transfers were estimated for the current level of the subsidy and for the situation with the subsidies increased by $10/tonne. Incremental public administration costs were calculated on the basis of both semi-annual and annual payments.

Using a conservative range of long run elasticities it has been estimated that through input substitution, increased local feed grain production, and superior delivery of feed assistance payments to the program target group that program benefits to the commercial agricultural industry in Nova Scotia could be increased by between

[74] This could result from a lump sum compensation payment from which the terminating feed assistance payments would be drawn.

$0.4 and $0.5 million annually with the change in administration. If the subsidy were increased by $10/tonne the producer benefits arising from the proposed policy change are estimated at between $0.7 and $0.9 million. The restructuring could therefore play a positive role in addressing the feed cost problems of producers resulting from the changes in feed freight equalization policy.

Price efficiency gains alone were estimated to outweigh the incremental public costs involved. Since feed grain is an export commodity with a clearly defined opportunity cost for the Canadian economy the social benefits from transforming the subsidy could be expected to outweigh the social costs of the policy option.

Chapter 4

Implications for Technical Change

4.1 Introduction

Industry representatives have sought FFA restructuring partly as a component of a concerted approach for the development of local feeding and grain production technologies.[1] Apart from domestic feed grain policy issues, producers have argued that soil and crop research has been particularly neglected in the region. Livestock Feed Board officials, Groenewegen,[2] and others have also suggested that attempts to restore the competitive position of Maritime producers, with respect to feed costs, should focus on technology development. This course of action has, however, been seen as separate from FFA policy.[3]

In this section economic theories regarding technical change and economic variables will be reviewed. Of particular relevance is the induced innovation hypothesis which suggests that innovations are biased towards inputs that become more expensive.[4]

The static welfare analysis in chapter 3 focused on the response of producers to adjust input mixes in a cost minimizing

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1 See: Maritime Agriculture and Grain Transportation, Submission to the House of Commons Transport Committee, MFC, NSFA, PEIFA, NBFA, August, 1983.

2 Comments to Maritime Farmers Council Feed Grain Committee, Amherst, N.S. May 14, 1984.

3 Kerr (1966) had recommended that productivity be a major objective of the then proposed feed grain agency.

4 The term is now widely used for all theories explaining the rate and bias of technical change as endogenous to the economic system.

manner as a result of an input price change. The tendency for firms (or public research institutions), to direct their innovation towards those inputs with rising or increased costs can reinforce the earlier conclusions. If innovation is responsive to price, additional welfare gains (losses) are indicated. Frequently such welfare effects have been found to outweigh the comparatively minor static welfare costs such as those measured in chapter 3. Specifically, the largest benefit of the proposed term restructuring of FFA in Nova Scotia could be as an inducement for technologies which result in productivity gains in feeding and crop production. If this is the case the competitive position of producers in the province could be expected to become less dependant over time on public assistance: technical change being cost-reducing by definition.

4.2 Innovation, Technical Change, and Bias

Schumpeter[5] made the distinction between invention (latent technology), innovation (from what was technically and economically feasible) and diffusion (the adoption of new technology by industry). He restricted "entrepreneurial innovation" to the activities of private business as apart from "technical innovation" or "scientific innovation." Recent usage of the term innovation has been more general embracing "the entire range of processes resulting in the emergence of novelty in science, technology, industrial management and economic organization."[6]

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5 Schumpeter, J.A. Capitalism, Socialism and Democracy New York: Harper & Row, Publishers, Inc., 1942. p. 82-83.

6 Hayami, Y. and V.W. Ruttan. Agricultural Development: An International Perspective, The John Hopkins University Press, Baltimore and London, 1971, p. 54.

The term "technical change" is defined here in accordance with Binswanger's definition of "changes in techniques of production at the firm or industry level that result both from research and development and from learning by doing."[7] Correspondingly technological change is considered by Binswanger as "the result of the application of new knowledge of scientific, engineering or agronomic principles to techniques of production across a broad spectrum of economic activity."[8] These definitions exclude changes in factor productivity or output compostition, resulting from movement to new, but previously known techniques, as a result of changes in factors prices or output prices. Technical change implies an increase in the efficiency of production and can be measured by the decrease in production costs with constant factor prices when both the initial and the new technology operate at their respective optimal input combinations.

Whether or not a technical change is biased is based on the shift in input shares at constant input prices with both the old and the new techniques operating at their optimal input combinations. If changes in technology result in changes in the ratio of marginal products then the change is "non-neutral."

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[7] Binswanger, H.P. "Induced Technical Change: Evolution of Though," in Induced Innovation, ed. H. P. Binswanger and V.W. Ruttan. The John Hopkins University Press, Baltimore and London, 1978, p.19.

[8] Ibid, p. 19.

Technical development at the farm level can result from advances in the general state of technology, from the acquisition of existing technical knowledge, or from innovative efforts. In the case of the diffusion of technical knowledge, it is only from the individual farm's perspective that a new production function is achieved. The term "technological development" is normally used in the more restrictive case of increases in the technical knowledge generally. The new production function that arises in this case reflects the overall state of technology rather than only the technical possibilities known to the farm.

The technical advances which would reduce the effects of lower feed grain price equalization in Nova Scotia of course includes both these types. Non-neutral (biased) technical changes which would change feed/output ratios, thus increasing the marginal product of feed to other factors, are of particular relevance. Feed grain and other feedstuffs are also intermediate outputs of the industry. Consequently a wide range of technologies in cropping and feeding need to be considered. These include modified intensive cereal management systems, new protein saving or soyameal substituting techniques in broiler production, methods to deal with regional soil fragipan problems, increased and speedier adoption of existing technology, and so forth.

4.3 The Induced Innovation Hypothesis

The induced innovation hypothesis states that the direction of technical change is influenced by changes in relative input and output prices and hence the state of technology becomes partly endogenous to the economic system. A firm in any given period is limited in its input-output combinations by the state of technology. In subsequent periods it may be able to change its state of knowledge and increase its flexibility with respect to input and output combinations. The source of this new knowledge can be the firm's own research, public research, or other firms. The essential question for this analysis is whether new knowledge is directed partly by forces in the economy and particularly by relative factor prices (or factor expenditures shares). There are of course influences which are noneconomic in nature. For example, properties of nature and the advancement of the basic sciences determine what is possible.

Hicks[9] first noted the influence of economic variables on technical change. Solow's[10] identified technical change rather than capital formation as the major source of economic growth in the U.S between 1909 and 1949. Salter[11] questioned the hypothesis in 1960. The debate and theory were advanced by among others, Fellner[12],

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9 Hicks, J.R. The Theory of Wages, 1st ed. MacMillan and Co. Ltd., London, 1932.

10 Solow, R.M. "Technical Change and the Aggregate Production Function," Review of Economics and Statistics 39(3), 1957.

11 Salter, W.E.G. Productivity and Technical Change, Cambridge University Press, Cambridge Mass, 1960.

12 Fellner, W. "Two Propositions in the Theory of Induced Innovation," Economic Journal 71, p. 305-308.

Kennedy[13], Samuelson[14], Ahmad[15], Hayami and Ruttan[16], and Binswanger[17].

Ahmad[18] in 1966 presented a model of the microeconomics of induced innovation. He used the concept of a historic innovation possibility curve (IPC) defined as the envelope of all possible isoquants which could result from the development of all possible processes given the state of the basic sciences. Each process in the set required a given quantity of resources in order to be developed and the total amount of research and development resources was also given. This latter feature made the determination of the rate of technical change exogenous. Ahmad's IPC may shift inward non-neutrally and could therefore be biased without economic forces influencing it, i.e. depending on the elasticity of substitution of the IPC. (See figure 4.1)

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[13] Kennedy C. "Induced Bias in Innovation and the Theory of Distribution," Economic Journal 74, 1964, p. 541-47.

[14] Samuelson, P.A. "A Theory of Induced Innovation Along Kennedy-Weisacker Lines," The Review of Economics and Statistics 47(4), 1965, p. 343-56.

[15] Amhad, S. "On the Theory of Induced Invention." Economic Journal 76, 1966, p. 344-57.

[16] Hayami, Y. and Ruttan, V.W. "Factor Prices and Technical Change in Agricultural Development: The USA and Japan 1880-1960," Journal of Political Economy 78, 1970, p. 115-41.

[17] Binswanger, H.P. "A Micro-Economic Approach to Induced Innovation," Economic Journal 84, 1974, p. 940-57.

[18] Ahmad, S. "On the Theory of Induced Invention," pp. 344-57.

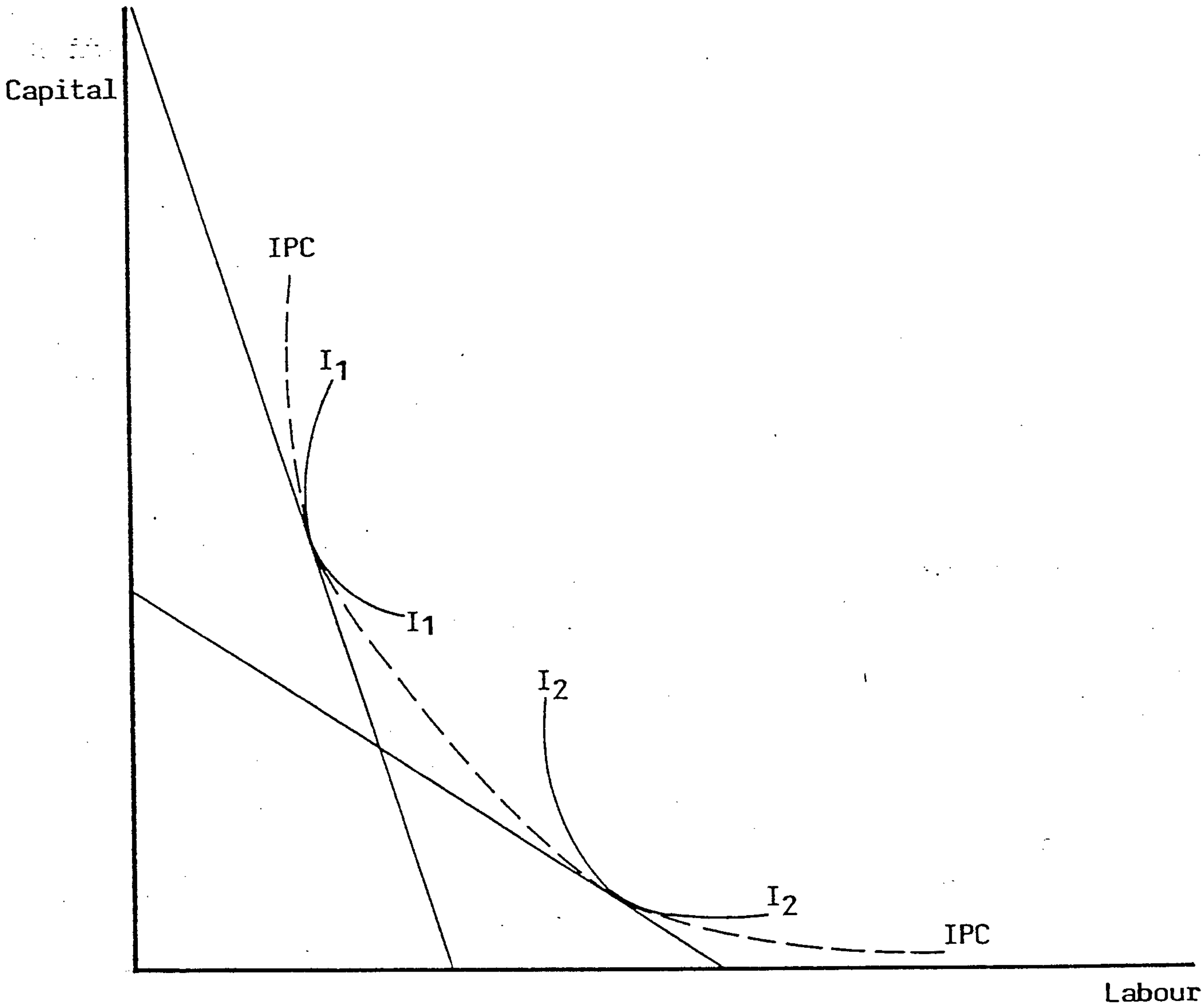

Figure 4.1 Ahmad's Induced Innovation Model

Demand induced innovation at the firm and industry level was first studied empirically by Griliches[19] and Schmookler[20]. Griliches's work is of particular relevance to this assessment of FFA payment changes. The technical progress of agriculture in Nova Scotia and the Maritime Provinces is largely dependent on technology transfers from other regions and subsequent adaption, and diffusion. There is a vast amount of new technology constantly being generated in North America, in Europe, and elsewhere. The unique soil and crop conditions of the maritime region, combined with the small size of the industry and the province's location (removed from the major centres of agricultural production and research), all impact upon the transfer, adaption, and diffusion processes.

Griliches incorporated location and adaptive research in a diffusion model of technology for the case of hybrid corn. He explained regional variation in the timing of initial hybrid corn production by the size and density of the potential hybrid seed market. It was hypothesized that private seed companies and public research stations allocated their efforts to the development of regional hybrid corn varieties where corn production was most concentrated. Thus, the potential rate of return to research investment was increased. Griliche's research further explained the rate of adoption and level of acceptance of the innovation by the

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[19] Griliches, A. "Hybrid Corn: An Exploration in the Economics of Technical Change," Econometrica 25, 1957, p. 501-22.

[20] Schmookler, J. Invention and Economic Growth. Cambridge, Mass: Harvard University Press, 1966.

absolute profitability of the shift[21] in the production function.

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[21] Hybrid corn was first grown on a substantial commercial scale in the early 1930's while Griliches published his analysis in 1957. Grain corn production in Nova Scotia did not increase over its low 1931 level until the late 1960's. It's role in provincial farming systems is still unclear with significant farm level innovation and experimentation continuing with respect especially to high moisture corn production and storage systems.

Griliches' model, and consistent with it the delayed hybrid corn experience of the Maritime Provinces, implies that the small size of Maritime agriculture, combined with the unique climatic and soil conditions in the region, will frequently impose technical disadvantages for the region. The regions share of feed grain output in North America has fallen steadily since World War II and this would not be anticipated based upon bio-physical evaluations of the regions agricultural land resource. (See p. 201)

Significantly, Griliches analysis also implies that the innovative effort of farms, and seed and supply companies (and possibly, even of the public sector), with respect to the development of intensive cereal management systems, will be partly a function of expected grain prices. The current outlook for low international grain prices will retard this process while the restructuring of FFA could be expected to, all else being equal, accelerate the regional adaption and diffusion of these new technologies.

Grain Corn Acreage, Nova Scotia Ontario and Manitoba, 1931-81

Year	Manitoba	Ontario	Nova Scotia
1981	221,095	2,171,777	4,562
1976	16,562	1,580,228	2,887
1971	9,088	1,263,187	2,969
1966	2,961	786,194	77
1961	4,052	395,714	89
1951	24,969	289,263	19
1941	76,906	250,984	21
1931	957	125,117	24

Source: Statistics Canada, Census of Agriculture, various editions,Ottawa, Statistics Canada.

Hayami and Ruttan[22] studied the role of factor prices in directing the extensive technical changes which occurred in Japanese and American agriculture over the eighty year period between 1880 and 1960. Their empirical tests of the theory of induced innovation supported the theory's ability to significantly contribute to the understanding of economic development. Later[23] they extended the theory to an induced development model which included public investment in agricultural research, the adaption and diffusion of agricultural technology, and the direction of institutional infrastructure.

A model of induced innovation in terms of the selection of research projects, and useful to this analysis, has been presented by Binswanger.[24] The model is depicted in figure 4.2. It is based on research processes/activities that have a cost and specific implications for factor proportions. Research administrators or firms have a choice of several research activities with different effects on the factor intensity of production. Changes in factor prices, scale of output, research costs, product prices, and market size are analyzed with respect to their influences on research project mix and the technology developed with the optimal research mix.

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[22] Hayami, Y, and V.W. Ruttan. "Factor Prices and Technical change in Agricultural Development: The United States and Japan, 1880-1960," Journal of Political Economy 78, 1970, pp 1115-41

[23] Hayami, Y., and V.W. Ruttan, Agricultural Development: An International Perspective, Baltimore, The John Hopkins University Press, 1971.

[24] Binswanger, H.P. "The Microeconomics of Induced Technical Change," in Induced Innovation, ed. H. P. Binswanger and V.W. Ruttan. Baltimore and London, John Hopkins Press, 1978.

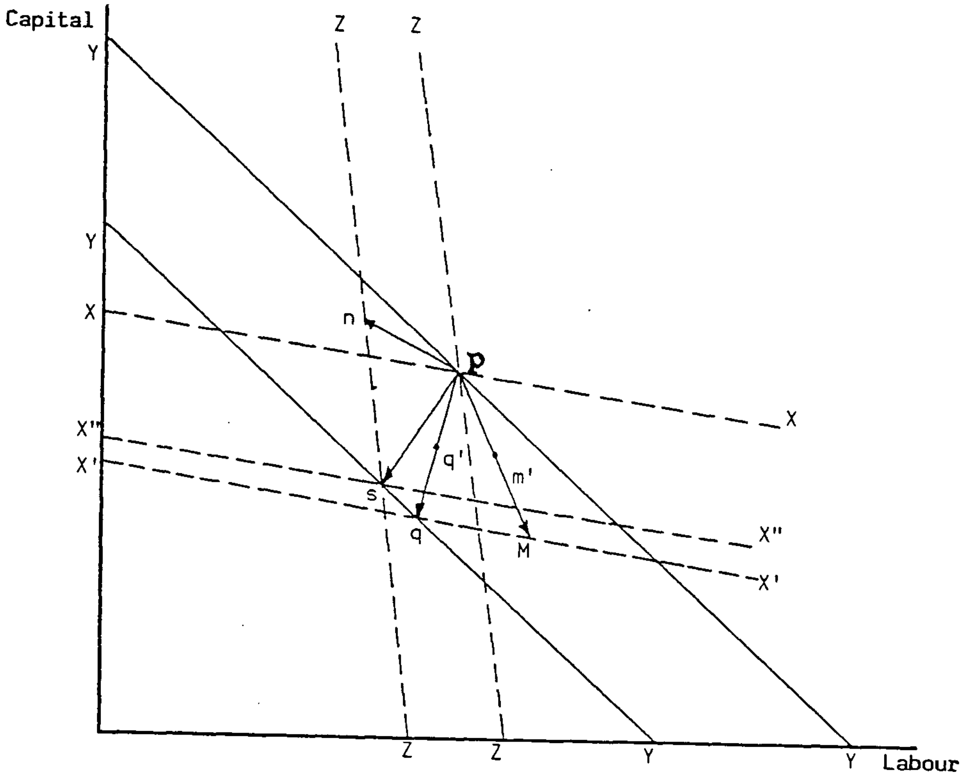

Figure 4.2 Induced Innovation with Many Possible Research Activities

(Source: Binswanger, H.P. "The Microeconomics of Induced Technical Change," in Induced Innovation, ed. by H.P. Binswanger, and V.W. Ruttan 1978).

In figure 4.2 point P is the existing input-output combination and the set of parallel lines are factor prices. The situation of relatively cheap labour and expensive capital is represented by XX and the reverse, expensive labour and cheap capital, by ZZ. YY is the intermediate situation. The arrows at q, s, n, and m represent four different research projects, each of which can change the optimum input-output combination. Note that m is extremely capital saving (and increases labour demand). The intermediate research projects of q and s reduce capital and labour respectively but to lesser degrees.

