A MARKET STRUCTURE FOR HIRED AND FAMILY LABOR IN CANADIAN AGRICULTURE

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ABSTRACT

A MARKET STRUCTURE FOR HIRED AND FAMILY LABOR

IN

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The focus and end-in-view of most agricultural policies has been to raise farm income in Canada as well as in other countries. The lack of estimates of coefficients relating to the major economic variables in explaining farm labor employment would be a major limitation to judge the interrelationships of policies affecting employment and farm labor mobility. In order to satisfy this deficiency, the objectives of this study are to examine the important variables which affect the farm labor market, to estimate the elasticities of demand and supply response for farm labor in respect to the important variables examined, to ascertain the time required for adjusting the current demand for and supply of farm labor to the long-run equilibrium level, to derive a structural relationship between the farm wage rate and the number of farm employment under equilibrium conditions, and to project farm labor requirements up to 1970.

To make the inquiry systematically, it is necessary to hypothesize that the quantity of farm labor demanded depends upon the real farm wage rate (X_1), the parity ratio (X_2), the quantity of farm machinery (X_3), and the productivity (X_4), or the time trend (T) reflecting technological improvements, and that the quantity of farm labor available is responsive to the real farm wage rate (X_1), the "adjusted" non-farm wage rate (X_5), and

the time trend (X_6) connected with economic growth.

Two categories of farm labor, hired and family, are considered in this study. Each of them is analysed on a regional basis. Five regions are formulated on the basis of the existing production pattern and the geographic delimitation, viz, Atlantic region including Nova Scotia, New Brunswick and Prince Edward Island; Quebec region; Ontario region; Prairie region including Manitoba, Saskatchewan and Alberta; and British Columbia region.

In order to test the hypotheses and to make the estimates derived as realistic as possible, it is assumed that the production patterns prevailing in each region are not changeable, that the mobility of farm labor from one region to another is not likely, that the major factors affecting the demand for hired and family labor in all regions are the same, that the major factors affecting the supply of hired and family labor in all regions are the same, and that the linear relationship exists in the structure of farm labor resource.

The statistical models used for analysis of both hired and family labor are made up of a long-run demand function and a long-run supply function, and two adjustment equations, one for the demand function and the other for the supply function. These adjustment equations are introduced under the assumption that neither the quantity of farm labor demanded nor supplied may be adjusted in response to an economic stimulus, immediately and completely within a given time period. Models estimated using Nerlove-type distributed lags give rise to two sets of structural equations--long-run equations and short-run equations. The parameter estimated for the lagged dependent variable implies a coefficient of adjustment which reflects

the relationship between short-run and long-run elasticities. This coefficient of adjustment can be obtained by subtracting the coefficient of the lagged variable from one. The long-run elasticities are derived from the short-run elasticities divided by coefficient of adjustment.

Furthermore, a recursive system exists in the market structure for both hired and family labor since the farm wage rate affecting the demand for hired labor and the supply of family labor is usually lagged one year. Therefore, the supply can be equated to the demand for both hired and family labor under equilibrium conditions. For estimation purposes, these equilibrium structural relations can be reduced into two reduced-form equations in terms of quantity of employment and farm wage rate for hired and family labor.

Based on the above considerations, the algebraic forms of long-run and short-run supply and demand functions for both hired and family labor can be formulated accordingly. With modification of time lags, these models are used for empirical analysis of this study.

The models are all fitted with annual data from 1946 to 1962. Original data are taken from the Dominion Bureau of Statistics and the Canada Department of Agriculture, with the exception of the productivity variable calculated by the writer. In order to be realistic and to reduce the degree of multi-collinearity, modification of data and the aggregation of variables are made accordingly, Furthermore, in order to identify whether the data are randomly distributed, a pre-test of auto-correlation, by using Von Neumann's Ratio as a criterion is also made. It shows that no auto-correlation exists in the residuals of supply and demand for both hired and

family labor in all regions.

In order to make a comparison two experiments were performed on the demand function for both hired and family labor; one used the productivity variable as an alternative to linear trend and another substituted the time variable reflecting technological improvements for the productivity; the former was designated as equation (1) and the latter as equation (2). The reduced-form equations were derived, for prediction purposes, from either equation (1) or (2) depending upon some statistical criteria. Those derived from equation (1) were used for predicting hired labor employment in B. C. and family labor employment in the Atlantic region and B. C.; while those derived from equation (2) were used for predicting both hired and family labor employment in the remaining regions. The aggregation of all regions is for Canada as a whole. Projections of hired and family labor requirements for 1965 and 1970 were made under certain qualifying assumptions.

The empirical results show that the demand for hired labor was apparently not responsive to the farm wage rate in all regions but slowly responsive to the other variables including parity ratio, farm machinery, and productivity; and that the supply of hired labor also was not or less responsive to the variables considered in all regions, with the exception of the farm wage rate in B. C. and the "adjusted" non-farm wage rate in the Atlantic region, both of which were statistically significant at the 10 percent level.

In more than 90 percent of the cases analysed, the price elasticities of demand for family labor were negative and significant in all regions, with the exception of the Prairie. They were low in the short-run and much higher

in the long-run. For the income and the cross elasticities of demand for family labor, the results show that they were significant at the five percent or higher levels only in one region; the former was in B. C. and the latter in the Atlantic, both of which were estimated to be high in the short-run and even higher in the long-run. The elasticity of demand for family labor with respect to the productivity was significant at the five percent or higher levels also in the Atlantic only. It was estimated to be elastic in the short-run and highly elastic in the long-run.

On the supply side, however, the results show that both the price elasticity and the alternative price elasticity of farm labor were consistent in sign with a priori expectations in the Atlantic only, and they were significant at the ten and five percent levels respectively.

The adjustment coefficients were much higher for hired labor than for family labor, suggesting that family labor has been slower than hired labor in adjusting to sustained price changes. Among regions the lowest rate of adjustment for both supply and demand for family labor was in the Prairie. It implies that the elimination of discrepancy between actual and equilibrium levels of employment requires a longer period of time.

The predicted equilibrium level of hired labor employment was greater than the actual level through most of the analysed period in all regions, particularly in the Atlantic and Ontario. In view of the average disequilibrium for the entire period, the hired labor employment was also deficient in all regions. In contrast, the predicted equilibrium level of family labor was less than the actual level throughout the analysed period in most of the regions. The highest average disequilibrium for the entire

period was found in the Prairie and the Atlantic.

Extending 1947-1962 trends, sizeable reductions in the farm labor employment in all regions are projected for 1970. In the eight years after 1962, in Canada as a whole, hired labor is forecast to increase by 14 percent whereas family labor is projected to decline by 42 percent. On a regional basis, the highest percentage of decline in family labor is projected to be in the Atlantic, Quebec, and Ontario regions. In view of decline in the absolute number, the three regions with the largest employment of family workers, i.e. Quebec, Ontario, and the Prairie, account for about 82 percent of the total decline in the future eight years after 1962.

For hired labor it is projected to be declining in the Prairie and B.C., increasing in the Atlantic and Ontario, and constant in Quebec during the 1962-1970 period.

If these projections were realized, 199 thousand man-equivalents of farm labor would likely have to find jobs in other industries in the period from 1962 to 1970, or, on the average, 25 thousand annually.

Judging from the nonsignificant price elasticities of supply in the Atlantic and Ontario, modest efforts through farm programs to raise the farm wage rate will not materially attract more hired labor available in these two regions. The more effective policies may be focussed on some non-economic aspects. For the off-farm migration of family labor, however, programs to raise the farm wage rate, in terms of residual farm income, on the long-term basis may be quite significant. In order to accelerate off-farm migration, general measures, such as more vocational training and re-training of rural youth, with a wide range of skills in non-agricultural fields, more adequate information about non-farm job opportunities, etc., are necessary.

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CHAPTER I

INTRODUCTION

The Canadian population engaged in farming has declined considerably since 1901 in relation to the total population of the country.[1] At the beginning of the twentieth century agriculture was the dominant industry. Of 5.4 million Canadians in 1901, 62.5 percent lived in rural areas, the majority being on farms. Sixty years later, in 1961, however, the farm population had diminished to 39 percent of the total, even though the total population had increased by nearly 13 million between 1901 and 1961. The agricultural labor force, consisting of workers 14 years and over, who are working or seeking work on farms, has also declined. After World War II, the declining rate of the agricultural labor force was much more rapid than that of the farm population. The reduction in the number of the agricultural labor force has been particularly noticeable since the mid-1940's. In 1946, there were 1,191,000 persons in the farm labor force; by 1961 there were only 691,000.[2] This decline fell largely in three of the regions, i.e. the Prairie, Ontario, and Quebec. The reduction in the Prairie accounted for 191,000, in Ontario 154,000, and in Quebec 136,000. Added together the changes in these three regions accounted for 96 percent of the total decline. In contrast with the farm labor force, the number of persons in the total labor force rose from 4.8 to 6.5 million during the same period.[3] Among the regions the greatest increase also occurred in Ontario and Quebec, but

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[1] See Appendix I.

