ALTERNATIVES TO THE SUBSIDY ALLOCATION IN THE

AGRI-FOOD SECTOR:

The Case of Vegetable Processing in Manitoba

by

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ABSTRACT

The main purpose of this study is to investigate the impact of subsidy allocations on the Fruit and Vegetable Processing Industry (FVPI), and particularly potato processing, in comparison to direct subsidies distributed to farmers in Manitoba.

The impact of subsidy funds on growth and development is evaluated using a well defined theoretical model. The dynamic model for the FVPI is based on optimal control theory and the adjustment cost hypothesis, utilizing the duality approach. Further analyses and comparisons of different subsidy scenarios are based on an estimated investment/production model, rural consumption patterns, and regional Input-Output (I-O) model.

Based on the estimated results, when a subsidy is allocated to farmers less than 26 cents of each dollar will remain in the rural community. The total increase in value added will be approximately 40 cents for each dollar transferred to the farmers. Furthermore, each $130,000 direct subsidy will likely create one domestic job.

However, when a subsidy is allocated based on production efficiency to the FVPI, one dollar spent has the potential of raising the domestic output by 80 cents,

and each $58,000 subsidy creates roughly one domestic job. Conversely, if a subsidy is not allocated efficiently to the processors, the change in the value added and employment will be marginal and substantially lower than the direct subsidy to the farmers.

The main conclusions obtained from the study are:

(a) Generally, a more detailed analysis of the production/investment and consumption relationship, prior to the allocation of subsidies, is needed for capturing the greatest economic benefit.

(b) The FVPI in Manitoba is over-capitalized after the mid-1970s.

(c) Capital expenditure in the FVPI is not sensitive to the cost of capital, due to different regional incentive programs.

(d) The establishment of a price enhancing program for raw material, such as a supply management board, may substantially reduce the level of capital expenditure in the long-run.

(e) Policies geared towards training and improving the productivity of human resources have a greater impact on enhancing rural growth and development.

CHAPTER 1

PROBLEM IDENTIFICATION

1.1 Introduction

Manitoba has been faced with the problem of slow growth over the past decades. For almost 50 years common indicators representing regional disparities, such as growth in employment, per capita income and population growth, have been below the national average. Continuous efforts of both the federal and provincial governments in promoting economic performance and in eliminating the disparity between Manitoba and the rest of Canada have not been particularly successful. Federal funds transferred to Manitoba in the 1980s have been around 40 percent of annual provincial revenues, second only to the Maritime provinces.[1]

Per capita incomes in Manitoba in the early 1980s were seven percent below the national average. In addition a high disparity in terms of per capita income exists, particularly as a result of Manitoba's large native population. The rate of migration to this province has often been negative. While Manitoba's rate of unemployment has been consistently slightly below the national average, the

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[1]Statistics Canada, Economic Account, Catalogue No. 13 - 213.

explanation lies partly in terms of disguised unemployment and underemployment in the agricultural sector. After the Maritimes, Manitoba's labour productivity in the agricultural sector is the lowest in Canada.[2]

While some regional economists hold the view that slow growth and regional disparity can be interpreted as signs of economic adjustment (Courchane: 1986), others believe that slow regional growth is the outcome of *historical* Canadian economic development (although not denying the economic adjustment process in Canada). Slow growth is considered an inevitable process which cannot be totally eliminated even when there is a high degree of economic adjustment (North: 1955, Watkins: 1963, Drache: 1976, Hum and Phillips: 1981).

Manitoba serves as an appropriate example of a region where slow growth is explained by past trends in economic development. Manitoba's past growth was heavily influenced by staple production, mainly wheat. In the decade from 1901 to 1911, the number of farms increased by 272 percent (Phillips: 1981, p. 19) and the value of agricultural production almost doubled between 1926 to 1950.

In the post-staple-led period, almost all regions in Canada, including Manitoba, have been faced with structural changes and slow growth of exogenous demand for staples (Hum and Phillips: 1981). Furthermore, the differential in the productivity growth rate between the staple and non-staple sectors (the latter

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[2]Statistics Canada, National Income and Expenditure Accounts, Catalogue No. 13-10.

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primarily produced in urban areas) has caused the relative price of non-staples to increase over time. In regions where staples are the leading sector, productivity increases in favour of the staple. Therefore, the relative cost of producing non-staple products increases over time. In addition, the labour force and general population become urbanized, and the overall rate of growth of rural regions witnesses a combination of rising unemployment, falling relative income and a consequent rural-urban migration (Baumol: 1967; Hum: 1984, pp. 5-8). For example, at the beginning of the twentieth century, the proportion of the Canadian labour force employed in agriculture was approximately 42 percent; by 1951 this was down to 20 percent and the current figure is less than seven percent.[3] In the prairie regions, the urban population increased at an average rate of eight percent per decade from 1930 to 1970. The rural population declined at an average of about two percent per decade from 1941 to the present.

The tendency towards declining growth and stagnation in rural areas (staple regions), according to most growth theories and hypotheses, is inevitable and endogenous as the staple enters its mature phase.[4] This suggests that the ability of a staple-led region to escape stagnation, without government intervention or long-run economic planning, is limited.

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[3]Statistics Canada, Census data, 1986.

[4]Examples of these are staple, growth pole and export-led theories.

Although government intervention can be justified on these grounds, the nature, direction and extent of the intervention policies have always been a matter of great controversy in Canada. These policies emerge from the complex interaction of different social values, goals and objectives. Even though policy decisions should be based on social and economic values, a third dimension, political values, often makes the process and outcome more complex and sometimes inefficient.

Since the early 1930s, various policies have been implemented by authorities to promote social welfare and maintain balanced growth in rural and urban regions. The most widely practised policies include:

1. increasing the volume of staple production;

2. diversifying the economic base of the region which relies heavily on the export of staples (as suggested by the Western Transition Conference in June of 1985 and the current Western Diversification Initiative);

3. direct subsidies to low income rural residents (e.g., to farmers; the 1986-88 Special Grains payments and 1989 Drought Assistance Payments); and

4. broadening the economic base of the rural areas via: (a) staple processing and encouraging import-substitution in the staple region, and (b) investment in infrastructure in order to attract more private

investment into the region (e.g. ring dikes for flood control; sewer and water systems).

Each of these policy approaches can produce problems. Policy concentration on increasing staple production for exports which are pro-trade biased, while exogenous demand is not expanding, can intensify the stagnation problem (Hum and Phillips: 1981, p. 19). Diversification away from staple exploitation is difficult; one has to consider the market opportunities and the geographical location of urban and rural areas at a given time (McCann: 1979, p. 79). Direct subsidies to farmers are politically appealing because of the speed of delivery; however, often, they may have political motivations rather than being an instrument to generate growth in a region (MacMillan: 1987, p. 19). Often, while the ultimate objective is to use the funds for promoting political objectives, the stated justification for the allocated funds is enhancing agricultural productivity and efficiency as well as protecting low income farmers. An attempt will be made, in this study, to further evaluate such phenomena and analyze the pertinent hypotheses developed accordingly.

An alternative policy to that of direct subsidy allocations at the farm level is the use of funds for broadening the economic base. For a mature staple-led region such as Manitoba, this latter policy may be more effective in promoting regional economic growth than the direct subsidy option. In the early stages of staple development, the rate of growth of a region depends on the exogenous

demand for staples, measured by the rate of growth of trade (e.g., of wheat in the Manitoba case). However, in the mature stage, the dampened growth of staple production, due to lower exogenous demand, has to be offset by increasing and promoting the production of other industries, preferably those which can process staples in the agricultural sector in the region. As McCann (1979) points out, lessons can be learned from the experience of staple-led regions in Canada. He hypothesizes that slow and restricted growth in Nova Scotia can be attributed primarily to the fact that this province did not engage in a staple processing policy as other provinces such as British Columbia.[5]

Recently there has been some controversy regarding the allocation of development funds in slow growth rural regions. The dispute is centred on whether the government assistance funds should go directly to the farmers or if they should be directed to alternative projects, such as broadening the economic base, which promote economic growth in the region. While funds allocated to the latter policy programs are generally designed and implemented based on economic efficiency criteria, income stabilization programs and other short-term subsidies generally result in inefficient resource allocations (MacMillan: 1987).

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[5]As McCann points out, unlike the salmon catch of B.C which was usually canned before export, much of the Nova Scotia fishery was exported. Furthermore, Nova Scotia's locational disadvantage and ownership regulation did not engage in the forestry product processing. Consequently, Halifax did not benefit from the industrial stimuli offered by the regional staple economy. Since McCann's study, however, B.C. has lost its ability to require processing before export.

Recent studies show that often farm subsidy programs direct most of the money to a small number of farmers who are already well off. These subsidies widen the distribution of income within the agricultural sector and lead to unfair competition in international markets. Most regions in Canada and the U.S. which are heavily dependent on farming have generated higher per capita incomes in the last 20 years than other rural regions, largely because of farm subsidy programs. But it is doubtful that high incomes of farmers can support a declining rural economy, even in those farm-dependent regions.[6]

In recent years there has been an ongoing effort to replace the Crow Benefit grain transportation subsidy program with a direct farm subsidy program.[7] Since the determination of federal payment of Crow Benefits to the railways in 1983,

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[6]For example see:
(1) J. Spriggs and G. C. Van Kooten: "Rationale for Government Intervention in Canadian Agriculture: A Review of Stabilization Programs", *CJAE*, Vol 36, 1988, pp. 1-21.
(2) R.D. Knutson and D.U. Fisher, "Fragmentation, Moving toward Consensus ", based on the National Government's Task Force on Rural Development, U.S.A., Choices, published by American Agricultural Economics Association, Second Quarter, 1988.

[7]For more details on this see:
(1) D. F. Kraft, "Grain Transportation Refund (GTR) and the Freight Rate Structure For Grain and Grain Products", Department of Agricultural Economics, unpublished paper, 1986.
(2) The Hall Commission Report "The Report of the Committee of Inquiry on Crow Benefit Payment", March, 1985, Winnipeg, Manitoba.

debate has been generated over alternative subsidy allocations, namely direct subsidy to the grain producers instead of the present payment to the railways.

In light of this and other controversies, the main objective of this study is to assess and evaluate the effects of alternative methods of allocating government funds to a selected food processing industry (e.g., fruit and vegetable) in Manitoba, as opposed to the general food production sector. It will be argued that greater investment in value-added industries contributes to the growth of GDP/income, on-farm and off-farm job opportunities and consequently overall economic growth. Additionally, processing industries located in rural areas are considered as major source of income for both farm and non-farm residence. The analysis involves development of an instrument for evaluating alternatives to stimulating long-run growth and will be applied to the southwestern Manitoba (Winnipeg Region, Figure 1.1). The study will focus on long-run benefits namely a higher level of employment and income.

Manitoba offers a suitable case for the evaluation of the above situation because (a) Manitoba is in its post-staple-led or maturing phase, and is experiencing a relatively slow rate of economic growth (Artibise: 1975); (b) in its rural regional portfolio Manitoba does not have the variety of staples that Alberta and Saskatchewan have, (e.g., oil, gas, uranium and potash), and (c) in recent years, a significant of amount direct subsidies has been transferred to Manitoba's farmers. The level of federal subsidy in 1987-88 was close to $782 million. The details and
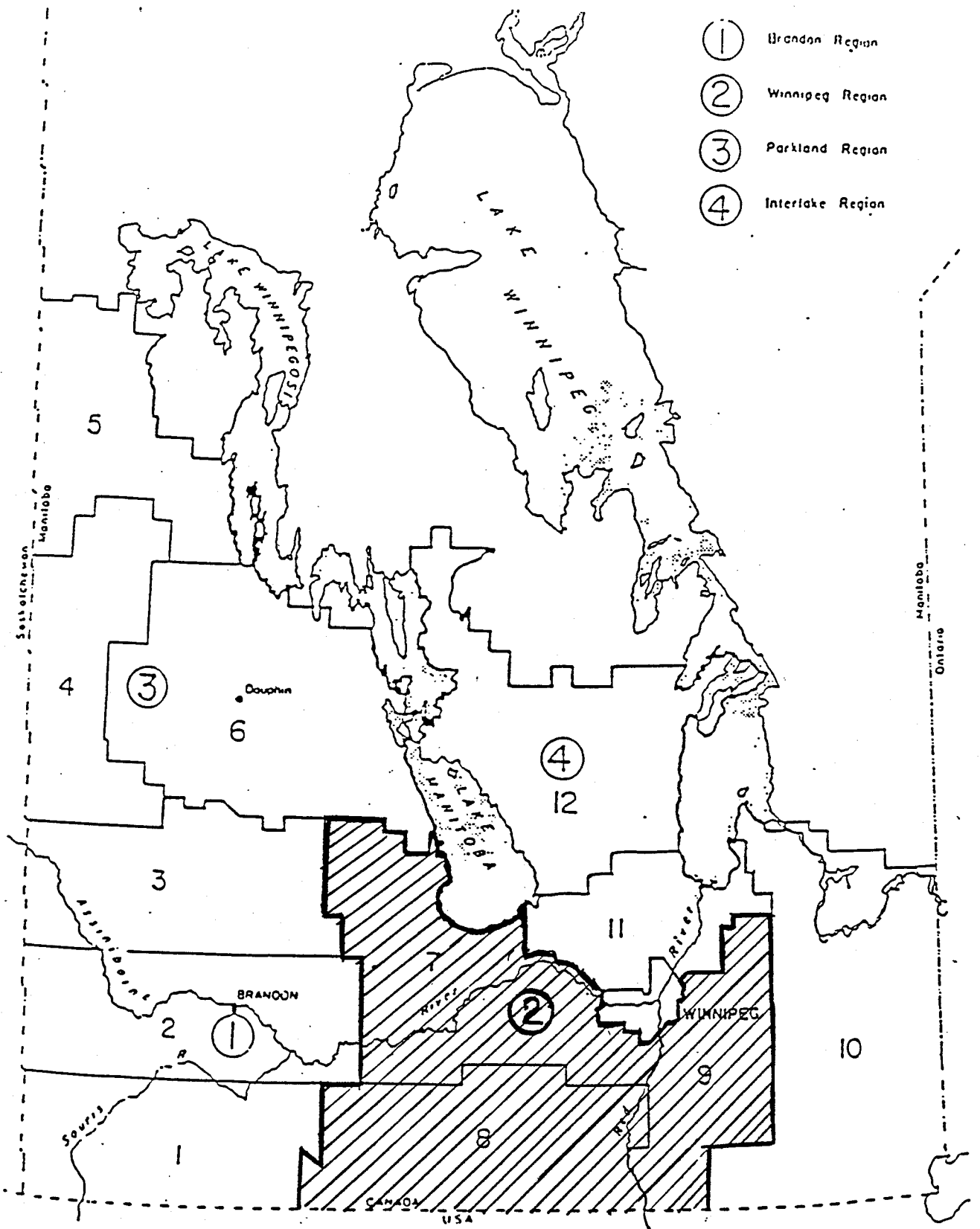
Figure 1.1 Manitoba Crop Districts and Regions , Manitoba Department of Agriculture

breakdown of both the federal and provincial agri-food expenditure in Manitoba for recent years are given in Tables 1.1 and 1.2.

Most regional development studies have adopted either short-run benefit-cost analysis (e.g., used for evaluating most development projects of the federal and provincial governments) or long-run benefit-cost analysis. Simple short-run benefit-cost analysis is politically appealing; however, there are several major weakness involved in this approach. First, it concentrates on short-run and direct effects only. Second, it does not provide a multiple-objective planning framework (Schulze 1985, p. 1036). Third, it focuses entirely on consequences, rather than placing value on the process used to move from the initial state to the final state (Kneese *et al.:* 1985).

Long-run analyses, on the other hand, have concentrated on providing a framework for estimating the indirect, as well as direct, impacts. They also involve the implementation of a multiple objective planning framework (such as higher levels of income and employment, and improvement in quality of life and income distribution). The Interlake project (MacMillan *et al.:* 1977) serves as one example which utilizes regional input-output (I-O) accounts for predicting direct and indirect impacts.[8] While this procedure overcomes some of the limitations referred to

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[8]MacMillan, J.A and S. Lyon (1977), "The Interlake Experience: A Description and Evaluation of Rural Development Program", Department of Agricultural Economics, University of Manitoba, Occasional Series No.9, 1977.

Table 1.1
Federal Government Expenditures in Agriculture, Manitoba
1982-1988

Federal	1982/83	1983/84	1984/85	1985/86	* 1986/87	* 1987/88
			-- $'000 --			
Direct payments through community programs	29,335	37,125	42,393	32,703	273,600	558,893
Crop Insurance	13,012	11,986	16,412	21,390	23,100	19,367
Financial Assistance	3,405	5,016	5,669	11,772	30,300	51,301
Transportation	95,673	115,408	118,908	151,368	175,100	150,248
Regional & Industrial Economic	17,733	15,565	21,616	9,047	14,900	2,936
TOTAL	159,158	185,100	204,998	226,280	517,000	782,745

* Preliminary data under revision

Source: Public Accounts of Canada, Agriculture Canada

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Table 1.2
Manitoba Department of Agriculture Expenditures

DIVISION	ACTUAL EXPENDITURES					MAIN ESTIMATE
	1984-85	1985-86	1986-87 - $ 000 -	1987-88	1988-89	1989-90
Administration and Finance	2,217.5	2,432.3	2,459.0	3,015.9	3,015.9	3,945.5
Man. Crop Insurance Corp.	4,140.7	5,525.7	5,372.8	4,664.3	4,795.6	5,167.0
Man. Agricultural Credit Corp.	12,503.9	11,090.3	7,542.6	16,063.4	21,885.2	16,454.0
Ag. Development & Marketing	10,739.7	10,690.3	11,022.3	11,606.5	11,998.1	12,997.2
Farm and Rural Development	11,207.6	11,510.7	11,481.0	12,215.7	10,790.3	11,005.4
Policy and Economics	1,812.2	1,841.5	1,940.2	2,539.7	2,719.2	2,943.4
Federal-Provincial Agreements	1,402.2	1,448.6	1,301.5	1,311.0	657.5	1,057.5
Income Insurance Fund	6,265.3	9,121.8	14,144.7	11,255.9	11,031.2	10,773.5
Drug and Semen Purchases	4,431.1	4,811.2	6,147.2	6,130.4	7,912.5	7,290.7
Education Tax Reduction Program	--	--	--	12,000.0	12,000.0	15,400.0
Emergency Interest Rate Relief	2,608.2	1,384.5	1,036.5	1,100.0	2,232.9	1,250.0
Emergency Drought Relief Program	1,999.6	--	--	--	18,300.0	--
Expenditure Related to Capital	3,004.6	3,956.9	5,343.5	4,150.0	4,850.0	--
						*:
TOTAL	62,332.6	63,813.8	67,791.3	86,053.8	112,188.4	88,824.2

** The total does not include the expenditure related to Capital.

Source: Supplementary Information For Legislative Review.

earlier, it suffers from several other shortcomings including the non-testability of the predicted results and the assumptions of constant prices, constant returns to scale and linear and static production relations. The I-O accounts also require a comprehensive definition of the notion of a sector, particularly of a service sector (Mason: 1987). Alternatively, these accounts can be used in conjunction with other disaggregated analyses or as a special case of a more general model.

At the present time, a more comprehensive procedure for assessing and evaluating the short-run as well as long-run benefits of agri-food expenditures, which focuses on a particular industry at the disaggregated level is not readily available. Therefore, the attempt in this study will be to develop a more comprehensive and general framework or model for assessing the impact of development funds on the agricultural sector over time. Different subsidy and development scenarios will be used in order to examine the predicted results on growth and development in Manitoba.

In order to develop relevant hypotheses, define objectives and establish the theoretical background for this paper, a brief review of the present state of the farm support program and the economic performance of the fruit and vegetable industry in Manitoba will follow.

1.2 Farm Support Programs

Between 1984 and 1988, federal outlays for farm price support programs and related direct payments to Canadian farmers averaged $3 billion per year.[9] Over the same period, *direct subsidy* payments to farmers have increased significantly. For Canada as a whole, these payments have increased from $0.3 billion in 1981-84 to an estimated level of $2.8 billion in 1988 (Figure 1.2). In Manitoba,in 1986-88, the average contribution of the federal and provincial governments has been $651.5 million and $76.9 million, respectively (Figure 1.3).

In recent years, there have been significant efforts to evaluate the effectiveness of such programs on the welfare of recipients and on the economic performance of the agricultural sector.[10] Government involvement in Canadian agriculture programs is justified on the grounds that the market either overlooks or

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[9]Federal Agri-Food Expenditure, Policy Branch, Agriculture Canada, Various years.

[10]For example see:
(1) C.S. Webber, J.D. Graham, and R.J. MacGregor, "A Regional Analysis of Direct Government Assistance Programs in Canada and Their Impacts on the Beef and Hog Sectors," Working Paper, Agriculture Canada,1988.
(2) G.C. Van Kooten, J. Spriggs, A. Schmitz, "The Impact of Canadian Commodity Stabilization Programs on Risk Reduction and the Supply of Agricultural Commodities", Working Paper 1989, Agriculture Canada.
(3) "A Report on the Evaluation of the Special Canadian Grains Programs Phase III", Deloitte, Haskins & Sells, Dec. 1987.
(4) Agriculture and Food Development Nova Scotia,"Mid-term Evaluation Canada/Nova Scotia Agriculture and Food Development Agreement, 1982-1987", Sept. 1985.