Binswanger illustrated the content of the model as follows:

> "If labour is cheap (factor price line XX), it is quite clear that the relatively labor-using activities q and m will lead to a larger cost reduction than will the labor-saving activities n and s. The graph is drawn such that, at XX, research activites m and q lead to an identical cost reduction. However,should wage rates fall further from XX, activity m would lead to a larger cost reduction and would thus be preferred over q, despite the fact that moving from q to m will increase absolute labor requirements. When the relative wage rate rises from X to Y, research approaches s and q lead to larger cost reduction than does m, that is, extremely labour-using research is eliminated as a possible choice. When the relative wage rate rises even further, to ZZ, the relatively less labour-saving activity q is also superseded by n and s, and should the relative wage rate rise beyond ZZ, n will be preferred over s because it leads to the largest cost reduction[25]."

For the purposes of policy implications related to the administration of feed assistance in Nova Scotia it is important to note that the model applies equally to private firms and to public research when public researchers or administrators are responsive to benefits. Expected benefits in these cases are the cost reductions.

Input prices are a determinant of the optimal research strategy. The direction of technical change as depicted in figure 4.2 is highly responsive to factor prices.

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25 Binswanger, H.P. "The Microeconomics of Induced Technical Change," in Induced Innovation, ed. H. P. Binswanger and V.W. Ruttan. Baltimore and London, John Hopkins Press, 1978, p. 99.

Binswanger has also represented the role of the economic environment or relative prices in the allocation of research resources among commodities.[26] In figure 4.3 the transformation curve T_0T_0 represents the output levels of two commodities initially achievable in a region that has fixed resources and faces perfectly elastic demand. By developing a technology that favors the output of commodity X movement to T_2T_2 is possible. Alternatively movement to T_2T_2 is possible with alternate research programs. The P_1 lines represent a relatively high price situation for X and the P_2 lines represent a high price for Y. The influence of output prices on the returns from research activities which have different effects on the productivity of different commodities is illustrated as follows. Point s is the output mix at the initial level of technology and with the high price for Y. With the development of T_1 the optimal ouput mixes changes to Q**. This change represents mainly an increase in the output of X. Alternatively, T_2 would result in the production point s* which involves mainly an increase in the output of Y. The welfare loss from a decision to develop T_1 despite a high price of Y and the technical opportunity as assumed and measured in terms of commodity X, is the distance from P_2** to P_2*.

There is now a large body of literature on the multiple paths of technical change in agriculture and on how differences in input and output prices over time and over space have appeared to influence innovation, invention, and the diffusion of technical change. The theory has been extensively tested and normally not rejected.

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[26] Ibid., P. 109.

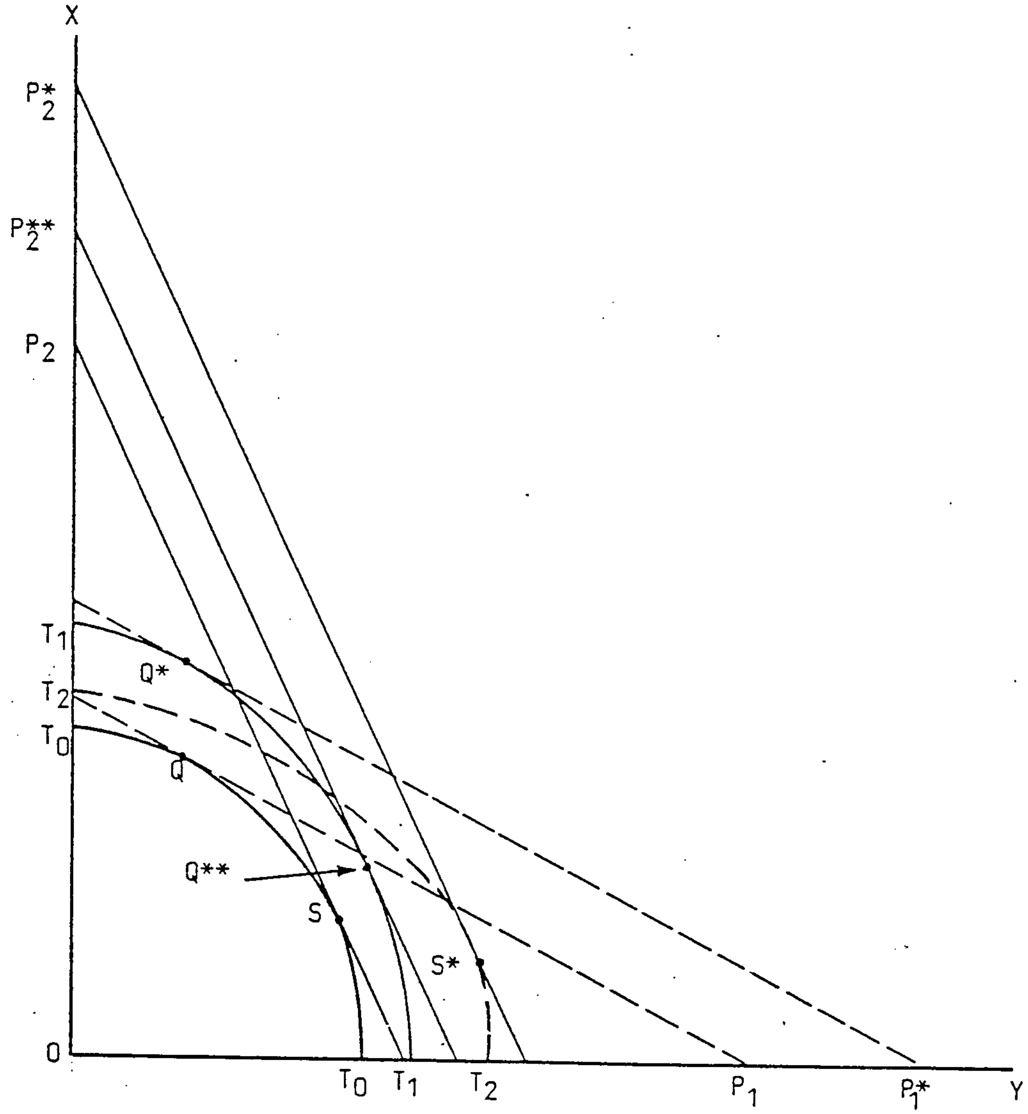

Figure 4.3 Research Resource Allocation to Commodities

Source: Binswanger, H.P. "Microeconomics of Induced Technical Change" in Induced Innovation, ed. by H. P. Binswanger and V. W. Ruttan, 1978.

4.4 Strategy and Qualitative Conclusions

Empirical studies have generally supported the position that farmers and others are induced by shifts in relative prices to search for technical alternatives which reduce the importance of the more expensive factor inputs in production. The qualitative implications of the introduction of the induced technical change hypothesis to this policy evaluation are clear. A further practical consideration is whether the price changes involved are sufficient to have an influence on technical change biases or rates of change[27]. Related to this question is the degree to which agricultural technology is responsive over periods of time to local factor price ratios and the prospects for technical advances which would alleviate comparative disadvantages in Nova Scotia.

In appendix E the state of production technology in Nova Scotia, including the prospects for reducing feed costs and past experiences regarding technical change and the possible influence of economics variables, is reviewed and discussed. There is some evidence reported that feed grain prices have influenced research directions and the diffusion, adaption, and adoption of relevant agricultural technologies. The prospects for technical change, which would lessen the intensity of imported (subsidized) feed grain utilization, are reported as significant.

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[27] Binswanger has found for biases in technical change with respect to land labour, machinery, and fertilizer in U.S. agriculture between 1948 and 1964 that "the direction of technical change may respond only to massive changes in relative prices." Binswanger, H.P. "The Measurement of Technical Change Biases with Many Factors of Production," American Economic Review 64, 1974, pp. 964-976.

A conceptual model of the use of induced technical change in alleviating feed cost problems in Nova Scotia is presented in figure 4.5. In terms of purchased feed and other inputs, the original output isoquant of the industry is Q^1. (Purchased feed includes both FFA grains and local cash grain while other inputs would include, among numerous other factors, the inputs which would be used in home grown feed grain production.) The initial input price ratio is P_0P_0 (which is the same as P_2P_2 and P_3P_3). The increased per unit cost of purchased feed results in the input price ratio P_0P_1. Technological change results in a new isoquant Q which is biased towards saving purchased feed. Given the initial input prices ratio the other inputs/purchased feed ratio at B is higher than at A. With relative input prices, as represented by P_0P_1, the point of tangency will be to the left of B.

Whether the input price ratio environment of P_0P_1, as opposed to P_0P_0, has an appreciable impact upon the rate or bias of technical change is at issue. Theory, the empirical literature, and the technology situation of the province as reviewed in appendix E (with respect to hog feeding technologies, grain production technologies, nutrition and feedstuffs research, poultry feeding technologies and dairying-forage technologies) and the generally fluid nature of the technical environment suggests that it does. This is highly significant in that accelerated and focused technological change would reduce the negative effects on the province of reduced feed price equalization or of any future termination of the FFA program.

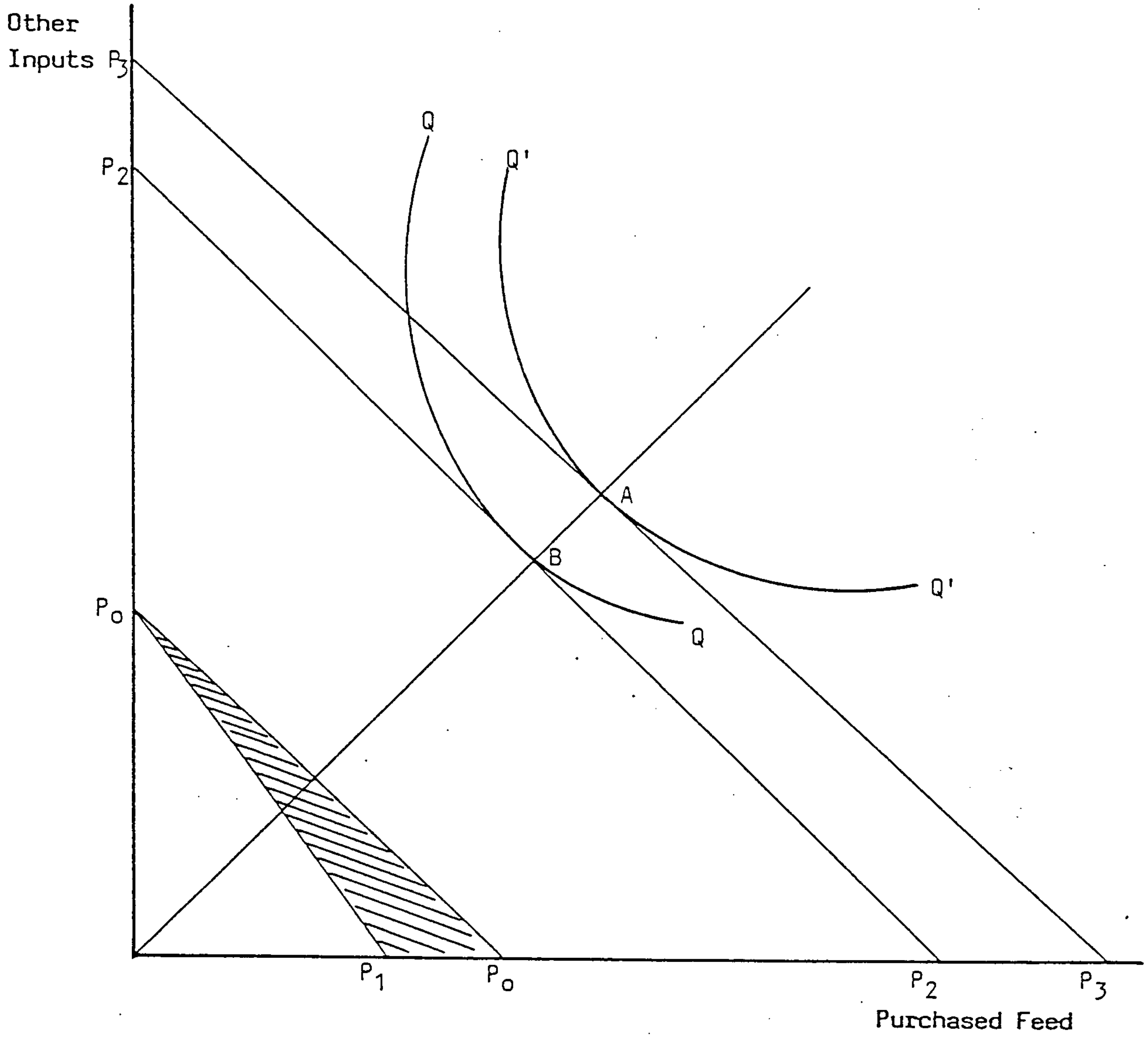

Figure 4.4 Purchased Feed Saving Technical Change

The strategy of transforming the FFA subsidy to add momentum to induced technical change is depicted in figure 4.5. With the removal of the freight subsidies the livestock supply curve shifts from SS to S'S'. The equivalent P_1P_2 product payment, however, sustains the production level at Q_1. The industry's new circumstance, with respect to feed input prices, becomes more orientated towards technical change which will reduce the effects of the reduction in freight equalization and/or its eventual termination. The objective is to move the supply curve to the right with technical change as, or before, the subsidy benefit is terminated. All else being equal, the province's competitive position would be restored if the Q_1 production level could be achieved with zero output subsidy.

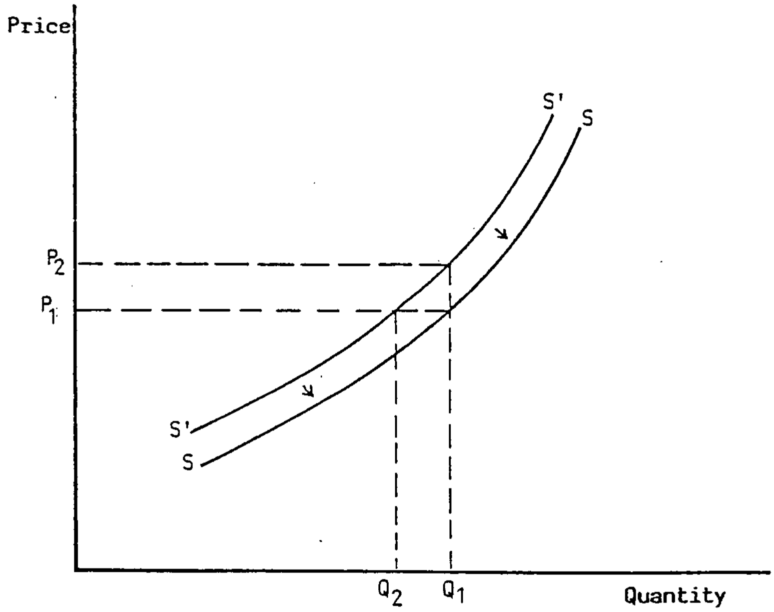

Figure 4.5 Subsidy Administration and a Strategy for Technical Change

Producers have been critical of the general level of public research and technology development in Nova Scotia and the rest of the Maritime region. The small size and unique conditions of the region together with the scarce nature of these technical and scientific resources and the competing demands from areas in Canada with much larger industries (and more homogeneous physical resources) make it difficult to secure the locally desired level of resource committment from the federal government.[28] As a low cost, unique opportunity for regional technology acceleration (and technical change broadly defined) over the existing life of the FFA Program the change in the method of FFA payments could be highly relevant in addressing the fundamental feed cost problems of the province.

The wide range of the technologies and the many aspects of technical change which could be induced are of significance. Nonprice means of accelerating technology development, while highly important, are not likely to influence technical change so broadly[29] and if so, not cost effectively. The price inducement to technical change could nevertheless be highly complementary with the usual public means of increasing productivity, i.e. research, extension, and agricultural education. If the same level of such resourses were

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[28] The comparative feed cost position of central Canada was changed drastically with the technical change originating from the development of hybrid corn. Much of this research and development was done in the U.S.

[29] In regional policy discussions with Agriculture Canada and the LFBC, technology development has often been discussed very narrowly in terms of local grain production technology, excluding such significant areas as feed inputs augmenting technical change.

applied to technical problems in the undistorted feed input market price environment it could reasonably be expected that projects would be better selected[30], diffusion more rapid, and farm level adaption more immediate.

4.5 Potential Benefits

The potential benefits from policy modifications which create an improved environment or inducements for technical change can be appraised from the basis of the value of the inputs subject to induced efforts to increase productivity and lower costs.

Based on Agriculture Canada's medium term five year forecasts for the average value of western grain and Ontario corn at current levels of utilization, the feed grains fed on Nova Scotia farms have an expected annual farm and track value of $45 million[31]. The farm value is for home grown grain and the track value is used for imported/subsidized grain. The real opportunity cost of these inputs (adjusted for freight subsidies only) is $49.8 million. This would be the cost faced by the Nova Scotia industry for these inputs with restructuring of the subsidy payments. Other components of the cost of finished feeds, i.e. protein supplements and other

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30 An example of this relates to local research which has been carried out on increasing the use of screenings in poultry rations. (See pp. 189-192). This project was an explicit response to the province's unusually high corn/screenings price environment. This relative price situation is largely due to differences in FFA subsidies. Therefore this research, while meaningful in the current price environment, is not neccessarily one of the many location specific innovations which could restore the province's competitive position in livestock and poultry production.

31 Farm value has been used for home grown grain and track value for imported feed grain.

protein supplements and other ingredients, and milling and local transport cost, add approximately $25 million to aggregate feed costs.

The aggregate productivity gains discussed below relate to feed inputs with an opportunity cost of $75 million. The assumed induced feed productivity gains have been selected at low levels partly in recognition of the smaller size of the percentage cost increases of finished feeds.

Even if conservative[32] rates of induced technical change are assumed the benefits indicated are highly significant relative to the public marginal costs involved. Assuming no change in the value of the feed inputs (which would otherwise be utilized) an induced productivity gain of only 0.05% annually would involve benefits of $37,500 in the first year. Calculated on the basis of the initial 0.05% induced rate of technical change, moderating in proportion with the reductions in feed costs achieved, productivity gains would increase to $183,000 by the fifth year, to $354,000 by year ten and to $515,000 in year fifteen. A 0.10% initial induced rate of productivity gains, with respect to feed inputs (moderating over time as before), would yield benefits of $75,000 in the first year increasing to $356,000 in year five, $669,000 in year ten, and $942,000 in year fifteen .

A sensitivity analysis with respect to assumed induced rates of technical change and for different circumstances with regard to the level of feed input price distortions is shown in tables 4.8 and 4.9.

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32 See appendix E.

Table 4.1

Benefits From Induced Technical Change Resulting From FFA Restructuring at Current Subsidy Level and Three Assumed Rates[a]

Year	Initial Rate of 0.05		Initial Rate of 0.10		Initial Rate of 0.20	
	Induced Rate of Technical Change	Benefit Stream $000	Induced Rate of Technical Change	Benefit Stream $000	Induced Rate of Technical Change	Benefit Stream $000
1	0.050	38	0.100	75	0.200	150
2	0.049	74	0.097	148	0.190	292
3	0.049	111	0.095	219	0.181	427
4	0.048	147	0.093	289	0.172	556
5	0.048	183	0.091	356	0.163	677
6	0.047	218	0.088	422	0.155	792
7	0.046	252	0.086	486	0.148	902
8	0.046	287	0.084	549	0.141	1007
9	0.045	320	0.082	610	0.134	1106
10	0.045	354	0.080	669	0.127	1199
11	0.044	387	0.078	727	0.121	1289
12	0.044	420	0.076	783	0.115	1374
13	0.043	452	0.073	837	0.110	1455
14	0.043	484	0.071	890	0.104	1531
15	0.042	515	0.070	942	0.099	1604
16	-0.008	509	-0.033	917	-0.106	1524
17	-0.007	504	-0.030	870	-0.096	1373
18	-0.007	499	-0.028	802	-0.087	1156
19	-0.006	494	-0.025	715	-0.078	881
20	-0.006	490	-0.023	610	-0.069	554

a Calculated on the basis of feed costs of $75 million in the absence of the inducement for technical change and with initial rates moderating in correspondence with the lower feed cost resulting from induced productivity gains relative to the initial cost increase.