[2] See Appendix II.

[3] See Appendix III.

not in the Prairie. It is obvious that, with the rapid decline in the farm labor force and the continued growth in the non-farm labor force, there has been a sharp accentuation of the decline in agriculture in the Canadian economy, particularly in Ontario and Quebec.

Compared with the non-agricultural industries,[4] agriculture in the recent decade has lost its importance, from the largest industry down to fifth, in all regions except the Prairie, in terms of employment.[5] The non-agricultural sector is composed of five components, namely manufacturing and mechanical; trade and finance; construction and transportation; mining, logging, fishing and trapping; and services. With the single exception of the second last component, all were larger than agriculture, as far as employment was concerned, in 1961.

The diminishing importance of agriculture has been the inevitable concomitant of the advances in technology which have encouraged the growth of secondary and tertiary industries. Mechanization and continuously improved techniques of production are the main reasons for successively employing less manpower year by year. Numbers of various kinds of machinery have remarkably increased in all regions, especially in the Prairie.[6] The other reason explaining the decline is the low income

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[4]The ten non-agricultural industries and agriculture make up the eleven Canadian industries as defined in the DBS Standard Industrial Classification of 1951. For convenience, the ten non-agricultural industries have been aggregated five principal components according to their close natures, as given in Appendix IV.

[5]See Appendix IV.

[6]See Appendix V.

elasticity of demand for farm products.[7] As per capita income increases,[8] a smaller proportion of total income is required to meet food expenses and higher proportions of income are spent on non-farm products.[9] Thus, while other industries continue to grow, the agricultural industry steadily falls behind.

In the voluminous literature,[9a] previously studied, dealing with migration and the agricultural labor force, little attention has been given to estimating the structural demand and supply relations underlying this sizeable resource transfer in agriculture. The focus and end-in-view of most agricultural policies has been to raise farm income. The inter-relationships of policies affecting employment and farm labor mobility might not be judged adequately if the estimates of coefficients relating to the major economic variables in explaining farm labor employment were not available.

A. Objectives of the Study

In order to obtain some useful information for the agricultural policy maker, the objectives of this study are stated as follows:

(1)To examine the important variables which affect the demand for and supply of farm labor;

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[7]See Appendix VI.

[8]See Appendix VII.

[9]Refer to Engel's Law

[9a]Refer to Appendix XIV

(2) To estimate the elasticity of demand and supply response for farm labor in respect of the important variables examined;

(3) To estimate the time required for adjusting the current demand for and supply of farm labor to the long-run equilibrium level;

(4) To derive a structural relationship between the farm wage rate and the number of farm employment under equilibrium conditions; and

(5) To predict farm labor required for the year 1970.

B. Hypotheses and Assumptions

To make the inquiry systematically, it is necessary to set up the relevant hypotheses from the theoretical structure of farm labor resource by referring to the problematic situation. The relevant hypotheses are:

(1) The demand for and supply of farm labor are responsive to the farm wage rate.

(2) The demand for farm labor is responsive to the prices received by farmers for all commodities.

(3) The demand for farm labor is responsive to the quantity of farm machinery.

(4) The supply of farm labor is responsive to the change of the non-agricultural wage rate adjusted by the unemployment rate.

(5) The demand for farm labor is affected by technological improvement.

(6) The demand for and supply of farm labor are changed in the time trend connected with economic growth.

These hypotheses are empirically testable and are confirmed with

empirical phenomena in view of the historical data. However, they are established under the following assumptions:

(1) The production patterns that have been prevailing in each region are not changeable.

(2) The mobility of agricultural labor from one region to another is not likely.

(3) The major factors affecting the demand for farm labor in all regions are the same.

(4) The major factors affecting the supply of farm labor in all regions are the same.

(5) The linear relationship exists in the structure of farm labor resource.

(6) Agricultural labor is assumed to be homogeneous.[9b]

C. Scope of the Study

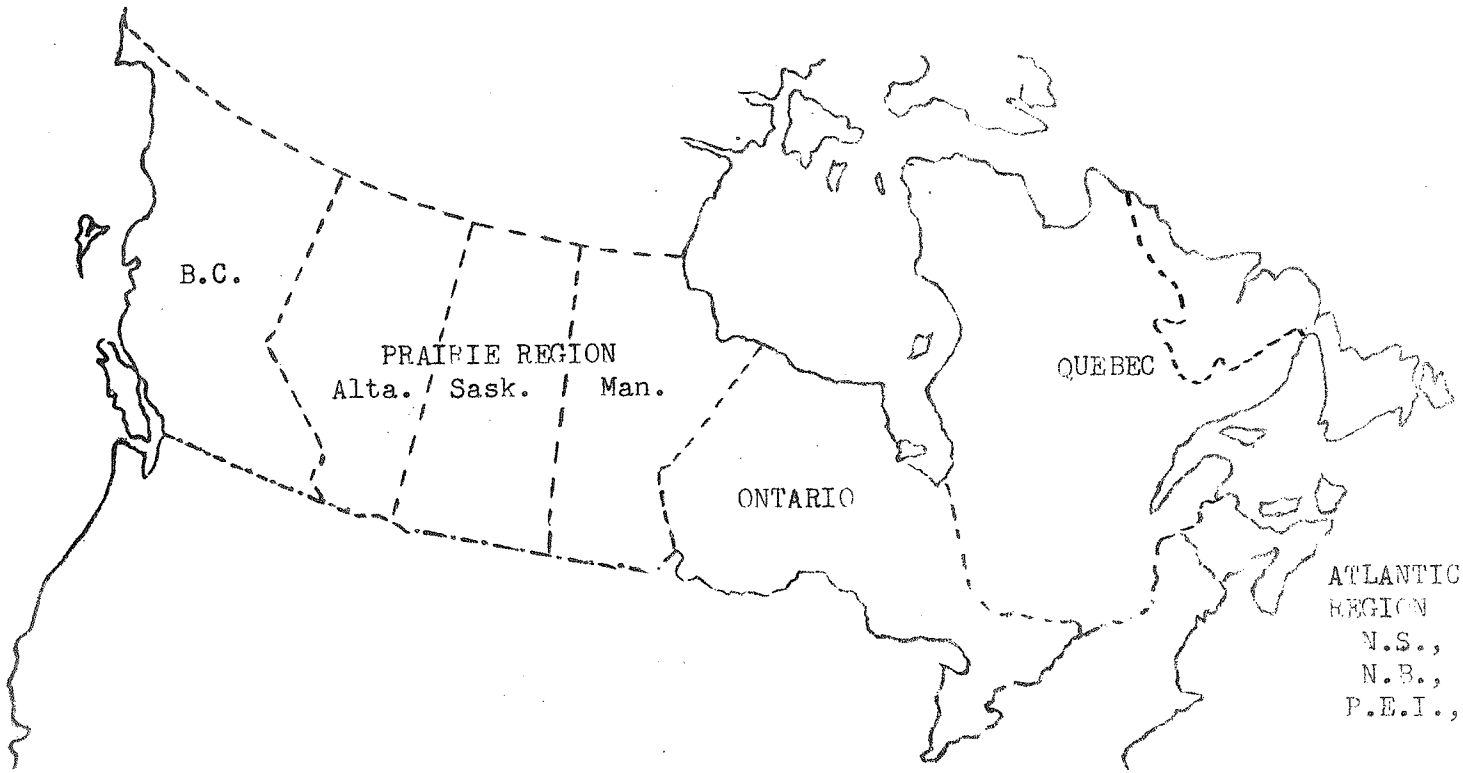
In this study two categories of agricultural labor--hired and family--are considered. Each of them is analyzed on a regional basis. Based on the existing production pattern and the geographic delimitation, five regions are formulated, namely the Atlantic region, including Nova Scotia, New Brunswick, and Prince Edward Island; the Quebec region; the Ontario region; the Prairie region, including Manitoba, Saskatchewan, and Alberta; and the British Columbia region (Figure I). Because of paucity of data, the time period of this study only covers 17 years, from 1946 to 1962. During this period there was no particular abnormality in the sequence of events which might distort the structural demand and supply relations for the farm labor force. Thus, an accurate assessment of the problem under study can be expected.

[9b] Refer to Appendix XIV.

This dissertation is composed of seven chapters. The introductory chapter gives a brief statement of the problematic situation, the objectives of the study, hypotheses and assumptions, and the scope of the study. The historical changes in Canadian agricultural labor, divided into four periods, viz, the settlement period from 1901 to 1930, the depression period from 1930 to 1939, the war-time period from 1940 to 1945, and the mechanization period from 1946 to the present, are illustrated in Chapter II. The third chapter is concerned with the theoretical framework, and the fourth chapter presents the methodology to be used. The central theme in Chapter V is to deal with the interpretation of empirical results. Chapter VI is devoted to the predictions and their implications. The last chapter gives the conclusions and recommendations.