Figure 1.2
Grain and Oilseeds Receipts
Canada 1981/84-1988
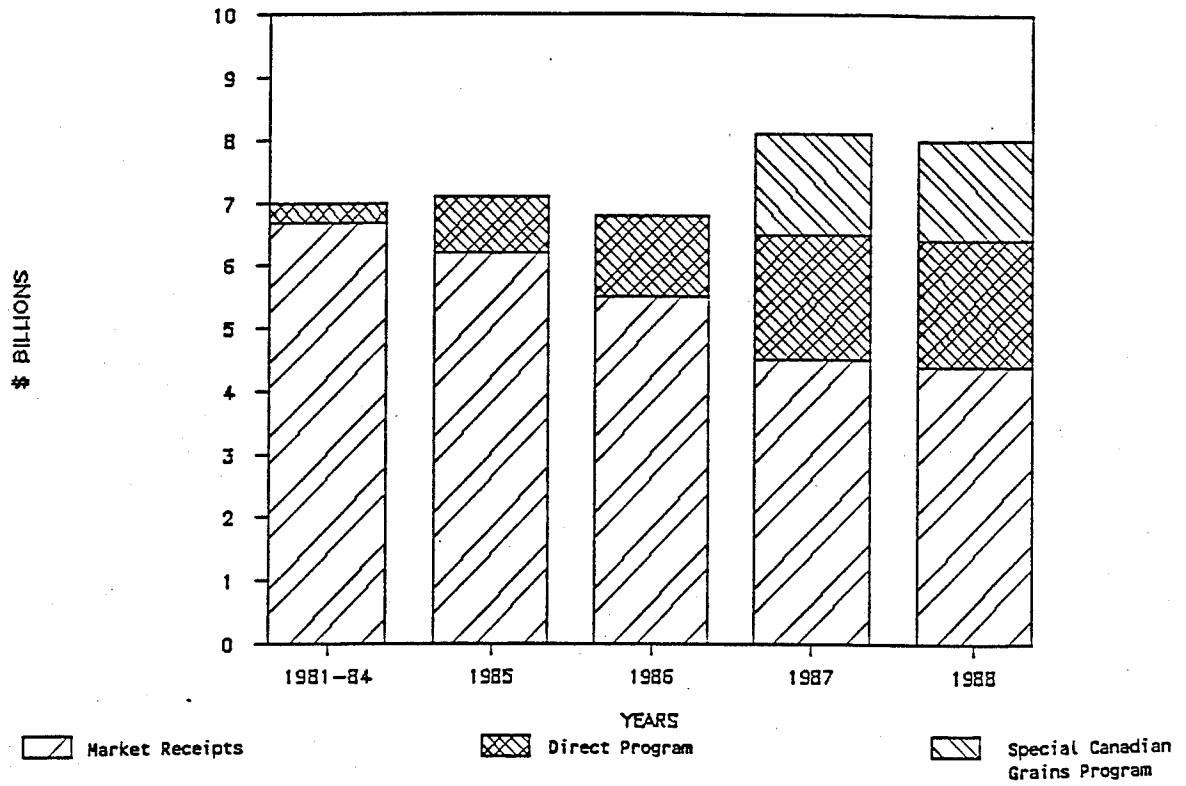
Source: Agriculture Canada
          Federal Agri-Food Expenditures,
          Agriculture Canada, Policy Branch

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Figure 1.3
Government Expenditures in Agriculture
Manitoba 1982-1988
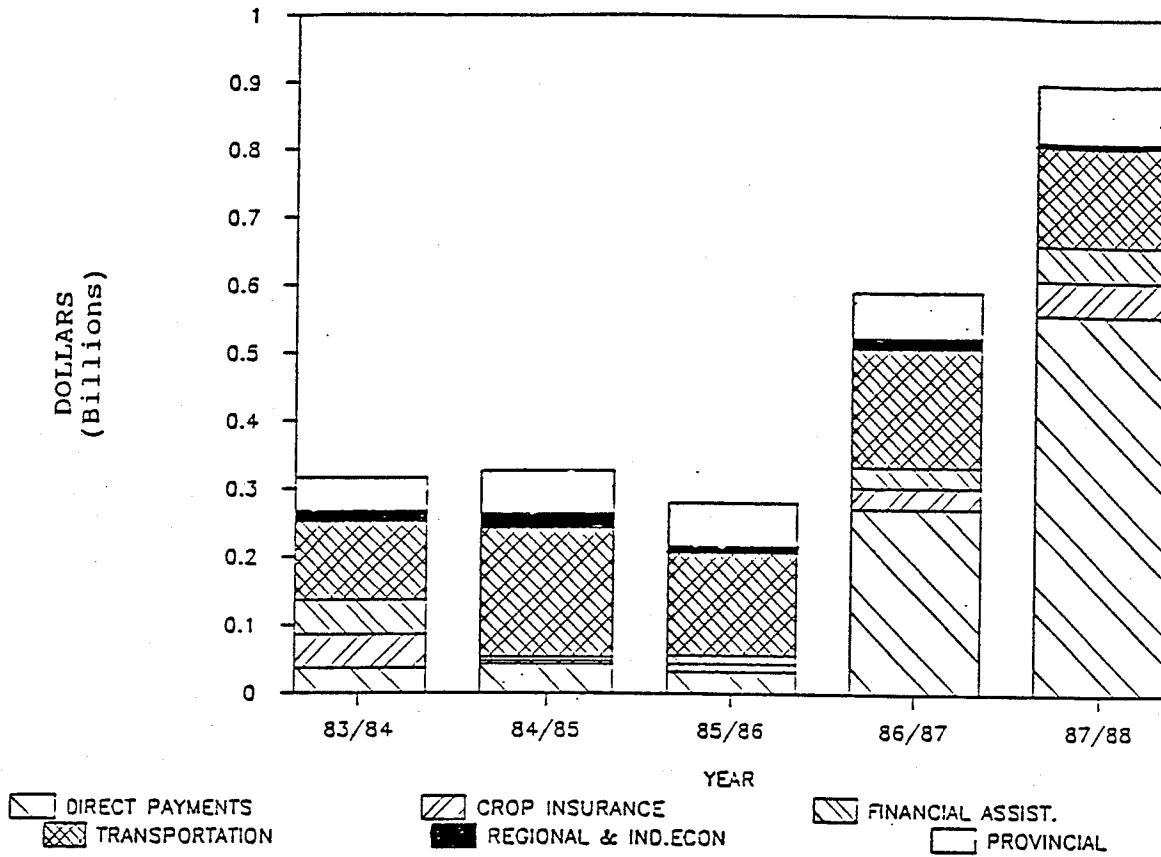
Source: Agriculture Canada and Manitoba Department of Agriculture

deliberately rejects certain social values and objectives or is distorted by the non-market activities of other countries (e.g.) U.S. and EEC subsidies). Subsidies are granted on the assumption that market production and consumption, at the farm level, will be altered to reflect these social values and objectives.

The main objective of the Canadian support programs are: (a) increasing production and marketing efficiency (geared to increasing the general level of farm incomes, which ultimately should imply lower dependency of the farm sector on government subsidies, and lower food prices); (b) protecting farmers against income instability and the natural hazards faced in agricultural production; (c) improving the distribution of income among farm families by assisting low income farm-operators and reducing the unemployment or underemployment rate among farmers (Forbes *et al.*: 1982, p. 18), and (d) matching competitors' subsidies (e.g. Special Grains payments).

The first objective, while promoting allocative efficiency, should also lead to an overall increase in the rate of growth of regional income and production. The second objective which deals with price and income instability issues justifies government involvement as a result of market failure phenomenon. In this case, the market is imperfect since the private sector does not provide adequate insurance and loans for individuals facing high risk.[11] The third objective, which requires

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[11]For a more general discussion on the theory and application of the risk analysis see "The Theory on Commodity Price Stabilization," D.M. Newberry and J.E. Stiglitz, New York: Oxford University Press, 1981.

subjective evaluation, aims at more equitable distribution of benefits and income.

The last objective justifies government support of programs as a result of world

subsidy competition.

So far, public policy has not been particularly successful in achieving the

first and second objectives in Canada. Government programs are often criticized

on the grounds that they are oriented towards supporting the income and the well-

being of farmers (objective three) rather than stimulating efficiency and growth

(objective one). More important is the criticism that such programs have most

benefited those farmers who least need government assistance.[12] As a result,

while efficiency and growth may have been ignored in favour of promoting equity,

there is no indication of improved income distribution at the farm level.[13] The

main reason for this shortcoming may lie in the fact that notions of *market*

efficiency, imperfect markets, and *equity* are treated simultaneously and without

distinction. As Kafoglis (1961: p.8) argues

> "...the distinction [between government objectives] is especially
> useful for the evaluation of specific government programs.
> Frequently governmental programs represent a response to economic
> efficiency, but in one way or another soon become involved in
> questions relating to equity. When this occurs there is a danger that
> the final result will serve to promote the special interest of particular

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[12]The same applies in the United States subsidy programs. See Moore (1987).

[13]For example see J. Spriggs and G.C. Van Kooten, "Rationale for Government
Intervention in Canadian Agriculture: A Review of Stabilization Programs,"
Canadian Journal of Agricultural Economics Vol.36, 1988, pp. 1-21.

groups to the detriment of economic efficiency and distributional justice..."

This argument may hold for support programs in the Canadian agri-food sector. Often it is difficult or even impossible to make a distinction between expenditures for stabilization (second objective) and income transfers to farmers (third objective). As Forbes *et al.* (1982: p. 41) point out, "...it may be questioned whether there would be a demand for stabilization programs if the transfer element were removed...." Among the present programs, supply management and to a lesser degree Tripartite Red Meat Stabilization (TRMS), the Agricultural Stabilization Act (ASA), and Western Grain Stabilization Administration (WGSA), are examples of such mixed policies.[14]

In order to carry out the objectives of this study, an attempt will be made to classify the federal and provincial agri-food support programs according to the above mentioned objectives in Manitoba. Based on consumption and production models available for the Canadian farm sector, the impact of various direct

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[14]Although the main objective of WGSA is to stabilize the farmer's income and cash receipts levels in Western Canada (Western Grain Stabilization Annual Report 1985-86; p. 3), the recent developments in the program are geared more towards transfer payments than price stabilization. Recently, there has been an attempt to increase the size of the pay-out to the new participants. It has been suggested that $750 million of the deficit should be written off by the federal government in 1987 (Agriculture Canada; Summary of Initiatives).

Also, the contribution of Manitoba's government, which matched equally to the federal contribution was approximately $111 million for 1986-87.

subsidies on regional growth can be evaluated. Subsequently, different subsidy scenarios will be developed based on the evaluations of such programs.

1.3 Fruit and Vegetable Industry

Despite the importance of the food processing industry in rural growth and development in many regions, little work on production and investment responses, in terms of industry's performance and efficiency, has been done for slow growth regions. For the Canadian fruit and vegetable industry, the only documented work is a descriptive report by a task force in 1979[15], prepared for the Department of Industry Trade and Commerce, which basically examines the major opportunities and constraints affecting the development of the industry at the aggregate level for Canada. In Canada, in 1984 the value of shipments of fruit and vegetables was more than $2 billion and the value added was $995 million.[16] Moreover, the industry employed more than eight percent of the total full time labour in the food processing industry, both at the national and the provincial (Manitoba) level.

Furthermore, the fruit and vegetable processing industry provides a major market for domestic farm products. Although increases in income have little

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[15]The Canadian Processed Fruit and Vegetable Industry, Government of Canada, A Report by the Sector Task Force, 1979.

[16] Fruit and Vegetable Processing Industry, Statistics Canada, Catalogue: 32-218.

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impact on overall food demand (i.e., demand is income inelastic), as income increases, consumers shift to higher quality and more convenient processed foods, which indirectly stimulates the portions of the farm sector, including fruits and vegetables.

A study of processed foods in the U.S. by Connor *et al.* (1985) confirms the existence of high income elasticities of demand for frozen fruits and vegetables. The most significant factors affecting this increasing demand have been: (a) changes in female labour force participation; (b) the switch to low fat and low cholesterol foods; and (c) an improved quality and greater variety of processed vegetables. The prices of most processed foods have been increasing faster than their fresh or relatively unprocessed counterparts, which may indicate an increased demand for processed foods at higher income levels.

In Canada, since the early 1900s the consumption of processed products has increased from 144 to 195 pounds per capita, while the consumption of fresh products has decreased from 288 to 250 pounds per capita. This shift is accounted for largely by potatoes, for which fresh consumption has decreased by 32 pounds per capita and consumption as a processed product has increased by 33 pounds per capita since 1961.[17] Table 1.3 shows the change in the pattern of demand for processed fruit and vegetables over the recent years. The most notable change is

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[17]L. Hunt, "International Competitiveness of Canadian Fruit and Vegetable Processing Industries, Food Market Commentary, Agriculture Canada, vol. 8, No. 4, 1986.

Table 1.3
Apparent Per-capita Consumption of All Processed
Vegetables and Fruits, Canada,
Selected Years, 1960-84

| | Vegetables | | | | Fruits | | | |
| | Canned | | Frozen | | Canned | | Frozen | |
Year	kg	%[a]	kg	%[a]	kg	%[a]	kg	%[a]
1960	9.52	8.0	1.62	1.3	19.42	17.7	0.99	0.9
1965	10.27	9.5	2.71	2.5	17.96	16.9	1.70	1.7
1970	9.13	7.7	3.53	3.0	16.76	15.6	1.43	1.3
1975	9.98	7.7	3.70	2.8	20.86	16.8	1.32	1.1
1980	10.36	7.5	6.23	4.5	17.08	13.0	1.32	1.0
1981	10.07	7.5	6.01	4.5	19.35	14.0	0.85	0.6
1982	10.82	7.9	6.29	4.6	17.59	14.1	0.85	0.7
1983	9.17	6.5	5.46	3.9	19.05	15.4	1.38	1.1
1984	8.31	6.1	6.16	4.6	20.05	15.9	1.04	0.8

[a] Percentage of total fresh, canned and frozen product.

Source: Statistics Canada, Apparent per Capita Food Consumption in Canada, Catalogue No. 32-330, Annual.

a reduction in demand for canned vegetables and a considerable growth in demand for frozen vegetable products. A greater variety of available processed and frozen vegetables, reduced calorie diets and consumer concerns over nutritious foods have contributed to this trend.

Although the fruit and vegetable processing industry is centred in Ontario, which accounts for approximately 60 percent of shipments and employment, it has a very important role in the economies of other regions. The industry provides job

opportunities for the local labour force, especially for females and students. Because of the industry's location in smaller centres, these jobs can be vital to the community's economy. In addition, the industry has impacts on other local and regional sectors, especially the farming sector which is the major supplier of the raw material.

According to the Sector Task Force Report (STFR: 1979, p. 3),[18] the market for processed fruit and vegetable products has been intensely competitive. Firms have been numerous and entry has been relatively easy. Firms have also had unimpeded access to inputs and technology. Furthermore, the threat of backwards integration by retail food chains has forced processors to continually improve their efficiency. In this environment, industry rationalization has been extensive.

In Manitoba the main raw material used for processing in the Fruit and Vegetable Processing Industry (FVPI) is potatoes. The industry is cost efficient and most of its firms are able to compete in the international market.[19] Since exporting processed potatoes involves low transportation costs relative to other processed foods (e.g. red meat), firms are in a position to export from Manitoba to

[18]The Canadian Processed Fruit and Vegetable Industry, Government of Canada, A Report by the Sector Task Force, 1979.

[19]L. Hunt, " The International Competitiveness of Canadian Fruit and Vegetable Processing Industries," Food Market Commentary, Agriculture Canada, Vol. 8, No. 4, 1986.

international markets. For instance, in Portage la Prairie, McCain serves a portion of the market of Japan and the Pacific Rim.[20]

The value added per person hour in Manitoba's FVPI has increased significantly over recent years. The value added in the FVPI is plotted against annual person hours, for 1961-84, in Figure 1.4. Although, the figure does not display any trend, the yearly value added has increased to a large extent. The pattern in the data reported reflects fundamental changes in the nature of production after the mid-70's. Extensive capital formation in the early 1970s and advancements in the production process are considered to be the main factors contributing to the structural changes.

Despite the domestically competitive environment, Manitoba's vegetable processing industry is suffering from some inherent disadvantages compared to its major competitors in the U.S. These include: (a) a shorter growing season; (b) a higher capital to output ratio; (c) a smaller domestic market; (d) higher transportation costs; and, (e) the cost burden of extensive government regulations in some regions.[21]

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[20]From McCain's Annual Report, 1979. This point was also expressed in an interview with the Plant Manager, September 1987.

[21]Environmental considerations have become an increasingly important factor influencing plant location, and have resulted in an additional cost to the industry (STFR: 1979).

Figure 1.4
Fruit and Vegetable Processing Industry
Total Value-Added per Man Hour
Manitoba, 1961-1984
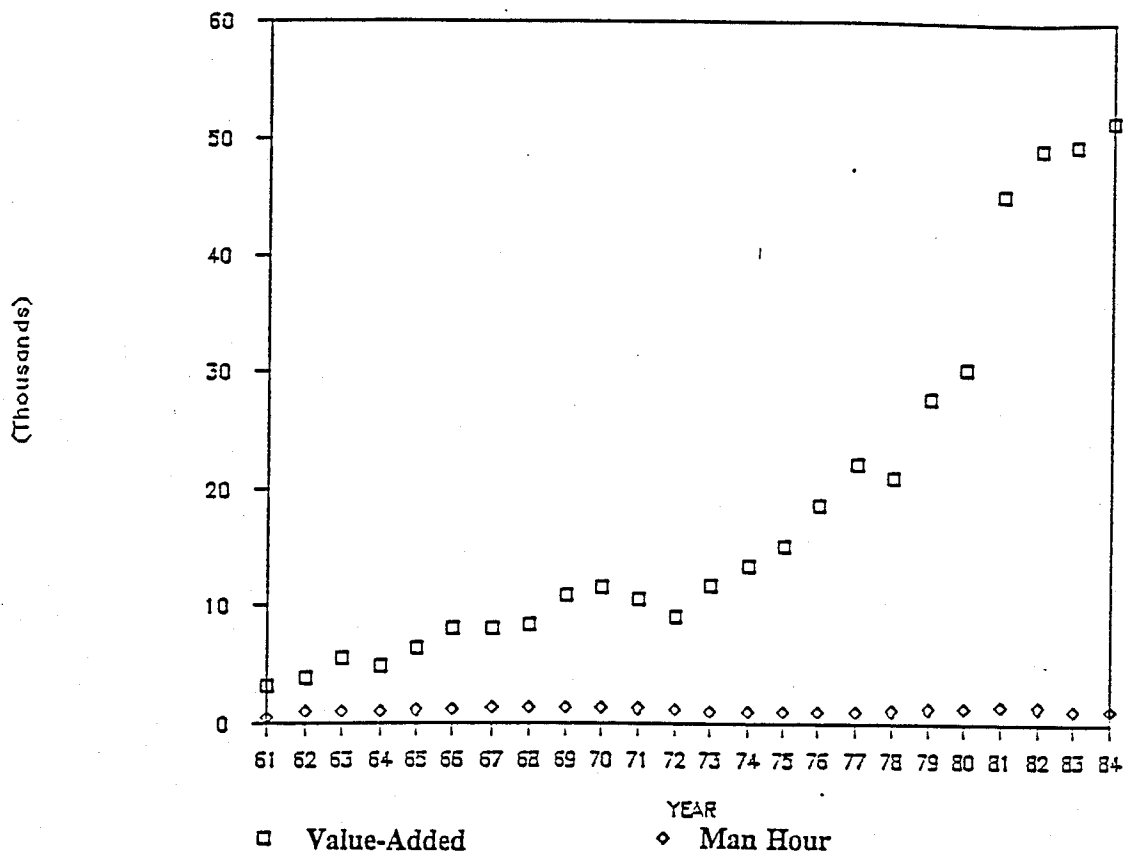
□ Value-Added   ◇ Man Hour

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As expressed by the local processors, a shorter growing season in Manitoba implies higher production costs for the industry. Because Manitoba's harvest season is approximately one third shorter than that of southwestern Ontario or the northern U.S., the capital investment required to achieve an equivalent output of seasonally processed products could be up to 50 percent greater. Although this is less the case for highly storable products such as potatoes, other inputs such as carrots and celery (used in the canning industry) have to be imported from the U.S. or western Canada in the off season.[22] Both storing and importing raw materials imply a higher cost of production for the industry.

Recently, the concern of most processors in Manitoba has been the possibility of growers forming a potato marketing board. Currently, growers with negotiation power have direct involvement in price setting with the processors. According to the Sector Task Force Report (STFR), the price disparity between horticultural crops in Canada and the U.S. has tended to increase and the industry has not shown a corresponding willingness to adjust prices downward when market conditions return to normal (STFR: 1979, p. 14). The possibility of the establishment of a national marketing board, with power to set production quotas and prices, has caused serious concerns among processing firms (Agriweek: June

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[22]This was expressed by production managers of McCain and Campbell in two interviews, September 1987.