Table 4.2

Benefits From Induced Technical Change From FFA Restructuring After An Increase of $10/tonne in Subsidy Levels and Three Assumed Rates[a]

Year	Initial Rate of 0.10		Initial Rate of 0.20		Initial Rate of 0.25	
	Induced Rate of Technical Change	Benefit Stream $000	Induced Rate of Technical Change	Benefit Stream $000	Induced Rate of Technical Change	Benefit Stream $000
1	0.100	75	0.200	150	0.250	187
2	0.099	149	0.194	295	0.241	368
3	0.097	222	0.189	436	0.232	541
4	0.095	293	0.183	573	0.225	708
5	0.094	363	0.178	705	0.216	869
6	0.093	433	0.173	834	0.208	1,023
7	0.092	501	0.168	959	0.201	1,172
8	0.090	568	0.163	1,079	0.194	1,315
9	0.089	635	0.159	1,197	0.187	1,453
10	0.088	700	0.154	1,310	0.180	1,585
11	0.087	764	0.150	1,421	0.174	1,713
12	0.085	828	0.145	1,528	0.168	1,836
13	0.084	890	0.141	1,631	0.162	1,955
14	0.083	951	0.137	1,732	0.156	2,069
15	0.082	1,012	0.133	1,829	0.151	2,179
16	-0.020	997	-0.070	1,777	-0.099	2,104
17	-0.018	968	-0.064	1,676	-0.090	1,963
18	-0.017	927	-0.059	1,531	-0.081	1,760
19	-0.015	875	-0.053	1,347	-0.074	1,502
20	-0.014	812	-0.048	1,126	-0.065	1,195

a Calculated on the basis of feed costs of $75 million in the absence of the inducement for technical change and with initial rates moderating in correspondence with the lower feed cost resulting from induced productivity gains relative to the initial cost increase.

A 0.10% initial induced rate of technical change would make the restructuring a very high pay-off public investment. Higher rates could conceiveably prevail especially if the economic inducements were to interact with a higher level of local research. Estimates of total factor productivity for Canadian agriculture are typically between 1.0% and 1.5%.[33] The rates of technical progress achievable in Nova Scotia feeding and feed crop production may be significantly above this level. While productivity rates discussed here are applied only to the value of feed inputs (excluding roughages) they would correspond with even smaller rates of total factor productivity increases which could be applied to the total value of factors utilized by the provincial livestock sector.[34]

If all of the induced productivity gains occurred as feed augmenting technical change (and none in feed production) the 0.10% rate is equivalent to feeders achieving the same output from 999 kg. of feed that required 1,000 kg the year before.[35] This rate is

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[33] See for example; Brinkman, G.L. An Analysis of Sources of Multifacter Productivity Growth in Canadian Agriculture, School of Agricultrual Economics and Extension Education, University of Guelph, December, 1984.

[34] Assuming annual factor productivity gains of 1.5% for Nova Scotia agriculture and feed inputs with a 25% contribution to output, the induced 0.10 productivity increase for feed inputs represents only a 1.7% increase in the rate of productivity gain for the industry i.e. the industry productivity gain would increase from 1.5% to 1.5255% initially.

[35] In appendix E the induced rate of feeding productivity gain estimated for the hog sector (with the current subsidy level) was equivalent to the producer initially achieving the same output with 993.3 kg that they did the year before with 1,000 kg. (see p. 215)

considered in addition to the increases in productivity which would otherwise have occurred in the absence of the autonomous development-adjustment measure. It also excludes changes in feed productivity resulting from input substitution.

An incremental 0.30% constant rate of productivity gain would translate into a $3.3 million improvement in the cost position of the provincial industry by year fifteen.[36] Such an achievement would be as important to the competitive position of the province as the FFA subsidy is today. It would require, all else being equal, roughly a 0.60% rate of autonomous productivity gains in feeding and feed input production (over and above the gains made elsewhere) to restore the livestock sector to the relative position it had in 1975-76. It is possible to make such gains but, of course, the availability of technical resources will be a limiting factor.

Transforming the FFA subsidy is consequently considered as a valuable component of any concerted approach to deal with regional feed cost problems and opportunities.

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[36] This calculation assumes feed costs would otherwise be $75 million throughout this period.

4.7 Summary

The theory of technical change and the influence of economic variables was reviewed. (A survey was also made separately of the prospects for feed cost reducing technical change in Nova Scotia and of evidence that feed grain prices have influenced such technologies in the past.) Numerous indications were found of the relevance of the concept of induced innovation to the proposed policy change being assessed here. It is possible that induced technical change benefits, resulting from the restructuring of FFA, could surpass price efficiency gains. In addition to alleviating the financial effects of reduced freight equalization such benefits would be of greater long term significance as they would fundamentally address the high feed cost problems of the province.

The restructuring of the FFA program is clearly neither a necessary nor sufficient condition for the rapid technical program needed to restore the position of the industry. It appears, however, to be a necessary condition for the achievement of maximum technical progress, at any given level of public investment in regional feed crop and feeding technologies. Targets in this area are also not likely to be achieved at least cost under the influence of the current program.

The policy change (compared with the current situation) can be assessed as a unique, low cost opportunity to stimulate wide ranging economic development which would tend to offset the negative effects of past national policy changes on producers, and others, in the province.

Chapter 5

Results from Policy Evaluation

In chapters 3 and 4 the long run price efficiency and induced technical change benefits from the policy change are calculated for what were considered conservative ranges of parameter values. The corresponding present values are given below for a fifteen year period of price efficiency benefits and for a twenty year period of induced technical change benefits. It is assumed that the program is terminated after the fifteenth year. The curtailment of technical change benefits beyond year 20 is purely arbitrary. The long run price efficiencies are considered achieved by the fifth year and the gains for the years between the short and long runs are interpolated. The present values for benefit transfers and costs are also presented in this chapter.

5.1 Evaluation Results

1. **Price Efficiencies.** Based upon the current real level of feed grain subsidies-price distortions and on the low and high long run parameters values shown in sections 3.3 and 3.4, the present value of benefits from price efficiencies (calculated with a 7% discount rate) resulting from the change in administration over a fifteen year period is between \$1.1 and \$1.7 million. If the subsidy were increased by \$10/tonne prior to the change in administration the increase in producer welfare was indicated at between \$2.8 and \$4.2 million and under the same conditions.

Table 5.1

Present Value of Indicated Price Efficiencies at Low, Medium, and High Long Run Price Elasticities of Feed Grain Demand and Local Supply, Three Discount Rates at the Current Subsidy Level, and After an Increase in FFA Rate of $10/tonne ($ Million)

Discount Rate	Current Subsidy Level			Increased Subsidy Level		
	Low	Medium	High	Low	Medium	High
5%	1.3	1.6	1.9	3.2	4.0	4.9
7%	1.1	1.4	1.7	2.8	3.4	4.2
9%	1.0	1.2	1.5	2.4	3.0	3.6

2. **Transfers.** The present value (7% discount rate) of the estimated transfers in favour of the commercial agricultural industry over a fifteen year period and at the current real subsidy level is $2.6 million. The present value of such transfers would increase to $4.1 million if the FFA rates were increased by $10/tonne prior to the policy change.

Table 5.2

Present Value of Estimated Transfers Resulting From the Policy Change at Three Discount Rates at the Current Subsidy Level and After an Increase of $10/tonne in FFA Rates ($ Million)

Discount Rate	Current Subsidy	Increased Subsidy
5%	2.9	4.7
7%	2.6	4.1
9%	2.3	3.6

3. **Induced Technical Change.** Based upon the low and high rates of induced technical change presented in section 4.5 the present value of industry benefits (with a 7% discount rate) over 20 years with the current level of subsidies prevailing until year 15 is between $2.9 and $9.2 million. If the subsidy were increased by $10/tonne and based upon the corresponding rates of induced technical change given in chapter 4, the present value of such benefits would be between $5.7 and $12.5 million.

Table 5.3

Present Value of Three Levels of Induced Technical Change Over Twenty Years at Three Discount Rates ($ Million)

Discount Rate	Current Subsidy Low	Current Subsidy Medium	Current Subsidy High	Increased Subsidy Low	Increased Subsidy Medium	Increased Subsidy High
5%	3.7	6.6	11.3	7.1	12.9	15.4
7%	2.9	5.3	9.2	5.7	10.4	12.5
9%	2.4	4.4	7.6	4.6	8.5	10.2

4. **Costs.** The present value (with a 7% discount rate) of the estimated incremental administration costs to the government of the policy change over 15 years with biannual payments is $727,000. With payments made to producers on an annual basis the public administration costs are approximately 50% of the bi-annual level. With payments made to producers on an annual basis, the public administration costs are approximately 50% of the bi-annual level. The present value of the estimated incremental financing costs on the part of the industry is $209,000 with the current level of the subsidy and $355,000 following a $10/tonne increase in rates.

Table 5.4

Present Value of Increased Public Administration and Industry Financing Costs Resulting from the FFA Policy Change at Two Subsidy Levels, Two Payment Periods and Three Discount Rates ($thousand)

Discount Rate	Public Administration Costs: Annual Payments	Public Administration Costs: Biannual Payments	Industry Financing Costs: Current Subsidy	Industry Financing Costs: Increased Subsidy
5%	830	415	239	404
7%	727	364	209	355
9%	646	323	186	315

5. **Net Benefits.** The present value (discount rate of 7%) of industry benefits from price efficiencies, transfers, and induced technical change, net of increased financing costs and at the current subsidy level was estimated at between $6.6 million and $13.5 million. Following a $10/tonne increase in FFA rates the present value of net industry benefits from restructuring the program was estimated at between $12.6 million and $20.8 million.

The ratio of net industry benefits (excluding transfers) to incremental public costs with payments made on an annual basis ranged between 5.2 and 14.7 at the current subsidy level and with the low and high values for long run price elasticities of demand and supply and for the induced rates of technical change as discussed. If the transformation in the basis of the subsidy occurred after an increase of $10/tonne then the indicated ratio of net industry benefits (excluding transfers) to incremental public costs would be between 11.2 and 22.5. With bi-annual payments these ratios are twice as large. With bi-annual payments these ratios were twice as large.

Table 5.5

Present Value of Net Industry Benefits From Restructuring FFA Over Fifteen years[a] at Three Discount Rates and Two Subsidy Levels ($ Million)

Discount Rate	Current Subsidy			Increased Subsidy		
	Low	Medium	High	Low	Medium	High
5%	7.7	10.9	15.9	14.6	21.2	24.6
7%	6.4	9.1	13.2	12.2	17.5	20.4
9%	5.5	7.7	11.2	10.3	14.8	17.1

Note: Low, medium and high estimates correspond with values used for long run elasticities and induced rates of technical change.

[a]Induced technical change, benefits are realized over a twenty year period.

Table 5.6

Ratio of Industry Benefits (Excluding Transfers) to Public Administration Costs at Three Discount Rates and Two Subsidy Levels ($ Million)

Discount Rate	Current Subsidy			Increased Subsidy		
	Low	Medium	High	Low	Medium	High
			Annual Payments			
5%	5.7	9.6	15.6	11.9	19.9	24.0
7%	5.2	8.9	14.7	11.2	18.5	22.5
9%	5.0	8.4	13.8	10.3	17.3	20.9
			Biannual Payments			
5%	11.4	19.2	31.2	23.8	39.8	48.0
7%	10.4	17.8	29.4	22.4	37.0	45.0
9%	10.0	16.8	27.6	20.6	34.6	41.8

6. **Benefits By Type of Farm.** The estimated industry benefits which would result if the policy were changed for 15 years allocated by type of farm and by source are presented in tables 5.7 and 5.8. These were calculated based upon the current subsidy level and for the case if the subsidy were increased by $10/tonne prior to the change in the method of payment. In the case of efficiencies realized in grain production the benefits have been assigned to farms according to their reported grain acreages.[1] Transfer benefits from the recovery of previous leakages have been allocated according to the proportion of FFA expenditures assigned to the commodity sectors.

The breakdown of induced productivity gains is highly tentative and should be considered only in terms of a rough approximation. These benefits have been allocated on the basis of the estimated price efficiencies in livestock feeding and grain production. The distribution of such technical gains could of course vary substantially from this pattern.

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1 Statistics Canada, "Census of Agriculture, Nova Scotia - 1981", Ottawa, October 1982.

Table 5.7
Net Present Value (Discount Rate of 7%) of Industry Benefits Resulting From the FFA Policy Change[a] at the Present Subsidy Level, Estimated by Source and by Type of Farm ($ million)

	Low[b]	Medium[b]	High[b]
Price Efficiencies[c]			
Cash Grain Growers	0.14	0.17	0.19
Dairy Farms	0.37	0.45	0.52
Poultry & Egg Farms	0.10	0.14	0.16
Hog Farms	0.21	0.28	0.35
Cattle Farms	0.28	0.37	0.48
Transfer Benefits[d] (less private financing costs)			
Cash Grain Growers[e]	0.37	0.37	0.37
Dairy Farms[f]	0.65	0.65	0.65
Poultry & Egg Farms[f]	0.55	0.55	0.55
Hog Farms[f]	0.74	0.74	0.74
Cattle Farms[f]	0.09	0.09	0.09
Induced Productivity Gains[g]			
Cash Grain Growers	0.37	0.63	1.04
Dairy Farms	0.97	1.71	2.81
Poultry & Egg Farms	0.26	0.50	0.88
Hog Farms	0.56	1.07	1.85
Cattle Farms	0.74	1.38	2.62
Implied Total Industry Benefits			
Cash Grain Growers	0.88	1.17	1.60
Dairy Farms	1.99	2.81	3.98
Poultry & Egg Farms	0.91	1.19	1.59
Hog Farms	1.51	2.09	2.94
Cattle Farms	1.11	1.84	3.19
Total[h]	6.40	9.10	13.2

[a] It is assumed that the policy is changed for a fifteen year period.
[b] Low, medium and high estimates correspond with the value used for long run elasticities and for rates of induced technical change.
[c] Includes price efficiencies arising from local grain production and livestock feeding adjustments. Grain supply effects on livestock farms have been allocated on the basis of grain acreages reported by type of farm in the 1981 Census of Agriculture for Nova Scotia.
[d] Transfer losses are sustained by hobby horse and other hobby farms and by a local flour mill. See p. 100 and p. 102.
[e] See p. 98.
[f] Proportioned according to FFA payments by commodity sector. See Robinson (1982).
[g] Proportioned on the basis of estimated price efficiencies arising in each sector. The distribution of such benefits is of course highly speculative. Induced technical change benefits are realized over a twenty year period.
[h] Columns may not sum to totals due to rounding. (See table 5.5.)

Table 5.8
Net Present Value (Discount Rate of 7%) of Industry Benefits Resulting from the FFA Policy Change[a] with a Subsidy Level $10 tonne Higher than at Present. Estimated by Source and by Type of Farm ($ million)

	Low[b]	Medium[b]	High[b]
Price Efficiencies[c]			
Cash Grain Growers	0.36	0.41	0.47
Dairy Farms	0.94	1.09	1.28
Poultry & Egg Farms	0.25	0.34	0.39
Hog Farms	0.53	0.68	0.86
Cattle Farms	0.71	0.90	1.18
Transfer Benefits[d] (less private financing costs)			
Cash Grain Growers[e]	0.37	0.37	0.37
Dairy Farms[f]	1.05	1.05	1.05
Poultry & Egg Farms[f]	0.98	0.98	0.98
Hog Farms[f]	1.15	1.15	1.15
Cattle Farms[f]	0.20	0.20	0.20
Induced Productivity Gains[g]			
Cash Grain Growers	0.73	1.25	1.40
Dairy Farms	1.91	3.33	3.83
Poultry & Egg Farms	0.51	1.04	1.16
Hog Farms	1.08	2.08	2.56
Cattle Farms	1.44	2.70	3.53
Implied Total Industry Benefits			
Cash Grain Growers	1.46	2.03	2.24
Dairy Farms	3.90	5.47	6.16
Poultry & Egg Farms	1.74	2.36	2.53
Hog Farms	2.76	3.91	4.57
Cattle Farms	2.35	3.80	4.91
Total[h]	12.20	17.50	20.40

a It is assumed that the policy is changed for a fifteen year period.

b Low, medium and high estimates correspond with the value used for long run elasticities and for rates of induced technical change.

c Includes price efficiencies arising from local grain production and livestock feeding adjustments. Grain supply effects on livestock farms have been allocated on the basis of grain acreages reported by type of farm in the 1981 Census of Agriculture for Nova Scotia.

d Transfer losses are sustained by hobby horse and other hobby farms and by a local flour mill. See p. 100 and p. 102.

e See p. 98.

f Proportioned according to FFA payments by commodity sector. See Robinson (1982).

g Proportioned on the basis of estimated price efficiencies arising in each sector. The distribution of such benefits is of course highly speculative. Induced technical change benefits are realized over a twenty year period.

h Columns may not sum to totals due to rounding. (See table 5.5.)

5.2 Summary

The expected industry benefits resulting from the proposed policy change are substantially in excess of costs. The net present value (calculated with a 7% discount rate) of such benefits in the case of a fifteen year restructuring program and at the current level of subsidies is estimated at between $6.4 million and $13.2 million. If the value of the subsidy were to increase the benefits from transforming the basis of payment would be expected to increase at an increasing rate. The largest gains are anticipated to arise from induced productivity increases i.e., technical change. Significantly these gains over-time would lessen the industry's dependance on the subsidy program.

Chapter 6

Summary, Conclusions and Recommendations

The objectives of this study were to present the relevant theoretical concepts, to measure price efficiencies, to consider implications for technical change, and to estimate producer welfare gains which could result from the proposed policy change. This chapter summarizes the economic considerations with regard to restructuring the FFA Program in Nova Scotia from an input to an output based subsidy. It also presents the conclusions drawn from the study and makes recommendations for further study.

6.1 Summary

An input based subsidy, except in the special case of a fixed input-output production technology, is of less benefit to producers than an equivalent output based subsidy. Feed grain demand in the different livestock subsectors was found to be responsive to price even in the cases of monogastric animals and under the constant output conditions that characterize the poultry, egg and dairy sectors in Canada. Provincial feed grain production (which is undertaken primarily by livestock farms) was furthermore found to be price elastic. Consequently, the mediuum and long run demand for imported feed grains in Nova Scotia is more price sensitive than aggregate feed grain demand.

In addition to price efficiencies, significant benefit transfers to producers were found to be achievable at given program expenditure levels with the policy change. These could help to address the unsatisfactory feed cost situation of producers in the province. Administration cost increases which would result from the policy change were estimated on the basis of current capacities in place and were found to be less than short run price efficiency gains.

The induced innovation hypothesis and extensive empirical investigations specific to agriculture suggest that the changes in input prices and expenditure shares resulting from the policy change could influence the technical progress of the industry. A review of provincial experiences and situations with respect to agricultural technology and of economic variables was supportive of the concept of technical change being partly endogenous to the economic system. There is widespread evidence that relative prices and/or expenditure shares have significantly influenced the province's agricultural technology with respect to directions and rates of change . This review indicated that there were also many technical prospects for reducing the intensity of purchased (subsidized) feed grain utilization. The basic feed cost problem of the province can usefully be considered in terms of lagging regional technology. Accordingly, the positive implications of the policy change for the acceleration and focusing of technical change are seen as highly significant.