FIGURE 1

MAP OF CANADA AND THE FIVE LABOR FORCE REGIONS



CHAPTER II

HISTORICAL REVIEW

Over the past decades, the rapid growth of the Canadian economy has brought about several dramatic changes in the agricultural labor force. Early in the century, farm workers were in great demand when agricultural settlement was spreading quickly across the Western provinces. The reverse was the case in the 1930's, when widespread unemployment during the depression period prevailed in all parts of the country. During the period of World War II, manpower was extremely tight. It was, however, not until the end of the War that the extensive application of farm mechanization eased the severe situation. In view of these different conditions, the use of farm manpower in Canada can broadly be divided into four distinct periods. The following table shows the changes in the farm labor force in different periods:

TABLE I

CHANGES IN THE CANADIAN AGRICULTURAL LABOR FORCE IN VARIOUS PERIODS

Number of the agricultural labor force, 1963 (in thousands)	Percentage change			
	1901-31	1931-39	1939-45	1945-63
655	+57.3	+22.3	-17.0	-42.7

Source: Computed from Ninth Census of Canada and Reference Paper No. 23, revised, Dominion Bureau of Statistics, Canada.

A. The settlement period

This period, from 1901 to 1930, was characterized by a rapid growth in agriculture, especially in the Prairie provinces. Owing to the expansion in agricultural settlement under the homestead program,[10] land was plentiful, and labor was relatively scarce.[11] Many young men and women from older communities in Ontario, Quebec, and the Atlantic provinces, as shown in Table II, were attracted by the rapidly growing settlements in the Prairie provinces. These young people migrated to the West either as farm operators or as wage earners. Moreover, a considerable number of workers was drawn from the U. S. and the European countries at that time in order to meet the urgent need of labor in Prairie agriculture.

While large quantities of manpower were added in the western part of Canada, some labor adjustments were also taking place in the older farming regions of the country. These changes were associated in the northern sections of Quebec and Ontario with the development of new farming areas but, in the main, they reflected either a stable or a declining position in agriculture as compared with the rapid growth in other industries. This

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[10] The homestead policy, under which 160 acres of land were given free to settlers in Western Canada, provided they fulfilled residence and other requirements, was introduced by the Dominion Lands Act, 1872. The government discontinued the policy in 1930 when the natural resources were transferred to the Prairie provinces.

[11] cf. Andrew Stewart, "Changes in Method of Agricultural Production in the Prairie Provinces," Economic Organization of Canadian Agriculture, edited by J. F. Booth, the Canadian Council, International Conference of Agricultural Economists (1940) p.126.

TABLE II

CHANGES IN THE PERCENTAGE DISTRIBUTION OF FARM LABOR FORCE AMONG REGIONS, 1901-63*

Year	Canada	Atlantic	Quebec	Ontario	Prairie	B.C.
1901	100	17.4	27.3	42.7	11.2	1.4
1911	100	12.2	21.9	32.9	30.3	2.7
1921	100	11.0	21.1	28.4	36.1	3.4
1931	100	9.6	20.2	27.0	39.3	3.9
1941	100	8.9	23.5	24.9	38.8	3.9
1946	100	7.8	23.3	27.0	39.3	2.6
1951	100	6.6	24.5	25.3	40.6	3.0
1961	100	8.4	20.5	24.2	42.7	4.2
1963	100	5.6	19.4	26.4	45.5	3.1

*Source: Computed from Appendix II.

development has encouraged a steady flow of young people out of agriculture in the Eastern provinces during the early decades of the century.[12] In Southern Ontario and in the vicinity of Montreal in Quebec, agricultural production became more intensive and, therefore, required more manpower. In the Atlantic provinces, some consolidation of farms was taking place during this period but the main development was a decline in improved farm acreage.[13] In addition to the absence of rapid economic expansion, generally, in this region, the reduction in farm acreage was the natural consequence of many acres of crop land being considered more suitable for lumbering activities in terms of profitability on the one hand and the existence of more lucrative employment opportunities in other parts of Canada and in the U.S. on the other.

Throughout its growth period up to 1930, some changes were, at the same time, also taking place in the internal composition of the farm working force. A high percentage of farmers were operators, and unpaid family workers counted for a small proportion of the total labor force in the Western provinces at that time. In the Atlantic provinces, the percentage of unpaid family workers during this period was higher than it was at the beginning of the century. Comparatively, the Prairie provinces had a relatively low percentage of unpaid family workers. The higher ratio in the Atlantic region reflected the relatively more scarce employment opportunities in non-agricultural sectors. Besides, employment opportunities available to

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[12] See Appendix II.

[13] See Table III.

potential operators were much more limited in the Atlantic provinces. British Columbia was the only region where the number of wage earners was consistently higher than the number of unpaid family laborers.[14] This was largely due to the dominance of dairying, market gardening, and fruit growing activities, all of which require high labor inputs. In Ontario, the proportion of wage earners on farms was also relatively higher than in other regions because the farm enterprises of beef cattle, dairying, and intensive cash crops demand more labor.

Extensive farming operations, particularly grain and ranching, had set the broad pattern of labor utilization in the Prairie region. In 1901, the average acreage per farm in this region was more than 100, compared with well below 70 acres in the other regions (Table III). At the same time, the number of cattle, other than milk cows, in the Prairie region, also exceeded that of the other regions, with the single exception of Ontario (Table IV). A large increase has also occurred in the number of the farm working force in the Prairie region during this period.[15] The growth of manpower was far from commensurate, however, with that of improved acreage. This fact is strikingly illustrated in a comparison of improved acreage-farm working force ratios (Table V). Acres per farm worker were doubled in the Prairie region, decreased by 66 percent in British Columbia, and showed very little change in the Atlantic, Quebec, and Ontario regions during this period. Meanwhile, livestock population on Prairie farms had also increased

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[14] See Census of Canada, 1931, Dominion Bureau of Statistics.

[15] See Table III.

TABLE III

IMPROVED ACREAGE IN FARMS, NUMBER OF FARMS, AND FARM WORKING FORCE, CANADA AND REGIONS, 1901-1961*

Year	Canada	Atlantic	Quebec	Ontario	Prairie	B. C.
			Improved acreages (in thousands)			
1901	30,166	3,393	7,440	13,266	5,593	474
1911	48,734	3,471	8,162	13,653	22,970	478
1921	70,770	3,128	9,065	13,169	44,863	545
1931	85,732	2,941	8,994	13,273	59,819	705
1941	91,636	2,785	9,063	13,363	65,532	893
1951	96,853	2,314	8,829	12,693	71,840	1,148
1956	100,326	2,227	8,630	12,572	75,706	1,167
1961	103,403	1,811	7,864	12,033	80,370	1,303
			Number of farms (in thousands)			
1901	511	105	140	204	55	7
1911	682	104	150	212	199	17
1921	711	99	138	198	255	22
1931	729	86	136	192	289	26
1941	733	77	155	178	297	26
1951	623	60	134	150	249	26
1956	575	53	123	141	232	25
1961	481	32	96	121	210	20
			Farm working force (in thousands)			
1901	717	125	196	306	80	10
1911	934	114	205	307	283	25
1921	1,035	114	218	294	374	35
1931	1,128	108	228	305	443	44
1941	1,084	96	255	270	421	42
1951	943	62	231	239	383	28
1956	781	50	166	215	324	26
1961	691	58	142	167	295	29

*Source: Ninth Census of Canada, and Census of Canada, 1961, Dominion Bureau of Statistics, Ottawa.