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20, 1988). Marketing boards' power can be treated as an additional factor contributing to the cost of raw materials.

Although a wide variety of incentive programs are available to industry from federal and provincial governments, the main concern should be focused on the effectiveness and efficiency of such programs in the context of competitiveness and regional growth. These programs generally provide assistance to improve productivity, financing, research and development. However, due to unfamiliarity with the industry's performance, they are often distributed on an ad hoc basis and not according to the needs of the industry.[23] Often assistance in the form of grants is provided to new firms which would undertake their project in the absence of government incentives. However, the distribution of grants should be based on a set of well defined objectives and the potential of the industry for further growth.

1.4. The Hypothesis and Objectives

Bearing in mind the goal of rural development and the analysis presented earlier, it is hypothesized that allocating development funds to the staple processing industry (e.g., fruit and vegetable processing, primarily potato processing) either directly or indirectly will generate a higher rate of growth in rural Manitoba in the

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[23]This shortcoming was pointed out by the officials in the Manitoba Department of Industry, Trade and Technology, September 1987.

long-run compared to a direct distribution of funds to farmers. Given this hypothesis, the following objectives can be identified for this study:

1. Evaluate of the impact of direct transfer funds on the productivity and growth of the regional economy.

2. Assess of the production and investment relations for a selected industry (fruit and vegetable).

3. Evaluate of the industry's output growth under different subsidy scenarios such as: (a) subsidies to production inputs (e.g., labour, capital, raw material--mainly agricultural products...); and (b) subsidies to the output price. The evaluation will be in the context of existing constraints, namely: (a) available demand; (b) transportation facilities; (c) available inputs, and (d) present regulations.

4. Evaluate long-run effect of funds allocated: (a) to the fruit and vegetable industry; and (b) as a direct subsidy at the farm level.

The following chapter provides an extensive review of literature and theoretical background in regional growth to set the stage for the development of the main hypothesis.

CHAPTER 2

THEORETICAL FOUNDATION

2.1 Regional Growth and The Staples Hypothesis

According to mainstream economic theory, the slow economic growth of some regions and the regional disparity within a nation are signs of economic adjustment, that is, adjustment to income, technology and demands at the domestic and international levels. Disparities are considered a temporary phenomenon. Factors of production, mainly labour and capital are expected to move freely within the national boundaries and disparities eventually will be eliminated. In this context, the role of government should be minimal and any intervention leads to further disparity (Courchene: 1986).

There is a great deal of controversy over the implication of this hypothesis. The hypothesis does not necessarily hold if the units of labour are not homogeneous and the actual migration process is selective of the more productive labour units by free movements of factors of production. In this case, the problem of disparity will be intensified.

In a study by Vasavada and Chambers (1986), the adjustment period for labour in the agricultural sector in the U.S. is estimated to be around ten years. Even if one ignores the sluggish adjustment of labour, there is no evidence that labour mobility will eliminate income disparities between regions and subregions. From a general survey of the empirical evidence, Okun and Richardson (1976) rule out the possibility of the positive impact of migration on the regional inequality of per capita income in the U.S.

In Canada both federal and provincial governments have always played an active role in attempts to eliminate regional disparities and to promote growth and development in specific regions. Although government intervention may be justified, the nature and extent of the implemented policies have always been a matter of great controversy. Nevertheless, policy makers and economists both agree on the principle that regional growth and development policies should be based on the history of development of each region. Slow growth and its associated problems are often the consequence of the past historical and economic characteristics in each region.

The Economic Council of Canada (1977) has pointed out that low productivity, urban structure, differences in wage rates, and the nature of exports are the major causes of regional disparities and slow growth. They also claim that the level of output and growth depend on the quality of the factors of production such as capital stock, skill of labour and technology. Furthermore, they suggest

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that unemployment is a function of productivity and technology. However, it may be argued that productivity itself can be affected by the type and the nature of the industry in question. For instance, the lower productivity rate in Quebec as compared with Ontario may be due to the fact that the province has different industry concentrations (Savoie: 1986).

Among several available theories and hypotheses explaining regional disparity and slow growth, the most widely accepted is the staple theory. This theory was initially developed by Harold Innis (1933) and was based on characteristics of the Canadian economy. The basic feature of a staples region is production and export of a natural resource product which is in strong international demand. In this case, the growth rate of the region is primarily dependent on the growth in trade. Later Fleming (1955), North (1955) and Watkins (1963), as well as others, expanded the staples theory. They concluded that over a longer time period, staple production ceases to be profitable either because of diminishing returns on the supply side, adverse shifts in demand resulting from cheaper sources of supply, or because of the low income elasticities of foreign demand or changes in tastes and preferences.

Recently, the validity of the staples theory was questioned in a study by the Economic Council of Canada (1977). The Council argued that regional disparities are the consequences of the regional differences in productivity, aggregate demand, and urban structure. According to this study, the weakness of the staples

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hypothesis is its inapplicability to other nations' histories of economic development, such as those of Switzerland and Argentina. Despite this criticism, since the staples hypothesis has been based on the economic history and evolution of the Canadian economy, when incorporated with the other available growth hypotheses, it explains to some extent the problem of regional growth and disparity in Canada (Hum and Phillips: 1981).

In their most recent report, the Economic Council of Canada (1988; p. 4)[24] argues that the severity of the recent decline in the price of staples products (mainly grain) and an unfavourable international trade environment have resulted in serious problems for prairie farmers. Although the causes of price reduction and depressed demand for the staples export, in recent years, are different from the causes in earlier periods, the outcomes are the same: lower demand for staple production and lower farm income.

Drache (1976) and Watkins (1977) have focused on the economic relationship of a resource based region with the rest of the world. They indicate that the concepts of staple production, regionalism, metropolis-hinterland, export-base and growth-pole are so interrelated that they can be interpreted as different manifestations of a common process. Staple growth and regionalism are

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[24]Economic Council of Canada, "Handling the Risks: A Report on the Prairie Grain Economy, 1988.

indistinguishable and the staples approach can be interpreted as a growth pole model.[25] All the growth models listed above explain the complex relationship between a region natural resource exports and its process of growth and development.

Hum and Phillips (1981) have attempted to explain these interdependencies among the available hypotheses/models in an analytical framework for both the staples and post-staple processes in the Canadian economy. Although their analysis is nothing more than a systematic treatment of the earlier descriptive work of Watkins (1963, 1977) on the staples hypothesis, their framework contributes to the extension of the hypothesis and its application to the post-staple period in the Canadian regions. The formal treatment of the Watkins work which is given by Hum and Phillips is summarized in the next section.

2.2 Analytical Analysis of Staples Hypothesis

2.2.1 Early Staples Stage

For simplicity, one may assume that a staples region at the early expansionary stage is producing only two types of output: staples (S) which are primarily produced for the purposes of external trade; and manufactured goods (M), with the region acting as a net importer of that commodity. The regional economy

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[25]For more detail on these hypotheses see; F. Perrouse and Mathew.

produces Sp and Mp units of both outputs. The level of regional consumption of each commodity is Sc and Mc, respectively. The region exports (Sp - Sc) of staple products and imports (Mc - Mp) of non-staple products. The real value of output of the region (y) is defined as:

$$y = Sp + Mp = Sc + Mc^{26}$$

(1)

Assuming zero balance of trade the volume of trade (T) is:

$$T = Sp - Sc = Mc - Mp$$

(2)

and the rate of growth (G) of the region is

$$G_y = dy/\bar{y}$$

(3)

Where:

$\bar{y}$ = initial level of output

dy = change in output per unit of time

Alternatively we can write

$$G_y = \frac{d(S_p + M_p)}{\bar{y}} = \frac{dS_p}{\bar{y}} + \frac{dM_p}{\bar{y}} = \frac{dS_p}{\bar{S}_p} \cdot \frac{\bar{S}_p}{\bar{y}} + \frac{dM_p}{\bar{M}_p} \cdot \frac{\bar{M}_p}{\bar{y}}$$

(4)

$$G_y = G_S^P \cdot \frac{\bar{S}_p}{\bar{y}} + G_m^P \cdot \frac{\bar{M}_p}{\bar{y}}$$

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[26]Assume both prices are equal to unity.

where G_s^p and G_m^p are the rate of growth of staple and non-staple output respectively, and both $\overline{S}p/\overline{y}$ and $\overline{M}p/\overline{y}$ are the average propensity to produce staple and non-staple products in the region. Based on relationship (1) we also have:

$$G_y = G_s^c \cdot \frac{\overline{S}_c}{\overline{y}} + G_m^c \cdot \frac{\overline{M}_c}{\overline{y}} \tag{5}$$

In relationship (4) and (5), the rate of growth of the region is a weighted average of the rate of growth in both staple and non-staple production. Therefore, the rate of growth for the region depends on both terms on the right hand side of the relationship (4). In the early stages of growth and development, due to the existence of external demand for the staple product, G_y depends heavily on the first element of the right-hand side which is the average growth rate in the staple product. In this case, the rate of growth for the region can be defined as:

$$G_t = \frac{dT}{\overline{T}} = \frac{d(Sp - Sc)}{\overline{Sp} - \overline{Sc}} = \frac{dSp/Sp\,[dSc/\overline{Sc}\cdot\overline{Sc}/\overline{Sp}]}{1 - \overline{Sc}/\overline{Sp}}$$

Rearranging, we have

$$G_s^p = \frac{dSp}{Sp} = \left(1 - \frac{\overline{Sc}}{\overline{S}_p}\right)\frac{dT}{\overline{T}} + \left[\frac{\overline{Sc}}{\overline{Sp}}\right]\frac{dSc}{\overline{Sc}} \tag{6}$$

G_s^p is the rate of growth of staple production. Its magnitude is determined by the first term on the right hand side since

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$$\left(\frac{\bar{Sc}}{\bar{Sp}}\right) \frac{dSc}{\bar{Sc}}$$

is relatively small. The rate of growth of the staple product is determined mainly by the volume of trade. Based on relationships (4) and (6), we can conclude that in staple regions, the rate of growth depends on the volume of staple production. That volume in turn depends on the volume of trade. In this case, the rate of growth of a region is determined outside the region by exogenous demand factors.

As the staple region grows, it might become more or less dependent on staple growth. If an increase in the demand (domestic) for non-staples induces a more than proportionate increase in staple exports, then staple growth is pro-trade biased. The regional economy becomes more dependent on trade. On the other hand, if the marginal propensity to export is smaller than the average propensity to export, staple expansion is anti-trade biased. The extreme case of pro-trade bias is what North (1955) refers to as the "staple trap." A decrease in external demand (and ultimately a decrease in price) induces producers to increase their staple production in order to compensate for income loss.

At the initial stages of growth, and in the absence of government policies, rising regional income results in increased consumption of non-staple goods. This, by itself, encourages a higher dependency on staples production in order to maintain the balance of payments.

2.2.2 Post-Staple-Led Period

As a region matures, labour productivity in the staple sector tends to grow faster than in the non-staple sector. This assumption can be justified on the basis of availability of abundant land for staple production.[27] As a result, the relative cost or price of non-staple products will increase over time. In order to demonstrate the above hypothesis, assume that both sectors are restricted to a single factor of production, Labour (L). The production functions for staples and non-staples are then:

$$S = \alpha L_1 e^{lt} \tag{7}$$

$$M = \beta L_2 \tag{8}$$

where α and β are structural coefficients, l represents the difference in productivity, and t is time. If wages (W) grow according to productivity performances, the average cost functions (AC) are:

$$AC_s = \frac{W_t L_1}{S} = \frac{\overline{W} e^{lt} L_1}{\alpha L_2^{lt}} = \frac{1}{\alpha} \tag{9}$$

$$AC_m = \frac{W_t L_2}{M} = \frac{\overline{W} e^{lt} L_2}{\beta L_2} = e^{lt} \frac{1}{\beta} \tag{10}$$

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[27]Note that land is not a significant input in non-staple production. On the other hand, services which comprise a large part of non-staple production tend to be labour-intensive, with a low potential of being the prime source of productivity increase.

The initial wage level $\overline{W}$ is set at unity for convenience. Given $AC_m/AC_s = \alpha/\beta \cdot e^{lt}$, the price of staple production and the internal terms of trade decline over time.

In the case of non-interventionary government policies, this simple analysis has the following implications for the staple region. The differential in productivity growth will result in the progressive transfer of labour from that region to other regions at the national level. Transfer will also take place inside the region as well as between urban and rural sub-sectors. Labour becomes more urbanized and rural areas would experience a decline in population.

Hartman and Seckler (1970) arrived at a similar conclusion using a different approach. They express regional production in terms of the total value of consumption (C_t), investment (I_t), net exports (E_t) in terms of value added, imports of consumer goods (M_{ct}) and imports of capital goods (M_{kt}). The total value of the regional output (y_t) is:

$$y_t = C_t + I_t + E_t - M_{ct} - M_{kt} \qquad (11)$$

where,

$$C_t = by_{t-1} \qquad 0 < \left[b = \frac{\partial C_t}{\partial y_{t-1}} \right] \qquad (12)$$

$$M_{ct} = cC_t \qquad 0 < \left[c = \frac{\partial M_{ct}}{\partial C_t} \right] < 1 \tag{13}$$

$$I_t = \left[K(C_t - C_{t-1}) - (M_{ct} - M_{ct-1}) + (E_t - E_{t-1}) \right] \tag{14}$$

$$M_{kt} = mI_t \qquad m = \partial M_k / \partial I_t > 0 \tag{15}$$

where K = investment-income ratio

substitute 12, 13, 14, 15 in 11 we get:

$$y_t = \frac{E_t}{1 - b(1-c)} + \frac{K(1-m)}{1 - b(1-c)}(E_t - E_{t-1}) + \left(\frac{b(1-c)[1 + (1-m)K]}{1 - b(1-c)} \cdot \right) y_{t-1}$$
$$- \left(\frac{b(1-c)(1-m)K}{1 - b(1-c)} \cdot \right) y_{t-2} \tag{16}$$

The first element in equation (16) is an export multiplier. The second element is the accelerator multiplier effect due to incremental changes in the exports. The last two elements explain the self-sustaining growth path. For a region in its post-staple-led period often the two terms representing self-sustaining growth are negative. As Samuelson (1939) has shown, the last two terms can be positive only if:

$$b(1-c) \geq 4K(1-m)/[1 + K(1-m)]^2$$

A region in its post-staple-led-period may not be able to generate endogenous growth because of high marginal propensity to import(m) and low

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investment-income ratio(K). Accordingly, as external demand for exports (mainly staple production) dampens, in the long-run the second element will either be very small or even negative. The first term becomes smaller over time as demand for the staple declines in the post-staple-led period. Consequently, as far as staple producing regions are concerned, while there is no chance for self-generating growth, due to a number of leakages, the level of income and production decreases or remains stagnant overtime.[28] This outcome is expected unless some interventionist policies are adopted by governments. The hard question before us is whether any policy strategy can mitigate, or even reverse, the tendency towards stagnation. The following section investigates several policy options and their potential impacts on growth and development in rural regions.

2.2.3 Modification Under "Balanced Growth" Policies

Consider a situation wherein the government implements a policy of balanced growth by allocating subsidies to domestic staple production either by:

a) maintaining the ratio of staple to non-staple production (consistent with policy 1 on page 4, if non-staple production is increasing),

b) implementing a price support policy (policy 3 on page 4),or

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[28]The post wheat-boom economy in western Canada appears to support the predictions outlined above.

c) promoting staple processing in the region (policy 4 on page 4). (The impact of such a policy is similar to promoting manufacturing production in the region).

For both cases a and b, the extreme situation will be supporting a constant staple to non-staple production ratio or a constant relative price of staples to non-staples.

In the first case where policy is to maintain a constant staple to non-staple production ratio, we have

$$\frac{M_t}{S_t} = \frac{\beta}{\alpha} \cdot \frac{L_2}{L_1} e^{-lt} \quad or \quad \frac{M}{S} \cdot \frac{\alpha}{\beta} \frac{L_2}{L_1} e^{-lt} = Constant \tag{17}$$

and

$$L_2 = \frac{\alpha L_1 e^{lt}}{\beta} \quad or \quad L = L_1 + L_2 \tag{18}$$

Substituting for L_2 from (18):

$$L_1 = L - \frac{\alpha}{\beta} L_1 e^{lt} = \frac{L}{1 + \frac{\alpha}{\beta} e^{lt}} \tag{19}$$

In the Limit $t \to \infty$, $L_1 \to 0$; Therefore there is a tendency for the complete depopulation of the staple sector.

In the second case, if the government maintains a constant ratio price policy, then total production is

$$Q = P_s S_t + P_m M_t = P_s \, \alpha L_1 e^{lt} + P_m \beta L_2$$

Where P_s and P_m are staple and non-staple prices, and Q is the quantity of total production.

For simplicity assume $P_s/P_m = 1$, then:

$$Q = \alpha L_1 e^{lt} + \beta L_2$$

$$\frac{M}{S} \cdot \frac{\alpha}{\beta} = \frac{L_2 e^{-lt}}{L_1} \tag{21}$$

$$L_1 = \frac{L_2}{K e^{lt}} \tag{22}$$

Where $L_2/L_1 \, e^{-lt} = k$ (Constant). In this case, growth per capita is:

$$\frac{Q}{L} = \frac{Q}{L_1 + L_2} = \frac{\alpha L_1 e^{lt} + \beta L_2}{\dfrac{L_2}{K e^{lt}} + L_2} = \frac{L_2 \left[\alpha/k + \beta \right]}{L_2 \left[1/k e^{lt} + 1 \right]} \tag{23}$$

in the limit

$$\frac{Q}{L} = \frac{\alpha/k + \beta}{1} = \delta \; Constant \tag{24}$$

$t \to \infty$

Based on the above relationship, the growth rate of the economy declines to a constant over time.

The impact of income transfer or direct subsidies to farmers on the regional economy can be analyzed using the Hartman and Seckler regional income model. Based on equation (16) the effect of a lump-sum subsidy, paid at time t, on regional income (y) in time t+1 is:

$$\frac{\partial y_{t+1}}{\partial y_t} \geq b(1-c)\left[1+(1-m)/K\right]/1-b(1-c) \tag{25}$$

For simplicity, assume in the limit c → 1 for a region that is totally dependent on imports. In this extreme case, the impact of the direct subsidy on the growth of the region in the future will be equal to zero. Consequently, direct subsidies in the form of income transfer to the regions with high import leakage has a very short lived impact (if any) on regional growth and development of the region.

In the third case, we assume that the region concentrates on staple processing through food processing firms. Since these firms are a sub-sector of the manufacturing sector, as the rate of production in the food processing industry rises, relationship (6) can be expressed alternatively as:

$$C_m^P = \left(1 - \frac{\bar{M}_c}{\bar{M}_p}\right)\frac{dt}{t} + \left[\frac{dM_c}{\bar{M}_c} \cdot \frac{\bar{M}_c}{\bar{M}_p}\right] \tag{26}$$

where the rate of growth of processed food depends on both the rate of growth of manufacturing trade and domestic manufacturing consumption. Since at the present time demand for most of processed food is relatively elastic,[29] the second term on the right hand side of equation (26) will be significantly different from zero and the level of manufacturing production will be stimulated by both manufacturing trade and higher domestic consumption. On the other hand, since the rate of growth of manufacturing production, G_m^p, is one of the components of G_y, a higher rate of growth of domestic production implies a higher rate of domestic growth. Therefore, policies that are geared towards the promotion of manufacturing production result in a higher rate of regional growth with less dependency on trade.

Greater concentration on staple processing leads to a positive rate of growth for the staple regions. As a region diversifies its export portfolio, preferably in the form of non-staple products, the first two elements in equation (26) may increase due to an increase in demand for non-staple commodities produced in the region. In addition, an increase in net exports (value added) of non-staples leads to reduced demand for imported consumption and capital goods, leading to reduced leakages in the regional economy. In this case, while the first two terms become greater, the last two terms in equation (16) may become non-negative. Consequently, an

[29]According to a study by J. Conner *et at.* income demand for processed and frozen vegetable is positive and relatively high.

increase in the production of commodities with higher value added results in a higher rate of regional growth.

Furthermore, food processing industries sell their output either to other industries as intermediate goods or to final consumers in domestic and international markets. In addition, food processors purchase their unprocessed raw materials from other industries, mainly the agricultural sector. These purchases generate indirect demand for more inputs, resulting in additional domestic employment and income.

Although there is a common belief that a higher rate of investment and production in the food processing industries implies a higher rate of domestic growth, there is little agreement on appropriate incentive policies for stimulating the domestic industry. Utilization of inappropriate production and investment models in each sector and sub-sector of the manufacturing sector result in erroneous judgments about the impact of alternative policies. Often, due to the lack of reliable output and input interrelationships, the allocated subsidies either have been ineffective or even have had adverse impacts in slow growth regions. As Berentsen (1977) points out, the lagging regions may benefit in the short-run from reduced unemployment and a higher average income as a result of government intervention policies. However, the prospects for long-run growth may not be good due to the absence of a complete understanding of the domestic opportunities and constraints in the region. Steinnes (1984) examined the

effectiveness of government tax incentives used for regional growth purposes in the U.S. He concluded that there is very little evidence to support the position that changing taxes is an effective means for encouraging economic growth since the incentive policies were not based on a systematic economic framework suitable for each region and industry.