6.2 Conclusions

The proposed policy change of restructing FFA has been analyzed and found to be a means to increase program benefits for producers. It would also by itself or in association with any broader initiative act to alleviate the problems resulting from the reduction of feed freight equalization in Nova Scotia. Immediate benefits would arise from the improved cost-effectiveness in financially assisting producers. In the longer term additional benefits would result from expected adjustment and development effects. If the government has intentions to terminate the program in the future or to reduce the level of assistance again, the restructuring would be a low cost means to reduce the further negative effects of such changes on producers and others in the province.

The indicated price efficiencies alone are sufficient to make the change in the FFA program desirable in terms of economic criteria. Such price efficiency benefits were found to increase at an increasing rate the higher the subsidy level. Consequently, if the government elected to increase the assistance to feeders the restructuring would be even more advantageous.

The largest benefits are expected to arise from the acceleration and direction given to technical change. These benefits would also be more significant as they would over-time fundamentally alter the feed cost circumstance of the province by reducing the intensity of imported feed grain utilization.

While changing the imput subsidy would be neither a necessary nor sufficient condition for the accelerated technical change which could restore the industry's competitive position, it appears to be a necessary condition for any public initiative to be cost effective in achieving this end. Any program package to address the province's feed cost problems which does not include modifying the current FFA Program and its effects cannot maximize results (at any given level of public investment) nor achieve targets at minimum costs. An important consideration in this assessment is the wide ranging nature of the technical change which would be feed cost reducing. It can be expected that public and private planning and resource deployment, in the presence of distorted prices, will be less well allocated in solving the economic problem of high feed costs in the province.

6.3 Recommendations for Further Study

A deficiency of the FFA Program which impacts upon any future research are its unclear policy objectives. A statement of the intent of the feed freight equalization policy at this time would likely be highly suggestive of useful research topics. This study concerned only the consideration of the proposed policy change and its effects on producers' welfare and on public costs. One limiting aspect of the benefit/cost approach taken was its non-optimizing nature.

With respect to the fundamental feed cost problem of the agricultural industry in Nova Scotia there are important policy variables not considered here. A number of national policies increase feed costs in the region. Also, the major determinants of the industry's rates of technical progress achievable over the next decade or so will not arise from the incremental economic inducements considered here. Nevertheless, the results of this study would be useful should policy makers decide to implement a concerted effort and comprehensive program with the objective of restoring the competitive position of the industry.

While the study did not ignore the implications for technical change (and a range of effects were entered into the benefit-cost accounting) the treatment may have been less then was warranted by this dynamic aspect. The policy option under consideration would be most likely to be adopted either in the context of a federal-provincial agricultural development agreement or in the event of a complete phaseout and termination of feed freight equalization. Consequently, the price incentives created for adjustment and development would probably be the central consideration for policy makers. The interactions which the new price environment might have with other public means to reduce high relative feed cost via technical change and to develop agriculture generally would be useful to investigate.

It is believed that the developmental effects of the policy change would be highly cost-effective compared with other projects which have been implemented or are under consideration to develop the region's agriculture. Unfortunately, evaluations on which such comparisons could be based have not been carried out. Such evaluations would aid in placing the proper priority and emphasis on the proposed policy change in the context of overall agricultural and regional development.

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APPENDIX A

Historical Summary

The federal government has paid freight subsidies on prairie feed grain shipments to Eastern Canada and to British Columbia since 1941 and on eastward shipments of Ontario corn since 1967. This program was orignially implemented as part of the war effort under the authority of the War Measures Act. There had been six similar short-term freight assistance programs in the previous 25 years and the 1941 Order-in-Council incorporated an expiry date (July 1, 1942). In 1966 Sauve, the Minister responsible for the program stated that the policy was continued after the war because import restrictions did not permit feeders to buy feed grains most advantageously and because of concerns with "protecting investments made necessary by wartime needs".[1]

While freight assistance was implemented in responce to wartime conditions such a policy had been advocated in the Maritime Provinces beginning in the 1930's. The 1941 decision was perceived and/or subsequently characterized (particularly by the regional cooperative movement) as the adoption of such a general policy.[2] Contemporary farm publications however presented the 1941 program purely in terms of the war effort and especially as related to the

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1 Canada, House of Commons Debates, October 6, 1966, p. 8421.

2 Such a perspective is presented in : "Feed and Freight Assistance", Prepared for the Maritime Federation of Agriculture, Moncton, New Brunswick, 1966.
A similar popular account is given in: Walsh, F. W. "Feed Freight Assistance" contained in We Fought for the Little Guy, Co-op Atlantic, Moncton, New Brunswick, November, 1978. pp.126-141.

fulfillment of the third wartime United Kingdom bacon contract[3]. Nevertheless the subsidy eventually and with the support of national farm organizations[4] evolved into a permanent policy.

The wartime rates of assistance paid practically all of the freight costs of moving feed grains from the prairies to Eastern Canada and to British Columbia. After the war increases in freight rates were followed by (eventual) adjustments in assistance rates. This process was irregular however and on at least one occasion in 1955 the federal government appears to have briefly adopted a policy of freezing the subsidy rates inrespective of any future rail rate increases [5].

Feed Freight Assistance by the 1960's was a major national agricultural policy and farm issue. Criticism of the program was common particulary in Western Canada. The political agenda of those farm groups supporting FFA at that time included having the program made statutory (like the Crowsnest Pass Agreement) and the establishment of an "eastern federal feed grain agency".[6] Such an

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3 See for example the; "Prince Edward Island Agriculturalist", Vol. 56 - Whole No. 2958-3010, Summerside, 1941.

4 Kerr, T. C., "An Economic Analysis of the Feed Freight Assistance Policy", Agricultural Economics Research Council of Canada, September, 1966, p. 14.

5 Ibid., p. 9.

6 Ibid., pp. 15-16.

agency was sought to counter the monopoly power of the Canadian Wheat Board which had been pricing grain so as to capture part of the subsidy benefit[7]. In Nova Scotia there was increasing concern about the long term effects that the policy was having on agricultural development.[8]

In 1966 the Livestock Feed Assistance Act was passed by Parliament. This established the Livestock Feed Board of Canada with one of its primary objectives "the fair equalization of feed grain prices" east of present day Thunder Bay and in British Columbia[9]. While there was no indication at that time that freight equalization was not a permanent policy, Maritime Members of Parliament from both sides of the House argued during the debate on the bill that the new agency should be orientated towards adjustment and development[10]. Kerr had made similar recommendations with respect to such an agency after a major study of the program and its effects[11]. While no changes were made in the legislation eventually the minister responsible (Sauve) gave repeated assurances in Parliament that this would be the orientation of the new board[12]. The measures and undertakings discussed in the House of Commons however were never subsequently acted upon.

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7 Ibid., pp. 44-55.
8 Ibid., p. 24.
9 Canada, "Livestock Feed Assistance Act", R. S., c. L-9, p. 3.
10 Canada, "House of Commons Debates", October 7, 1966, pp. 8463-8483 and October 11, 1966, pp. 8515-8550.
11 Kerr (1966) pp. 139-141.
12 Canada, "Debates", (1966) pp. 8484-8498.

A significant change was made in the program in 1967. This involved the announcement that for the purpose of the Act that Ontario corn would be considered a "feed grain". Consequently freight subsidies to establish "farm price equalization" were paid on eastward shipments[13] of Ontario corn to the Maritime Provinces.

Between 1968 and 1973 assistance rates were not adjusted for freight rate increase. These however were minor and the subsidy continued to pay a high proportion of transport costs. The rapid development of corn production in Ontario during this time was one element which was altering support for the policy[14]. The Federal Task Force on Agriculture[15] reporting in 1969 recommended that the program be eliminated with compensation paid to the provinces affected.

In 1974 the federal government announced the "New Feed Grain Policy". The objectives of which were listed as:

"1 to provide a fair and equitable base price for feed grains across Canada;

2 to provide relief for the producer against depressed feed grain prices.......

3 to encourage the growth of livestock and feed grains (production) across Canada according to natural factors and the natural potential of the various regions of Canada"[16].

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13 Canada, "House of Commons Debates", October 123, 1967, p. 3065.

14 The 1967 policy change appears to have been made partly to appease Ontario corn growers.

15 Canada, "Report of the Federal Task Force on Agriculture", Ottawa, December, 1969, pp. 76-78.

16 Canada, "New Feed Grain Policy", Press Release, May 22, 1974, p. 1.

Subsequently in 1976 freight assistance on feed grain shipments to southern Ontario and western Quebec was eliminated with five years of equivalent funding committed towards the development of local grain production and handling systems in those areas. It was also announced at that time that feed freight assistance to the Atlantic Provinces and Eastern Quebec would be continued until "a high degree of self-sufficiency in grain"[17] was achieved.

The 1976 announcement was widely interpreted as securing the competitive position of Maritime livestock producers with respect to feed grain[18]. This perception contributed to substantial expansion of the regional hog industry in the late 1970's and early 1980's. Such expansion was encouraged by federal-provincial agricultural development agreements which were also premised on the maintenance of feed grain "price equalization" with Central Canada.

Real energy price increases and rapid inflation during the late 1970's resulted in substantial increases in freight rates[19]. This led to a sharp reduction in the real value of the subsidies and in the degree of "price equalization" with other regions. By the 1980's there was widespread industry concern about the industry's feed cost situation.

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17 Canada, "Modifications to the Feed Grain Policy", Press Release, May 31, 1976, pp. 1-2.

18 For example see, Tyrchniewicz, E. W. "Transportation Problems in Canadian Agriculture with Special Reference to Grain," Proceedings of the Canadian Agricultural Economics Society, 1976, pp. 29-30.

19 See table 1, p. 4.

In 1982, in response to growing concerns, the Nova Scotia Federation of Agriculture requested that feed freight assistance be restructured from an input to an output based payment system so as to increase realized benefits to feeders and to accelerate adjustment and development[20]. This option had been previously explored by Robinson[21]. It was also requested by the orgainiztion that a number of restrictions related to the importation of feed ingredients, on the use of foreign shipping and on the regional development and importation of grain production technologies be modified. Later the Maritime Farmers' Council requested a restructuring of feed freight assistance in the region as a whole and a restoration of the 1976 level of assistance/equalization[22].

After a number of meetings and a cursory analysis of the proposal the federal minister informed the Council that:

> "the Livestock Feed Board of Canada were not able to accept the proposal as it was presented. This does not mean that they, nor I, disagree with the objectives. At my request, the Department and the Livestock Feed Board of Canada are looking into alternatives which can achieve these underlying objectives in a satisfactory manner"[23].

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20 Nova Scotia Federation of Agriculture, "The Domestic Feed Grain Policy and Nova Scotia Agriculture". Submission to the Technical Consultations on the Domestic Feed Grain Policy, Halifax, August 25, 1982.

21 Robinson, D. E., "Restructuring Feed Freight Assistance", Discussion Paper, Nova Scotia Departrment of Agriculture and Marketing, Halifax, May 1982.

22 Maritime Farmers Council, "Maritime Agriculture and Grain Transportation." Submission to the House of Commons Transport Committee, August, 1983.

23 Correspondence to Mr. Hank deBoer, Chairman Maritime Farmers' Council Feed Grain Committee, March 16, 1984.

Concerns with long term development and particularly with grain crop development had characterized Maritime responses to the FFA policy dilemma in the early 1980's. As the economic position of the regional hog industry deteriorated further however this became less of a factor. Among others, the Maritime Council of Premiers have made appeals for increased freight subsidies in recent years.

APPENDIX B

A Note on the Determination of Product Payment Rates and the Mechanics of Transforming the Subsidy

The determination of product (output) payments used for this analysis will correspond with that presented in the Maritime Farmers Council Working Paper "The Arithmetic of Restructuring Feed Freight Assistance"[1]. Per unit product payments are calculated on the basis of the average amount of FFA grain utilized across individual commodity sub-sectors. In estimating these averages a distinction was made between FFA corn and other grains since the subsidy rates differ. The payment rates are accordingly equal to the estimated FFA subsidy expenditures for each commodity sector (i.e., dairy, hogs, turkeys, etc) divided by total production of that product in the base year.

An advantage of this approach compared with payments based on the average input of all grain is that it reduces the "dilution effect" when the assistance is reallocated to output[2]. The degree to which "home grown" grain is utilized or to which grain and livestock production is complimentary or competitive varys by livestock and

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1 Robinson, D. E. "The Arithmetic of Restructuring Feed Freight Assistance", Maritime Farmers Council Working Paper, November, 1982.

2 Groenewegen (1984) undertook his analysis entirely on payments based upon the average grain input including subsidized and non-subsidized grains. He also applied such a system of subsidy payments uniformly across the entire Maritime industry. Since there are significant differences between the three provinces in the proportions of FFA and non-subsidized grains utilized the transfer of benefits from current program recipients to others who experience windfall gains was found to be substantial.

poultry sector. The extent to which grain substitutes can be utilized also varys by type of animal. Transfers arising from such causes can be avoided. Those egg producers, for example who would realize a lower subsidy benefit under the suggested payment basis used in this analysis would do so not because of the non-subsidized grain produced and utilized on dairy farms but because their feed conversions are below the overall egg sector average feed/output ratio. Furthermore the degree of "dilution" remaining within each sectors would correspond directly with the demonstrated ability of farms in those sectors to reduce the utilization of subsidized grain. (Whether by achieving higher feed productivity, by producing their own grains or by substituting higher quality forages etc.)

The MFC Working Paper presented a detailed set of feed accounts by commodity sectors for 1980. This was derived from commodity cost of production surveys and models and from information contained in the 1981 Census of Agriculture in which all farms reported their feed expenditures, livestock populations and grain acreage[3]. When similar 1986 Census of Agriculture information is available these accounts could be readily updated.

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[3] Statistics Canada, 1981 Census of Canada, Agriculture, Nova Scotia Cat. No. 96-904, October 1982.

The real level of the aggregate subsidy and of subsidy rates for this analysis are assumed constant throughout the 15 year period. Given the low level of the current subsidy a phase-down schedule was not incorporated. If such a policy change were implemented of course adjustments might be made at intervals to reflect changing imported grain input/output ratios. A lump sum settlement could conceivably be sectorized such that an annual 15 year stream of compensation-adjustment payments would be distributed with the product rates varying with production levels. Such a lump sum settlement if equal to the real value of 1984-85 FFA subsidy expenditures for Nova Scotia over fifteen years and discounted at 6 % would equal $27.8 million.

Except in the case of hogs the assumption of fixed product rates could be expected to closely approximate actual rates. Livestock and poultry production levels are not expected to change significantly.

An institutional feature of the Nova Scotia industry which would facilitate the transformation of the subsidy to an output basis is the high proportion of livestock and poultry which is marketed through marketing boards or commissions. Such commodities include fluid milk, industrial milk, cream, chicken, turkeys, eggs, hogs and wool. The only exception is the cattle sector where numerous similar deficiency payments have been administered by the Agricultural Stabilization Board in the past. The incremental cost of administering the subsidy differently are estimated in section 3.5.1.

APPENDIX C

Monthly Average Corn Prices, Gulf Ports, Chicago, Chatham and Truro With Price Spreads 1978-85 ($Can/tonne)

	Gulf Ports No. 2 Yellow	Chicago No. 2 Yellow	Chatham No. 2 C.E.	Truro No. 2 C.E.	Price Spreads: Truro-Gulf Ports	Price Spreads: Gulf Ports Chicago	Price Spreads: Chicago-Chatham
1978							
J	106	96	84	99	-7	+10	+12
F	112	96	85	100	-12	+16	+11
M	115	103	96	111	-4	+12	+7
A	127	113	104	119	-8	+14	+9
M	126	113	111	126	0	+13	+2
J	119	111	110	125	+6	+8	+1
J	109	101	103	118	+9	+8	-2
A	105	97	104	119	+14	+8	-7
S	106	98	101	116	+10	+8	-3
O	114	103	99	114	0	+11	+4
N	117	105	107	122	+5	+12	-2
D	116	105	109	124	+8	+11	-4
1979							
J	125	107	109	126	+1	+18	-2
F	128	111	111	128	0	+17	0
M	128	112	112	129	+1	+16	0
A	128	114	119	136	+8	+14	-5
M	130	121	125	142	+12	+9	-4
J	141	131	134	151	+10	+10	-3
J	153	137	142	159	+6	+16	-5
A	139	130	141	158	+19	+9	-11
S	140	128	148	165	+25	+12	-20
O	140	126	129	146	+6	+14	-3
N	138	120	120	137	-1	+18	0
D	135	124	124	141	+6	+11	0
1980							
J	123	116	120	141	+18	+7	-4
F	132	121	121	142	+10	+11	0
M	129	120	115	136	+7	+9	+5
A	128	122	119	140	+12	+6	+3
M	130	121	127	148	+18	+9	-6
J	131	122	134	155	+24	+9	-12
J	151	140	150	171	+20	+11	-10
A	166	153	161	182	+16	+13	-8
S	164	158	155	176	+12	+6	+3
O	164	158	149	170	+6	+6	+9
N	174	160	157	178	+4	+14	+3
D	176	167	161	182	+6	+9	+6

continued Monthly Average Corn Prices, Gulf Ports, Chicago, Chatham and Truro With Price Spreads 1978-85 ($Can/tonne)

	Gulf Ports No. 2 Yellow	Chicago No. 2 Yellow	Chatham No. 2 C.E.	Truro No. 2 C.E.	Price Spreads Truro-Gulf Ports	Gulf Ports Chicago	Chicago-Chatham
1981							
J	177	167	166	191	+14	+10	+1
F	172	165	166	191	+19	+7	-1
M	169	163	166	191	+22	+6	-3
A	173	166	168	193	+20	+7	-2
M	169	164	165	190	+21	+5	-1
J	163	161	164	189	+26	+2	-3
J	171	167	165	190	+19	+4	+2
A	153	146	157	182	+29	+7	-11
S	140	130	147	172	+32	+10	-17
O	135	123	125	150	+15	+12	-2
N	133	121	118	143	+10	+12	+3
D	130	118	117	142	+12	+12	+1
1982							
J	139	124	117	147	+8	+15	+7
F	140	127	112	142	+2	+13	+15
M	143	129	111	141	-2	+14	+18
A	146	129	119	149	+3	+17	+10
M	148	133	122	152	+4	+15	+11
J	150	138	129	159	+9	+12	+9
J	138	128	134	164	+26	+10	-6
A	129	115	125	155	+26	+14	-10
S	124	106	121	151	+27	+18	-15
O	114	100	99	129	+15	+14	+1
N	126	116	102	132	+6	+10	+14
D	132	118	108	138	+6	+14	+10
1983							
J	135	123	113	146	+11	+12	+10
F	145	133	120	153	+8	+12	+13
M	154	144	127	160	+14	+10	+17
A	164	151	142	175	+6	+13	+9
M	166	151	150	183	+17	+15	+1
J	167	159	161	194	+27	+8	-2
J	174	161	162	195	+21	+13	-1
A	192	174	172	205	+13	+18	+2
S	186	170	176	209	+23	+16	-6
O	184	168	164	197	+13	+16	+4
N	185	171	161	194	+9	+14	+10
D	181	166	155	188	+7	+15	+11

continued Monthly Average Corn Prices, Gulf Ports, Chicago, Chatham and Truro With Price Spreads 1978-85 ($Can/tonne)

	Gulf Ports No. 2 Yellow	Chicago No. 2 Yellow	Chatham No. 2 C.E.	Truro No. 2 C.E.	Price Spreads Truro-Gulf Ports	Gulf Ports Chicago	Chicago-Chatham
1984							
J	177	162	156	191	+14	+15	+6
F	171	162	158	193	+22	+9	+4
M	187	176	166	201	+14	+11	+10
A	189	182	174	209	+20	+7	+8
M	189	184	181	216	+27	+5	+3
J	192	186	187	222	+30	+6	-1
J	189	180	182	217	+28	+9	-2
A	181	166	187	222	+41	+15	-21
S	171	153	185	218	+47	+18	-32
O	160	146	136	169	+9	+14	+10
N	154	145	136	169	+15	+9	+9
D	151	141	138	167	+16	+10	+3
1985							
J	158	145	140	174	+16	+13	+5
F	162	149	137	171	+9	+13	+12
M	166	155	144	178	+12	+11	+11
A	164	156	152	186	+22	+8	+4
M	160	154	152	186	+26	+6	+2
J	159	152	152	186	+27	+7	0
J	155	147	146	180	+25	+8	+1

Source: Derived from, United States Department of Agriculture, Economic Research Service. Feed Situation and Outlook Report. Various Editions. Washington, D.C.: Government Printing Office. Statistics Canada: Cereals and Oilseeds Review. Cat. No. 22-007 Various Editions, Ottawa: Statistics Canada.