TABLE IV

LIVESTOCK AND POULTRY ON FARMS, CANADA AND REGIONS, 1901-1961*

Year	Canada	Atlantic	Quebec	Ontario	Prairie	B. C.
			Cattle-milk cows (in thousands)			
1901	2,409	306	768	1,066	244	25
1911	2,595	290	754	1,033	484	34
1921	3,229	274	801	1,065	1,022	67
1931	3,523	253	851	1,118	1,199	102
1941	3,626	269	1,001	1,156	1,108	92
1951	2,908	200	896	922	803	83
1961	2,990	171	1,007	992	725	92
			Cattle other than milk cows (in thousands)			
1901	3,167	350	598	1,422	697	100
1911	3,931	333	699	1,469	1,325	105
1921	5,141	332	794	1,569	2,303	143
1931	4,450	282	857	1,396	1,784	131
1941	4,891	237	756	1,484	2,181	233
1951	5,463	226	745	1,544	2,706	238
1961	8,952	274	908	2,123	5,271	370
			Pigs (in thousands)			
1901	2,354	145	404	1,563	200	42
1911	3,635	207	794	1,888	712	34
1921	3,324	162	691	1,386	1,043	42
1931	4,700	170	728	1,359	2,391	52
1941	6,081	160	808	1,882	3,153	78
1951	4,916	199	1,108	1,755	1,802	49
1961	5,333	149	912	1,686	2,542	42
			Sheep (in thousands)			
1901	2,510	593	655	1,046	183	33
1911	2,174	471	637	742	285	39
1921	3,200	565	856	979	739	61
1931	3,627	418	734	1,045	1,284	146
1941	2,840	275	526	662	1,251	126
1951	1,479	185	317	360	532	67
1961	1,564	142	195	341	767	103
			Poultry (in thousands)			
1901	17,923	2,094	3,284	10,465	1,717	363
1911	31,793	2,698	5,162	14,489	8,432	1,012
1921	43,347	2,851	5,482	16,504	16,495	2,015
1931	65,153	3,548	8,165	23,736	25,343	4,361
1941	63,471	3,137	8,318	23,057	26,172	2,787
1951	67,934	3,983	10,583	24,738	24,831	3,730
1961	77,995	3,837	13,731	27,645	26,375	6,174

*Source: Ninth Census of Canada and Census of Canada, 1961, Dominion Bureau of Statistics.

TABLE V

CHANGES IN RATIO OF THE IMPROVED ACREAGE TO THE FARM WORKING FORCE, CANADA AND REGIONS, 1901-1961*

Year	Canada	Atlantic	Quebec	Ontario	Prairie	B.C.
	.....Acres per farm worker.....					
1901	42.1	27.1	38.0	43.4	69.9	47.4
1911	52.2	30.4	39.8	44.5	81.2	19.1
1921	68.4	27.4	41.6	44.8	120.0	15.6
1931	76.0	27.2	39.4	43.5	135.0	16.0
1941	84.5	29.0	35.5	49.5	155.7	21.3
1951	102.7	37.3	38.2	53.1	187.6	41.0
1956	128.5	44.5	52.0	58.5	233.7	44.9
1961	149.6	31.2	55.4	72.1	272.4	44.9

*Source: Computed from Table III.

rapidly[16] (Table VI). The population of five major livestock groups on Prairie farms in 1931 was higher than that in any of the other four regions.

B. The Depression Period

As the rapid expansionary years in agriculture began to tail off, the great depression period set in. This period lasted ten years, from 1930 to 1939, during which time many people moved from urban centres into agriculture. This is a common feature of prolonged depression periods because the manufacturing plants usually reduce output or close down when faced with a loss of markets. In this crucial period, the unemployed urban workers, in the absence of unemployment insurance, preferred to return home to the farm rather than live on relief in urban centres. Others who had always lived in urban centres were persuaded to join the "back-to-the-land" movement. Agriculture, unlike the manufacturing plants, still tended to keep going in spite of the decline in prices and the difficulties of marketing farm products. There was a strong tendency for farmers to increase production in an effort to maintain income. For these reasons the labor force in agriculture apparently increased by 22.3 percent during the depression period. There was also a substantial inter-regional shift of manpower. In the Prairie region, in addition to the economic setback, natural hazards, such as drought, rust, grasshopper and other insect infestations[17] were to aggravate the depressed economy. Many families were forced to leave their

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[16] Actual figures are given in Table IV.

[17] cf. Britnell, The Wheat Economy, p. 63.

TABLE VI

TRENDS IN LIVESTOCK AND POULTRY ON FARMS, CANADA AND REGIONS, 1901-1961*
1901=100

Year	Canada	Atlantic	Quebec	Ontario	Prairie	B. C.
			Cattle--milk cows			
1901	100.0	100.0	100.0	100.0	100.0	100.0
1911	107.7	94.8	98.2	96.9	198.4	136.0
1921	134.0	89.5	104.3	99.9	418.9	268.0
1931	146.2	82.7	110.8	104.9	491.4	408.0
1941	150.5	87.9	130.3	108.4	454.1	368.0
1951	120.7	65.4	116.7	86.5	329.1	332.0
1961	124.1	55.9	131.1	93.1	279.1	368.0
			Cattle other than milk cows			
1901	100.0	100.0	100.0	100.0	100.0	100.0
1911	124.1	95.1	116.9	103.3	190.1	105.0
1921	162.3	94.9	132.8	110.3	330.4	143.0
1931	140.5	80.6	143.3	98.2	256.0	131.0
1941	154.4	67.7	126.4	104.4	312.9	233.0
1951	172.5	64.6	124.6	108.6	388.2	238.0
1961	282.7	78.3	151.8	149.3	756.2	370.0
			Pigs			
1901	100.0	100.0	100.0	100.0	100.0	100.0
1911	154.4	142.8	196.5	120.8	356.0	81.0
1921	141.2	111.7	171.0	88.7	521.5	100.0
1931	199.7	117.2	180.2	86.9	1,195.5	123.8
1941	258.3	110.3	200.0	120.4	1,576.5	185.7
1951	208.8	137.2	274.3	112.3	901.0	116.7
1961	226.6	102.8	225.7	107.9	1,271.0	100.0
			Sheep			
1901	100.0	100.0	100.0	100.0	100.0	100.0
1911	86.6	79.4	97.3	70.9	155.7	118.2
1921	127.5	95.3	130.7	93.6	403.8	184.8
1931	144.5	70.5	112.1	99.9	701.6	442.4
1941	113.1	46.4	80.3	63.3	683.6	381.8
1951	58.9	31.2	48.4	34.4	290.7	203.0
1961	62.3	23.9	29.8	32.6	419.1	312.1
			Poultry			
1901	100.0	100.0	100.0	100.0	100.0	100.0
1911	177.4	128.8	157.2	138.5	491.1	278.8
1921	241.9	136.2	166.9	157.7	960.7	555.1
1931	363.5	169.4	248.6	226.8	1,476.0	1,201.4
1941	354.1	149.8	253.3	220.3	1,524.3	767.8
1951	379.0	190.2	322.2	236.4	1,446.2	1,027.5
1961	435.2	183.2	418.1	264.2	1,536.1	1,700.8

*Source: Computed from Table IV.

holdings in the drought-stricken Prairie. Some who came originally from Eastern Canada had returned to join new farming settlements in the northern regions of Quebec and Ontario. The movement of the agricultural labor force is shown in Table II.

To sum up, no shortage of farm labor occurred during this period. There were not only few opportunities available elsewhere for the usual flow of labor out of agriculture, but also many who lost their jobs in other industries returned to the farm. As a result a substantial amount of unemployment developed in agriculture.[18]

C. The War-time Period[19]

The growth in the agricultural labor force in Canada reached a peak in 1939 and, since then, has declined rapidly. During the War the increasing demand for high-protein food such as beef and pork, etc. both in Europe and at home, made it necessary for the pig and cattle populations to be augmented significantly in 1941.[20] The increased population of livestock required more labor on farms. This development, plus the mass exodus of young men and women to join the Armed Services or to take advantage of the higher wages offered in non-agricultural industries, was not only to wipe out the farm labor surplus which had been built up during the depression period, but was also to result in severe shortages of farm labor. There were only 1,118,000

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[18] The amount of surplus labor on Canadian farms during the 1930's is not revealed by the decennial Census Data.

[19] World War II.

[20] See Table IV.

persons employed in agriculture in 1943.[21]

D. The Mechanization Period

With the end of the war, the farm labor force rose in numbers briefly with the re-establishment of veterans on farms in 1946. However, shortly after this time, it began to taper off and has been decreasing rapidly. As measured by the average annual data for persons employed in agriculture, the number of farm workers[22] in Canada declined from 1,186,000 in 1946 to 641,000 in 1963 (Table VII). The total decline of 545,000 workers, therefore, averaged approximately 32,000 per year. Among the five regions, the Prairie, Ontario and Quebec have experienced the greatest reduction in absolute numbers between 1946 and 1963. The decline in the Prairie accounted for 171,000 of the total decline of 545,000 workers. Ontario and Quebec suffered losses of 150,000 and 154,000 workers respectively. In sum, the changes in these three regions accounted for 87 percent of the total decline in Canada. For the decreasing rate in the period, 1946-1963, the number of persons employed in Canadian agriculture was declining at an average compound rate of 2.7 percent per year (Table VIII). Among the three regions with the largest number of farm workers, (i.e. Ontario, Quebec and the Prairie) the highest rate of decline was not registered in the Prairie, but in Quebec.

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[21] Refer to Reference Paper No. 23, revised, Dominion Bureau of Statistics.

[22] Including all groups of employment status, age, and sex.