Based on the above argument, the impact of government incentive policies for each industry should be evaluated in a well specified production and investment model at the microeconomic level for that particular industry. For this purpose a brief review of the more recent developments in static and dynamic production and investment models is in order.

2.3 Static Production and Investment Theory

In previous studies of production and investment responses in the agricultural and manufacturing sectors, Binswanger (1974) and Christensen *et al.* (1973) have assumed static profit maximization or cost minimization models as a basis for the firm's policy functions. A profit maximizing firm in a competitive industry makes decisions about the combination of inputs and level of output such that profit is maximized. Based on the static profit maximization theory, a change in relative prices results in the reallocation of the factors of production and a new optimal output level.

A profit maximizing firm in a competitive industry is faced with a static production function

$$Y = f(X, K) \tag{27}$$

where X is a vector of variable inputs and K is a vector of quasi-fixed inputs. The objective function of such a firm is:

$$\text{MAX } \pi = P_y f(X, K) - WX \tag{28}$$

where W and P_y are prices of variable inputs and output and π is profit. A firm maximizes profits conditional on a given stock of quasi-fixed factors by choosing variable input quantities. First order conditions of equation (28) yield the optimal quantities of inputs (X) as a function of prices and quasi-fixed inputs:

$$X^* = h(W, P_Y, K) \tag{29}$$

The possibility of obtaining derived demands depends on the parametric representation of the underlying technology. An alternative and more convenient approach is to derive the policy equations indirectly based on duality theory.[30] The duality approach incorporates the relevant economic information into an indirect objective function which satisfies certain regularity conditions. For instance, the indirect function for the firm's optimal decision defined by the profit function is:

$$g(W, P, K) = \text{MAX } \{P_y f(X,K) - WX\} \tag{30}$$

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[30]An extensive discussion of the advantages of such an approach is given in Diewert (1974), Pope (1982) and Lopez (1982).

Derived functions are obtained by Hotelling's Lemma:

$$-X^* = g_W (W, P_y, K) \tag{31}$$

$$Y^* = h_{py} (W, P_y, K) \tag{32}$$

where X^* and Y^* are derived demand for input X and supply for output Y, respectively.

In the static profit theory, it is assumed that input quantities adjust to price changes instantaneously. However, in reality, some factors of production may not be perfectly variable. Sluggish adjustments of production factors may be due to several reasons. Delivery lags, adjustment costs, delayed entrepreneurial reactions, or the rising marginal cost of borrowing are considered the main causes for these lags.

The presence of quasi-fixed factors makes it necessary to modify the existing static theory. Attempts to use partial adjustment and other distributed lag specifications in applied econometric models for firms have not been particularly convincing. As Nerlove (1972: p. 223) points out, the shortcoming of the lagged specification models is the lack of theoretical justification for the lag structures.

An alternative to the above modification are those models which explicitly incorporate interrelated factor demands into the firm's short-run demand responses. For instance, Samuelson (1953), Lau *et al.* (1976), and McFadden (1978) introduced restricted variable costs or profit functions, known as the La Chatelier Principles, in order to reflect production or technological constraints facing a firm.

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Although these are superior to the static models, economic theory is still of limited use in explaining the economic factors affecting the time path of adjustment from short-run to long-run.

More recent investment studies in the context of the theory of the firm which rely on the theory of internal adjustment cost, explicitly incorporate dynamic optimization and thereby provide well-defined measures of short, intermediate, and long-run price elasticities within traditional economic framework.

The adjustment cost hypothesis postulates a functional relationship between the size of input adjustments and the cost incurred in making these adjustments. The relationship can be of the following form:

$$C = C(I) \tag{33}$$

where C is the pecuniary cost associated with gross investment, I. The hypothesized first and second derivatives of equation (33) are:

$$\frac{\partial C(I)}{\partial I} > 0 \qquad \frac{\partial^2 C(I)}{\partial I^2} \gtrless 0 \tag{34}$$

Based on the above relationship, as gross investment increases, adjustment costs increase as well. The second order condition specifies the shape of the curvature. However, the only functional form that is consistent with sluggish input adjustment and increasing marginal adjustment cost for all sizes of investment is a globally convex function. This hypothesis can be integrated into a dynamic profit

maximizing model. The following section discusses how this hypothesis is integrated into a dynamic model of the firm.

2.4 Dynamic Production and Investment Theory

Epstein (1981) has developed a dynamic investment model by incorporating the internal cost of adjustment hypothesis in a more general model using the duality approach. Sluggish input adjustments are regarded as a form of asset fixity. There is no need for a decision concerning the quasi-fixed production factors. Assume that all factors are quasi-fixed; $Y = f(K,I)$, is a generalized production function, where Y is output and K is a vector of quasi-fixed inputs and I is the vector of investments in quasi-fixed inputs. Y satisfies the following properties: $Y > 0$ and $f(K,I)$ is twice continuously differentiable in its arguments. Also $f_I < 0$ if $I > 0$ and $f_I > 0$ if $I < 0$; that is, $f(K,I)$ is strictly convex in I. The firm maximizes the discounted stream of net cash flow over the planning horizon. The firm's objective function is:

$$MAX \int_0^\infty \left[P_y f(K, I) - P^k K \right] e^{-rt} \tag{35}$$

$$s.t. \quad \overset{\circ}{K} = I - \delta K$$
$$K_{(0)} = K_0$$

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where r is the constant discount rate, p^K is the vector of rental prices of stocks, δ is a diagonal matrix of depreciation rates, and $\overset{o}{K} = I - \delta K$ is the equation of motion. It is assumed that the firm initially maintains static expectations about input and output prices and actual prices diverge from expected prices. The firm revises its estimates of future prices since the investment plan is revised every period.

The optimal value of function (35) may be represented by a dual function, J(P, K), with a Hamilton-Jacobi-Bellman equation as

$$rJ = MAX\ [\ P_y f(K, I) - P^K I + J_K(P, K)\ (I - \delta K)\ ] \tag{36}$$

where P is a vector of both output and input prices (P_Y and W). Also $J_K = \partial J / \partial K$ is the vector of shadow prices associated with quasi-fixed stocks. Epstein has demonstrated that under regularity conditions:

a) J>0 and I and J_k and f(k,I) are twice continuously differentiable,

b) J_k>0 when I>0, and J_k<0 when I<0,

c) and J is convex in P; $rJ\text{-}J_k \overset{o}{k}{}^*$ is also convex in p.

Assumption (a) requires that both J and J_k obey a weak regularity condition. Assumption (b) indicates that when there is a positive shadow price of stock, the firm invests. Similarly, a negative shadow price results in disinvestment of quasi-fixed stocks. Assumption (c) has the implication that the dynamic optimization hypothesis imposes conditions involving third order properties of the value

function. In order to obtain the policy equations, the envelope theorem can be applied to equation (36) yielding:

$$rJ_{wi} = \pi_{wi} + J_{Kwi}(I - \delta K)$$

$$= -X_i + J_{Kwi}(I - \delta K) \tag{37}$$

$$rJ_P = \pi_P + J_{KP}(I - \delta K)$$

$$= y + J_{KP}(I - \delta K)$$

$$rJ_{PK} = -I + J_{KP}K(I - \delta K)$$

where,

$$\pi_{wi} = \frac{\partial \pi}{\partial_{wi}}$$

$$J_{Kwi} = \frac{\partial^2 J}{\partial K \partial_{wi}}$$

$i = 1,...,n$

n = number of inputs

Rearranging (37):

$$I = [rJ_P K + \delta K J_{KP}K] / J_{KP}K - 1 \tag{38a}$$

$$X_i = -rJ_{wi} + J_{Kwi}[rJ_P K + \delta^K] / J_{KP}K - 1 \tag{38b}$$

$$Y = rJ_P - J_{KP}[rJ_P K + \delta K] / J_{KP}K - 1 \tag{38c}$$

Equations (38a), (38b), and (38c) together provide a system of optimal investment demand, input demand and supply equations. When J function satisfies the

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regularity conditions, this system provides a theoretically consistent method for empirically modelling quasi-fixed input adjustments.

2.5   Input-Output Model

Further economic responses at the regional level (direct and indirect) to allocated funds can be analyzed by incorporating the estimated results obtained from the policy functions and the farm consumption patterns in regional I-O model.

Input-Output (I-O) analysis represents the structural interdependency of an economy at the national, regional, or provincial level. The basis of any I-O model is static theory of production, which reveals inter-industry and inter-sectoral interdependencies in a region. An I-O model is based on the premise that an economy's production patterns are stimulated directly by final demands for its goods and services.

The framework of I-O is based on the following relationship:

$$GDE = GDP \tag{39}$$

Where GDE is the gross domestic expenditure in the form of final demand and GDP is the gross domestic product at market prices. In other words the basic assumption in any I-O model is that the supply of commodities is equal to the final demand in the particular regions. In addition, in order to satisfying the regional income accounting identity, the I-O tables satisfy the industry (sector) account. For

each sector, the total output (G) must equal its total inputs (U). This implies that for a jth sector output is:

$$G_j = \sum_{i=1}^{m} U_{ij} \qquad \text{(39a)}$$

m = number of inputs.

A traditional Leontief I-O model consists of a set of simultaneous, linear production functions, representing the production structure of all sectors (agriculture being one) in the economy. The production patterns are stimulated directly by final demands for its goods and services which are exogenous to the model (Miernyk: 1969, pp. 99-103). The model can be solved to determine the change in sectoral output level. Simulated sectoral outputs, based on changes in final demand, depend on the magnitude of I-O multipliers. Sectoral output is determined by the following relationship:

$$G = (I - A)^{-1}F \qquad \text{(39b)}$$

where G is a vector of sectoral output, F is the matrix of final demand, I is the identity matrix and A is the multiplier matrix which contains the partial derivatives of the gross outputs with respect to the final demands ($\partial G_i/\partial G_{ij} = a_{ij}$).

i , j = 1,....,n

n = number of sectors in the region.

In a regional I-O model coefficients have a slightly different definition. Given the trade flows from a region (M) to another region (L), the regional impact of a final demand change (F^L) in region L is:

$$G^L = (I - A^U)^{-1} \quad F^L \qquad\qquad (39c)$$

where A^U is the regional multiplier matrix.[31]

2.6 Summary

In attempts to explain the causes of the slow growth of the staples producing regions in Canada, several hypotheses were presented in this chapter. Factor productivity, urban structure, regional endowments and the history of economic development are considered as the main factors forming the economic characteristics of any particular region.

Furthermore, a more complete version of the staples hypothesis, extended to the post-staples-led period, was presented. A relatively higher productivity growth in the staple production v.s. other industries results in the progressive transfer of labour from staple producing regions (rural) to the other regions. This may lead to a structural change in the regional economy. The movement of the most productive factors of production from the rural area to the urban area, on the other hand, results in a higher degree of the value added leakages and consequently

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[31]For details see R.E. Miller, and P.D. Blair, Input-Output Analysis: Foundations and Extensions, 1985, Prentice-Hall Inc.

a lower level of income and economic growth for the region. As a result, the chance of self-generating growth for such regions without interventionist policies is very limited.

Government support policies may intensify rural-urban economic disparities. Examples of maintaining a constant ratio of staple to non-staple production or price policy were given. As the demand for processed food - both at the domestic and international level - is relatively income elastic, a higher rate of growth is expected to be achieved domestically as food processing takes place in the region.

In order to assess the alternative policy instruments in the food processing sector a dynamic investment model based on optimal control theory and in the context of the adjustment cost hypothesis was presented. For further analyses at the regional level, a brief discussion of the provincial Input-Output (I-O) model was given in this chapter.

CHAPTER 3

THE MODELLING PROCEDURE

One way of investigating the contribution of regional development funds to the rate of growth is to compare the effect of subsidies at the farm level with the use of funds as an incentive tool for a higher rate of production by the food industry. Figure 3.1 illustrates a hierarchy of the models suitable for this purpose. The aggregate model can be divided into three distinctive parts as follows.

3.1   Subsidy Scenarios

Several subsidy/incentive scenarios are developed based on the recent pattern of direct subsidies and regional development funds. Estimated policy functions for the FVPI as well as a consumption/production farm household model can be used to assess the impact of different scenarios.

3.2   Consumption, Investment and Production Models

3.2.1 Farm and Households Model

The impact of direct subsidies to farmers on the economic growth and development of a region can be analyzed through models of farm producers'

Figure 3.1
A Hierarchy of Models for the Assessment of
Subsidy Allocation and the Evaluation of Policy Responses
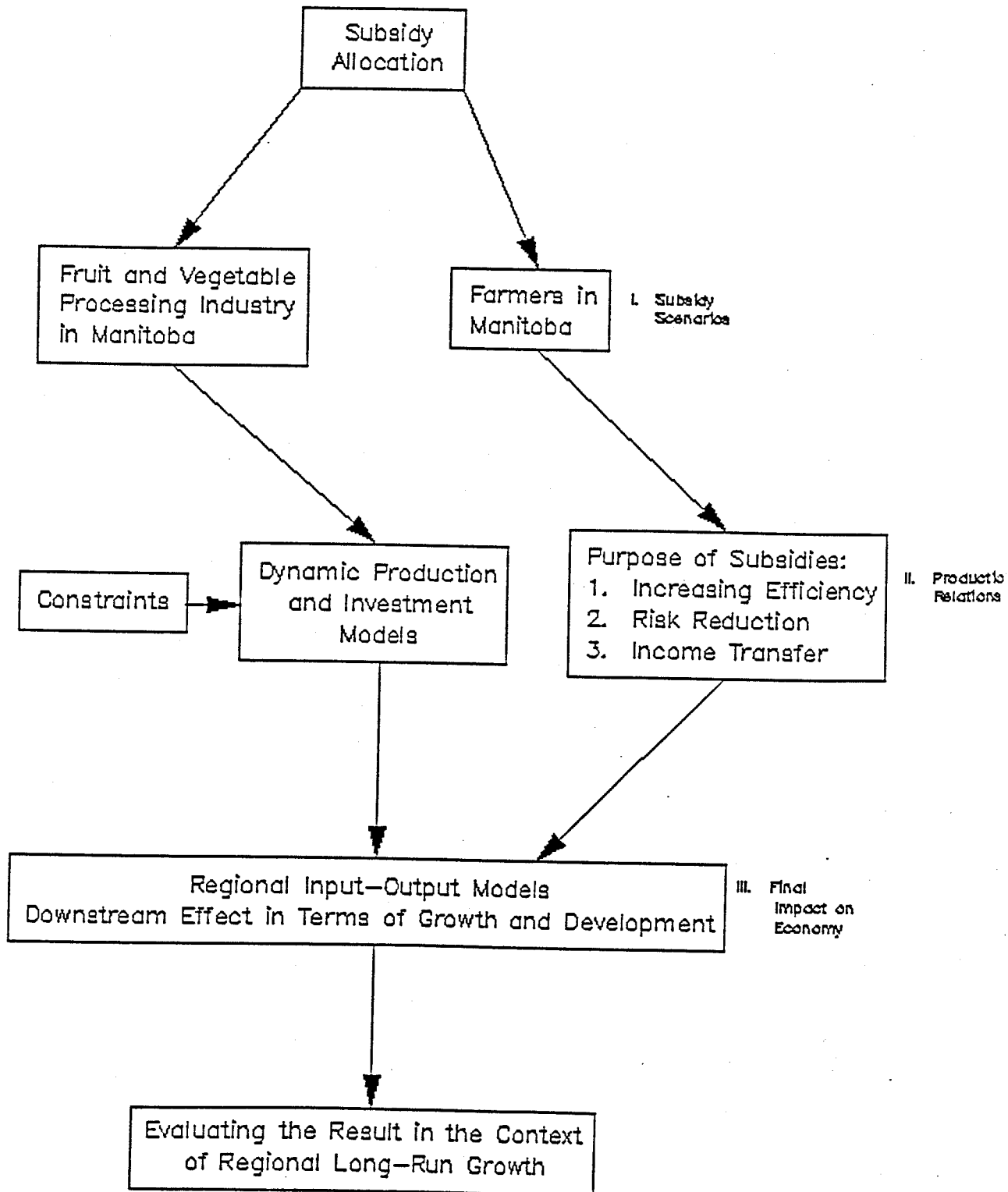
behaviour. Recently, Lau and Lin and Yotopoulos (1978), Barnum and Squire (1979), and Lopez (1980) have attempted to develop consumption, investment and production models for the Canadian farm sector. Among those, Lopez has developed a model for Canada based on the farmer's joint utility and profit functions. Since the foundation of the model developed by Lopez is very similar to the dynamic model to be used for the FVPI, and it is consistent with economic theory, it was decided to adopt his model for the farm household sector.

Lopez assumes that farm households maximize their utility subject to a budget constraint and available hours of work. The indirect utility maximization problem of the farm household is defined as:

$$G(P, \tilde{\pi}(q), W; Z) \equiv \max \{u(H-L_1, H-L_2; X)\} \qquad (40)$$

s.t.

$$PX + \tilde{\pi}(q)(H-L_2) + W_2(H-L_1) < Z \qquad (41)$$

$$H-L_1 > 0 \qquad H-L_2 > 0 \qquad X > 0$$

$$L_1 + L_2 \leq H$$

where,

$\qquad$ X $\quad$ = $\quad$ purchased commodities

$\qquad$ P $\quad$ = $\quad$ price index of commodities n consumed by household

$\qquad$ q $\quad$ = $\quad$ vector of output and input prices

$\qquad$ $\tilde{\pi}$ $\quad$ = $\quad$ shadow price of on-farm labour

$\qquad$ W_2 $\quad$ = $\quad$ price of off-farm labour

$\qquad$ Z $\quad$ = $\quad$ total income

H   =   total number of available hours

L_1 =   on farm labour (number of hours)

L_2 =   off farm labour (number of hours)

Further relations are:

$$\tilde{\pi}(q;L_1) = \text{profit function} \tag{42}$$

$$f(q;L_1)/\partial L = \tilde{\pi}(q) \tag{43}$$

where $\tilde{\pi}(q)$ is the shadow price of labour which is determined endogenously in the model.

The impact of direct government subsidies on the level of consumption can be traced via farmers' demand equations. For instance the estimated demand function for consumption goods (S) is:

$$S = \frac{41.45 P_3^{98}[Z-(-2418)P_3 + 2.812EP_3 - 42.76FP_3]}{1.124P_1^{98} + P_2^{98} + 41.45P_3^{98}} \tag{44}$$

where,

$$P_1 \equiv \tilde{\pi}, \quad P_2 \equiv W_2 \quad and \quad P_3 = P$$

Based on this relationship income elasticity for consumption at the farm level is:

$$\frac{\partial S}{\partial Z} = \frac{Z}{S_3} = \frac{\partial P_3 X}{\partial Z} \cdot \frac{Z}{P_3 X} = \frac{Z}{X} = \frac{41.45 P_3^{98}}{1.124 P_1^{98} + P_2^{98} + 41.45^{98}} \cdot \frac{Z}{X} \tag{45}$$

This relationship can be used for evaluating the impact of direct government subsidies on the level of farm household consumption.

Lopez's model has several limitations, among them: the farm model is highly aggregated in terms of commodity and consumption categories and the rural consumption pattern is based on the national data, not a particular region. In addition, the data set used by Lopez is cross-sectional while analysis on the FVPI is based on time series data. As a result, the estimated elasticises for each model (consumption and FVPI) may have different interpretations. The consumption elasticities are interpreted as long-run elasticities while the FVPI elasticises are short-run elasticities. This problem can be partially overcome by using a dynamic model for the FVPI, from which both short-run and long-run elasticises can be estimated. At the present time, Lopez model is the only model which offers a consumption function for rural Canada consistent with economic theory.

3.2.2 Dynamic Production and Investment Model for The FVPI

Any development funds available for the food processing industry may be allocated to firms on the basis of market performance and the economic potential of the firms in the industry. If it is desired that the increased output will ultimately promote the growth and development of the region, then subsidies should be allocated carefully to those factors most capable of promoting the industry's output. This can be achieved by either subsidizing input-improvements in labour productivity, lowering the cost of capital, lowering the cost of raw materials and

import-substitution, etc., or subsidizing the output price or marketing costs. In order to investigate the impact of different subsidy scenarios on the FVPI in Manitoba, a mathematical model based on production relationships, primary costs and prices, and existing constraints will be developed in the next section. Since the main objective of this study is to develop a model representing the behaviour of the FVPI in Manitoba, a detailed explanation of the mathematical model and the econometric form of the model will be presented in the following sections.

3.3 The Mathematical Form of the Model for The FVPI in Manitoba

The dynamic production and investment model developed for the FVPI is an extension of that used by Lopez (1985) for the Canadian food processing industry in which a direct profit function was used to estimate the policy functions. The method of using a direct profit function is not workable for more than one or two quasi-fixed stocks even with a quadratic specification of the technology. One has to make *a priori* assumptions about the sluggish inputs and the nature of the technology. For the purpose of this study, since there is no information available at the disaggregated level, a more general model based on the optimal control theory developed by Epstein (1981) is used. As Epstein points out, embedding the adjustment cost hypothesis in a dynamic duality approach permits the specification

of an indirect objective function that could be utilized to obtain the implied policy functions.