APPENDIX D

Total FFA and Millfeeds Shipments and the Price of FFA Grains and Soyameal by Month, Nova Scotia 1978-84

	FFA Shipment		Price of FFA Grains[a] and Soyameal					
	Total	Millfeeds	Wheat	Oats	Barley	Corn	Millfeeds	Soyameal
	tonne		$/tonne					
1978								
J	10,336	189	103	99	94	99	98	278
F	26,115	1,453	106	98	94	100	104	269
M	33,475	2,059	110	98	94	111	104	303
A	30	-	116	104	97	119	110	314
M	15,415	545	117	104	96	126	110	311
J	11,262	675	117	96	94	125	112	301
J	16,614	362	116	89	91	118	112	307
A	22,965	859	118	90	88	119	105	303
S	15,352	1,253	119	92	87	116	102	306
O	9,951	514	126	99	89	114	102	325
N	22,944	1,267	129	105	96	122	103	328
D	14,034	469	119	107	93	124	91	337
1979								
J	13,818	1,302	113	108	94	126	108	335
F	17,606	1,060	116	108	97	128	122	344
M	29,892	1,700	127	102	101	129	124	351
A	2,799	166	131	105	106	136	123	340
M	20,008	777	138	114	123	142	120	338
J	15,449	1,212	152	127	127	151	130	363
J	20,623	785	158	135	122	159	138	361
A	11,615	973	153	135	123	158	128	344
S	17,072	657	157	136	130	165	128	341
O	17,172	1,065	160	134	136	146	128	329
N	16,167	1,147	156	133	141	137	129	340
D	13,272	767	152	134	136	141	131	336
1980								
J	14,853	610	158	135	139	141	133	332
F	30,201	1,725	154	131	134	142	133	322
M	37,772	2,882	150	127	134	136	137	312
A	-	-	148	125	134	140	137	309
M	11,828	1,154	140	127	137	148	137	315
J	16,359	775	156	133	142	155	140	316
J	22,711	769	173	148	158	171	133	351
A	20,430	1,200	184	160	167	181	143	361
S	12,029	329	191	164	171	176	141	395
O	19,379	2,158	190	162	167	170	148	423
N	13,462	971	202	172	173	178	155	437
D	19,503	2,389	200	177	181	182	166	399

continued Total FFA and Millfeeds Shipments and the Price of FFA Grains and Soyameal by Month, Nova Scotia 1978-84

	FFA Shipment		Price of FFA Grains[a] and Soyameal					
	Total	Millfeeds	Wheat	Oats	Barley	Corn	Millfeeds	Soyameal
	tonne		$/tonne					
1981								
J	14,728	266	195	180	179	191	177	399
F	17,200	1,534	195	175	178	191	180	385
M	35,440	1,365	192	170	174	191	161	379
A	517	5	194	169	174	193	161	392
M	24,097	591	199	165	176	190	163	396
J	16,633	700	197	162	174	189	159	377
J	14,325	456	196	158	178	190	163	381
A	14,492	337	184	146	166	181	145	380
S	16,914	782	176	146	159	172	131	349
O	21,021	1,738	167	148	147	150	140	343
N	16,524	1,133	162	155	142	143	148	337
D	23,180	2,082	160	163	140	142	154	348
1982								
J	12,155	805	167	142	152	147	162	363
F	20,473	879	167	141	151	142	168	362
M	43,580	1,939	164	138	148	131	153	356
A	365	-	172	145	154	149	158	369
M	11,955	571	174	147	159	152	158	374
J	16,448	687	179	154	162	159	160	363
J	18,468	591	176	151	158	163	164	361
A	17,074	1,154	159	134	140	155	146	343
S	11,796	1,013	153	129	131	151	127	319
O	15,055	823	144	120	129	129	126	314
N	20,556	1,450	154	129	137	132	133	335
D	14,152	318	158	132	139	138	145	341
1983								
J	22,178	980	164	136	139	145	141	344
F	15,609	822	169	141	143	152	140	345
M	32,668	1,244	169	145	141	159	142	344
A	-	-	183	139	145	174	144	356
M	14,950	327	184	139	142	182	146	354
J	16,718	414	190	137	140	193	141	351
J	19,865	1,464	197	136	138	194	146	366
A	14,226	525	207	144	154	204	150	399
S	21,062	1,104	207	169	170	208	158	433
O	15,827	1,119	210	177	176	196	158	420
N	19,817	635	208	171	173	193	161	418
D	16,391	1,326						

Source: Derived from information obtained from the Atlantic Provinces Transportation Commission and from the Annual Report (various editions) of the Livestock Feed Board of Canada.

[a] Lower of Thunder Bay spot or formula prices for western grain.

Appendix E.

Survey of Feed Cost Reducing Technical Change Prospects and Economic Influences

There is substantial empirical evidence that the theory of induced technical change is relevant in understanding aspects of economic development. Important considerations affecting the policy implications of this theory for feed cost problems in Nova Scotia are the prospects and conditions for accelerated feed cost reducing technical change in the province. The central question for this analysis is the degree to which regional agricultural technology is responsive over periods of time to local price ratios. Related to this question are the industry's prospects for technical advances which would alleviate this comparative disadvantage. One line of inquiry regarding the behavioural question concerns whether there is evidence that the rates and directions of past technical change in the province have been influenced by economic variables such as prices and expenditure shares.

The technical gains which will or can be made over the next fifteen years or so would remain highly speculative even after substantial investigation. Unknown advances in the basic sciences, global technological changes, and the level of public technical resources in the region[1] will all effect such progress. The goal of this investigation is more limited. It is to assess whether the autonomous stimulant of a higher (undistorted) feed input price

[1] The level of public technical resources may, of course, be partly determined by economic variables.

environment is likely to result in incremental productivity gains of significance relative to the economic problems of the industry.

In making this assessment consideration is given to six areas of regional agricultural technology. These are feedstuffs and nutrition, grain production, land resource use, hog feeding, poultry feeding, and forage production and utilization and dairy feeding. The principle questions addressed in each case are whether accelerated technical change can reduce the province's comparative disadvantage related to feed costs and whether the local feed input price environment is likely to affect such progress.

E.1 Feed Stuffs and Nutrition

Research in the Maritime region has examined a wide range of feed grain and soyabean meal substitute possibilities including apple pomace[2], oat groats[3], naked oats[4], cull potatoes[5], potato

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[2] Proudfoot, F.C. "The Utilization of Dried Apple Pomace in Poultry Grower Diets" Agriculture Canada, Kentville Research Station Annual Report, 1971.

[3] Hulan, H.W. F.C. Proudfoot, and C.G. Zarkadus. "Nutritive Value and Quality of Oat Groats for Broiler Chickens," Canadian Journal of Animal Science 61, 1981. pp. 1013-1021.

[4] Hulan G.W., F.G. Proudfoot. "The Nutritive Value of Locally Grown Naked Oats (Avena Nuda) For SCWL Laying Hens To 308 Days," Agriculture Canada, Kentville Research Station Annual Report, 1984.

[5] Nicholson, J.W.G. and T.M. MacIntyre. "Potato - Hay Silage for Steers," Agriculture Canada, Nappan Experimental Farm Research Summary, 1976.

Nicholson, J.W.G., J.A. Wright, R.E. McQueen, R.S. Bush, and P.L. Burgess. "Use of Cull Potatoes in Beef Growing -Finishing Systems," Prepared for CSAS - Truro N.S. July 11 -13, 1983.

processing wastes[6], alfalfa meal[7], poultry manure[8] (pasturized organic protein), domestic garbage[9], cheese whey[10], fish silage[11], extended pastures[12], squid and crab meal[13], ground hay[14], tartary

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[6] Nicholson, J.W.G. "Potato Steamed Peel Waste for Pigs," Agriculture Canada, Fredericton Research Station Annual Report, 1982.

Hulan, H.W. and F.G. Proudfoot. "The Nutritive Value of Potato Waste Meal for Broiler Chicken," Agriculture Canada, Kentville Research Station Annual Report, 1979.

[7] Nicholson, J.W.G., T.M. MacIntyre, T.A. Van Lunen. "Use of Dehydrated Alfalfa in Place of Grain for Ewes", Agriculture Canada, Nappan Experimental Farm Research Summary, 1979.

[8] Nova Scotia Dept. of Agriculture and Marketing, Annual Research Report, 1975.

[9] Proudfoot, F.G. "The Effects of Feeding Glass Particles of Different Sizes to Broiler Chickens," Canadian Journal of Animal Science 56, 1977.

[10] Singh, R.K., and A.E. Ghaly. "Feasibility of Cheese Whey Processing For Production of Food and Feed Supplements," Paper No. 85-504, Annual Meeting Canadian Society of Agricultural Engineering, 1985.

[11] Winter, K.A. and A.H. Javed. "Fish Silage as a Protein Source for Early Weaned Calves," Canadian Journal of Animal Science 60, 1980 pp. 787-789.

Winter, K.A. and L.A.W. Feltham. "Fish Silage: The Protein Solution," Agriculture Canada, Research Branch Contribution, 1983

Van Lunen, T.A. "Evaluation of Fish Silage As a Feed Source for Swine," Agriculture Canada, Nappan Experimental Farm Research Summary, 1984.

[12] Kunelius, H.T. "Assessment of Fodder Kale, Fodder Rape and Stubble Turnip For Late Season Grazing," Agriculture Canada Charlottetown Research Station Research Summary , 1984.

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[13] Hulan, H.W. and F.G. Proudfoot. "Nutritional Value of Squid Meal as a Source of Dietary Protein for the Chicken Broiler," Agriculture Canada, Kentville Research Station Annual Report, 1977.

Laflamme, L.F. "Adaption of Beef Cattle to Crab Meal In Their Diet," Agriculture Canada, Nappan Experimental Farm Research Summary, 1984.

Larmond, E. H.W. Hulan and F.G. Proudfoot. "Cooking Characteristics and Eating Quality of Broiler Chicken Fed Squid Meal," Poultry Science 59, 1980, pp. 2564-2566.

[14] MacIntyre, T.M. and J.W.G. Nicholson. "Ground Hay vs. Grain in the Diet of Ewes," Agriculture Canada, Nappan Experimental Farm Research Summary, 1977.

buckwheat[15], and "Universal Feed Stock" (UFS)[16]. The high price of soyabean meal in this region has led to research on developing canola and fish meal usages[17], faba beans[18], whole seed canola,

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15 Nicholson, J.W.G., R.E. McQueen, E.A. Grant, and P.C. Burgess. "The Feeding Value of Tartary Buckwheat for Ruminants," Canadian Journal of Animal Science 56, 1976, pp. 903-808.

16 UFS is a privately developed feed source produced from the fermentation of fish by-products, cull potatoes and other ingredients. Hog feeding trials are scheduled for this product at the Nappan Experimental Farm in the spring of 1986.

17 Hulan, H.W., F.G. Proudfoot, and K.B. McRae. "The Nutritional Value of Tower and Candle Rapeseed Meals for Turkey Broilers Housed Under Different Lighting Conditions," Poultry Science 59, 1980, pp. 100-109.

Hulan, H.W. F.G. Proudfoot. "The Nutritional Value of Rapeseed Meal for Layer Genotypes Housed in Pens," Poultry Science 59, 1980, pp. 585-593.

Hulan, H.W.; Proudfoot, F.G. "Replacement of Soyabean Meal in Chicken Broiler Diets by Rapeseed Meal and Fish Meal Complementary Sources of Dietary Protein," Canadian Journal of Animal Science 61, 1981, pp. 999-1004.

Hulan, H.W. A.H. Corner, D.M. Nash, and F.G. Proudfoot. "Growth Heat Weight, Cardiac Lipid and Pathology of Chickens Fed Rapeseed and Other Vegetable Oils," Poultry Science 61, 1981, pp. 1670-1671.

Hulan, H.W. and F.G. Proudfoot. "The Nutritional Value of Rapeseed Meal for Caged Layers," Canadian Journal of Animal Science 60, 1980, pp. 139-147.

Winter, K.A. "Use of Fishmeal and a Growth Promotant For Holstein Steers," Agriculture Canada, Charlottetown Research Station Annual Report, 1984.

Anderson, D.M., and T.A. Van Lunen. "Evaluation of Canola Meal in Corn Based Diets For Starter, Grower, and Finisher," Agriculture Canada, Nappan Experimental Farm Research Summary, 1984.

Hulan, H.W. and F.G. Proudfoot. "The Nutritional Value of Rapeseed Meal for Broiler Breeders," Agriculture Canada, Kentville Research Station Annual Report, 1979.

18 Cox, A.C. "Faba Beans for Laying Hen Rations," Agriculture Canada, Kentville Research Station Annual Report, 1974.

and full fat soyabeans[19] as well as a stress on other means of reducing protein requirements.[20] Because of the price differences between wheat screenings and corn, (related partly to aspects of the FFA policy and its administration), there has been research

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19 Gervason, P., M. Tugwell, and M. Conley. "Potential for Production and Feeding of Soyabeans and Canola in Nova Scotia," AFDA Project Report 1985-1 Published under authority of Agriculture Canada, 1985.

Hulan, H.W. and F.G. Proudfoot. "The Nutritive Value of Locally Grown Full-Fat Soyabeans for Layer Genotypes," Agriculture Canada, Kentville Research Station Annual Report, 1983.

20 Hulan, H.W. and F.G. Proudfoot. "Protein Level in Turkey Broiler Growing and Finishing Feeds," Poultry Digest 40, 1981, p. 326.

Hulan, H.W. and F.G. Proudfoot. "The Effect of Different Dietary Protein Levels in a Three-Stage Diet System on General Performance of Chickens Reared to Roaster Weight," Poultry Science 60, 1981, pp. 172-178.

Hulan, H.W. and F.G. Proudfoot. "Bio-Economic Effects of Feeding Turkey Broilers Grower-Finisher Diet Combinations Differing in Protein Level," Poultry Science 60, 1981, pp. 358-364.

Hulan, H.W. and F.G. Proudfoot. "Effect of Feeding Different Levels of Dietary Protein in Grower Diets and Switching from Starter-Grower-Finisher at Different Ages on the Performance of Turkey Broilers Slaughtered at 84 to 98 Days of Age," Poultry Science 60, 1981, pp. 603-610.

Hulan, H.W. AND F.G. Proudfoot. "New Low Protein Dietary Regimens for Rearing Broiler Chicken to Roaster Weight in a Three-Stage Diet System," Agriculture Canada, Kentville Research Station, Annual Report, 1979.

Hulan, H.W. and F.G. Proudfoot. "A Comparison of the Nutritive Value of Diets Formulated with (Conventional) and Without a Minimum Protein Constraint for SCWL Laying Hens," Agriculture Canada, Kentville Research Station Annual Report, 1983.

undertaken on replacing corn with screenings in poultry rations.[21] Other corn substitution possibilities have also been studied.[22]

With respect to the agenda for regional research on feed stuffs and nutrition Hulan and Proudfoot have reported,

> "Since the cost of feed ingredients is continuing to escalate and since there are limitations as to the type of ingredients suitable for poultry feed formulations, there is a continual search for economical yet nutritionally sound feed ingredient for livestock and poultry feeding.[23]"

Saunders and Cox have similarly commented,

> "A great deal of interest developed in alternative sources of protein for poultry rations during the past year. This increasing interest was precipitated by unprecedented increases in poultry feed (as well as other prices) due primarily to the increased cost of traditional protein sources.[24]"

Cox explained the selection of one research project by stating, "With today's increase in feed prices the economics of faba bean

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[21] Hulan, H.W. and F.G. Proudfoot. "The Nutritive Value of Wheat Screenings for SCWL Laying Hens," Agriculture Canada, Kentville Research Station Annual Report, 1983.

[22] Hulan, H.W. and F.G. Proudfoot. "The Nutritive Value of Ground Rye as a Feed Ingredient for SCWL Laying Hens," Agriculture Canada, Kentville Research Station Annual Report, 1983.

Proudfoot, F.G. "The Utilization of Ground Rye in Broiler Finisher Diets," Agriculture Canada, Kentville Research Station Annual Report, 1976.

Cox, A.C. "Wheat Evaluation for Broiler Rations," Agriculture Canada, Kentville Research Station Annual Report, 1974.

Cox, A.C. "Utility Wheat Evaluation in Broiler Rations," Agriculture Canada, Kentville Research Station Annual Report, 1974.

[23] Hulan, H.W. and F.G. Proudfoot (1983).

[24] Saunders, R.F., and A.C. Cox. "Sources of Protein for Broiler Rations," Agriculture Canada, Kentville Research Station Annual Report, 1974.

rations for laying hens was investigated on a commercial farm.[25]" It should be noted that the removal of feed grain price distortions would only affect innovation with respect to protein ingredients to the degree that the overall level of feed costs had an influence. The LFBC is however, studying the extension of freight subsidies on protein ingredients. Such a development could adversely affect private sector innovation and adoption of alternate protein sources[26] and other protein saving technologies. Current widespread farm level innovations and experimentation with full fat soyabeans, whole canola seed, and faba beans could also be negatively affected,[27] as could attempts of dairy producers to harvest higher protein forages etc.

<u>Conclusion</u>. The regional research agenda on feed stuffs and nutrition has been oriented towards special regional problems and opportunities. These economic situations are characterized by

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[25] Cox, A.C. "Faba Beans for Laying Hen Rations," Agriculture Canada, Kentville Research Station Annual Report, 1974.

[26] Hulan and Proudfoot's comments and their own long term research programs directed closely to industry economics and problems indicate that such subsidies might also affect the focus of public research.

[27] The relationship between price and farm level innovation with respect to protein feed inputs has been noted in a regional farm publication as follows, "Because the oil meals tend to be more expensive here due to the transportation costs, many farmers are looking at ways of growing their own protein supplement. Some that have been tried but have not found widespread acceptance are fababeans, peas and sunflowers. Currently interest centres on soybeans and canola." Animal Production Pointers. "Whole Soybeans and Canola Seed For Cattle Feed," <u>Farm Focus</u> 12, No. 5, July 25, 1984.

unusual price ratios between feeds and ingredients. Researchers have explicitly stated that price situations have influenced their selection of research topics with respect to nutritional and feed studies.

Such findings suggest that feed ingredient price distortions have disorientated the technical progress of the region to some degree. An example of this is the attempt to increase the utilization of screenings in place of high energy corn. Since the unusual regional corn/screenings price ratio is partly the result of the feed freight equalization policy and its administration this is not necessarily one of the many research projects which could over time lessen the region's fundamental disadvantage with respect to feed grain prices.

E.2 Grain Production Technologies

Prior to the mid-1970's Maritime grain production technologies lagged noticably behind continental technology frontiers. Nova Scotia and the other Maritime provinces accounted for a declining share of North American feed grain production during the entire post-war period. There was little grain production technology available or investigated during this time that was specific to the region. Despite unique Maritime soil and climatic conditions the use of grain varieties developed for the Canadian Prairies was widespread.