TABLE VII

PERSONS EMPLOYED IN AGRICULTURE: CANADA AND REGIONS, ANNUAL AVERAGES,[a] 1946-1963*

Year	Canada[b]	Atlantic[b]	Quebec	Ontario	Prairie	B. C.
	.....thousands of persons.....					
1946	1,186	92	277	320	466	31
1947	1,122	86	253	300	450	33
1948	1,096	81	246	290	444	35
1949	1,077	81	242	285	432	37
1950	1,018	78	254	254	403	29
1951	939	62	229	238	382	28
1952	891	58	209	228	375	21
1953	858	56	203	220	358	21
1954	878	50	214	253	338	23
1955	819	49	172	236	331	31
1956	776	49	165	213	323	26
1957	744	53	171	192	305	23
1958	712	56	161	175	296	24
1959	692	56	154	174	284	24
1960	675	55	135	177	279	29
1961	674	56	137	162	293	26
1962	653	46	131	157	293	26
1963	641	35	123	170	295	18

*Source: Labor Force Surveys, Dominion Bureau of Statistics, Ottawa.

[a]Average for 1953 to 1963 are based on monthly surveys, while before 1953 they are based on quarterly surveys.

[b]Newfoundland included from 1950.

TABLE VIII

TRENDS IN NUMBER OF PERSONS EMPLOYED IN AGRICULTURE, CANADA AND REGIONS, 1946-1963*

1946=100

Year	Canada	Atlantic	Quebec	Ontario	Prairie	B. C.
	.....Percentage.....					
1946	100.0	100.0	100.0	100.0	100.0	100.0
1947	94.6	93.5	91.3	93.8	96.6	106.5
1948	92.4	88.0	88.8	90.6	95.3	112.9
1949	90.8	88.0	87.4	89.1	92.7	119.4
1950	85.8	84.8	91.7	79.4	86.5	93.5
1951	79.2	67.4	82.7	74.4	82.0	90.3
1952	75.1	63.0	75.5	71.3	80.5	67.7
1953	72.3	60.9	73.3	68.8	76.8	67.7
1954	74.0	54.3	77.3	79.1	72.5	74.2
1955	69.1	53.3	62.1	73.8	71.0	100.0
1956	65.4	53.3	59.6	66.6	69.3	83.9
1957	62.7	57.6	61.7	60.0	65.5	74.2
1958	60.0	60.9	58.1	54.7	63.5	77.4
1959	58.3	60.9	55.6	54.4	60.9	77.4
1960	56.9	59.8	48.7	55.3	59.9	93.5
1961	56.8	60.9	49.5	50.6	62.9	83.9
1962	55.1	50.0	47.3	49.1	62.9	83.9
1963	54.0	38.0	44.4	53.1	63.3	58.1
Average decreasing rate	2.7	3.6	3.3	2.8	2.2	2.5

*Source: Computed from Table VII.

The decline in the agricultural labor force in this period is radically different from that experienced in the war-time period; the former could be called the "push out" phase and the latter the "pull out" phase. Since the beginning of this period the number of farms has become increasingly fewer and the size of the farm, on the other hand, larger and larger.[23] Reduction in the number of farms will naturally result in reduction of that part of the farm labor force made up of the farmers themselves. In addition, the large and extensive increase in farm mechanization[24] has replaced many workers. If farm consolidation and mechanization continue, further decline in the farm labor force can be expected in the near future.

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[23] See Table III

[24] See Appendix V.

CHAPTER III

THEORETICAL FRAMEWORK

The purpose of this chapter is to provide the relevant theoretical framework to guide the empirical investigation of supply of and demand for farm labor resources in a dynamic situation. In order to discuss the theoretical consideration relevant to this study, it is necessary to resort to the concept of economic dynamics. The relevant theory based on this concept will involve a brief discussion of the production function, the resources demand and supply functions, the recursive system, and the state of equilibrium.

A. The Concept of Economic Dynamics

Hicks defines economic dynamics as those parts of economic theory where every quantity must be dated.[25] Harrod, in his "Toward A Dynamic Economics", suggests that dynamics should be confined to the dynamic of continuing changes as against once-and-for-all changes. Frisch argues by saying that a system is dynamic if values of variables at different points of time are involved in an essential way.[26] It is clear from these definitions that dynamics refers to the situation where continuous changes are

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[25] J. R. Hicks, Value and Capital, Oxford: At the Clarendon Press, Second Edition, 1946, p. 115.

[26] Ragnar Frisch, "On the Notion of Equilibrium and Disequilibrium," Review of Economic Studies, 1935-1936.

taking place in the economy under consideration and where the method of analysis is such that the passage of time is considered in any case. Economic dynamics enables one to predict, not only in the sense of forecasting but also in the general sense of relating an event to the events which preceded it. Accordingly, it may also be defined as the study of economic phenomena in relation to interpreting events over time. And the dynamic analysis is concerned with the analysis of changes in the economy. In analyzing a situation like this, special attention should be given to the varying kinds of lags, to the way in which economic forces produce changes, and to the paths of those changes.

B. The Production Function

There are many forms of production functions. The general production function may be expressed as:

$$Y = f(X_1, X_2, \ldots\ldots X_n) \quad \ldots\ldots (1)$$

where $X_1, X_2, \ldots X_n$ are resources used in the production of output Y. If π is designated as profit, then the profit function can be presented as:

$$\pi = f(X_i)P_Y - \sum_{i=1}^{n} P_i X_i, \; (i = 1, 2, \ldots n) \quad \ldots\ldots (2)$$

where P_Y stands for the price of output, and P_i for the prices of various inputs. In other words, profit is the difference between gross revenue and total costs. Profit is maximized when all resources are used at levels such that their net marginal return is zero. Hence, the conditions of profit maximization are defined in equations (3a-c) by setting the partial

derivatives of profit with respect to each resource equal to zero.[27]

$$\frac{\partial \pi}{\partial X_1} = \frac{\partial Y}{\partial X_1} P_Y - P_1 = 0 \quad \text{.....(3a)}$$

$$\frac{\partial \pi}{\partial X_2} = \frac{\partial Y}{\partial X_2} P_Y - P_2 = 0 \quad \text{.....(3b)}$$

$$\vdots$$

$$\frac{\partial \pi}{\partial X_n} = \frac{\partial Y}{\partial X_n} P_Y - P_n = 0 \quad \text{.....(3c)}$$

From these equations, it is obvious that the magnitude of input of each factor depends on the technical coefficients in the production function (1) and the magnitude of prices for resources and products. In a static economy, prices of both inputs and outputs are assumed to be given, the size of profit depends solely upon the technical coefficients. The entrepreneurs need only consider employing such-and-such quantities of factors and producing such-and-such quantities of products, and need not ask when the factors should be employed and when the products should come to be ready for sale. Under dynamic situations, however, the prices of both inputs and outputs vary through time and the magnitude of profit does not only depend on the technical coefficients but also the prices on inputs and outputs. The entrepreneurs should ask such questions about prices and even pay special attention to the changes which affect the relationship between factors and products.

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[27] cf. E.O. Heady, Economics of Agricultural Production and Resource Use, N.J., Prentice-Hall Inc., 1961. pp. 1-200.

C. The Resource Demand Function

The demand functions for resources are derived by solving the equilibrium equations (3a-c) for X_i. The equations must be solved simultaneously for the X_i if interaction among resources is present. If resources are independent in production, each equation can be solved individually for X_i. The implicit demand function for the i-th resource may be expressed as:

$$X_i = f\left(\frac{P_i}{P_Y}, \frac{P_j}{P_Y}, X_k\right) \quad \ldots\ldots(4)$$

where P_j is the price of substituting resource for X_i, and X_k the level of other factors which affect the demand for X_i. With modifications for time lags and other real world conditions, equation (4) is used as a general basis for the empirical model of factor demand.

The use of price ratios in static demand functions does not appear to be justified in a dynamic model. Farmers must make their decisions about how much X_i should be used on the basis of expected rather than actual product prices because of the length of the farm production period. When the production plans are made, considerable uncertainty may exist about output price, due to time lag in production. However, planning the level of use, purchasing and applying inputs are nearly concurrent actions and input prices are subject to little uncertainty. Thus the use of price ratios in dynamic models could be expected to decrease the demand quantity of resources, and is not strictly correct from a logical standpoint.

Although some controversy exists over the appropriateness of price ratios in dynamic models, they have certain advantages in statistical time series application as follows:

1. Avoidance of errors from use of general price deflators,

2. Reduction of multicollinearity, and

3. Increase in degrees of freedom.

These advantages may justify the use of ratios if the errors are not large. If the sacrifice in higher intercorrelations, a loss of degrees of freedom, and errors from the general deflators are considered less than forcing a symmetric response to input and output prices, the separate input and output price variables should be considered in the regression analysis.