Furthermore, the use of flexible functional forms for dual functions, in the context of optimal control theory, permits imposing fewer restrictive assumptions about the nature of technology compared to other commonly used production functions such as Cobb-Douglas and CES. As noted by Pope (1982) econometric estimation based on the dual approach may be more precise since the degree of multicollinearity among factor prices is less severe than among factor amounts. In addition, input prices are more likely to be truly exogenous to firms than are input quantities.

Based on the structure of the FVPI, it can be assumed that the firms maximize profit over an infinite time horizon, and firms are able to solve for the optimal controls uniquely in terms of the shadow prices of the capital stocks. Quasi-fixed stocks are assumed to decay geometrically at a constant rate. Then the problem is to:

$$\text{Max} \int_0^\infty [\pi(W,p,k(t),I(t)) - W^k I(t)]e^{-rt}dt \qquad (46)$$
$$I(t)$$

s.t.

$$\overset{o}{K} = I(t) - \delta k(t)$$

$$K(o) = K_0$$

where,

W^k = rental price of capital

W = a vector of input prices

p = price of output

k = quasi fixed input (capital)

I = gross investment

$\overset{o}{K}$ = net investment

δ = depreciation rate of capital

r = discount rate

t = time

π = profit

The postulated dual function, $J(K,p,W^K,W)$ can be of this form:

$$J\ (K,P,W^K,W) = a_o + \begin{bmatrix} a_1^T & a_2^T & a_3^T & a_4^T \end{bmatrix} \begin{bmatrix} K \\ P \\ W^K \\ W \end{bmatrix} + \frac{1}{2}\begin{bmatrix} K & P & W^K & W \end{bmatrix}$$

$$\begin{bmatrix} A_{11} & A_{12} & A_{13} & A_{14} \\ A_{21} & A_{22} & A_{23} & A_{24} \\ A_{31} & A_{23} & A_{33} & A_{34} \\ A_{41} & A_{24} & A_{43} & A_{44} \end{bmatrix} \begin{bmatrix} K \\ P \\ W^K \\ W \end{bmatrix}$$

(47)

where a and A are appropriate dimensioned vectors and matrices, respectively. This is a second order quadratic function which is flexible. The derived policy functions; investment function (I^*), demand for factors of production (X^*), and supply the function (Y^*) can provide a first order approximation at the point generated by an arbitrary value function.

The corresponding investment, demand and supply equations are:[32]

$$I^* = r[(A_{31}K + A_{32}P + A_{33}W^K + A_{34}W) + wKA_{31}]/A_{31-1} \tag{48a}$$

$$X^{*i} = -r[a_4 + A_{41}K + A_{42}P + A_{43}w^K + A_{44}w + A_{41}]/I^* \tag{48b}$$

$$Y^* = r[a_2 + A_{21}K + A_{22}P + A_{32}W^K + A_{42}W^K - A_{21}]/I^* \tag{48c}$$

$$m = r + A_{21}^{-1} \text{ [33]}$$

Equation $m = r + A21$ represent an accelerator for the adjustment process. where,

a4 = a row matrix representing the price of the variable factors of production

A34 and A44 = square matrixes representing the price coefficients of the factors of production.

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[32]The details of the derivation of the derived function are given in Appendix A.

[33] For more detail on derivation of the adjustment coefficient see Epstein (1982).

It is assumed that at any point of time each individual producer in the industry makes a plan to maximize the net present value of the profits over current and future time periods. It is also assumed that prices are constant. However, in the next period if prices and other parameters change, contrary to the producer's expectation, the earlier plan would not be optimal and a new plan will be adopted in order to maximize the profit.

3.4 Short-Run and Long-Run Elasticities

An essential feature of dynamic models is the distinction between short-run and long-run behaviour. The adjustment cost framework provides a powerful theoretical rationale for maintaining a distinction between short-run and long-run economic behaviour.

Although within a static context long-run demand and supply are expected to be more elastic than in the short-run, with dynamic analyses this may not necessarily be the case. As Treadway (1970) points out, in the context of dynamic behaviour the firm may hire more in the short-run than the long-run in response to a fall in wages. This may be so if in the short-run it costs less to adjust variable factors rather than quasi fixed factors. In the long-run the opposite is true. For instance an increase in the raw materials price may cause an increased usage of raw material if it is accompanied by a lower marginal adjustment cost of the labour stock.

Short-run supply and demand elasticities can be obtained by the following relationships:

Supply elasticities:

$$\eta^{sr} = \frac{\partial Q}{\partial P} \cdot \frac{P}{Q} \tag{49}$$

Demand elasticities:

$$\eta_j^{sr} = \frac{\partial Xi}{\partial pj} \cdot \frac{pj}{X_i} \tag{50}$$

Where P_j is a vector of output and input prices.

Long-run elasticities can be computed in a similar fashion:

Supply elasticity: $\quad \eta^{lr} = \frac{\partial Q^*}{\partial} \cdot \frac{P}{Q} \tag{51}$

Demand elasticities: $\quad \eta_j^{lr} = \frac{\partial X_i}{\partial pj} \cdot \frac{Pj}{X_i} \tag{52}$

Long-run impacts can be calculated directly using the following relationship

$$\frac{\partial X_j^{lri}}{\partial pj} = \frac{\partial X_j^{Sr}}{\partial pj} + \frac{\partial X_j^{Sr}}{\partial_K} \cdot \frac{\partial K}{\partial p_j} \tag{53}$$

$$\frac{\partial Q^{lr}}{\partial p_j} = \frac{\partial Q^{Sr}}{\partial P_j} + \frac{\partial Q^{Sr}}{\partial K} \cdot \frac{\partial K}{\partial p_j} \tag{54}$$

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Therefore, long-run elasticities are:

$$\eta_j^{lr} = \eta_j^{Sr} + \left[\frac{\partial Q_j^{Sr}}{\partial K} \cdot \frac{\partial K}{\partial p}\right] \cdot \frac{Q}{p} \qquad \text{supply} \qquad (55)$$

$$\eta_j^{lr} = \eta_j^{Sr} + \left[\frac{\partial X_j^{Sr}}{\partial K} \cdot \frac{\partial K}{\partial p_j}\right] \cdot \frac{X_j}{p_j} \qquad \text{demand} \qquad (56)$$

3.5 Model Specification

For empirical purposes, it is assumed that FVPI for processed output uses factors: capital (X^K), labour (X^L), energy (X^E), and intermediate materials (potatoes, carrots, celery, X^M). In Canada, 55 percent to 60 percent of the cost of production in the FVPI consists of fresh fruits and vegetables. The other significant costs are: cost of capital at approximately 23 percent; cost of labour at 10 percent to 12 percent; and cost of energy at 3 percent of the total average (STFR: 1979).

The system of investment demand, derived demand and supply functions with capital, labour, energy, and raw material as inputs in the reduced form is expressed as follows:

$$X^{*K} = I_t^* = \pi_{10} + \pi_{11}K + \pi_{12}P_t + \pi_{13}W_t^k + \pi_{14}W_t^L + \pi_{15}W_t^E + \pi_{16}W_t^M + \varepsilon_{1t}$$
$$(57a)$$

$$X_t^{*L} = \pi_{20} + \pi_{21}K + \pi_{22}P_t + \pi_{23}W_t^K + \pi_{24}W_t^L + \pi_{25}W_t^E + \pi_{26}W_t^M + \varepsilon_{2t}$$
(57b)

$$X_t^{*E} = \pi_{30} + \pi_{31}K + \pi_{32}P_t + \pi_{33}W_t^K + \pi_{34}W_t^L + \pi_{35}W_t^E + \pi_{36}W_t^M + \varepsilon_{3t}$$
(57c)

$$X_t^{*M} = \pi_{40} + \pi_{41}K + \pi_{42}P_t + \pi_{43}W_t^K + \pi_{44}W_t^L + \pi_{45}W_t^E + \pi_{46}W_t^M + \varepsilon_{4t}$$
(57d)

$$Y_t^* = \pi_{50} + \pi_{51}K + \pi_{52}P_t + \pi_{53}W_t^K + \pi_{54}W_t^L + \pi_{55}W_t^E + \pi_{56}W_t^M + \varepsilon_{5t}$$
(57e)

where, endogenous variables are:

I^* = I^{*K} = investment demand for FVPI

X^{*L} = quantity demand for labour

X^{*E} = quantity demand for energy

X^{*M} = quantity demand for raw material

Y^* = quantity supply of output

Exogenous variables are:

K = capital stock

P = price of output

W^K = rental price of capital

W^L = cost of labour

W^E = cost of energy

W^M = cost of raw material

ε = 1,...,5 ; are disturbances appended to each equation. The vector of errors $[\varepsilon_1, \varepsilon_2, ..., \varepsilon_5]$ is assumed to be normally distributed with zero mean and constant variances.

3.6 Data

The required data for 1961-84 consist of price and quantity indices of output, labour, energy, raw materials, gross investment, capital stock, real rental rate of capital, depreciation rate, interest rate, and relevant price indices.[34]

A system consisting of the investment function, derived demand and supply functions for labour, energy and raw material was estimated using a two stage least square procedure. As each agent makes investment decisions simultaneously, joint estimation of these equations under specified assumptions improves the efficiency of the parameter estimates.

Due to unavailability of some of the required data, the level of aggregation was quite high. In one case, national gross investment was used instead of provincial investment. Lack of data on government subsidies given to the Manitoba FVPI could have misrepresented the real rental rate of capital.

With the available 24 observations (1961-84) the input categories could not be extended. For the same reason, reduced form coefficients were estimated assuming a linear simultaneous model rather than a non-linear system. Furthermore, in order to keep the number of estimated coefficients within a reasonable range, it was assumed that the actual level of all factors of production, except capital, adjust instantaneously to the desired level. In fact this assumption

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[34]Details on the source of data and estimation procedures for the required indices are given in Appendix B.

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is not very far from reality considering the nature and availability of the factors of production. The majority of workers in this industry are unskilled and producers have access to abundant electricity and raw materials without any major difficulty.[35] Therefore, it is safe to assume that all factors of production, with the exception of capital, adjust to their desired level within one year.

Likewise, due to the presence of multicollinearity among most exogenous variables (mainly prices) and the small degrees of freedom, it was assumed that technological change in the FVPI is embedded in the system.[36]

As investment and production decisions at any time period are based on past information, capital stock and the price of output were lagged one period. Since the price of agricultural commodities as well as processed food are more dependent on domestic and international exogenous factors (e.g., weather, the world price of the agricultural products, the commodity price cycle) rather than endogenous macro economic variables (e.g., the inflation rate) nominal price indices of output and raw material were used instead of real indices. The price of energy and the wage rate were deflated by the Price Deflator Index (PDI).

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[35] According to the claim made by major vegetable processing firms in the Portage Le Prairie there is no shortage of unskilled labour in the area. It is easy for the processors to purchase raw material, mainly potatoes, from the local producers by engaging in advanced contracts with the growers. If there is a shortfall, it is possible to import the required raw material from other Western provinces.

[36]i.e. it is collinear with the other endogenous variables therefore no technical change variable is required.

3.7 Final Impact

Further economic responses for both the direct allocation of funds to either farmers or food processors can be assessed through an I-O model. For Manitoba, an I-O model was developed by Statistic Canada which is presently based on 1979 production patterns.

Changes in farmers' incomes and changes in the production of food processors based on subsidy scenarios can be used as inputs for the Manitoba I-O model. Any changes in these sectors will be transmitted to other sectors of the economy in the I-O model.

Therefore, by considering different subsidy scenarios, estimates of the differential impacts of subsidies on the regional economy can be provided, which will be useful to government planners and decision makers.

CHAPTER 4

EMPIRICAL RESULTS

4.1 Discussion of Results

The empirical analysis conducted in this study involves the estimation of simultaneous equations described by equations 57a-57e. Both two and three stage least squares (2SLS, 3SLS, respectively) are utilized for estimation purposes. Since both results were almost identical, the results of 2SLS are reported.

The estimated short-run and long-run coefficients for investment, output, derived demand equations with their t-ratios (under the regression coefficients), the adjusted coefficient of multiple determination (R), and the Durbin-Watson (DW) statistic for the FVPI in Manitoba are reported in Tables 4.1 and 4.2.[37] Further, plots of the predicted and actual variables versus time indicates that the model fits the data reasonably well (Appendix C).

The adjustment coefficient for capital, m = -.748 (capital stock coefficient), is significant at a ninety-five percent confidence level. This coefficient has the interpretation of being the adjustment speed. A higher value for this coefficient is associated with a higher adjustment speed. When all production factors are at their

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[37]For the derivation of the long-run coefficients see Epstein (1981).

Table 4.1
Estimated Parameters, FVPI , Short- Run

	Intercept	Capital (K)	Output (P)	Price			
				Capital (w^K)	Labour (w^L)	Energy (w^E)	Raw Material (w^M)
Investment Demand Equation (I)							
R^2 = .70	36166.37	-.748*	-	-	5799.19	-	2047.83
DW = 1.8	(2.99)	(-4.82)			(2.71)		(1.5)
F Ratio = 6.13							
Output (Y)							
R^2 = .93	183.43	-.0022	1.75	11.39	-68.57	-93.59	-15.54
DW = 1.07	(1.8)	(-1.6)	(5.17)	(2.75)	(-3.76)	(-1.7)	(-1.3)
F Ratio = 35.5							
Labour (X^L)							
R^2 = .66	997.1	-.0087		71.12	-135.95	-388.69	
DW = 1.54	(2.311)	(-1.5)	-	(4.1)	(-1.78)	(-1.66)	-
F Ratio = 5.36							
Energy (X^E)							
R^2 = .93			3.22	37.65		-490.23	
DW = 1.55	-	-	(2.93)	(2.78)	-	(-2.63)	-
F Ratio = 37.08							
Raw Material (X^M)							
R^2 = .85		-.0032	3.5	14.19	-110.68	-	-97.71
DW = 1.34		(-1.3)	(5.8)	(1.)	(-3.3)		(-4.48)
F Ratio = 15.28							

* m = -.748 is the adjustment coefficient and is equal to $r+A_{21}^{-1}$

Table 4.2
Estimated Parameters, FVPI, Long-Run

	Intercept	Capital (K)	Price				
			Output (P)	Capital (W^K)	Labour (W^L)	Energy (W^E)	Raw Material (W^M)
Investment Demand Equation (I)							
R^2 = .70	36166.37	-.748*	-	-	5799.19	-2047.83	
DW = 1.8	(2.99)	(-4.82)			(2.71)		(1.5)
F Ratio = 6.13							
Output (Y)							
R^2 = .93	183.43	-.0022	1.76[a]	11.39	-69.126[a]	-93.59	-15.73[a]
DW = 1.07	(1.8)	(-1.6)	(5.17)	(2.75)	(-3.76)	(-1.7)	(-1.3)
F Ratio = 35.5							
Labour (X^L)							
R^2 = .66	997.1	-.0087	-	71.12	-138.144[a]	-388.69	-
DW = 1.54	(2.311)	(-1.5)		(4.1)	(-1.78)	(-1.66)	
F Ratio = 5.36							
Energy (X^E)							
R^2 = .93			3.22	37.65		-490.23	
DW = 1.55	-	-	(2.93)	(2.78)	-	(-2.63)	-
F Ratio = 37.08							
Raw Material (X^M)							
R^2 = .85		-.0032	3.6[a]	14.19	-111.497[a]		-98[a]
DW = 1.34		(-1.3)	(5.8)	(1.)	(-3.3)	-	(-4.48)
F Ratio = 15.28							

[a]Change in coefficients in the Long-run.

* m = -,748 is the adjustment coefficient and is equal to $r+A_{21}^{-1}$

desired values, it takes approximately one and half years (inverse value of m) for capital stock to adjust to its desired level. The estimated capital adjustment coefficient for Manitoba is lower than the one obtained by Lopez for the food processing industry in Canada. Using 1961-79 data, he concludes that it takes approximately two and one third years for capital to adjust fully to its optimal levels after an exogenous change has taken place.

A relatively fast speed of adjustment, based on the historical data for FVPI is consistent with the fact that the industry after the mid-1970's was over capitalized. Government financial contributions towards the cost of capital and development grants plus many tax incentives were the main factors contributing to over capitalization in this industry.[38] Changes in investment plans and output levels, particularly changes in the positive direction, have a low adjustment cost and therefore a high speed of adjustment coefficient when industry is operating at excess capacity.

Cross-adjustment coefficients provide some additional information. When capital stock exceeds its desired value, it discourages demand for labour and raw materials, and supply of output (cross-adjustment coefficients of -.0087, -.0032, and -.0022, Table 4.1). In fact, the high cost of maintenance of plant and equipment,

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[38]This point was expressed by the officials in the Department of Industry Trade and Technology, Industry Branch, Winnipeg, Manitoba.

which may have been forced to operate at excess capacity, may have prevented the industry from reaching its desired level of production.

Static and dynamic theories of the firm do not place sign restrictions on input demand with respect to other input prices. It is well known that an increase or decrease in the quantity demanded of other inputs depends on whether the inputs are substitutes or complementary. As is evident from the estimated coefficients, capital expenditure is a substitute for labour and raw materials (coefficients of -.0087 and -.0032, Table 4.1). Therefore, a higher cost of labour and raw materials implies a more capital intensive operation in the FVPI.

The surprising result is that the real rental rate of capital (cost-of-capital), does not have any impact on the level of investment (insignificant coefficient). Two explanations can be put forward for such a result. Firstly, highly aggregated data on capital expenditure and estimated values for the rental rate of capital may have contributed to the imprecise results. The same explanation holds for the positive relationship between the supply of output and the rental price of capital. Secondly, this result may be due to the fact that capital expenditure was subsidized under different regional incentive programs by the government. In fact, the insensitivity of capital formation to the cost of capital suggests that investment in this industry has been more dependent on government policy than on relevant operating costs.

4.2 Estimated Elasticities

Tables 4.3 and 4.4 contain average price elasticities for the short-run and long-run. A higher price of output implies a greater use of raw vegetables, mainly potatoes. A one percent increase in the price of output leads to a greater change, approximately 1.3 percent increase, in demand for raw materials. As expected, due to the excess capacity prevailing in the FVPI over the period under study, the short-run and long-run elasticities are almost identical.

The estimated equations indicate that any increase in wage rate or cost of raw material has an opposite effect on the capital expenditure in the FVPI, both in the short-run and long-run. Policies which contribute to lowering these costs to processors will encourage higher capital formation in this industry.

The price elasticity of output is positive and less than unity in both the short-run and long-run. The price of energy, labour and raw material with respect to output are of the expected negative sign. A one percent decrease in price of labour and energy is likely to result in a 0.33 and 0.35 percent increase, respectively in the supply of output. The change in output supply as a result of change in the price of raw material is inelastic and it is estimated at 0.17 percent.

A higher price of output stimulates the supply of output, energy consumption, and demand for raw material. A one percent increase in the price of output is likely to result in a 1.3 (1.4 in the long-run) percent increase in demand for raw material.

Table 4.3
Short-Run Price Elasticities of Demands and Supply
(at the mean value), FVPI

	Price				
	Output (P)	Capital (W^k)	Labour (W^L)	Energy (W^E)	Raw Material (W^M)
Output (Y)	.84	.77	-.33	-.35	-.17
Investment (I)			-.86		-2.85
Labour (X^L)		1.09	-.15	-.33	
Energy (X^E)	.89	1.67		-1.21	
Raw Material (X^M)	1.3	.77	-.45	-.91	

Table 4.4

Long-Run Price Elasticities of Demands and Supply
(at the mean value), FVPI

	Price				
	Output (P)	Capital (W^k)	Labour (W^L)	Energy (W^E)	Raw Material (W^M)
Output (Y)	.83[a]	.77	-.34[a]	-.35	-.17
Investment (I)			-.86		-2.85
Labour (X^L)		1.09	-.14[a]	-.33	
Energy (X^E)	.89	.67		-1.21	
Raw Material (X^M)	1.4	.77	-.45[a]		-.92[a]

[a]Change in elasticities in the long-run.

Furthermore, increase in the real wage rate of labour will depress the demand for raw materials and labour. A 10 percent decrease in the real wage increase the demand for labour 1.5 (1.4 in long-run) percent and for raw materials 4.5 percent respectively. Results indicate that labour and raw materials are complementary factors of production. The demand for energy and labour will change in the opposite direction of the change in the real price of energy. The price elasticity of demand for energy with respect to its own price is greater than unity.

The demands for labour, energy, and raw materials have a positive relationship with the rental price of capital. Within the context of dynamic maximization, one can not place sign restrictions on the elasticities of derived demand with respect to other input prices. When the rental rate of capital increases, more of substitutes will be demanded. Again, since the industry experienced excess capacity over the period under study, other inputs were substituted for capital whenever maintenance expenditure and other financial expenditures became more expensive.