In the subsequent period, corresponding with high international grain prices and reduced regional feed freight equalization, the technology of grain production in Nova Scotia advanced rapidly. Significantly the technical directions have also been particularly orientated for the region. It is furthermore evident that provincial farmers are playing an important role in the development of these new technologies and their incorporation into commercial farming systems. Many consider the province to be a leader in the development and use of modified intensive cereal management systems[28] in North America. These high nitrogen[29] systems include the use of fungicides[30] (bayleton, tilt, bravo), growth regulators[31] (ethephon, lycocel, cerone), the split application of fertilizers, the use of tramlines[32] for these applications, and the management of protein levels in the grain. While these developments

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28 MacLeod, J.A., H.W. Johnson, J.B. Sanderson, and H.G. Nass. "Intensive Management of Winter Wheat", Canadex 112.21, 1981.

Jones, R.W. "Response of Six Selected Cultivars to Graduated Management Input in a Cultivar Evaluation Format," Agriculture Canada, Kentville Research Station Annual Report, 1983.

Gourley, C.O., R.W. Delbridge, and J.E. Milligan. "Yield Response of Wheat and Rye to Optimal Application of Fertilizer, Fungicide and a Plant Growth Regulator," Agriculture Canada, Kentville Research Station Annual Report, 1977.

N.S. Winter Grain Marketing Board. "Cereal Management System Comparison, A Three-Year Technology Acceleration Project Under the Canada/Nova Scotia Agri-Food Development Agreement," 1983.

29 MacLeod, J.A., H.W. Johnson, and H.G. Nass. "Use of Supplementary N and Fungicide on Opal Wheat," Agriculture Canada, Charlottetown Research Station Annual Report, 1983.

30 Suzuki, M., and H.W. Johnson. "Effects of pp-333, Abscisic Acid, DPX-3778, SN-49537 and Tilt on Lennox Winter Wheat," Agriculture Canada, Charlottetown Research Station Annual Report, 1983.

Martin, R.A. "Potential for Foliar Applied Fungicides in Cereal Production," Agriculture Canada, Charlottetown Research Station Annual Report, 1983.

31 Johnson, H.W., J.A. MacLeod. "Application of Cerone to Winter Wheat Increases Yield and Reduced Lodging Severity," Agriculture Canada, Charlottetown Research Station Annual Report, 1983.

Jones, R.W., M. Teal, and E. McDow. "Effects of Growth Regulators and Fungicides on Performance of Lennox and Monopol Winter Wheat," Agriculture Canada, Kentville Research Station Annual Report, 1983.

32 Johnson, H.W. "Do Tramlines Reduce Cereal Yields?" Agriculture Canada, Charlottetown Research Station Annual Report, 1983.

have been the most noteworthy, research, adaption, and farm level trial and innovation is also occurring with regard to high moisture corn, protein crops, high flotation early seeding, etc.

The applicability of european management techniques[33] is of special significance as it addresses regional problems related to weather vulnerability. These techniques have been utilized more for the production of milling wheat to date than for feed grains. This focus on milling wheat is of course entirely based on relative prices.

Farmers have been active in this process of technical change playing key and continuing roles. The first importation of a european grain variety, opal wheat,[34] was undertaken privately and illegally. A special exemption from the Canada Seed Act was eventually granted. More recently, a wider range of european varieties obtained as a result of private initiatives from european seed houses have been tested with a special research permit. The popular and now standard winter wheat variety, lennox,[35] as well as

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[33] MacLeod, L.B., H.W. Johnson, J.H. Lovering, H.G. Nass, D.L. Bates, and J.E. Peil. "Report on a Cereal Research Mission to the U.K., The Netherlands and West Germany," Agriculture Canada, Charlottetown Research Station Annual Report, 1977.

[34] See "The Opal Affair," Country Guide, February, 1969, pp. 67-69.

[35] Nass, H.G. "Lennox Winter Wheat," Canadian Journal Plant Science 56, 1976, pp. 401-402.

monopol and vulka were obtained from these endeavours. There are now indications that Canadian seed companies are interested in commercial opportunities for marketing privately licensed european varieties.

While there are some provincial similarities with european grain production areas, physical and economic conditions require substantial modifications in the technologies being imported. This involves farm level experimentation with imported technology.[36]

The "high technology" being used in Nova Scotia for grain production is currently narrowly based with regard to types of grains, and farming areas. The technical possibilities exist, however, for a wide range of applied grain production innovations including the development of complete cropping systems. At a more rudimentary level, low levels of cropping skills still characterize a substantial segment of the provincial dairy sector (and other parts of the industry). This makes the wider application of existing technology a consideration, i.e. the greater diffusion of existing technical knowledge can be an important factor in reducing feed grain production costs. Economic distortions can be removed for the small cash crop sector with compensating payments on commercial marketings, but these incentives would not apply to the industry broadly.[37]

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[36] In the case of the most significant farm level technology development, special public assistance is being given via the Technology Acceleration Program of the agreement on agricultural development between Agriculture Canada and the Province.

[37] Development of cash crop grain production also does not address the feed cost situation of the industry.

In estimating the benefits from increased extension and the expected grower participation with respect to the same types of agricultural technology in Britain, Menz and Webster[38] focused on economic variables. Annual reports of the Soils and Crops Branch of the Nova Scotia Department of Agriculture and Marketing have similarly noted experiences regarding the level of interest in new types of technology at the farm level. There is a rough correlation[39] between these observations and commodity price levels.

The economic incentives which would result from changes in the FFA Program could therefore be expected to contribute to the technical progress of grain production in the province. Progress in developing regional grain technology will be partly a function of future grain prices.

Institutional innovation could be part of the progress in reducing provincial feed grain production costs. Fobes[40] and

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38 Menz, K.M., and J.P.G. Webster. "The Value of a Fungicide Advisory Programe for Cereals, " Journal of Agricultural Economics 32, 1981, pp. 21-29.

39 In 1981 for example, the assistant director reported "with the ever increasing cost of purchased protein for livestock feed, more and more Nova Scotia farmers are expressing renewed interest in developing home grown crops to supply this important ingredient".

Soils and Crop Services Branch, "Annual Report, Soils and Crop Services," Nova Scotia Department of Agriculture, 1981, p. 43.

40 Fobes, W. "Agro Service Rings as a Tool for Reducing Costs on Family Farms," Canadian Journal of Agricultural Economics 1982, pp. 153-174.

Fobes, W. "Agro Service Rings as Facilitators of Inter-farm Resource Use and Rural Development with Emphasis on the Mixed Farming Areas of Canada," paper no. 83-102 submitted to CSAE at the 1983 Annual AIC Conference.

Robinson[41] have suggested institutional arrangements which could potentially reduce machinery costs. Another such change involves the protein content of grain. Techniques have been adapted on Nova Scotia farms to manage the protein content of grains. To date these have been used by the more advanced cash crop growers mainly to ensure meeting minimum standards for milling wheat. The feed industry offers no price premiums for higher protein levels although there are discounts for grain below what they consider standard for alternate western grains. Problems involve the grading system, feed industry handling of variable protein content grain, and lack of trade experience with high protein grain in feed formulations, etc. The latent crop technology however exists. What is needed is primarily a commercial system and applied nutritional research. Additional protein can be produced at relatively low costs and the economics of grain production in the province would be improved with this development. There are no North American experiences in this area. High relative protein costs make such technical and institutional changes especially valuable in Nova Scotia.

One area where increased technical sophistication could lessen a provincial constraint on feed grain production involves the special case of rye. Rye has not historically been a major crop in Nova Scotia or in the other Maritime provinces. It is, however,

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41 Robinson, D.E. "A Low Cost Public Measure to Reduce Machinery Costs on Nova Scotia Farms," Nova Scotia Department of Agriculture and Marketing, Halifax, Nova Scotia, 1982.

considered by agronomists as one of the best-adapted cereals grown in the region.[42] Rye crops are not usually harmed by winter kill, disease, nor hindered by the regional grain production problems associated with wet springs and seeding, and wet falls and harvest. Its early harvest increases the use of otherwise idle and expensive equipment and this crop does better than most other grain crops on infertile and poorly drained acid soils. It can also reduce soil erosion problems in some farming situations.

The introduction of higher yielding rye varieties combined with successful premium priced sales of rye to a local distillery resulted in increased provincial rye production in the late 1970's. This increased production was primarily for cash sale. With the termination of these purchases by the distillery the Nova Scotia Grain Marketing Board has sold this crop to the feed industry and directly to livestock producers. Prejudices however among feeders against this product (and related to its association with ergot and the response of livestock to high rye content rations) have forced prices below barley equivalent levels. Nutritionists consider that much of the unpopularity and discrimination against rye is unfounded.[43]

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42 Langille J.E., and J.A. MacLeod. "Growing Fall Rye for Grain in the Atlantic Provinces," Agriculture Canada Publication 1578, 1976.

43 Nicholson, J.W.G. "Where Does Rye Fit as a Feed," paper presented to Feed Grain Workshop, Amherst, N.S. April 15, 1983.

This situation would not change with FFA restructuring except that the higher rye prices would result in greater production and therefore increased familiarity with the product. In the case of rye grown for home feeding a $12 - $20/tonne disincentive on this progress would be removed. This could be expected to aid in the dissipation of unwarrented views toward this product.

Table E.1

Rye Production, Acreage, and Commercial Marketings 1976,1979-84

	Total Production		Commercial Marketings	
	Acreage	Tonnes	Tonnes	$/Tonne
1984	4,500	5,700	-	-
1983	4,000	4,300	1,668	N.A.
1982	4,000	4,600	2,521	137
1981	5,300	5,700	3,381	156
1980	N.A.	N.A.	1,815	206
1979	N.A.	N.A.	1,349	196
1976	1,206	N.A.	-	-

Conclusion. Maritime grain production technologies between 1941 and the early 1970's (a period in which feed grain prices were "equalized" with Thunder Bay) lagged noticably behind continental technology frontiers. The Maritine provinces accounted for a declining share of North American grain production throughout this period. The use of grain varieties developed for the Prairies became common despite Maritime soil and climatic conditions. In the subsequent decade the adoption and adaption of new more regionally specific technologies has been pronounced. This technology development coincided with decreasing price distortions from freight equalization and with higher international grain price. Commercial grain growers played an active role in this progress.

The casuality between price and this technical change, of course, can not be established. However, those principally involved have often stated publicly that their activities would not have been undertaken with the freight equalization policy as it existed in the past nor is current development in their view at the level which would be achieved with higher market determined prices i.e., if the FFA Program did not continue to suppress economic opportunities in this regard.

The level of support for research has been identified by many as a major constraint to Maritime grain development. This is, however, also the case for the major grain growing regions of Canada where the international competitive position of grain growers may have deteriorated.[44] The required research and technology resources

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[44] Canadian grain yields have declined relative to major competition in the last 15-20 years.

for accelerated development in Nova Scotia, consequently, can be considered to have very high opportunity costs. The uniqueness of Maritime growing conditions further impacts adversely upon the economics of technology development in the region. Research and embodied technology from other areas is not as transferable as it otherwise would be and visa versa. Even with substantial increases in funding the technology resources of the region will remain small relative to those of much larger and more homogenous agricultural regions, i.e., the Prairies, Southern Ontario, the U.S. Mid-West, the Great Plains region etc.

Given such circumstances the induced innovation hypothesis appears highly relevant to policy considerations in Nova Scotia. Theory and past experiences with grain technology development suggests that the removal of FFA price distortions is a necessary condition to achieve maximum technical change at any given level of public investment. Conversely any public target for crop development will not be achieved at least cost in the presence of the current program and its effects.

E.3 Land Resource Technologies

Agriculture in Nova Scotia has developed a land intensive commodity structure.[45] The industry has a large component of nonland based production such as poultry and eggs, greenhouse products, mink, and land intensive horticulture. Dairying, the largest farm sector, utilizes less land per unit of output than dairy production in other parts of Canada and correspondingly utilizes

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[45] Robinson, D.E. "Economic Opportunities for Land Based Expansion" paper no. 83-315 CSSS/CSAE Joint Symposium, AIC 1983 Conference.

more purchased feed inputs. This is also the case for hog production. The share of farm production which accrues as a return to land ownership has been the lowest of any province in Canada, excluding Newfoundland. (See table E.2), While the industry's past growth and current structure has this orientation there is a large supply of land suitable for agriculture in the province. Nova Scotia has the lowest ratio of agricultural land utilization to cropping capability (defined as CLI Class 1 to 3 agricultural land) in Canada.[46]

A bio-physical evaluation of Canadian land resources for grain production (Nowland, Dumanski, and Stewart[47]), estimated that Nova Scotia has 2.4 million acres "moderately suitable" or better for the production of spring wheat. (3.2% of the total similarly classified land across Canada.) This acreage is several times the total area presently used for agriculture in the province. Nowland et. al. also estimated that there were 2.9 million acres of land in Nova Scotia "moderately suitable" or better, for barley[48] production (2.5% of all such land in Canada). These figures are surprisingly favourable in regard to the grain potential or agricultural land

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[46] This is a general feature of the region. Soil scientists say that Prince Edward Island may have the lowest utilization of its natural class 2 land in as favourable a climate of any place in the world. It is the only province in Canada farming an area of land less than its endowment of class 2 land.

[47] Nowland, J.L., J. Dumanski, and R. S. Stewart. "Natural Resource Base," in Part I. Production Base and Production Potential of the Eastern Grains Industry (prepared for the Eastern Grains Conference, Montreal, October 28-29, 1982) Research Branch, Agriculture Canada.

[48] The estimates for spring wheat and barley are not additive.

supply of the province. They represent substantial proportions of the land in Canada which could grow these crops but isn't now in farm production. Also, spring wheat and barley are not two of the most likely feed grain crops for provincial expansion.

The divergence of bio-physical evaluations of the province's agricultural land resources with the record of land utilization can largely be explained in terms of the economic limitations of special bio-physical characteristics of the regional land resource. It is also suggested by some[49] that a low level of technological inputs with regard to specific land problems has been an element of the comparatively low utilization of land in the region.[50] It is possible that the economics of crop production could be significantly improved with the development of land use technologies specific to

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49 Correspondence with Mr. John Nowland, Special Advisor Natural Resources, Agriculture Canada and conversations with Mr. Tony Schori, formerly Land Use Advisor, NSDAM.

50 The 1978-79 Inventory of Canadian Agricultural Research (ICAR) reported that there were 0.36 professional person years engaged in land research in the Maritimes compared with 172.09 across Canada. This share (0.2%) was substantially below the region's share of farm production and particularly below its share of land with agricultural capabilities. The great divergence here, i.e. between the region's national share of farm production or land used by agriculture, compared to physical measurements of land with agricultural capabilities, also reflects the relative magnitude of land related problems and constraints. In the only subsequent edition of ICAR (1980) the number of person years involved in land research increased to 4.69 out of a national total of 153.41. The region has, relative to its farm production, a disproportionately large share of national agricultural research but the low investment in such an area as regional land use problems can of course be highly significant to development.

Table E.2

Estimated Returns to Agricultural Land and Ratio of Agricultural Land Utilization to Cropping Capability (CLI Class 1-3) by Province 1981

Province	Avg. Land Returns $/acre[a]	Improved Land Utilization '000 ac	Total Est. Returns to Land $000	Value of Agricultural Products Sold	Est. Land Returns as a % of Sales	Ratio Improved Land to CLI class I-III
PEI	16	501	8,074	140,370	5.8	0.50
NS	11	440	4,803	198,608	2.4	0.15
NB	7	474	3,543	154,011	2.3	0.15
QUE.	15	5,829	88,421	2,031,902	4.4	1.07
ONT.	36	11,162	398,611	4,691,669	8.5	0.62
MAN.	13	13,595	176,128	1,444,577	12.2	1.07
SASK.	10	48,619	508,287	3,078,108	16.5	1.22
ALTA.	10	30,937	308,582	3,264,822	9.5	1.17
B.C.	11	2,337	25,395	799,654	3.2	1.00
CAN.	13	113,921	1,425,752	15,832,069	9.0	1.01

Source: Derived from Statistics Canada, Census of Agriculture 1981 and Environment Canada. Soil Capability Classification for Agriculture. Canada Land Inventory Report, No. 4. Ottawa, 1972.

a This is based on total rent reported paid by farm operations and total land rented. Over one third of improved agricultural land in Canada is rented and a similarly large proportion is rented in each province individually so these estimates are based on a broad market. Building rentals and quality differences between owned and rented land may introduce biases.

Maritime conditions. Nowland[51] has speculated that the technical solution to such regional land use problems as posed by soil fragipans would make it economically possible for the region to grow a high proportion of feed grain requirements.

While farm groups have been highly vocal in demanding more resources for the development, selection and testing of grain varieties and materials suitable for the region and for the development of total grain production systems, basic land research has not received as much industry attention. The private sector response to land problems has been largely in terms of demands for public assistance for capital investments in land upgrading. With regard to the fundamental problems of the land resource, these appear to require very expensive amounts of research and technology development. It is not likely that private innovation and investment will effect these substantially. Individual farmers have, however, been active in developing land moleing techniques.

Conclusion. One area for important technical advances, specific to the production conditions of the province, involves lower cost techniques to deal with special land use problems. The interactions between high rainfall and dense fragipans are an example. Regional

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[51] Nowland, J.L. "The Land Base for Cereals and Production Potentials Maritime Provinces." Presentation to Maritime Feed Grain Workshop, Amherst, N.S. April 14, 1983.

feed grain production costs could be lowered with such progress. The removal of feed grain price distortions could be expected to increase the farm demand for new cropping technologies. Increased basic research is probably required before private sector innovation could yield significant benefits in this area.

E.4 Hog Feeding Technologies

Although hogs are nonruminant animals there is considerable variation internationally in hog feeding technologies. This reflects local resource scarcities. The extreme situations are represented by grain exporting North America and by China. Grain is seldom fed to pigs in China, the largest pork producing country in the world. The different types of hogs raised in these two parts of the world closely correspond with their economic environments. Chinese pigs are characteristically pot bellied and have large digestive tracts. North American hogs would not be as productive if fed the same diets. The feed substitution possibilities for pork production in Canada and China with and without technical change could be depicted by unique isoquants on a common innovation possibilities curve such as conceptualized by Ahmad.[52]

Brief consideration will be given here to the technical prospects for some alternative feeds and systems. Nova Scotia accounts for less than 0.5% of the swine research in Canada and the U.S. and it would be difficult for the local industry to move in a radically different technical direction compared with the rest of the continent. While feed prices are higher in Atlantic Canada than in any other hog

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[52] See pp. 120-121.

producing region in North America it is significant that european hog feeding (with even higher feed prices) is not substantially different despite Europe's immense technical resources. Consequently, the major attention will be given to the gains which are possible from the wider application of existing technical knowledge largely common to all of North America. Evidence related to the influence of feed input price levels on the processes of technical change is also considered.

All hog producing regions have attempted to improve or maintain the competitive position of their industries through public research, education, and extension. An active public research and technical role is normally expected just to maintain a region's relative position in terms of productivity and efficiency. Unique technical advances with long lasting pay-offs are still possible. For example, for over 15 years the Nova Scotia hog industry has marketed the highest indexing hogs in Canada. The premium prices received for these high "quality" (high lean meat to fat) hogs has been an important factor in producer returns. This local technology has been highly significant in offsetting the advantages of producers in more naturally favoured hog production areas.[53]

[53] There is a disagreement among local feed industry nutritionists and extension workers and producers on the basis of the high indexing carcasses in the province. The former attributed this success largely to the low energy content of local feeds (this would relate to the relatively high corn/barley-oats price ratio of the region) and the later to the genetic stock of the provincial swine herd and its development over time. The effect of the energy level of the diet on "carcass quality" also appears to be subject of debate in the animal science literature. While there is some evidence that decreasing the dietary energy level of the feed increases the lean meat content of hog carcasses (and reports completely to the contrary) it seems doubtful that the low energy feeds of the province could be the principle reason for these provincial performance levels.