The quantity demanded for labor resource in agriculture depends upon the wage rate and other related factors, such as prices received by farmers, farm machinery in stock, etc. The wage rate is considered as an endogenous variable and the related factors as exogenous variables. For the hired farm labor, all factors affecting the quantity of demand are assumed to be lagged one year because there is a planning period during which farm operators plan to hire farm labor for the succeeding year based on the current wage rate and the level of other related factors. For the farm family labor, however, the quantity demanded depends upon the current price of labor (residual farm income) and other related factors with the exception of the farm price received, which is lagged one year.

From this functional relationship of demand for farm labor, the elasticity[28] of demand for labor with respect to each variable can be derived.

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[28]The elasticity of factor X with respect to its own price, i.e. price elasticity, is defined as $\frac{dx}{dP} \cdot \frac{P}{X}$ where P and X are mean values if it denotes average elasticity; P and X are single values if it denotes point elasticity. In the same way the elasticity of factor X with respect to other factors can also be defined.

The higher the elasticity, the more responsive is the demand for farm labor to a change in the variable.

D. The Resource Supply Function

The resource structure of an industry depends not only on the nature of factor demand function but also the nature of the supply function for resources. A general supply function for a resource X_i may be expressed as:

$$X_i = f(P_i, P_i', X_k) \quad \ldots\ldots(5)$$

where P_i is the input price of X_i in an industry, P_i' the input price of X_i for an alternative use, and X_k the other related factors affecting the supply of X_i. Like a demand function, equation (5) becomes the basis for the empirical model of factor supply after a modification for time lags and other real world conditions.

Consider again supply of labor resource in agriculture. The quantity of labor available depends upon the wage rate offered, the alternative income opportunities, and the other related factors such as the size of the civilian labor force, etc. For hired farm labor, the quantity supplied is usually determined by current farm wage rates as compared with the non-farm wage rate. In contrast, the residual farm income affecting the quantity of farm family labor supplied could be lagged one year because whether the family labor is used on farm or is employed in non-farm industries is based on the comparison of residual farm income in the preceding year with non-farm wage rates.

The labor supply elasticity with respect to its own price and other related factors can be derived from the supply function. The elasticity describes the degree of responsiveness of the labor supply to a change of

respective variables.

E. The Recursive System

The early econometric analysis of supply and demand from time series data assumed a monocausal relationship. That is, price (or quantity) was chosen as the dependent (effect) variable, and was considered as a function of the quantity (or price) and other independent (causal) variables. H. Schultz and E. J. Working disagree with this simple cause-effect relationship.[29] They realized that only under certain conditions could the structural demand or supply function be identified by using the single equation, least-squares statistical model. Owing to this shortcoming, new statistical techniques were developed,[30] in order to satisfy the basic premise of structural economic relationships in an interdependent system. The fundamental point of the new statistical techniques was to examine the nature of the causal structure underlying economic variables in the real world. To satisfy the causal structure underlying economic variables, the recursive model was considered as the most fundamental at an abstract level of economic theory. The recursive model is composed of a sequence of causal relationships. The variables of economic variables during a given period are determined by equations in terms of values already calculated, including the

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[29]Henry Schultz, The Theory and Measurement of Demand; Chicago: The University of Chicago Press, 1938, pp. 72-114; E.J. Working, "What Do Statistical Demand Curves Show?" Quarterly Journal of Economics, 41; pp. 212-35, 1927.

[30]R. Bentzel and B. Hensen, "On Recursiveness and Inter-dependence in Economic Models," Review of Economic Studies, 22; pp. 153-68, 1954-55.

initial values of the system. A formal pattern of the recursive system may be expressed as:

$$d_t = D\ (P_t) \quad \text{.....(6a)}$$

$$s_t = S\ (P_{t-1}) \quad \text{.....(6b)}$$

$$P_t = P_{t-1} + r(\ d_{t-1} - s_{t-1}) \quad \text{.....(6c)}$$

where d is the quantity demanded, s the quantity supplied, P the price, and the subscript t refers to time and runs over consecutive periods, say t = 1, 2, 3,.....In equation (6a), demand during time period t as a function of the price during the same period (P_t) implies that, if price (P_t) is known, the demand (d_t) can be derived. Also it expresses a causal hypothesis that the demand function shows how demand reacts to changes in price. In equation (6b) supply during period t expressed as a function of the price during the preceding period (P_{t-1}) based on the assumption that the quantity supplied for next year, say t, is determined by the prevailing price, say P_{t-1}. Equation (6c) explains price during period t as an adjustment in the price during the preceding period. Price will rise or fall as demand exceeds or falls short of supply. In other words, it serves to explain the causal mechanism behind movements.

The recursive system can also be shown as the following arrow scheme:

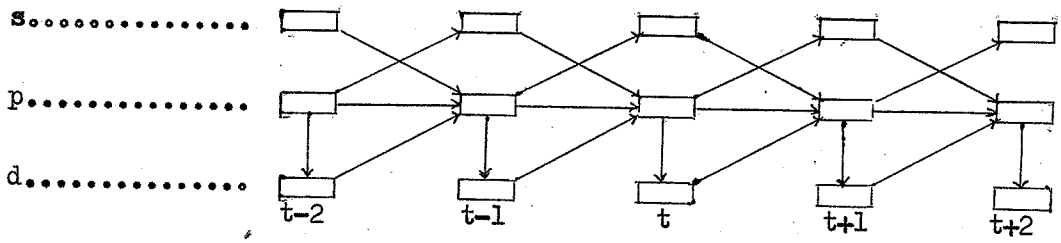


FIGURE 2. ARROW SCHEME FOR THE RECURSIVE SYSTEM

In the scheme, the arrows indicate the explanatory variables d, P, s, and their lags involved. Given initial values P_o, s_o, the development of the three explanatory variables d_t, s_t, and P_t, can be traced by calculation.

For the statistical treatment of this system, two properties of the relations involved are of essential relevance.

(1) It is recursive in a twofold sense: (a) If the development of the three variables is known to time t-1, the estimated value of each of these variables at time t can be derived by this system, (b) the variables at time t can be obtained one by one, first s_t or P_t, and then d_t.

(2) Each equation in the system may be interpreted as a hypothesis of unilateral causal dependence with the causal variable to the right and the effect variable to the left.

Actually, the demand and supply functions in this system are borrowed from the simple case of cobweb theory. The cobweb theory states that:

$$d_t = D\ (P_t) \qquad (7a)$$

$$s_t = S\ (P_{t-1}) \qquad (7b)$$

$$d_t = s_t \qquad (7c)$$

The only difference between the recursive system and the cobweb theory is that the former does not specify the time required for reaching the equilibrium, whereas the latter assumes an instantaneous adjustment to equilibrium

within each period. Logically, both of these two models are the general forms and are formulated as a chain of causation. Statistically, they are simple to handle, since these unbiased and consistent estimates for their parameters can be obtained by using the ordinary regression analysis. Formally, however, while model (6a-c) is applicable to any set of time series data, the model (7a-c) can only be applicable to the case where the elasticity of demand is greater than that of supply.

F. The Equilibrium

As is well known from the cobweb theory, three possible cases for the price-quantity relationship are illustrated in Figure 3.

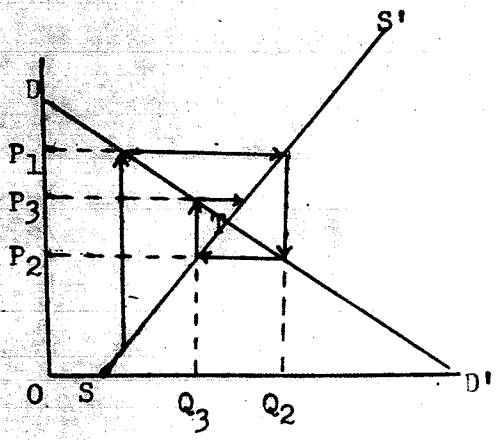
Case I: The case of convergent fluctuation towards equilibrium exists if the demand curve is more elastic than the supply curve.

Case II: The case of divergent fluctuation with increasing oscillation exists if the demand curve is less elastic than the supply curve.

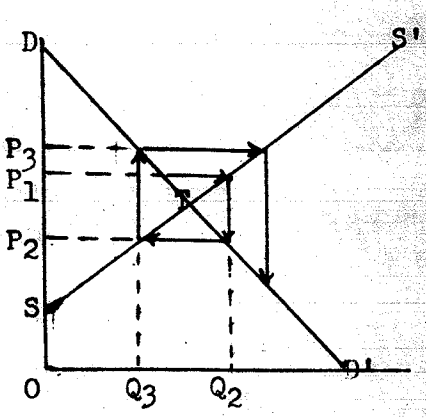
Case III: The case of continuous fluctuation waltzing around the point of equilibrium exists if the demand and supply curves have the same elasticity.

Referring to the demand for and supply of labor resource in agriculture, Case I is more realistic because the elasticity of demand is usually greater than that of supply. Therefore, the equilibrium labor employment and the equilibrium wage rate can be derived from the structural equations by setting $d_t = s_t$.