With respect to the quantitative results of the FVPI model, it appears that positive changes in the price of output will stimulate the demand for raw material. While level of output is not very sensitive to the price of raw material and labour in the short-run, the level of investment, either by expansion or new capital expenditure, will decrease drastically in the long-run. Cost of capital does not play

a significant role in determining the level of investment in the industry. It appears that capital formation in the industry is partly a factor of government policies and not real cost of capital.

4.3 Economic Analysis

The important objective of empirical analysis is to construct models that can be used by policy makers to make decisions that are consistent with social objectives. Since the purpose and objective of this study are to evaluate alternative development policies in the food processing sector, an effort will be made to assess such policies utilizing the estimated results.

The main objectives of most regional development policies are to enhance: (a) regional or local income, and (b) off-farm and on-farm employment opportunities. As mentioned earlier, permanent improvement in economic performances and standards of living in a region depends on the amount and nature of investment expenditures. For a region to be able to generate a higher rate of economic growth in the long-run, the two main objectives (greater GDP and employment opportunities in the region) should be promoted in such a way that one stimulates the other. An increase in investment expenditure and output should provide greater job opportunities and higher income within the targeted district rather than in outside regions.

As shown in Figure 4.1, investment and production decisions contribute to the GDP/income and on-farm and off-farm job opportunities and consequently to growth.

A higher level of output implies a greater demand for labour in the processing sector. Processing industries in the rural areas are believed to be a vital source of off-farm income for those farmers who are suffering from the present financial crisis.

According to the Economic Council of Canada (1988)[39] off-farm income has increased from 10 percent of total farm family income in the late 1940's to 50 percent in the 1980s. Thus, for the past several decades off-farm work has made a significant contribution to realized farm income. Off-farm income provided by local institutions (schools, hospitals, stores, etc.) in the rural area is more dependent on the number of families in the surrounding areas which unfortunately is declining.

If for any reason food processors expand their operations, the greater demand for factors of productions leads to a higher off-farm income for farmers and contributes to the survival of the farm communities. According to the estimated coefficients, for any 10 percent decrease in the real wage rate to the

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[39]Economic Council of Canada, "Handling the Risks: A Report on the Prairie Grain Economy", 1988, p. 38.

Figure 4.1

The Impact of the Subsidy/Incentive Allocation on
Farm and FVPI in Manitoba

Subsidy
Allocation

Fruit and Vegetable
Industry in Manitoba

Farmers in
Manitoba

Greater
Investment/
Output

Investment
Decisions

2. Dynamic
production
and
investment
model

1. Consumption
and
production
farm
model

Farm
Consumption
Model

Change in
Consumption

Greater
Off-Farm
Jobs/Income

Production
Decisions

Greater
On-Farm
Jobs/Income

Demand for
Labour

Farm
Production
Model

Change
in
Production

Demand for
Raw Materials

Greater
Demand
for
Electricity

Demand for
Energy

Economic Impact: Regional Input-Output Models
Downstream Effect in Term of Growth and Development

Evaluating the Result in
the Context of L-R Regional Growth

processors[40] increase in labour productivity, the increase in the labour demanded and in output is 1.4 percent and 3.3 percent, respectively.

A greater demand for raw materials, mainly potatoes, from the processing industry is another source which contributes to the survival and well-being of the farm communities in the rural areas. In fact, one of the contributions of this study is to estimate the derived demand for raw material (potatoes) in Manitoba. The previous estimated demand functions for raw materials are either too aggregated or have estimated consumer demand and thus have ignored the derived demand for potatoes by the FVPI.

Lopez (1985) estimated derived demand for all intermediate raw materials for food processors, including red meat, beverages and fruit and vegetables for Canada. Although the estimated derived demand is based on a well-specified economic theory, it is too aggregated and has limited application in terms of policy recommendations.

The only other study which attempted to estimate demand for potatoes for the Canadian regions is the Potato Forecasting Model of Agriculture Canada (1984).[41] The estimated demand for potatoes in the prairie region lacks a proper theoretical foundation. In that study the demand for table potatoes, based on final

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[40]Cost of labour can be subsidized by government programs.

[41]Destroel, J.J. "Potato Forecasting Model", Working Paper No.9, Marketing and Economic Branch, Agriculture Canada, 1984.

consumption, represents the total demand for potatoes. In fact, as shown in Table 4.5, the end use of potatoes is so different in the three prairie provinces that disaggregated models are required for each region for the purpose of policy recommendations. In Manitoba 65 percent of produced potatoes are used by the FVPI, which is the highest among all the provinces in Canada. In Saskatchewan this share is zero and most of the product is used for direct consumption. Consumer demand and derived demand emerge from two different theoretical origins and are determined by different factors, and, in fact, it is wrong if one is mistaken for another.

Table 4.5
Disposition of Marketed Potatoes in Canada, 1986

	Table Percentage	Seed Percentage	Processing Percentage
Newfoundland	99	1	0
Prince Edward Island	55	33	12
Nova Scotia	95	5	0
New Brunswick	20	25	55
Quebec	60	5	35
Ontario	55	5	40
Manitoba	25	10	65
Saskatchewan	90	10	0
Alberta	65	10	25
British Columbia	80	10	10
Canada	47	18	35

Source: D. Karamchandani, "In Economic Importance of Plant Wealth in Canada: The Case of Golden Nematode and Potato Wart," Food Market Commentary, Agriculture Canada, Vol. 9, September 1987.

CHAPTER 5

SUBSIDY SCENARIOS

5.1 The Pattern of Agri-Food Expenditures

Between 1982 and 1987 the federal government's expenditure in the agri-food industry rose, in nominal terms, by an average of over 28 percent per year. As shown in Table 5.1 Manitoba with a 56 percent increase in its share of federal government expenditure on the agri-food industry, had a higher share compared to the national average. With a four percent rise in provincial government contributions to Manitoba's agri-food industry, the total increase in both federal and provincial contributions to the agri-food industry in Manitoba amounts to 60 percent annual increase.

Although total expenditures in the agri-food industry for Manitoba have increased, there has been a significant change in the allocation of funds to the various departments. As shown in Table 5.2 direct contributions to the commodity programs increasing 200% on average per year. Added to this figure is a 20% increase in another major direct contribution, Crop Insurance, resulting in a total increase of approximately 150% in direct payments to the Manitoba farmers by the

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Table 5.1
Government Expenditures in the Agri-Food Sector
1982-83 to 1986-87

	1982-83	1983-84	1984-85	1985-86	1986-87	Annual Average Rate of Growth
			- - $ Millions - -			
Federal Government Expenditures[a]						
a. Manitoba	159.2	185.1	204.9	226.3	517.	(56%)
b. Canada	2173.9	2665.5	3269.8	3390.1	4633.9	(28%)
Provincial Government Expenditures[b]						
a. Manitoba	58.2	51.8	62.3	63.8	67.7	(4%)
b. Canada	1434.1	1289.6	1443.6	1726.2	2122.2	(12%)

Source: [a]Agriculture Canada, Public Accounts of Canada, various years.
[b]Provincial public accounts.

federal government.[42]

On the contrary, expenditures on regional development activities fell by an average of 4 percent per year over the same period. A report by Agriculture Canada (1985)[43] indicates that the impact of such a decline is becoming evident due to a continuous strain on the resources needed to undertake long term projects, particularly in the areas of research and development.

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[42]This figure will be even higher if provincial contribution is included.

[43]I. Singhall, "Fiscal Framework and Agricultural Expenditures in Canada", *Canadian Farm Economics*, Agriculture Canada, Vol. 19, No. 1, 1985 p. 21.

Table 5.2
Federal Agri-Food Expenditures for Canada and Manitoba
1982-87

	1982-83	1983-84	1984-85	1985-86	1986-87	Annual Average Rate of Growth
			- - 000's Millions - -			
Direct Contributions						
Direct Payments Through Commodity Programs						
Manitoba	29,335	37,125	42,393	32,703	237,600	200%
Crop Insurance						
Manitoba	13,012	11,986	16,412	21,390	23,100	20%
Total	42,347	49,111	58,805	54,093	296,700	150%
Other Contributions						
Financial Assistance						
Manitoba	3,405	5,016	5,669	11,772	30,300	197%
Freight Assistance						
Manitoba	95,673	115,408	188,908	151,368	175,100	21%
Regional Development Funds						
Manitoba	17,733	15,565	21,616	9,047	14,900	-4%

Source: Federal Agri-Food Expenditures, Regional Development Branch, Agriculture Canada, various issues.

For empirical purposes, it is interesting to develop several scenarios based on the recent patterns of distributed funds in the agri-food industry and the present issues concerning policy makers and producers in the FVPI in Manitoba.

Assume an increase of 1 percent in direct subsidy payments which is about $1.7 million[44]. Under this assumption the 4 scenarios depend on who receives the subsidy:

Scenario A: Direct subsidy to farmers.

Assume that such contributions are given to the processors. This amount can be allocated to the followings:

Scenario B: Subsidy to the price of output.

Scenario C: Subsidy to the price of labour.

Scenario D: Subsidy to the price of raw material.[45]

Ultimately, the changes in the level of output - demand for labour, demand for raw materials, and other factors of production in the processing sector - can be compared with the changes in the consumption and farm output.

5.2   Scenario A: Direct Subsidy to Farmers

Assume that the $1.7 million subsidy is allocated to one of the categories under the direct subsidy contributions in the agri-food sector (Table 5.2). According to the model for farm consumption/production estimated by Lopez

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[44] One percent of 150% average increase in the direct payments between 1982 and 1987 is about $1.7 million.

[45]It is possible to allocate the subsidy to the cost of transportation, marketing, etc. However, since these costs are not an integral part of this study scenarios dealing with such costs are excluded.

(1980), discussed in Section 3.2.1, an average of 95 percent of the allocated funds will be spent on household consumption. The income elasticity for consumption at the farm level is:

$$\eta_I = \frac{41.45 P_3^{.98}}{1.124 P_1^{.98} + P_2^{.98} + 41.45 P_3^{.98}} \cdot z$$

where,

η_I = income elasticity of consumption

z = the ratio of subsidy allocations to consumption.

If we assume that prices are fixed in the short-run and z is close to 1, then the value of the estimated income elasticity is about[46]:

$$\eta_I = .95$$

If $1.7 million is allocated as a direct subsidy to farmers then it is expected that $1,615 million of that will be spent on consumption goods.

5.3 Scenario B : Subsidy to the Price of Output

Based on the latest available data for the FVPI, $1.7 million contribution to the sale or the value of shipments is equivalent to a 1.6 percent ($1.7 M /

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[46]Setting the z value close to 1 is not an unrealistic assumption as farmers spend most of the direct received subsidies, which are transitory incomes, in the short-run.

$103.9 \text{ M})^{47}$ increase in the price of output. Based on the estimated elasticities,[48] the value of output or sale increases approximately $1.4 million which is 1.3 percent (.83 × 1.6 percent) of the total value of shipments in 1984.

Any increase in the price of output, either by market forces or subsidy allocation through incentive policies, increases the demand for raw materials. As shown in Table 5.3, a 1.6 percent increase in the price of output increases the demand for raw materials by 2.16 percent (1.35 × 1.6 percent). The total value of change based on 1984 raw material consumption is about $1.2 million ($53.08 M × .0216).

The change in the required energy will be about $62,720, which is 1.4 percent (.89 × 1.6 percent) of $4.48 million (1984 energy expenditures).

5.4   Scenario C: Subsidy to the Price of Labour

Assume the $1.7 million contribution is given to the cost of labour which is about 15 percent of the total cost of labour in 1984.[49] This contribution is equivalent to a 15 percent ($1 .7 M/ $11.3 M) reduction in the wage rates.[50]

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[47]The total value of the shipments in the FVPI in 1984 was about $103.9 million.

[48]Tables 4.3 and 4.4.

[49]For instance, contributions to the cost of training, hiring summer students, or part time labour.

[50]The total value of wages payments in 1984 was $11,322,000.

Based on the estimated elasticities the value of output or sales will increase by approximately $5.2 million, which is 4.9 percent (.33 × 15 percent) of sales in 1984.

The lower cost of labour implies higher demand for labour. The price elasticity of the demand for labour is -.145. In the event that 15 percent of the cost of labour is recovered by the producers, the increase in person hours will be about 26,923, which is approximately 2.18 percent (.145 × 15 percent) of 1984 labour person hours.

Table 5.3
Subsidization of Prices Based on 1984s Prices and Quantities
FVPI in Manitoba

Allocated $1.7 M Subsidy	Sale $	Demand for Labour Man-Hr	Demand For Raw Material $	Demand for Energy $
		Increase		
Scenario B				
1. Price of Output	1,351,506	-	1,146,506	62,720
Scenario C				
2. Price of Labour	5,198,100	26,923	3,582,832	-
Scenario D				
3. Price of Raw Material	51,810	-	1,464,980	-

Furthermore, as labour and raw materials are complementary inputs, a higher demand for labour implies a higher demand for raw materials and vice versa. The increase in raw materials will be $3.6 million, which is about 6.75 percent (.45 × 15 percent) of the 1984 cost of raw materials.

5.5   Scenario D: Subsidy to the Price of Raw Materials

In this case, assume that $1.7 million, which is about 3 percent ($1.7 M / $53.08 M)[51] of the total cost of raw materials in 1984, is given to producers.[52] A 3 percent reduction in the cost of raw material leads to a $519,810 increase in the value of output, which is 0.5 percent (.17 × 3 percent) of the value of output in 1984.

As a result of the 3 percent reduction in the price, the increase in demand for the raw material will be $1,464,980, which is 2.76 percent (.92 × 3 percent) of the value of raw materials in 1984.

The other cases, subsidy allocation to other factors of production, capital and energy, were not evaluated. Predictions about the subsidization of the cost of

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[51]The total cost of raw material in the FVPI was $53,079,000.

[52]This subsidy can cover any type of contributions that lowers the cost of raw materials in a particular season to the producers. For instance, building storage space for storing fruits and vegetables in order to keep the price low in the off season periods, or conducting research for improving the quality of raw materials.

capital do not seem to yield valuable results, as the available data on capital expenditure are too aggregated and government subsidies to the cost of capital are not included in the rental cost of capital index. Regional data on gross capital expenditure are not available for the FVPI in Manitoba as the information is classified confidential.

Another factor, energy, which constitutes only 2.5 percent of the cost of production is produced out of the rural community. Therefore, changes in the consumption of energy does not have a significant impact on local growth and development.

As mentioned earlier, the $1.7 million subsidy was allocated under three different scenarios (B, C and D) to the price of output, price of labour and price of raw materials. Based on the model the changes in sales, demand for labour, and raw materials are dependent on two factors: the dollar value or units of output and factors of production.[53] Obviously, the higher the total value of units of output or inputs, the lower the percentage of a given subsidy to each unit will be. Also, the degree of responsiveness of output, labour demand and demand for raw materials to the price reduction depends on their estimated elasticities. For instance, since the cost of labour is approximately 12 percent of the total cost of production and the cross price elasticity between output and the cost of labour is

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[53]Assume output and input prices are fixed.

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higher than other cross elasticities (-.33), an increase in the levels of sale will be relatively high ($5,198,100) compared to the price changes in other scenarios.

The lowest level of increase in sales is when the price of raw materials is subsidized. Since the major cost of production consists of the cost of raw materials (60 percent), and as the cross elasticity between output and the price of raw materials is very low (.17), it follows that the impact of this subsidy on the level of output based on scenario D will be the lowest compared to the other scenarios. Accordingly, one should not expect a significant change in the level of production if a potato marketing board is established with the intention of increasing the price of potatoes in the short-run.[54] However, as the total cost of raw material constitutes a large percentage of the cost of production, a slight rise in the price of raw materials leads to a great increase in the variable costs. Consequently, the profit margins for processors will decline. Moreover, since the degree of sensitivity of capital expenditure to changes in the price of raw materials is very high (the cross elasticity is 2.85 (Tables 4.3 and 4.4)), investment decisions in the long-run are very responsive to the expected price of raw materials used.[55]

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[54]It is assumed that changes in the imported raw materials are marginal.

[55]In the summer of 1988, Carnation Food Co. delayed its decision for the expansion of its plant (an investment worth of $20 million) in the anticipation of a potato marketing board establishment. See Manitoba Cooperator, December 22, 1988.

The estimated results suggest that while expectations about the changes in the price of raw materials do not have a very drastic impact on the level of production in the short-run, they can lead to extensive changes in investment by the firms in the long-run.

5.6   Regional Economic Impacts

The relationships between the various sectors in the economy beyond the agricultural sector for the Southwestern Manitoba are examined through the use of a series of Input-Output (I-O) models developed by Prairie Farm Rehabilitation Administration (PFRA).[56]

The results of the I-O accounts are in 1979 dollars. Due to the existing interdepedencies between different sectors of the economy, any change in the exogenous sector(s) will change the demand for other commodities in all other sectors.

5.6.1   Case 1:   Scenario A: Direct Subsidy

The impact of a \$1.615 million (\$1.7M direct subsidy) increase in the level of farm consumption

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[56]For details concerning the development of the model see and Kulshreshtha *et al.* (1985). Also for details on the structure of regional I-O models see Arthur *et al.* (1987).

Table 5.4
Consumption Pattern in the Prairie Provinces
Rural Farm, Percentage, 1978

	Percentages	Modified Percentages Based on Lopez Model $\eta = .95$
1. Food	16.5	20.0
2. Shelter	10.9	13.0
3. Household Operation	4.3	5.0
4. Furniture and Equipment	5.7	6.8
5. Clothing	7.4	8.9
6. Personal Care	1.5	1.8
7. Medical and Health	2.5	3.0
8. Tobacco and Alcoholic Beverage	3.1	3.7
9. Transportation	16.5	19.8
10. Recreation	5.5	6.6
11. Reading	0.4	0.5
12. Education	0.5	0.6
13. Miscellaneous	4.0	4.8
Consumption	78.8	95.0
14. Tax	15.8	
16. Security	2.9	
17. Gifts and Contributions	2.6	
Expenditure	100.00	

Source: Statistics Canada, Family Expenditure Data in rural Canada, 1982, Catalogue 62-555.

Table 5.5
The Available Subsidy for Rural Consumption[a] - $1,615 (000s)

		Thousand Dollars
1.	Food	323.00
2.	Shelter	209.95
3.	Household Operations	80.75
4.	Furniture and Equipment	109.82
5.	Clothing	143.74
6.	Personal Care	29.07
7.	Medical	48.45
8.	Tobacco and Alcoholic Beverage	59.75
9.	Transportation	319.77
10.	Recreation	106.60
11.	Reading	8.07
12.	Education	9.70
13.	Miscellaneous	166.33
Total		1,615.00

[a] Change in consumption based on $1.7 million subsidy.

(an exogenous change) can be traced in the Southwestern Manitoba's economy through the Prairie region I-O model. First, it was necessary to allocate the $1.615 million dollar subsidy to the different sectors of the economy. The consumption pattern in the rural area of the Prairie region is available from a 1978 report by PFRA.[57] Table 5.4 shows the percentage of consumption from different sectors,

[57]The data is based on Statistics Canada Family Expenditure data.

Table 5.6
The Percentage Share of Expenditures by Farmers, Rural Areas in the Prairie Region

Sector	Percentage	Consumption Based on 1,700 Subsidy (000)
Food		
Prepared at home	86	277.78
Eating Places	13	41.99
Purchased on Trip	1	3.23
Total	100	323.00
Shelter		
Property Taxes Insurance, Etc.	43	90.27
Water Fuel and Electricity	39	81.79
Other Accommodations	18	37.79
Total	100	209.95
Household Operation		
Communications	38	30.78
Laundry, etc.	5	4.05
Cleaning Supplies	17	13.77
Paper Supply	13	10.53
Others	27	21.87
Total	100	80.75
Furniture and Equipment		
Furniture	30	32.7
Appliances	26	26.52
Major (22%)		
Small (4%)		
Miscellaneous		
(household items)	44	50.6
Clothing		
Women	38	54.34
Footwear	5	7.18
Others	57	82.22
Total	100	143.74

Table 5.6 (Continuation)

Sector	Percentage	Consumption Based on 1,7 M Subsidy (000)
Personal Care		
Personal Services	33	9.6
Toilet Preparations	48	13.92
Others	19	6.18
Total	100	29.07
Medical and Health	100	48.45
Tobacco and Alcoholic Beverages		
Tobacco	35	20.9
Alcoholic Beverages	65	38.8
Total	100	59.75
Transportation		
Auto and Truck	96.7	309.
Purchase (54%)		
Gas (21%)		
Insurance (5%)		
Others (17%)		
Transportation Services	3.0	9.6
Others	.3	1.1
Total	100.	319.77
Recreation		
Admissions	8	8.48
Equipments	15	15.9
Outdoor Equipments	38	40.5
Others	39	1.34
Total	100	106.6
Reading	100	8.07
Education	100	9.7
Miscellaneous		
Interest on Loans	50	32.6
Others	50	32.6
Total	100	64.6
Grand Total		**1,615**

with the modified percentage for farmers in the Prairie region.[58] The increase in the expenditures in each industry are reported in Table 5.5. Furthermore, farmers' expenditures on different commodities within categories were broken down into disaggregated items according to their expenditure pattern.[59] The percentage share of each category with calculated expenditures is presented in Table 5.6.