Despite some relatively high performance indicators, the Nova Scotia hog industry has below average feed conversion rates. This is partly the result of the FFA rate structure favouring lower energy feeds. The Livestock Feed Board of Canada reports that Maritime feed consumption per hog is 4.2% higher than in Ontario[54] although Nova Scotia conversion's are possibly above those of the region as a whole. Decreasing the industry average feed input by 100 lbs per market hog has become an operational target of the swine extension staff of the NSDAM. Many individual producers are already achieving this level of conversion in their operations. The 1983 Nova Scotia Swine Farm Business Summary[55] reported that on sample farms "feed fed per hog raised varied as much as 173 kg (381 lbs.)" Standard deviations were not reported. The sample was not random and may have included better than average producers.

Van Arsdall and Nelson[56] have reported that the standard deviation of feed input per unit of output for U.S. producers in 1980 was 175 lbs. per litter in feeder pig production, 17 lbs. per hundredweight of gain in farrow-to-finish operations and 21 lbs. per hundredweight of gain in feeder pig finishing.

Reports of considerable variation of feed/output ratios between farms are significant given the standard nature of most hog production operations in the province. While the static price

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54 Livestock Feed Board of Canada, "Annual Report 1982-83", Montreal, p. 3.

55 Farm Management Division, "Nova Scotia Swine Business Summary 1983", Nova Scotia Department of Agriculture and Marketing, Truro, N. S., 1983.

56 Van Arsdall, R.N., and K.E. Nelson. U.S. Hog Industry. USDA, Agricultural Economics Report No. 511, 1984, p. 27.

efficiency adjustments to variations in the feed/hog price ratio are of a minor nature, for many farms there are large gains possible from technical efficiencies. This situation is depicted in figure E.1. Two farms with differences in technical efficiency are operating on isoquants I_1 and I_2 The initial prices for feed and other inputs results in optimal input combinations along the A ray and they operate at C and F respectively. With higher feed prices such that points along the B ray are optimal they will change to D and F. In the particular case of hog production the price efficency gains are frequently small.[57] The technical efficiency gains which are possible, are much larger for many and perhaps most farms.

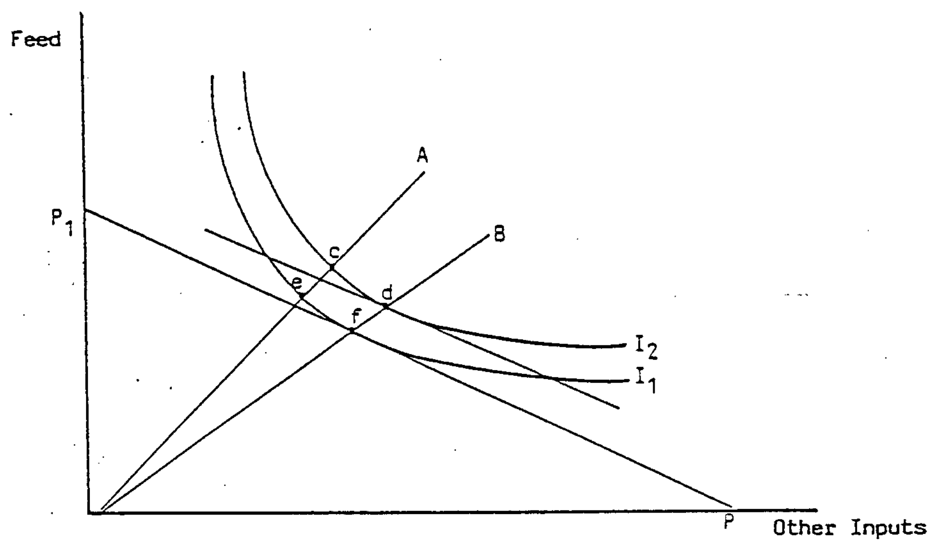

Figure E.1 Technical Efficiency and Price Efficiency

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57 See pp. 80-88.

Whether or not advancements in technical efficiency would be influenced by input prices is an important issue. Feed costs are generally equivalent to over 60% of revenue in hog production. Returning to figure E.1 the higher feed cost situation can be represented by the isocost line PP and, as such, it involves a change in a major cost factor, and hence in the total economic position of the enterprise. Such a situation would pose higher opportunity costs for not making the more significant transition from point C to point F.

There is some evidence that the level of feed prices has influenced the rate at which technical knowledge has been applied to commercial hog feeding in Nova Scotia. This includes an indication of the magnitude of the effect which can be used to assess the possible gains resulting from policy changes.

Between 1966 and 1979 the Economics Branch of Agriculture Canada collected data annually from seven feeder hog operations in Nova Scotia.[58] Over this period the feed to carcass weight ratio decreased. (See table E.3) Real feed costs ($/tonne) and hog returns ($/cwt) can "explain" 46% of the variation in the year to year change in the feed input per unit of pork output achieved over this period. (See table E.4) The parameter estimate for the feed cost variable was significant at the 8 percent level and the parameter estimate for hog returns at the 2 percent level with one-tail t-tests.

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[52] See: Gunn, T.C. "Economics of Hog Feeding Enterprises in Nova Scotia," Canadian Farm Economics 12, 1977, pp. 1-7.

Table E.3

Cost of Feed, Hog Returns and Feed to Carcass Weight Ratio, Seven Hog Feeder Operations, N.S. 1966-79

	Cost of Feed[a] $tonne	Farm Returns[b] Received $/cwt	Feed Consumption Per Hog Equivalent Raised	Dressed Weight Per Hog Equivalent Raised	Feed to Carcass Weight Ratio
1966	93.05	36.20	656.0	155.0	4.23
1967	96.14	31.15	633.0	154.0	4.11
1968	90.85	30.50	588.0	152.5	3.85
1969	86.66	36.23	605.0	161.4	3.74
1970	92.39	32.62	615.0	162.0	3.79
1971	93.93	26.29	599.0	163.0	3.67
1972	93.93	37.49	593,0	159.0	3.72
1973	153.47	55.19	605.0	160.0	3.78
1974	178.83	53.63	557.0	161.0	3.46
1975	180.59	70.06	600.9	158.4	3.79
1976	179.71	66.59	593.0	157.6	3.76
1977	183.02	61.74	553.0	158.2	3.50
1978	183.61	72.45	611.8	168.0	3.64
1979	209.31	66.73	587.8	164.9	3.57

Source: Nova Scotia Hog Feeder Enterprise Study
Economics Branch, Agriculture Canada, Truro.

a Average cost all rations including delivery costs.

b Market returns plus stabilization payments and bonuses.

In the presence of the apparent inward movement of isoquants (and especially the intractable nature of this shift) the effect may be considered as mainly technical change as opposed to input substitution, i.e. movement to new farm production functions not to new points on the same production functions. Comparisons against other regions such as Ontario where feed costs are lower, wages higher, and the opportunity cost of management higher, but feed consumption per hog reportedly 4.2% less, support the belief that these changes represent largely factor augmenting productivity increases.[59] A trend variable used in equation 1.2 suggested that the rate of feed conversion increases was slowing but the variable was not statistically significant.

A component of the year to year change in feed conversions did relate to adjustments which did not involve technical change. The principle adjustment would relate to hog shipping weights. Given diminishing feed conversions for mature animals a lower feed/hog price ratio makes heavier shipping weights optimal and vice versa. There are however, very narrow limits for such adjustments. Changes in slaughter weights were a minor factor in the variation in feed conversions (see table E.3). When the change in dressed weights was used to explain annual differences in feed conversion gains the variable was not significant and had the wrong sign. (see equation 1.3, table E.4). The slight upward trend in this period of dressed weights was related to changes in grade regulations and was a modifying factor in feed conversion gains in later years.

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[59] Hours of labour per hog raised also decreased sharply.

Table E.4

OLS Regressions of Year to Year Change in Feed Consumption Per Hog to Carcass Weight, Seven Farms, Nova Scotia 1966-79

		Constant	Real Cost of Feed $/tonne[a]	Real Return to Hogs $/cwt[b]	Trend	Carcass Wt. Change	R SQ.
1.1	Coefficient	-0.241	-0.008	0.029			0.460
	(t-ratio)	(-1.290)	(-2.000)	(2.900)			df=10
1.2	Coefficient	-0.248	-0.008	0.028	0.007		0.481
	(t-ratio)	(-1.298)	(-2.000)	(2.800)	(0.636)		df=9
1.3	Coefficient	-0.210	-0.009	0.031		-0.008	0.476
	(t-ratio)	(-0.650)	(-2.120)	(2.860)		(-0.700)	df=9

a Survey farms total average cost per tonne of purchased feeds including creep feeds, starter, grower and finisher /(GNEIPI).

b Total returns $/cwt for survey farms includes market returns as well as deficiency payments and bonuses / (GNEIPI).

Literal interpretation of equation 1.2 is useful in respect of the magnitude of the implied effects and their plausibility. The \$11.20/tonne and \$2.40/cwt price changes[60] which would result from the policy change being evaluated, would presumably induce a 0.0067 kg per kg increase in the annual improvement in feed to carcass conversion rates. Such an autonomous effect would improve feeding margins in the first year by \$0.14/hog and by \$2.13/hog[61] in year fifteen. If it were assumed that the induced effect would diminish linearly over time and in proportion to the reductions in feed costs relative to the initial policy induced feed cost increase, then the year fifteen improvement would be \$1.68/hog.

Taken as pure productivity gains these figures are both economically significant and technically plausible. Such an improvement in the industry's competitive position would be a positive and worthwhile step. On the other hand the implied gain is not inconceivable. All else being equal provincial conversions would still be inferior to those in Ontario at the end of the 15 year period, i.e. the total implied 15 year induced gain would be less than the present difference in Maritime and Ontario conversion rates.

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60 In the 1971 dollar used in the regression the price changes are \$3.70/tonne and \$0.79/cwt.

61 Calculated on the basis of an initial input of 0.365 tonne of feed per 77 kg of dressed pork and with a feed price of \$275/tonne.

In calculating the net effect of the price changes the negative influence of higher hog returns, (resulting from the direct payment of assistance) has been included. It is possible that with a well understood fixed term payment program, in lieu of the freight subsidy, that the moderating effect of higher hog returns would be negated. For producers wishing to remain in the industry in the medium term the onus arising from policy would be firmly placed on management.

The implementation of a $10/tonne increase in freight subsidies could be expected to reduce the rate of feed conversion gains by 0.021 kg per kg per annum.

The technical changes considered above involve an accelerated movement of farms towards "state of the technology" practices. Technological changes from the application of new scientific principles have not been considered. One area of interest for new technological advances of interest involves the substitution of grain, soyameal, and other protein supplements by other feed stuffs. Some local hog feeding research projects were noted in section E.1.

Consistent with the theory of induced technical change, much of the recent research on alternative feed stuffs for hogs has been carried out in locations where grain prices are relatively high and during high grain price periods. The researchers reporting these investigations have also referred to changing economic conditions as the basis for undertaking such projects.[62] Recent literature has

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62 Livingstone et. al. (1977), Whittmore and Taylor (1975).

included studies on using swedes (brassica napus) as a replacement for barley,[63] potato feeding,[64] and potato processing[65] techniques for pigs, and the use of cabbage (brassica oleracea),[66] other brassica crops,[67] and grass silage in the diet of pigs. The

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63 Livingstone, R.M., A.S. Jones, and I. Mennie. "Sweden (Brassica Napus) For Growing Pigs: Chemical Composition and use as a Replacement For Barley in the Diet." Animal Feed Science Technology, 2, 1977 pp. 31-40.

64 Whittemore, C.T. "The Potato (Solanum Tuberosum) as a Source of Nutrients for Pigs, Calves and Fowl - A Review." Animal Feed Science Technology, 2, 1977 pp. 171-190.

Wittemore, C.T., A. Scott, and L.W. Moffat. "The Inhibition of Nitrogen Digestion in Diets for Growing Pigs Containing Various Sources of Raw Potato." Potato Research, 18, 1975 pp. 322-325.

Whittemore, C.T. A.G. Taylor, I.W. Moffat. and A. Scott. "A Nutritive Value of Raw Potato for Pigs," Journal Agriculture Food Agriculture 1975, pp. 255-260.

65 Livingstone, R.M., T. Atkinson, B. Baird. and R.M.J. Crofts. "The Effect of Processing Potatoes on the Apparent Digestion by Pigs of Organic Matter and Nitrogen Measured Overall and at the Terminal Ileum," Proceedings of Nutr. Soc. 1977, pp. 36-58A.

Livingstone, R.M., B.A. Baird, T. Atkinson, and R.M.J. Crofts. "The Effect of Different Patterns of Thermal Processing of Potatoes on Their Digestibility by Growing Pigs," Animal Feed Science Technology 4, 1979, pp. 295-306.

Livingstone. R.M., B.A. Baird, T. Atkinson, and R.M.J. Crofts. "The Effect of Either Raw or Boiled Potato Juice on the Digestibility of a Diet Based on Barley in Pigs," Proc. Nutr. Soc. 1979, pp. 38-50A.

66 Livingstone R.M. B.A. Baird, and T. Atkinson 1980 "Cabbage (Brassica Oleracea) in the Diet of Growing - Finishing Pigs," Animal Feed Technology, 5, 1980 pp. 69-75.

67 Livingstone, R.M. and A.S. Jones. "The Potential for Brassicas as Feed for Pigs and Ruminants," Rowett Research Institute 1977.

Greenhagh, J.F.D., I.H. McNaughton, and R.D. Thow. "Brassica Fodder Crops," Eds. Proc. U.K. Conf., SADC/SPBS, Feb. 1977, pp. 102-105.

experiences of technically advanced high grain-soya priced Europe suggests that major changes in these respects are not of substantial relevance for North American producers at this time. However, more technical information on the processing of potatoes and on the feeding of grass and fish silage to pigs could be minor factors in improving the viability of hog production on particular farms in Nova Scotia.

Conclusion. Significant improvement in the competitive position of the hog sector in Nova Scotia is possible from the accelerated application of feeding technologies. Theory and some empirical evidence suggests that greater productivity gains would be induced in the higher feed grain price environment which would result from the proposed policy change compared with what would otherwise be the case.

The transformation of the FFA Program therefore could be expected to positively influence the level of economic viability achievable by this sector in the medium and long runs.

E.5 Poultry Feeding Technology

Research has been undertaken in Nova Scotia on the utilization of several alternate poultry feed ingredients and on other means to lower protein requirements. Such technologies are of particular relevance to the regional cost position and werediscussed in section E.1. Nevertheless, modern industrialized poultry and egg production technology is advancing rapidly and largely independant of local price ratios. As was the case for hogs the benefits from any incremental price inducements, for technical change, are more likely to arise in this commodity sector from the accelerated adoption of existing technologies and methods. The prospects for such gains will be considered here and not the development of location specific poultry technology.

In poultry (meat) production Nova Scotia feed conversion coefficients may be above the national average. A survey commissioned by the Canadian Chicken Marketing Agency reported that 1982 feed conversion rates for broiler chicken on a provincial industry level ranged from 2.032 in British Columbia to 2.235 in Saskatchewan with a weighted national average of 2.169. The reported Nova Scotia rate was 2.150.[68] A similar survey for 1979 reported a weighted national average of 2.176, while the Nova Scotia rate was 2.160 (table E.5). This situation (i.e. the difference in advancement of the production function of poultry feeding in Nova Scotia compared with other feeding sectors in the province and especially compared with the egg sector discussed below) is consistent with the expectations derived from the induced innovation hypothesis in that poultry feed prices in Nova Scotia have the largest ($/tonne or percentage) differentials compared with prices in other regions of any type of feed (See table E.6). This has also been the situation for an extended period.[69]

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[68] For Nova Scotia and the other smaller provinces the survey included all producers. In the case of the larger provinces large samples were taken. Standard deviations were not reported.

[69] Report of the Joint NSFA/NSDAM Feed Committee, December, 1981. Halifax, Nova Scotia Department of Agriculture and Marketing.

Table E.5

Reported Provincial Average Feed Conversion for Broiler Chicken, 1979 and 1982

Province	1979	1982
B.C.	2.166	2.032
Sask.	2.307	2.235
Man.	2.176	2.075
Ont.	2.126	2.110
Que.	2.222	2.209
N.B.	2.297	2.218
N.S.	2.160	2.150
Nfld.	2.191	2.198
Eight Provinces (Wt. Ave.)	2.176	2.169

Source: Canadian Chicken Marketing Agency (Touche Ross and Partners Reports).

In 1983 the Livestock Feed Board of Canada reported that broiler feeds were $50-60/tonne higher than those in Ontario. The higher corn/soyabean meal composition of high energy broiler feeds is part of the basis for such large price differences. No freight subsidies are paid on protein supplement ingredients and the rate on corn is lower than on (lower energy) western grains. A further factor is the higher manufacturing margins in the provincial feed industry for poultry feeds compared with other regions or other feeds. Graham, Beames, and Shelford[70] estimated that the gross manufacturing margin for poultry feeds in Atlantic Canada from August 1974 to July 1977 averaged $16/tonne above those in any other region.

70 Graham J.D., R.M. Beames, and J.A. Shelford. "Ingredient Costs and Formula Feed Pricing in Canada," Canadian Journal of Agricultural Economics 30, 1982, pp. 209-222.

While poultry feed conversions in Nova Scotia are possibly better than the national average, they are not the best in Canada. Significant further improvements are technically possible. An improvement in provincial feed conversion rates to the Ontario's level (if achieved solely due to factor productivity) would increase net returns (producer rents) by $265,000 annually. On the same basis, achieving the reported British Columbia average (1982) would yield benefits of $818,000. Some Nova Scotia producers now achieve these levels of performance.

The proposition that the economic environment may influence the rate and direction of technical changes on farms producing broilers is supported by results of a research project carried out by Funk and Tarte.[71] In investigating the farmer decision process in purchasing broiler feeds they reported that on the basis of criteria such as returns, feed conversion factors, and feed cost that growers recognize "a problem" and move "to the second stage of the decision process, the search for information." This involved "a series of efforts to obtain specific information concerning feed brands and dealers, feed prices and conversions and other related information." These activities required a commitment of time, effort, and expense. The description of the process which they give is similar to the behavioural model of cost reduction developed by Radner[72] in which

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71 Funk T.F., and F.C. Tarte. "The Farmer Decision Process in Purchasing Broiler Feeds," American Journal of Agricultural Economics 60, 1978, pp. 678-682.

72 Radner, R. "A Behavioral Model of Cost Reduction," The Bell Journal of Economics 6, 1975, pp. 196-215.

the manager's behavior is to allocate cost reduction efforts towards the input with the greatest potential for cost reduction.

The fact that reported Ontario feed conversions are superior to Nova Scotia's, while feed prices are substantially cheaper in that province, supports the belief that the lower Nova Scotia feed productivity level reflects mainly a difference in total factor productivity and not partial productivity differences resulting from input substitution.

In contrast to the relatively high feed conversion rates achieved in provincial poultry (meat) production, national cost of

Table E.6

Broiler & Layer Feed Prices Differences, Nova Scotia and Ontario 1977-83

	Broiler Feeds					
	Starter		Finisher		Laying Mash	
	$/tonne	%	$/tonne	%	$/tonne	%
1977	32.30	15.4	33.25	17.5	8.00	4.5
1978	37.00	17.5	40.00	20.6	8.50	4.7
1979	33.50	13.7	37.85	16.8	8.75	4.2
1980	39.25	15.3	52.00	22.2	12.75	5.7
1981	40.80	14.4	46.50	17.9	12.60	5.1
1982	41.45	14.5	53.40	18.7	16.90	7.5
1983	50.00	19.0	60.20	20.7	14.65	6.1

Source: Derived from retail feed prices published in the Annual Reports of the Livestock Feed Board of Canada, various editions 1977-84.

production surveys have reported below average conversions for egg producers in Nova Scotia. The most recent such survey indicated that the Nova Scotia egg sector had the lowest feed productivity of any province. The actual data from these surveys at the provincial level is confidential.[73] Also in contrast with the situation in the poultry (meat) sector laying feeds in Nova Scotia have comparatively small price differences compared with these same feeds in the rest of Canada (See table E.6). These long standing price situations may have been a factor in the sharply different performance levels of the Nova Scotia egg and poultry producers measured against their respective counterparts in the rest of the country. The proportion of brown egg layers in the provincial flock and possibly the age of the egg sectors' capital stock (buildings and equipment) are also factors in the lower provincial feeding efficiencies in the case of egg production.