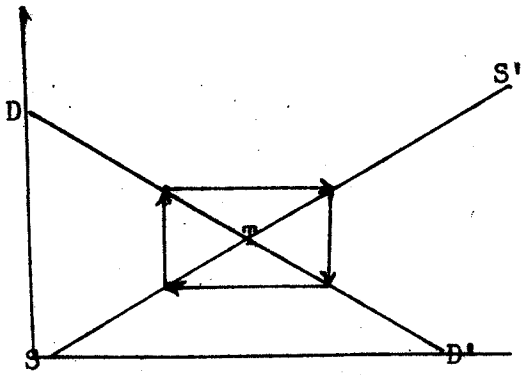
FIGURE 3. THREE POSSIBLE CASES FOR THE COBWEB THEORY



CASE I



CASE II



CASE III

CHAPTER IV

THE METHODOLOGY

In this chapter an attempt is made to present a discussion on the methodology used in the empirical analysis of this study. The discussion includes five subdivisions, namely: choice of variables, sources and modifications of data, limitations of time series data, the models, and the method of analysis.

A. Choice of Variables

The variables selected are based on the hypotheses set up in Chapter I and the theoretical structure of agricultural labor resource discussed in Chapter III. Conceptually, variables relevant to the demand function for both hired and family labor are the farm wage rate[31] as an indicator of the labor price, the parity ratio as an indicator of the relative profitability of farming, the quantity of farm machinery as a main substitute for labor, and the productivity as an indicator of technological improvement. In practice, however, the productivity variable cannot really represent the technological improvement because it involves weather factor which may distort the normal trends in the passage of time. Since there is low and non-significant coefficients of simple correlation existing between independent variables, this productivity variable is therefore still included in the demand function. For making a comparison, the use of time trend as

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[31] Residual farm income is used instead of farm wage rate in the demand function for family labor.

a variable rather than the productivity representing technological and other changes is also considered. On the supply side, the functions for both hired and family labor include theoretical independent variables, the farm wage rate,[32] the non-farm wage rate, the unemployment rate, and the time trend. However, the problem of multicollinearity arises because the variables--nonfarm wage rate and unemployment rate--are highly correlated. This type of error due to multicollinearity will result in the estimates of the regression coefficient having large variance because the error in these closely correlated variables tends to play a dominant role in determining the value of the parameters. In order to avoid the errors resulting from multicollinearity and to increase the degrees of freedom, the modification and aggregation of variables are practically necessary. The non-farm wage rate and the unemployment rate may be aggregated into an "adjusted" non-farm wage rate variable. This variable is a composite of the annual index of manufacturing industry hourly wages adjusted by the percentage of unemployment in the total labor force. The aggregating procedures are based on the following formula:

$$P_N' = P_N (1 - aU)$$

where P_N' is the "adjusted" non-farm wage rate, P_N the actual hourly earnings of workers in manufacturing industries, U the percentage of unemployment in the regional economy, and a the constant coefficient taken 10 years' average (1954-1963) from the data based on regional unemployment rate.[33] The higher the constant coefficient, the lower is the level at which unemployment of

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[32] Same as footnote 31.

[33] See Appendix VIII.

the total labor force will call forth no further off-farm opportunities. For example, if constant coefficient is 5, P_N' becomes zero or negative when the unemployment rate reaches 20 percent or more. At the full employment situation, the variable becomes equivalent to the average level of earnings by workers in manufacturing industries. Such an aggregation will considerably lower the correlation coefficients between independent variables and thus reduce the degree of multicollinearity.

Additionally, a lagged dependent variable is included in both demand and supply functions for hired and family labor. This variable is introduced on the assumption that farm operators may not adjust demand for farm labor in response to an economic stimulus and farm people, likewise, may not adjust the supply for farm labor completely within a given time period. Farm people probably cannot adjust the supply of farm labor instantaneously to an economic stimulus partly because of age group and partly because of the difficulty in disposing of their fixed assets. Reasons for farm operators not adjusting the demand for farm labor instantaneously to economic conditions include the following:

1. Habit and inertia are important components of all behavior.

2. Changes in economic variables may be considered to be only temporary, and the costs involved in adjustment and re-adjustment may more than offset the gains from maintaining a continuous position of equilibrium.

3. Certain resources, including the organization of the firm, are of a durable nature. Adjustments in a variable resource may be delayed because

of complementarities among these durable goods.

4. Changing the quantity of a resource may involve the acquisition of new knowledge which takes time to accomplish.

5. Previously signed contracts may commit a farm operator to a given production pattern, despite the fact that current economic conditions are changing.

B. Sources and Modifications of Data

The data used in this study are time series observations. The major sources of original data on all variables selected are taken from the Dominion Bureau of Statistics and the Department of Agriculture, with the exception of productivity calculated by the writer. In order to be realistic, however, some modifications of the original data should be made. Accordingly, the data on farm employment, which consist of all sex and age groups, are modified in terms of the man-equivalent[34] on the basis of the following ratings:

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[34] A man-equivalent is defined as an adult male of average capacity, fully employed for a 12-month period. All other labor will be rated on the basis that 10 hours equal one day and 26 days equal one month, i.e.,

$$\text{man-equivalent} = \frac{\text{number of days worked}}{26} \times \frac{1}{12} = \frac{\text{number of months worked}}{12}$$

TABLE IX

AVERAGE MAN-EQUIVALENT RATINGS

Sex	Age Group		
	14-19 (A)	20-54 (B)	55 and over (C)
Male	.756	1.000	.808
Female	.210	.345	.190
Female-Male ratio	.278	.290	.235

The procedures of modification are as follows:

$$\left[\begin{array}{l}.278 \times \text{No. of females in group (A)} \\ + \text{No. of males in group (A)}\end{array}\right] \times .756 + \left[\begin{array}{l}.290 \times \text{No. of females in group (B)} \\ + \text{No. of males in group (B)}\end{array}\right]$$
$$\times 1.000 + \left[\begin{array}{l}.235 \times \text{No. of females in group (C)} \\ + \text{No. of males in group (C)}\end{array}\right] \times .808 = \text{Total man-equivalents.}$$

The data on residual farm income are obtained by subtracting hired farm wages from the total agricultural labor income and dividing by the number of man-equivalents. The calculation of the "adjusted" non-farm wage rate follows the formula mentioned in the preceding section, where the constant coefficient for unemployment rate (a) for the Atlantic region is 9, Quebec 7, Ontario 4, the Prairie region 3.5, and British Columbia 6.

The index of productivity is obtained by dividing output components by input components, and taking the average of 1935-1939 as a base. Sometimes it is called an output-input index. The input components consist of such

items as: (1) taxes and interest on indebtedness, (2) hired labor wages, (3) feed and seed, (4) fertilizer and agricultural lime, (5) electric power, (6) miscellaneous, vegetables and supplies, (7) shared expenses on tractor, truck, auto-engine, and combine, (8) gross rent, (9) building repairs, (10) machine repairs, (11) interest[35] on real estate, livestock, and machinery, (12) depreciation on buildings, and (13) depreciation on machinery. The output components are categorized into field products, animal products, and forest products, each of which includes cash income and income in kind. All items included in input and output components are deflated by their corresponding price indexes. Thus, both input and output components are calculated in terms of real values.

C. Limitations of time series data

In analysing time series data, problems of autocorrelation and multicollinearity usually arise. Multicollinearity is present when two or more theoretically independent variables are highly correlated. The latter has already been discussed under the heading "Choice of Variables". The problem of autocorrelation occurs when there is correlation between successive observations in the series so that the residuals are not randomly distributed. In demand and supply analysis, the residuals at time t are influenced by those at time t-1, and are also affected by the residuals at time t + 1. Tests have been devised and recommended for examining autocorrelation in the residuals. The most common testing method is the Von Neumann's Ratio (K)

[35]Calculated on the basis of 6.2 percent.

which involves the ratio of the "mean-square successive difference" to the "variance of residuals".[36] That is, autocorrelation among sample residuals is evaluated in relation to the variance of residuals. This ratio (K) is given as:

$$K = \frac{\Delta e^2}{S_e^2}$$

where $\Delta e^2 = \sum_{t=1}^{n-1} (e_t - e_{t-1})^2 / n-1$, and $S_e^2 = \sum_{t=1}^{n} e_t^2 / n$; Δe^2 is a measure of autocorrelation and e_t is the residual at time t.

Critical values of K for one and five percent levels of significance have been tabulated.[37] A computed K is indicative of positive autocorrelation if it falls below the critical value of K (the lower critical value). If it exceeds the corresponding critical value of K' (the higher critical value) there is negative autocorrelation. A computed value of K which falls between two critical values, K and K', shows that no evidence of autocorrelation is present.