The direct and indirect effects of increased consumption, based on the outlined expenditure pattern, were estimated using the Manitoba regional I-O model. Table 5.7 presents the change in the total value of output, employment, and value added. Total direct and indirect changes in the value added is approximately $688,430 and the increase in employment is around 13 person/years. Note that the service sector receive the major portion of the indirect benefits both in terms of output and employment. Since most of the service and trade institutions are located in the urban areas or head office in the urban centres, the benefit of such changes for the rural communities will be very small.

5.6.2 Case 2: Scenario B, C, and D: Subsidy to the FVPI

In order to be able to compare the impact of subsidy allocations in the FVPI with direct subsidies to farmers, it was necessary to estimate the total impact (direct

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[58]The share of consumption for each category is adjusted based on the estimated income elasticity from the Lopez Model.

[59]Statistics Canada, Family Expenditure Data.

Table 5.7
Total Output and Employment Effects by Sectors
$1.7M Direct Subsidy

Sector Description	Direct Subsidy to Farmers (000)
	Manitoba
Forestry/Fishing	1.12
Non-Fuel	1.34
Ag. Processing	235.32
Other Manufacturing	42.17
Construction	22.54
Utilities	86.83
Trade	116.25
Transportation,etc.	55.77
Finance, etc.	153.58
Services	335.80
Value Added	688.43
Total Employment	13.40[a]
Ag Processing (person/year)	235.32

[a]Trade and services have the highest rate of increase in employment.

and indirect) of such a policy for the FVPI.[60]

For this purpose, changes in the value of sales in response to the estimated

elasticities in the FVPI, based on scenarios B, C and D, were treated as a change

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[60]Note that the changes reported in Tables 4.3 and 4.4 are just direct changes.

in the final demand for processed fruits and vegetables. Alternatively, if we assume that the FVPI is an exogenous sector in the I-O model, then we can estimate the total direct and indirect impacts for the region.

The changes in the value of output, employment and value added for the three scenarios are reported in Table 5.8. The results indicate that subsidy to the cost of labour has the highest impact on total employment (29 person/yr.), value added (1,133,940), and the total value of sales, both in the FVPI and at the aggregate level. In terms of employment in the food processing sector (including FVPI), scenarios B and C show the highest impact among the available scenarios (Tables 5.7 and 5.8). As most of the food processing firms are located in rural areas, the two scenarios, B and C, have the highest potential for providing off-farm job opportunities for farmers in the rural areas. In addition, the increases in the agricultural sector for Scenario B is the highest among all four scenarios.

After comparing the two alternatives (direct subsidies to the farmers and subsidies to the food processors) it seems that final benefits, in terms of promoting economic growth and development, depend on the farmers' consumption patterns and the food processing industry's performance. Since, in general, consumption patterns do not change considerably and most of the consumed commodities are imported into the rural region, the benefits based on Scenario A are limited in terms of growth and development.

Table 5.8
Total output and Employment Effects by Sectors
$1.7M Subsidy to FVPI

	Change in Output (000$)		
Sector Description	Subsidy to Price of Output (Scenario B)	Subsidy to Cost of Labour (Scenario C)	Subsidy to Cost of Raw material (Scenario D)
Agriculture	34.11	131.19	1.30
Forestry/Fishing	0.26	1.01	0.01
Non-Fuel	0.57	2.18	0.02
Fuel Mines	0.09	0.34	0.00
Ag. Processing	338.85	1,303.26	12.99
Other Manufacturing	22.01	84.65	0.84
Construction	5.70	21.92	0.22
Utilities	8.27	31.81	0.32
Trade	86.62	333.17	3.32
Transportation, etc.	16.84	64.75	0.65
Finance, etc.	25.18	96.83	0.96
Services	64.75	249.05	2.48
Value Added	294.82	1,133.94	11.3
Total Employment (person/year)	7.5	28.84	0.29
Ag. Processing Employment	2.58	9.9	0.1
Agricultural Sector Employment (person/year)	0.21	0.81	0.01

However, when subsidies are available to the processors, (Scenario B-D), the long-run benefits depend on the performance, technical relationships, and dynamic behaviour of the industry. If subsidies are not allocated efficiently in the food processing sectors (for instance Scenarios B or D) then the benefits received may be lower than the case of the direct subsidy to the farmers.

CHAPTER 6

SUMMARY AND CONCLUSION

6.1 SUMMARY

Over the past few decades Manitoba's economy has been faced with net out-migration and a lower rate of economic growth and a greater rate of unemployment compared to national averages.

The continuous efforts of both federal and provincial governments to promote economic performance and to maintain a balanced growth in the urban-rural areas have not been particularly successful. The federal funds transferred to Manitoba in recent years are the second highest among the provinces. In addition, average subsidies to Manitoba farmers in recent years totalled over $0.5 billion a year.

This study has two broad objectives, namely:

1) to review the relevant literature concerning the causes of slow economic growth and regional disparities in resource base regions in rural areas of Canada, and

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2) to compare and evaluate the impact of direct government subsidies to either farmers or food processors on regional growth and development in Manitoba; more specifically, and to develop and estimate a conceptual model for a selected food processing industry (Fruit and Vegetable Processing Industry (FVPI), primarily potato processing) in Manitoba. Analyses and comparisons of different subsidy scenarios are based on an estimated model, rural consumption patterns, and a regional Input-Output (I-O) model.

While slow growth and regional disparities may be signs of market and economic adjustments, there is no strong evidence to suggest that regional disparities in Canada, and particularly in Manitoba, are merely due to a market adjustment process. According to the relevant theories/hypotheses and the history of economic development of resource based regions in Canada, dependence on an unprocessed staple export, and low productivity of the factors of production are considered to be major factors contributing to slow growth.

Based on this premise, government subsidies/financial assistance are distributed among different economic agents (e.g. farmers, food processors, producers) for promoting economic growth and development in rural regions. The impact of such subsidies on regional growth and development is evaluated by incorporating rural communities' consumption patterns and estimated elasticities of the FVPI policy functions into a regional I-O output model.

A system of dynamic supply and derived demand functions, based on optimal control theory and the adjustment cost hypothesis, and utilizing the duality approach for the FVPI in Manitoba was estimated. Two-stage least squares was used to estimate the structural parameters and elasticities based on 1961-1984 data.

Conclusions at the Industry Level

In the first step of the analysis, conclusions were drawn using estimated elasticities for the FVPI. The results indicate that during the period under study, capital stock adjusted to the desired level fairly rapidly. A relatively high speed of adjustment is consistent with the fact that after the mid 1970s, the industry has been operating at excess capacity. The similarities between the magnitude of the short-run and long-run adjustments further confirms the presence of over capitalization in FVPI in Manitoba.[61]

The change in output supply as a result of change in own price and price of factors of production is inelastic. A one percent decrease in the price of labour and raw materials is likely to result in 0.33 and 0.17 percent increases in output, respectively. Furthermore, any increase in the real wage rate of labour will depress the demand for raw materials and labour. A one percent increase in real wage lowers the demand for labour 0.14 percent and for raw materials 0.45 percent. A

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[61]Recently Campbell Soup has announced closure of its Portage la Prairie plant in 1991 due to the presence of excess capacity and inefficiencies

one percent increase in the price of output leads to a greater percentage (approximately 1.4 percent) increase in demand for raw materials. Lower costs of labour, costs of raw materials, and other costs of production imply a higher level of output and a greater demand for domestic labour and raw material. For this reason, processing industries in the rural areas create greater demand for locally produced raw materials and labour, which contribute to the survival of rural communities.

The real rental rate of capital did not have any significant impact on the level of capital expenditures. During the period under study, capital expenditures were often subsidized under different regional programs. Investment decisions had been affected primarily by government policy rather than by relevant operating costs.

The level of capital expenditure is sensitive to changes in the price of raw material. A one percent increase in the price of material will depress the level of investment by 2.8 percent. The estimated results suggest that, although an increase in the price of raw materials, for example due to quantity restriction supply management, may not have a drastic impact on the level of production in the short-run, it can lead to extensive changes in the level of investment in the long-run.

General Conclusions: Regional Analyses

Lopez (1984) provided estimates of the change in total rural consumption based on direct government transfer of funds in Canada. According to his estimation, 95 percent of the direct transfer funds to farmers will be spent on goods and services. The latest survey conducted by Statistics Canada[62] indicates that rural families' expenditure on food and transportation represent approximately 33 percent of total expenditures. Other major expenditure items of furniture, equipment and clothing comprise about 15 percent of total expenditure.

The impact of selected subsidy scenarios can be estimated by incorporating rural consumption patterns and estimated policy function's elasticities into the provincial and sub-provincial I-O model. As the I-O models are more suitable for comparison of alternative scenarios rather than actual estimation, the focus of the following analyses is on the comparison of four subsidy scenarios. Two cases are examined in this study as follows:

Scenario A: Direct subsidy to the farmers

An increase of $1.7M in direct subsidy payments, one percent of the average annual contributions in 1982-1987 to Manitoba farmers.

As most of the commodities consumed by farmers in rural communities are imported, the major portion of benefit leaks out of the rural area. Since the service

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[62]Statistics Canada, Family Expenditure Data in Canada, 1982.

sector, which is located primarily in urban areas, receives the major portion of the indirect benefits, the net benefit of such changes in terms of domestic value added, output, and employment for the rural communities will be minimal. The total direct and indirect changes in the domestic value added is approximately $350,000 and the increase in employment is around 11 person/years.

The next three scenarios are:

An increase of $1.7M in the subsidies to FVPI, in one of three forms:

Scenario B: <u>$1.7M Subsidy to price of output;</u>

Scenario C: <u>$1.7M Subsidy to the cost of labour;</u> and

Scenario D: <u>$1.7M Subsidy to the cost of raw material.</u>

The results indicate that subsidies to the cost of labour (Scenario C) have the highest impact on total employment, value added and total value of sales, both in the FVPI and at the aggregate level. The total increase in the value added under Scenario C is $1.1 million, with an employment increase of about 29 man/years employment.

In terms of employment in the food processing sector (including FVPI), Scenario B and C show the highest impact of the four scenarios. As most of the large vegetable processing firms are located in rural areas of Manitoba, the two scenarios (B and C) have the highest potential for providing off-farm job opportunities for farmers.

After comparing the two alternative cases, it can be concluded that economic benefits, in terms of promoting economic growth, depend on farmers' consumption patterns and the food processing industry's performance. Because most consumed commodities are imported into the rural region, the benefits from Scenario A are limited. However, when subsidies are available to processors, the long-run benefits depend on the performance, technical relationships, and dynamic behaviour of the industry. If subsidies to the FVPI are not allocated efficiently in the sector, then the benefits received may be lower than in the case of the direct subsidy to farmers.

6.2   Empirical Results

The results for the FVPI equations indicated total labour that it takes approximately one and a half years for capital stock to adjust to its desired level. A relatively high speed of adjustment is consistent with the fact that, after the mid-1970s to mid-1980s, the industry was over capitalized. This was the main reason for similarity between the short-run and long-run adjustment rates. A higher price of output also stimulates energy consumption, demand for labour, and demand for raw materials. The demand for all factors of production, except investment, was sensitive to related price changes. Some of the cross price elasticities were significant.

The real rental rate of capital or cost of capital did not have any impact on the level of capital expenditure. This can be rationalized on the grounds that capital expenditure was subsidized under different regional incentive programs by the government. Having estimated the model for FVPI, the next step was to compare the downstream effects of different subsidies on the level of output and employment for Southwestern Manitoba. For this purpose four subsidy scenarios were developed based on the pattern of government expenditure in the agri-food industry in recent years. A direct subsidy to farmers was evaluated under the first scenario. Under the last three scenarios, subsidies were allocated to the price of output, price of labour, and price of raw materials. Changes in the level of output, regional value added, and employment for each scenario were evaluated by the Prairie regional I-O model.

6.3   Conclusion

This study investigated the impact of subsidy allocations to Fruit and Vegetable Processing Industry (FVPI) versus direct subsidies distributed to farmers on economic growth in southwestern Manitoba. The objective was to develop a general framework for assessing the impact of the development funds on rural regions.

Unlike the present practices which are based on an ad hoc allocation of subsidies, the impacts of the subsidy funds on rural growth and development were

evaluated using a well defined model. The general conclusion is that subsidy allocation in the agri-food sector can improve conditions in rural areas if it is distributed on the basis of production efficiency, technical relationships and consumption patterns in the regions.

The empirical findings of this study suggested that between the mid 1970s to mid 1980s the industry was over capitalized. Furthermore, the establishment of a price enhancing program such as a potato supply management board, which reduces supply and raises prices, does not have a significant impact on the level of output and derived demands in the short-run. However, such programs may have a drastic effect on the investment decisions in the long-run. It appears that capital expenditure in the FVPI is more sensitive to the government policies than to cost of capital.

6.4   Policy Recommendations

The results have important implications for the implementation of policies aimed at raising rural communities' growth. This study has focused on two policies; Case 1, direct government subsidies to farmers, and Case 2, encouraging private investment in the rural regions (via subsidies to the food processors with high value added potential).

An important policy question is which of these two alternatives is more effective in encouraging further regional growth. Based on the estimated

coefficients, less than 26 cents of each dollar spent by government in Case 1 will remain in the rural community and the rest will leak out of the region. The total increase in the value added will be approximately 40 cents for each dollar transferred to farmers. Furthermore, each $130,000 thousand direct subsidy will likely create one job.

If subsidies are allocated to the FVPI (Case 2), then one dollar spent has the potential of raising food processing output by 80 cents. When the subsidy is allocated based on technical efficiency, the value added per dollar subsidy will be about 67 cents and each $58,000 subsidy creates roughly one job. The reason for this is that food processors stimulate both forward and backward economic linkages in the rural regions. As a result, a greater source of off-farm income and market for farm products will become available to the rural communities.

However, if the subsidy to the processors is not allocated based on production efficiency (e.g. scenario C, D), the change in the value added and employment will be marginal and substantially low. Thus, on the basis of the greater increase in the regional growth indicators, Case 2 should be preferred to Case 1 only if the subsidy allocation in the processing sector is done efficiently.

Federal subsidies for farming do not translate automatically into a greater rate of growth for rural communities. Higher farm income based on federal subsidies do not appear to significantly enhance economic growth in the rural communities, even in farm dependent regions. Alternatively, a subsidy allocation

to the food processing industries can improve the economic conditions in the rural areas. However, the subsidy has to be distributed on the basis of production efficiency and input-output technical relationships in each industry. Unlike past practices, where subsidies were allocated on an *ad hoc* basis, a more detailed analysis of production/investment relationships is needed for capturing the greatest economic benefit. For instance, in the models presented here FVPI subsidies to human resources and the price of output have a relatively greater impact on regional economic indicators than do the other alternatives.

According to the estimated coefficients, for any 10 percent decrease in the real wage or increase in labour productivity the direct increase in the demand for labour and output in the FVPI is 1.4 percent and 3.3 percent, respectively. As low productivity of factors of production in slow growth regions is one of the obstacles to a higher rate of growth and development, policies geared towards training and improving productivity of labour should be encouraged. Hence, when the goal is to enhance regional growth and farm families' income, one might prefer to increase the amount of subsidies for labour training, rather than direct transfers of funds to the farmers.

Using the estimates of the investment/production FVPI model, it can be concluded that the establishment of a price-enhancing program such as a potato supply management board, which by reducing supply raises the price, may not have a substantially adverse effect on the level of output, off-farm jobs, and demand for

raw materials in the short-run. However, such programs may reduce the level of investment, as the choice of location and expansion of the industry is affected by the availability and price of raw materials needed by processors.

6.5 Limitations and Extensions

The limitations of any study are related to the set of assumptions underlying the conceptual model. Due to unavailability of data, there is a high level of aggregation for some of the data used. This may have resulted in less accurate estimators than desirable. The unavailability of continuous data on government subsidies given to the FVPI in Manitoba may have resulted in bias in some of the estimated coefficients. The actual cost of capital has been lower than indicated in the data used in this study. If an accurate cost of capital could have been obtained, the estimated cost of capital coefficients may have become significant. An extension to this study would be to incorporate the subsidy values into the rental cost of capital as they become available.

Furthermore, this study assumes that the industry behaves as a single firm within a perfectly competitive market situation. This study is a partial equilibrium analysis and assumes prices are exogenous to the model, while in reality production decisions are formed in accordance with the present and expected prices, and vice versa.

The consumption/production farm model was adopted from Lopez's study which is highly aggregated in terms of the commodities and regions. The consumption/production patterns are based on national rural data while provincial data are provided for the FVPI. In addition the data set is not recent. Furthermore, Lopez estimates long-run elasticities based on 1970 Canadian Census data, while estimated elasticities for FVPI are based on a time series data and hence are short-run elasticities. Therefore, a possible extension to this study is the development of a disaggregated simultaneous model for rural consumption/ production patterns in Manitoba for the evaluation of direct subsidies on consumption and production patterns of farmers.

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APPENDIX A

Based on optimal control theory, the net present value of the time path of firm's planned profits in terms of the indirect function (J function) is:

$$J(W, P, W^K, W, K_o, r, t_o) = \int_{t=0}^{\infty} [\pi (p, W^K, W, K^*(t), I^*(t) - W^K I^*(t)] e^{-rt} dt \tag{1}$$

The Hamilto-Jacobi (H-J) equation for the above dynamic problem is

$$\frac{-\partial J(P, W^K, W, K_o, t, t_o)}{\partial t}$$

$$= \underset{1(t_o)}{Max} \left[\pi (\cdot) - W^K I(t_o) + \frac{\partial J(\cdot)}{\partial K} (I(t_o) - \delta K_o) \right] \tag{2}$$

Differentiating J( ) with respect to t_o, and applying the envelope theorem, and substituting the result in 2 leads to the following version of the H-J equation.

$$rJ(\cdot) = Max \left[\pi (\cdot) - W^K I(t_o) + \frac{\partial J(\cdot)}{\partial K} (I_{(t)} - \delta K_o) \right] \tag{3}$$

Applying the envelope theorem to 3 for infinitesimal changes in prices we have:

$$r\frac{\partial J}{\partial W^K} = -I_o^* + \frac{\partial^2 J(\cdot)}{\partial K \partial W^K} \cdot (I_o^* - \delta K_o) \tag{4a}$$

$$r\frac{\partial J(\cdot)}{\partial W^i} = \frac{\pi(\cdot)}{\partial w^i} + \frac{\partial^2 J(\cdot)}{\partial K \partial W^i}(I_o^* - \delta K_o) = -X_o^{*i} + \frac{\partial^2 K(\cdot)}{\partial K W^i}(I_o^* - \delta K_o) \qquad (4b)$$

$$r\frac{\partial J(\cdot)}{\partial P} = \frac{\partial \pi(\cdot)}{\partial P} + \frac{\partial^2 J(\cdot)}{\partial K \partial P}(I_o^* - \delta K_o) = Y_o^* + \frac{\partial^2 J(\cdot)}{\partial K \partial P}(I_o^* - \delta K_o) \qquad (4c)$$

Substituting 4a into 4b and 4c, we obtain

$$I* = \frac{\left[r\dfrac{\partial J}{\partial W^K} + \delta K \dfrac{\partial^2 J}{\partial K \partial W^K} \right]}{\left[\dfrac{\partial^2 J(\cdot)}{\partial K \partial W^K} - 1 \right]}$$

$$X^{*i} = -r\frac{\partial J(\cdot)}{\partial W^i} + \frac{\partial^2 J(\cdot)}{\partial K \partial W^i} \frac{\left[r\dfrac{\partial J(\cdot)}{\partial W^K} + \delta K \right]}{\dfrac{\partial^2 J(\cdot)}{\partial K \partial W^K}} - 1$$

$$X^{*i} = -r\frac{\partial J(\cdot)}{\partial W^i} + \frac{\partial^2 J(\cdot)}{\partial K \partial W^i} \frac{\left[r\dfrac{\partial J(\cdot)}{\partial W^K} + \delta K \right]}{\left[\dfrac{\partial^2 J(\cdot)}{\partial K \partial W^k} - 1 \right]}$$

$$Y^* = r\frac{\partial J(\cdot)}{\partial P} - \frac{\partial^2 J(\cdot)}{\partial K \partial P} \frac{\left[r\dfrac{\partial J(\cdot)}{\partial W^K} + \delta K \right]}{\left[\dfrac{\partial^2 J(\cdot)}{\partial K \partial W^K} - 1 \right]}$$

Where I is investment function and X and Y are derived demand and output functions, respectively.

Data

The following set of data were collected for the 1961-84 period.

1.   **P = price index of output**

base: 1971 = 100

This index is a composition of several other indices such as frozen french fries, frozen potatoes, frozen fruits, and canned vegetables. Since in Manitoba the supply of frozen potatoes and fries as reported by the Manitoba Department of Agriculture is much greater than other products in the FVPI (over 90 percent), a greater weight was given to the price of frozen potatoes and fries (90%) in the composite index.

Source of Data

a.   Industry Price Indexes, Statistic Canada publications, Catalogue 62-011

b.   Statistics Canada, Winnipeg, Manitoba.