The overall Canadian feed to egg conversion rate was reported by the most recent cost of production survey as 4.02 lb per dozen eggs.[74] While this is superior to the Nova Scotia rate it is below the feed efficiency level achieved by the U.S. industry. In 1984 the U.S. average feed input per dozen eggs was approximately 3.94 lb[75]

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[73] This information was obtained from communication with Nova Scotia Egg Marketing Board and Canadian Egg Marketing Agency officals.

[74] Ibid.

[75] Derived from USDA, Feed Outlook and Situation Yearbook, ERS, December 1985 and USDA Livestock and Poultry Outlook and Situation Report, ERS, May, 1985.

despite problems with avian influenza that year. While the average provincial feed conversion is not known it is possible that the difference between it and the U.S. level of performance has a larger effect on relative feed costs in Nova Scotia at present than does the FFA Program. This would definitely be true for some individual operations.

If the change in the FFA method of payment resulted in small induced feeding efficiencies the economic benefits could potentially be large relative to the incremental public costs associated with such a policy change. They could be of significance for the competitive position of this sector. With egg transportation costs of 5-7¢/doz[76] (and all else being equal) egg producers in an importing region are competitive with feed prices $26-38/tonne higher, if feed conversions (in both regions) are 4.10/lb/dozen. If both regions achieve 3.90 lb/dozen conversions the producers in the high cost regions are competitive with feed prices $29-40/tonne above those of the competing region.

<u>Conclusion</u>. There is some evidence that the feeding efficiencies achieved over the next fifteen years in poultry and egg production would be higher with the policy change than would otherwise be the

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[76] Derived from $1200-1500 for a carload lot of 1500 boxes of 15 dozen and representative of shipments from Pennsylvania or Ontario to Nova Scotia.

case. Combined with a broader technical initiative it is conceivable that the competitive position of the provincial industry could be significantly improved in this period.

E.6 Forage and Dairy Feeding Technologies

Dairy farming technologies are more specific to location than is the case for hogs and poultry production. The technology used in forage production and utilization is also characterized to an extent by local soil and climatic conditions and by the economic environment. Opportunities for lowering provincial feed costs are presented by both latent forage technologies of particular relevance to Maritime feed costs and growing conditions and by the accelerated adoption of existing and future advances in general dairy feeding technology. This review will assess the prospect for such technical change.

Technical change in forage production and utilization appears to offer substantial scope for reducing the intensity of feed grain use by the dairy sector in Nova Scotia. Compared with dairy farms in other provinces and in other countries grain feeding is relatively high in Nova Scotia. The generally low quality of provincial forages is the major cause of this situation. Forage quality is important in grain substitution because of nutrient concentration and its effects on feed intake. Higher quality forage is consumed in greater amounts by cows per day and this is often of greater importance in lessening concentrate requirements than the effect of greater digestibility per unit of forage consumed per se.

Lawson[77], in specific reference to the Maritime region, has stated that, "A long tradition of poor-quality forage with low intake and utilization has made the dairy farmers heavily dependent on purchased concentrates and grain", and further,

> "The nutritionists working with DHAS believe that the average dairy cow obtains about 65% of its digestible nutrient requirements from forage crops. Attempts to increase this to 70% have been hampered by the inability of the average farmer to improve his forage quality in terms of digestible energy. Nutritionists have detected considerable improvement in the best samples from farmers over the years, but they still believe that the quality of the average forage sample has not improved greatly."

It has been estimated by Young[78] that an increase of one per centage point in the protein content of Ontario hays would represent about 64,510 tonne of actual protein "that could be eliminated from purchased feed invoices." Similarily he adds an increase of one per centage point represents "a sizable amount of TDN or energy." Based upon forage quality-grain requirement relationships reported by

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77 Lawson, N.C. "Forage Crops in Quebec and the Atlantic Provinces" in Proceedings of the National Forage Symposium 1981 Agriculture Canada, 1983, pp. 15-23.

78 Young W.S. "Forage in Ontario," in Proceedings of the National Forage Symposium, , 1981, Agriculture Canada, 1983, pp. 24-27.

Stone, Spalding, Merrill, and Reed[79] calculated for a cow producing 12,000 lbs of 3.5% b.f. milk, feed grain demand on Nova Scotia dairy farmers would fall by more than 17,500 tonnes if forage quality were increased from "fair" to "average" levels. (See table E.7)

Table E.7

Amounts of Grain Required for a 10 Month Lactation According to Forage Quality[a]

Production Level(3.5%Milk)	High Quality Forage[b]	Average Quality Forage[c]	Fair Quality Forage[d]
		- lb -	
18,000	5400	6450	7800
15,000	3900	4800	6000
12,000	2500	3300	4400

Source: Stone, et. al.

a Calculated for 90 days of lead feeding + 215 days for typical lactation curves at each level of production.

b ½ corn silage + ½ hay cut by June 15.

c ½ corn silage + ½ hay cut by June 15-30.

d ½ corn silge + ½ hay cut after July 1.

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79 Stone J.B., R.lW. Spalding, W.G. Merrill and J.T. Reid. "A Dairy Cattle Feeding Program For High Production," in Proceedings 1964 Cornell Nutrition Conference, pp. 82-88.

Forage production and utilization technology in Canada was considered at the National Forage Symposium in 1981.[80] It was the opinion of many participants including LeRoux[81], Young[82], Winch[83], and Saidak[84], that substantial and comparatively large productivity gains could be made if existing technology were applied more extensively. They also stated that current research and technology development in Canada was insufficient considering the potential of latent technologies in this area. This opinion is also shared by

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[80] See: Proceedings of the National Forage Symposium 1981, Agriculture Canada, Cat No. A22-103/1983E.

[81] "Yields of forage could be doubled and quality dramatically increased if all existing technology were applied on currently used areas. At present however, we in Canada are not reaching our forage potential...... forages certainly can play a much larger role in our agricultural industry than they do at present." Ibid, p. 11.

[82] "Although considerable advances can be made using technology already available, the introduction and use of new technology could place perennial forage crops more strongly in competition as an energy source. The genetic potential, production recipe, and harvest-preservation systems are all implicated and should be examined for potential improvements." Ibid, p. 24.

[83] "Although the technology for increased yields and quality from forage crops is available it generally is not used. The potential of forage has not been fully realized.....If forage crops are indeed low-cost feeds and if the potential for yield and quality has not been obtained it would appear that perennial forage crops could play a very significant role in the crop and livestock systems of the future." Ibid, p. 57.

[84] "A highly visible characteristic of forage producers is their reluctance to use the technology now available for forage production. Some forage production experts consider that production could be doubled and quality significantly improved through the increased use of fertilizer and by harvesting at the optimum stage of growth." Ibid, p. 109.

the Canadian Agricultural Research Council.[85] It was noted by Winch that research on forage in the Maritimes was particularly low especially given its production value relative to total agriculture in the region.

Clearly the accelerated adoption of existing technical knowledge with respect to both forage production and utilization and advances in technologies specific to the Maritime region could fundamentally lessen Nova Scotia's comparative disadvantage with respect to feed grain. In respect to the wider use in feeding of existing knowledge Nicholson has for example said,

> "Utilization of the low-quality feed requires considerable skill by cattle feeders in knowing what feed to give the various classes of stock for optimum results and in devising adequate suppplementation. Improper use of low-quality roughage can be the limiting factor in milk production or can require expensive grain supplements or both."[86]

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[85] In 1981 the Council stated, "Research on forage crops is not strong enough in Canada compared to what we are doing for other commodities. More research on establishing forage crops on difficult and often poorly drained land, soil fertility requirements, rejuvenation of stands, plant breeding, plant physiology, disease and insect control and measuring productive capacity in terms of beef are lines of endeavour to pursue now because it takes a long time to gather data and understand what to recommend when we're dealing with problems of such complexity and variability."

Canadian Agricultural Research Council, "Recommendations for Research and Development in Agriculture and Food in Canada, Report to Canadian Agricultural Service Coordinating Committee by Canadian Agricultural Research Council," 1981, pp. 11-12.

[86] Nicholson, J.W.G. "Forage Utilization in Eastern Canada," in Proceedings of the National Forage Symposium 1981, Agriculture Canada, Cat. No. A22-103/1983E, pp. 19-23.

Basic scientific advances are forseen which would allow greater exploitation of the feeding value of forage. Winch has stated in this regard,

> "Further reductions in the use of grain in rations may be possible and appear to be related to the higher intake of low-moisture high quality forage which could set the direction for future research into the greater use of forage in rations.....Attention should be given to the quality components, their levels in the crops and the relationship between forages and grain or other crops in livestock production."[87]

The technical possibilities and limitations with respect to the greater use of forages in place of grain in dairy production are still not well defined. In a review of what dairy science knows about maximizing the use of forage, Wangsness and Muller have commented, "Currently we do not know the potentials for feeding high producing cows adequately on high forage diets."[88] In this regard they reported that forage quality is of "foremost concern." and that substantial reductions in grain inputs are technically and economically feasible,

> "If higher quality forages and higher energy density feeds are used and if the other factors discussed can be altered, grain feeding could decrease by 400 to 500 kg (in U.S.) per cow per year. Therefore, the forage to concentrate ratio would be more toward a 65:35 or even 70:30 instead of the current 60:40 for the entire lactation. A correct distribution of forages, grain and protein supplement over the entire lactation is essential in maximizing use of forages."[88]

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[87] Winch, J.E., "Forage the National Picture." in <u>Proceedings of the National Forage Symposium, 1981</u>, Agriculture Canada, Cat. No. A22-103/1983E, pp. 57-65.

[88] Wangsness P.J. and L.D. Muller. "Maximum Forage for Dairy Cows," <u>Journal of Dairy Science,</u> 64, 1981, pp. 1-13.

Consistent with the induced technical change hypothesis higher grain and oilmeal prices in the last decade led to an increase in the investigation of forage feeding technologies in dairy production.[89] Among others, Holter, et. al. and DePeters and Kesler, have explained their selection of research topics in terms of increased grain and protein input costs. Whether or not regional researchers, extension workers, and dairy producers would innovate and incorporate to a faster and greater extent this new scientific knowledge in a higher grain price environment is central to this consideration of FFA changes and technical change in the Nova Scotia dairy sector.

Conference participants at the Forage Symposium frequently questioned the technology transfer system in Canadian agriculture in the face of the wide gap they perceived in existing farm and technical efficiencies. It was not noted that in parts of the

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[89] DePeters E.J. and E.M. Keslen. "Partial Replacement of Concentrates by High Quality Hay for Cows in Early Lactation," Journal of Dairy Science 63, 1980, pp. 936-944.

Holter J.B. W.E. Hylton, C.B. Smith, and W.E. Urban. "Reducing Concentrate Feeding for Lactating Dairy Cows," 1982 Journal of Dairy Science 65, 1982, pp. 37-51.

Donker, J.D. and F.A MacClure. "Response of Milking Cows to Amounts of Concentrate in Rations," Journal of Dairy Science 65, 1982, pp. 1189-1204.

Turnbull G.W., D.W. Claypool, and E.G. Dudley. "Performance of Lactating Cows Fed Alfalfa Hays Graded by Relative Feed Value System," Journal of Dairy Science 65, 1983, pp. 1205-1211.

Davenport, D.G., A.H. Rakes, B.T. McDaniel, and A.C. Linnerus. "Group-Fed Concentrate-Silage Blend Versus Individually-Fed Concentrates and Group-Fed Silage for Lactating Cows," Journal of Dairy Science 66, 1983, pp. 2116-2123.

country competitive imported feeds are subsidized. This may have had an influence in dampening technical advances in such areas including the Maritime region. The general national situation, with respect to slow progress, is still of significance. It was Winch's opinion that,

> "Whether or not forage crops will achieve their potential and become a major contributor to low-energy, low-grain farming systems will depend on the following: Changing the attitude of farmers, administrators, and politicians; developing a strategy... and increasing personnel and research. ... This strategy should consider the diversity of needs across Canada. . . . and should be directed towards a substantial reduction or a more efficient use of grain in forage-livestock rations."[90]

There is substantial empirical evidence that agricultural price distortions affect both the adoption of research and technology and the underlying research agenda itself, i.e. the "attitudes" of farmers, administrators, and politicians.

In recent years progress has been made on the better dairy farms in Nova Scotia. The decreases, since 1980, in kg of meal per kg of milk produced as shown in figure E.2 are largely attributed to achieved increases in forage quality. Other factors such as the increased use of forage analysis would have also contributed to technical efficiency gains. The recent experience, with regard to the number of forage samples submitted to the provincial chemistry lab, provides some evidence that farm level technical change is

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[90] Winch (1983) p. 65.

responsive to input prices. The use of this services/technology increased substantially (+30%) in 1981. The 1980-81 period was characterized by high real feed prices (See table E.8).

Table E.8

Forage Samples Submitted to the Provincial Chemistry Lab and Dairy Feed Prices 1977-84

	No. of Samples Submitted	Index of Real Dairy Feed Prices[a] (1971=100)
1984	2920	97.4
1983	2650	95.4
1982	2515	97.6
1981	2504	112.7
1980	1931	110.1
1979	1928	105.6
1978	1953	96.5
1977	2115	105.2

Source: Statistics Canada <u>Industry Selling Price Indexes</u>, Cat. No. 62-011, Ottawa: Statistics Canada and Nova Scotia Department of Agriculture & Marketing, Soils and Crops Branch Annual Report Various Editions.

[a] Feed Industry Selling Price Index for Complete Dairy Feeds/Gross National Expenditures Implicit Price Index.

A substantial variation in the quality of forage and of feeding management on dairy farms in Nova Scotia is still found. The percentage of net energy derived from meal on Dairy Herd Analysis Service (NSDAM) herds ranged from 8% to 68% in 1984 and averaged 42%. Feed costs per litre of milk ranged form 8.6¢ to 30.10¢ and averaged 16.8¢.[91]

Improvements in regional forage technologies are not limited to the dairy sector. They would also improve the viability of beef and sheep production. Grass silage may also be an economic alternative feed for sow pigs in some farming situations.

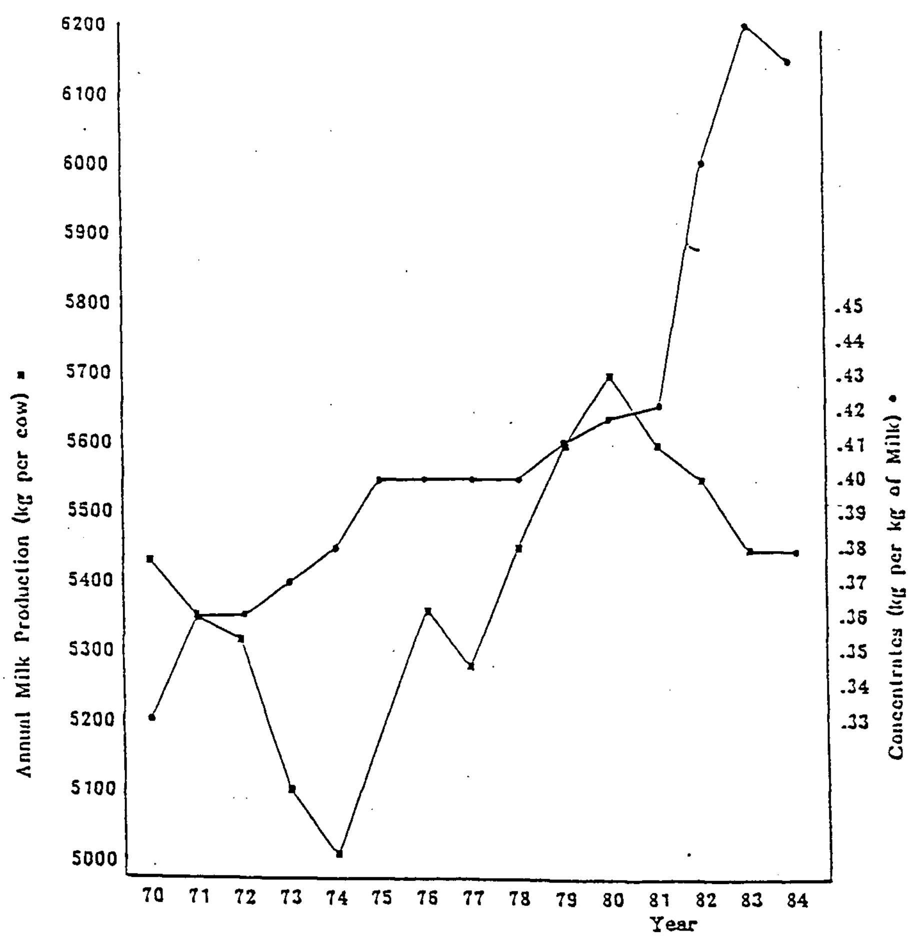

Figure E.2 - Annual Milk Production Per Cow and Concentrate Feeding Per Unit of Milk Production, DHAS Annual Averages, 1970-84.

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91 Livestock Services Branch, "Dairy Herd Analysis Service Annual Report," Nova Scotia Department of Agriculture and Marketing, 1984.

Conclusion. The prospects for achieving a significant reduction in the intensity of imported feed grain utilization from broadly defined technical change in forage production and utilization and in the accelerated adoption of dairy feeding technologies appears significant. The rate and direction of these changes can be expected to be influenced by the method of payment used by the FFA Program. The adverse effects of the reduction in feed equalization on the industry (and of any possible future termination of FFA) could be expected to be reduced overtime by the policy change.

E.7 Summary

The direction of animal nutrition and feed stuffs research in Nova Scotia and the Maritime region has been orientated largely towards local problems and opportunities characterized by unusual price ratios. Researchers have explicitly stated that relative prices have influenced their selection of research projects. The incorporation of such research into commercial production systems by innovators can be expected to be determined largely by their assessments of the expected costs, including risks, against the expected returns.

The scarcity of grain technology specific to regional growing conditions has adversly effected grain development in Nova Scotia. Recently, farmers have introduced and adapted new foreign technologies and have encouraged increased public research on such technologies. High grain prices resulting from reduced feed freight equalization and strong international markets appear to have induced this activity. (Individual farmers have stated this explicitly). This strongly suggests that the future technical progress in grain production in Nova Scotia will be partly a function of grain prices. The development of grain technology in the region faces many difficulties including the uniqueness of growing conditions, the high opportunity costs for the grain research resources needed, and low expected international grain prices. There is substantial evidence that the removal of price distortions is a necessary condition to achieve maximum technical progress at any given level of public investment and that conversely such changes are a necessary condition for the achievement of any public development targets at least cost.

In the view of some soil scientists the development of new land use technologies specific to the region's land resource would make it economical for farmers to produce "a high degree of feed grain requirements."[92] Until a major public research program has been undertaken the scope for private innovation appears limited in this area.

The accelerated adoption of existing feeding technologies for hogs, poultry, and dairy cattle would immediately reduce the intensity of imported grain utilization and feed costs. The production and utilization of forage feeds is included here. There is some evidence that feed prices have influened the rate of adoption of such technologies in the past. The achievement of high comparative levels of feeding efficiency, would improve the competitive position of provincial feeders.

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[92] Nowland (1984).