2.   **Q = quantity of output**

base: 1961 = 100

Data for the quantity of output are not directly available. An aggregate quantity index of output was built using the "factor reversal" procedure. This approach, which is also known as Fisher Index approach, utilizes data on total expenditure and price index and total expenditure. We can construct a Corresponding implicit output quantity index using the following equation:

$$\left(\frac{P_1}{P_0}\right)\times\left(\frac{Q_1}{Q_o}\right) = \frac{\left(\displaystyle\sum_{i=1}^{n} P_1^i Q_1^i\right)}{\displaystyle\sum_{i=1}^{n} P^i Q^i} \tag{1}$$

assuming $Q_1/Q_0 = \dfrac{f(P1)}{f(P0)}$ then:

$$\frac{Q_1}{Q_0} = \frac{\dfrac{\displaystyle\sum_{i=1}^{n} P_1^i Q_1^i}{f(P_1)}}{\dfrac{\sum P_o^1 Q_o^1}{f(P_0)}} \tag{2}$$

where Q_1/Q_0 can be interpreted as the index of average level of production.

3.   **L = man hours of labour**

   unit: thousands of hours.

Fruit and Vegetable Processing Industry, Statistic Canada publications, Catalogue 32-218.

4. W^L = wage rate

Unit: dollar per hour

Due to the unavailability of wage rates in the FVPI, wage rates in the food processing industry in Manitoba were used instead.

5. W^E = industrial price index for energy in Manitoba

base: 1971 = 100

Since the major source of energy usage in FVPI is electricity, the industrial price index for electricity is used to represent the price index for energy.

Source of Data

a.   Industry Price Indices, electricity selling price indexes over 5000 kW to non-residential customers, Statistics Canada publication, Catalogue: 62-011.

b.   Statistics Canada, Prices Division, Ottawa.

6. E = index representing quantity of energy used in the FVPI

base: 1961 = 100

The quantity index for energy was obtained, using the Fisher Price Index approach, and based on the total expenditure data and price of energy available for the Manitoba's FVPI.

7. W^M = price of raw material

In Manitoba the main raw material used for processing in the FVPI is potatoes. The major producers (Carnation, Campbell soup, and McCain) in this industry are mainly involved in the preparation of frozen vegetables including french fries, potato chips, and canned soups. According to the Manitoba Department of Agriculture, about 95 percent of the processed vegetables produced by major processors in Manitoba are potatoes.

Due to the unavailability of the data on the remaining five percent of the raw material, it was decided to use Manitoba's potato prices as a proxy for the cost of raw materials.

Source of Data

    a. From 100 Years of Agriculture in Manitoba, A Statistical Profile (1881-1900), Manitoba Agriculture publication.

    b. Statistics Canada, Prices Division Ottawa.

8. **M = Index representing quantity of raw material**

   base: 1961 = 100

   The quantity index for raw material was obtained, using the Fisher Price Index approach, and based on data available on total expenditure of the raw material and composite price index for Manitoba's FVPI.

9. **I = Investment in the FVPI**

   unit: thousands of dollar

   Due to the confidentiality of data on capital formation for Manitoba's FVPI, the national data were collected instead. The data consist of expenditures on construction, machinery and equipments plus repair expenditures.

   Source of Data

   a. Fruit and Vegetable Processing Industry, Statistics Canada, Catalogue: 32-218.

   b. Investment Statistics: Manufacturing Sub-Industries, Catalogue: 61-518 and 61-214.

10. **K = Capital Stock**

    unit: thousands of dollar

    Data on the capital stock are not available even at the national level. However, since data for gross investment in the FVPI are available, capital stock

can be approximated by the perpetual inventory method using the following relationship.[63]

$$K_t = I_{t-1} + (1-\delta)K_{t-1} \qquad\qquad (3)$$

where,

I_{t-1} = gross investment at time t-1

δ = constant rate of depreciation

Substituting backwards for Ks, the approximation to (3) is

$$K_t \approx I_{t-1} + \sum_{t-2}^{s} (1-\delta)^{t-s+1} I_{t-s} \qquad\qquad (4)$$

where s is an arbitrary number which represents the impact of gross investment on the level of future capital stocks. Since different values of s do not have a significant impact on the results, s=10 was chosen arbitrarily for estimating the capital stock values.

Data on the actual depreciation rate in FVPI in Canada are not available. However, the depreciation rate on machinery and equipments in the food sector for the U.S. are estimated in a study for the National Centre for Food and Agricultural Policy by Capalbo *et al.* (1985). The estimated depreciation rate for 1948-78 in the U.S. fluctuates between .1429911 and .154306, with a mean value of .15 and standard deviation of .003. Based on this study, and the fact that the U.S. and Canadian agri-food sector are very similar in terms of investment behaviour, a

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[63]Ball (1985) uses the same procedure to calculate capital stock for the agricultural sector in the U.S.

constant depreciation rate of 15 percent was assumed for estimating capital in FVPI.

In order to come up with a better approximation for the capital stock, equation (1) was used to estimate the capital stock for 10 years (1951-84) prior to the data set. This procedure yields a more accurate estimated figure for the beginning of the data set.

11. W^K = Real Rental Rate of Capital

One way of estimating this rate is to employ a relationship which represents a price which an entrepreneur is willing to pay for renting the equipment/machinery/buildings. Major factors determining the real rental rate of capital are: price of capital, average general price level and interest rate. The real rental rate of capital (W^K) can be obtained by the following relationship adopted from Parkin *et al.* (1986; p.166):

$$W^K + \frac{P^K}{P}\left[\left(\delta + r_m\right) - \frac{VP^{Ke}}{P^K}\right]$$

P^K = price of capital

p = average price level

δ = depreciation rate

r_m = market interest rate

$$\frac{VP^{Ke}}{P^K} = \text{Rate as price of capital expected to rise.}$$

For Canada the ratio of pk/p has remained relatively constant for 1926-84.[*]

Furthermore, $\left(\dfrac{VP^{Ke}}{P^K}\right)$ is nothing but the expected rate of inflation (p^e). Therefore,

the real rental rate of capital can be expressed as:

$$W^K = \delta + r_m - p^e = \delta + r$$

where,

     r   = real rate of interest

     δ = is assumed to be 15 percent.

     p^e = expected rate of inflation.

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[*]Capital price rose .3 of a percent relative to consumer goods.For more details please see P. Parkin, and R. Bade, Modern Macroeconomics, Prentice-Hall Canada, 1982, p.236.

APPENDIX C

Plot of the Actual and Estimated Values

PLOT OF NI*YEAR   LEGEND: A = 1 OBS, B = 2 OBS, ETC.
PLOT OF NIHAT*YEAR SYMBOL USED IS *
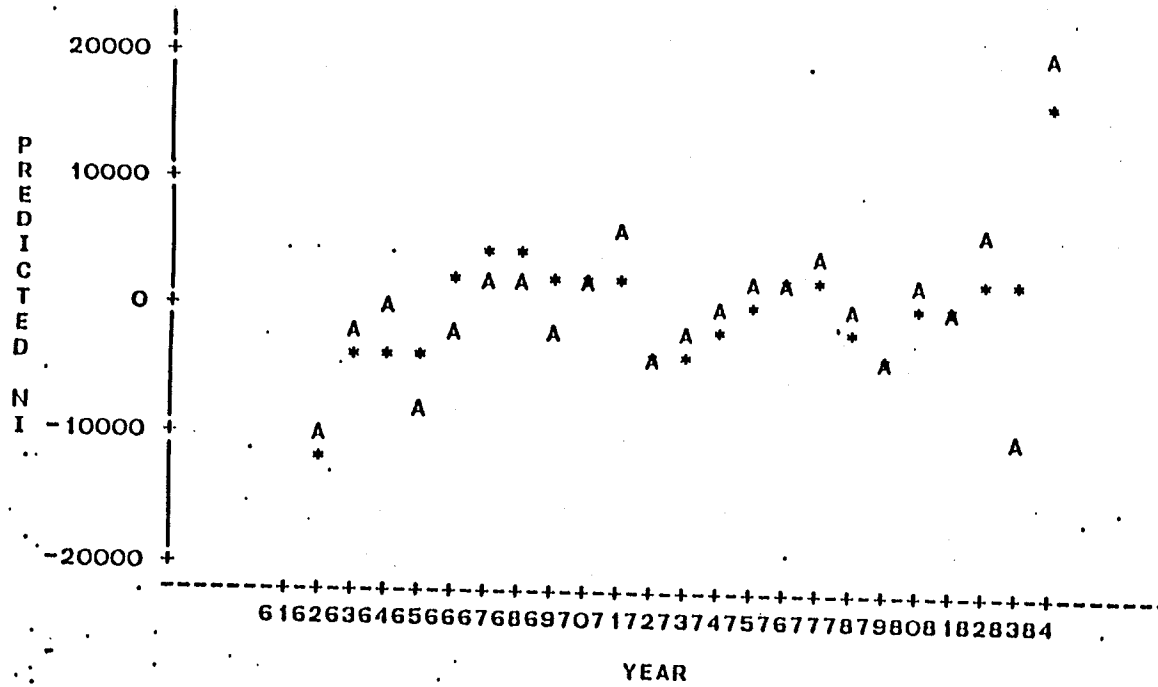
Investment Function

A actual investment
* predicted investment

PLOT OF Q*YEAR   LEGEND: A = 1 OBS, B = 2 OBS, ETC.
PLOT OF QHAT*YEAR   SYMBOL USED IS *
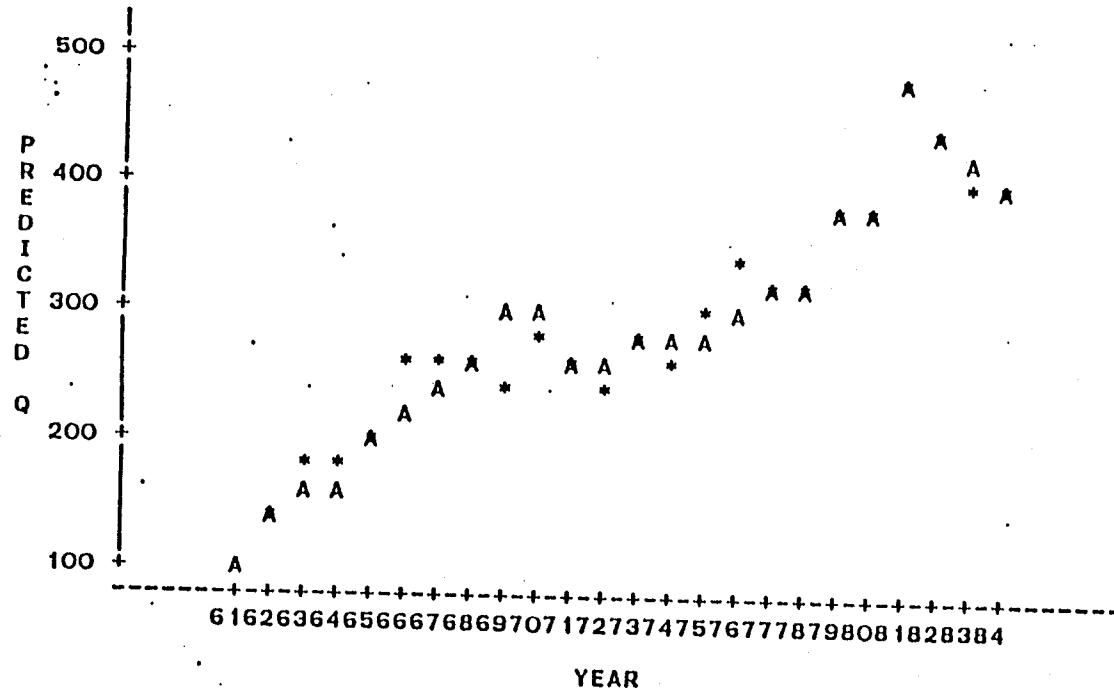
Supply Function

A actual output
* predicted output

```
PLOT OF L*YEAR        LEGEND: A = 1 OBS, B = 2 OBS, ETC.
PLOT OF LHAT*YEAR     SYMBOL USED IS *

        |
   1750 +
        |
P       |
R  1500 +                                              *
E   .   |                                              A
D       |
I  1250 +              A      A                    A      A
C       |            *   *   *                    A      *
T       |           *         *    A  A         A    *
E       |                  A      *            *  *    *     A  A
D  1000 +         A  A  * * A           A A A     A     *  *       A  A
        |         *      A              A A A   A      A
L       |                              *    A
        |
    750 +    .
        |
        |
    500 +    A
     ----+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+----
        6162636465666768697071727374757677787980818283 84
                              YEAR
```
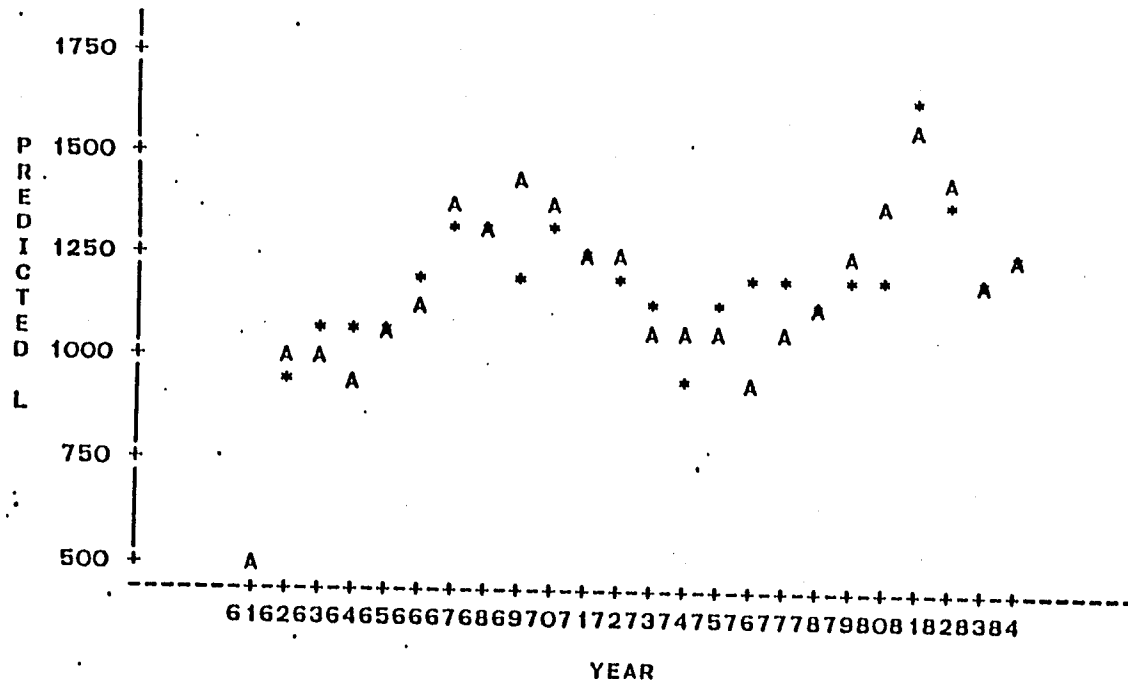
Derived Demand for Labour

A actual demand
* predicted demand

```
    PLOT OF M*YEAR        LEGEND: A = 1 OBS, B = 2 OBS, ETC.
    PLOT OF MHAT*YEAR     SYMBOL USED IS *

    600 +
P                                                    A
R   500 +                                        *
E                                                   A
D                                                     A        A
I   400 +                                   A      *
C                                       A       *      A      A
T                          *  *   A  A  *        A        *   A
E                           A  A  *    *       *    *        *
D   300 +   *          A A          *   A    A
                                   A A          *
M           A  A    *                A A
    200 +       *  A
               A
    100 +   A
        -----+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-----
        616263646566676869707172737475767778798081828384

                              YEAR
```
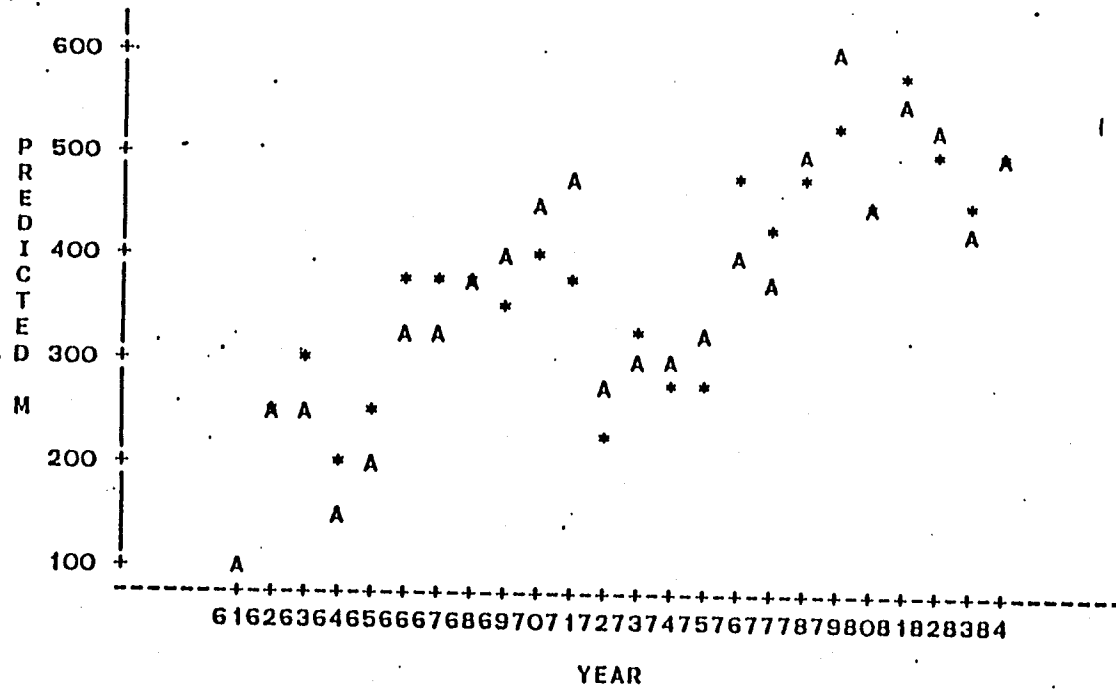
Derived Demand for Raw Material

A   actual demand
*   predicted demand

```
       |
  1250 +
       |                                                          A     A
     P |
     R 1000 +                                                   * * A
     E |                                                          A
     D |
     I  750 +                                                A
     C |                                                  A *
     T |                                              A *
     E |                                              *
     D  500 +                                   * * * * A
       |                               A              A
     E |                       A A A A A         A
       |                   A A   * *   *     A
       |               * A A           *       A
  250 +         * A A
       |         A
       |     A
       |
     0 +
       --------+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+--------
         616263646566676869707172737475767778798081828384

                              YEAR
```
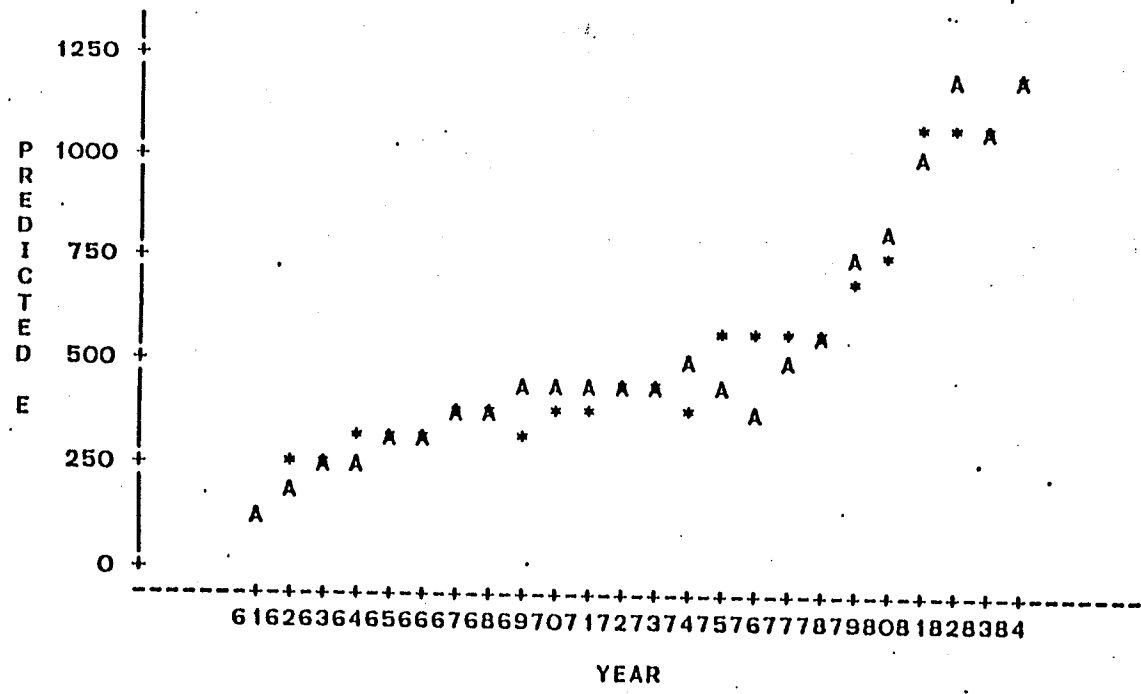
Derived Demand for Energy

A   actual demand
*   predicted demand