In case autocorrelation exists, the least-squares estimates will be biased and not have minimum variance. In other words, the autocorrelated series give less information than do completely random ones. Therefore, adjustment of the data is necessary. While aggregation of variables is an effective treatment for reducing multicollinearity that has been mentioned

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[36] M. Ezekiel and K. A. Fox, Methods of Correlation and Regression Analysis, New York: John Wiley and Sons, Inc., 1961, p. 335.

[37] Ibid. p. 341.

in Section A, the method of First Difference is suggested as an effective device for lessening autocorrelation. If autocorrelation were present in the data used in this study, the method of First Difference would be applied.

D. The Models

The models used for analysis of both hired and family labor are made up of a long-run demand function and a long-run supply function, both of which are stochastic, and two non-stochastic adjustment equations, one for the supply function and another for the demand function. The adjustment equation is introduced because it is assumed that the actual demand for and supply of farm labor, between one period and the next, changes only by some fraction of the difference between the current level and the long-run equilibrium level. Long-run elasticities are estimated by using this concept of a distributed lag which was developed by Nerlove.[38] Operationally, when quantity demanded or supplied is treated as the dependent variable, the technique involves that the addition of the dependent variable with a one period lag is considered as an additional independent variable in the original demand or supply equation. The parameter estimate of this variable implies a coefficient of adjustment which reflects the relationship between short-run and long-run elasticities. The coefficient of adjustment can be obtained by subtracting the coefficient of the lagged variable from one. The long-run elasticities are derived from the elasticities of the short-run

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[38] Marc Nerlove, "Distributed Lags and Estimation of Long-Run Supply and Demand Elasticities: Theoretical Consideration," Journal of Farm Economics, Vol. 40, May 1958, pp. 301-311.

equations divided by the coefficient of adjustment. Based on the above considerations, the conceptual models for each region can be illustrated algebraically. A long-run labor demand function may be written as:

$$\bar{Y}_i = a_i + a_{1i}X_{1i} + a_{2i}X_{2i} + a_{3i}X_{3i} + a_{4i}X_{4i} + e$$

where $\bar{Y}_i$ = the long-run quantity of hired or family labor demanded in the i-th region,

X_{1i} = the index of farm wage rate for hired labor or index of residual farm income for family labor, deflated by the consumer price index,

X_{2i} = the index of price received by farmers in the i-th region, deflated by the index of price paid by farmers for items used in production, i.e., parity ratio,

X_{3i} = the index of quantity of farm machinery in the i-th region,

X_{4i} = the index of productivity in the i-th region, and

e is a random error term.

The long-run quantity demanded cannot be estimated directly from this model because the other variables change continually over time. Let Y_i be the current quantity demanded and assume that the current quantity demanded would be changed in proportion to the difference between the long-run quantity and the current quantity. By this assumption, the adjustment equation can be expressed as:

$$Y_i - Y_{i(t-1)} = b_i(\bar{Y}_i - Y_{i(t-1)}),\ 0 < b_i < 1$$

where b_i is a coefficient of adjustment for the i-th region indicating that

proportion of the disequilibrium is removed in one time period. Substitution of this adjustment equation into the long-run demand equation leads to a short-run labor demand function as follows:

$$Y_i = a_i b_i + a_{1i} b_i X_{1i} + a_{2i} b_i X_{2i} + a_{3i} b_i X_{3i} + (1-b_i) Y_{i(t-1)} + a_{4i} b_i X_{4i} + b_i e$$

and is estimated in the form:

$$Y_i = \pi_1 + \pi_2 X_{1i} + \pi_3 X_{2i} + \pi_4 X_{3i} + \pi_5 Y_{i(t-1)} + \pi_6 X_{4i} + \pi_7$$

where π_i $(i = 1, 2, \ldots\ldots, 7)$ are statistics of the corresponding terms of the above equation.

On the supply side, a long-run labor supply function may be expressed as:

$$\overline{Y}_i = a_i + a_{1i} X_{1i} + a_{5i} X_{5i} + a_{6i} X_{6i} + e$$

where $\overline{Y}$ = the long-run quantity of hired or family labor supplied in the i-th region,

X_{5i} = the "adjusted" non-farm wage rate in the i-th region, i.e. the actual hourly non-farm wage rate deflated by the consumer price index and adjusted in accordance with the unemployment situation,

X_{6i} = the linear time trend, and

the other variables interpreted the same as in the previous demand function.

In the same way, a short-run labor supply function can be developed

by introducing the adjustment equation in it as below:

$$Y_i = a_i b_i + a_{1i} b_i X_{1i} + a_{5i} b_i X_{5i} + (1-b_i) Y_{i(t-1)} + a_{6i} b_i X_{6i} + b_i e$$

and estimated in the form:

$$Y_i = \pi_1 + \pi_2 X_{1i} + \pi_8 X_{5i} + \pi_5 Y_{i(t-1)} + \pi_9 X_{6i} + \pi_7$$

With modification of time lags, models used for the empirical analysis of hired and family labor are:

1. (a) Long-run demand function

for hired labor:

$$\overline{Y}_{i(t+1)} = a_i + a_{1i} X_{1i} + a_{2i} X_{2i} + a_{3i} X_{3i} + a_{4i} X_{4i} + e$$

for family labor:

$$\overline{Y}_i = a_i + a_{1i} X_{2i(t-1)} + a_{3i} X_{3i} + a_{4i} X_{4i} + e$$

(b) Short-run demand function

for hired labor:

$$Y_{i(t+1)} = a_i b_i + a_{1i} b_i X_{1i} + a_{2i} b_i X_{2i} + a_{3i} b_i X_{3i} + (1-b_i) Y_i + a_{4i} b_i X_{4i} + b_i e$$

for family labor:

$$Y_i = a_i b_i + a_{1i} b_i X_{1i} + a_{2i} b_i X_{2i(t-1)} + a_{3i} b_i X_{3i} + (1-b_i) Y_{i(t-1)} + a_{4i} b_i X_{4i} + b_i e$$

2. (a) Long-run supply function

for hired labor:

$$\overline{Y}_i = a_i + a_{1i} X_{1i} + a_{5i} X_{5i} + a_{6i} X_{6i} + e$$

for family labor:

$$\overline{Y}_i = a_i + a_{1i}X_{1i(t-1)} + a_{5i}X_{5i} + a_{6i}X_{6i} + e$$

(b) Short-run supply function

for hired labor:

$$Y_i = a_i b_i + a_{1i}b_i X_{1i} + a_{5i}b_i X_{5i} + (1-b_i)Y_{i(t-1)} + a_{6i}b_i X_{6i} + b_i e$$

for family labor:

$$Y_i = a_i b_i + a_{1i}b_i X_{1i(t-1)} + a_{5i}b_i X_{5i} + (1-b_i)Y_{i(t-1)} + a_{6i}b_i X_{6i} + b_i e$$

E. The Method of Analysis

Since it is assumed that a linear relationship exists in agricultural structures, both demand and supply functions are estimated by single-equation least-squares method. The models are all fitted with data from the period 1946-1962. After the empirical results are derived from demand and supply functions, several statistical tests are used to determine their validity, viz, a t-test for the regression coefficient and an F-test for the coefficient of determination. Moreover, since a recursive relationship exists in the market structure[39] for both hired and family labor, the quantity of labor and the level of labor price, under equilibrium conditions, can be determined accordingly. By using this relationship, the quantity of both hired and family labor required for the future can also be predicted under certain assumptions.

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[39] Refer to Chapter III

CHAPTER V

INTERPRETATION OF EMPIRICAL RESULTS

This chapter presents the empirical results for hired and family labor markets estimated from a recursive model by using the single-equation least-squares method. The presentation involving the hired labor market will be given first; it will be followed by that involving the family labor market. Each of these two categories includes the demand function, the supply function, and the structural relationship under equilibrium conditions.

A. Hired Farm Labor Market

The demand function

Two experiments were performed on the demand function for hired farm labor. In the first experiment the productivity variable was used as an alternative to linear trend, whereas in the second, the time variable reflecting technological improvements was substituted for the productivity variable. By doing so, the statistical results derived for some regions could be improved.

The statistical results for hired labor demand functions are shown in Table X. Standard errors are included in parentheses under the regression coefficients. The equation number is indicated by (1) and (2). Equation (1) contains the productivity variable while a time variable, rather than the productivity, is included in equation (2). The value of R^2 and the Von Neumann Ratio are also presented in this table.

In general, the statistical results estimated from both equations (1)

TABLE X

REGRESSION COEFFICIENTS, STANDARD ERRORS, AND OTHER STATISTICAL RESULTS FOR HIRED LABOR DEMAND FUNCTIONS

Region		R^2	Constant	X_1 t-1	X_2 t-1	X_3 t-1	Y t-1	$X_{4(1)}$ t-1 or T(2)	V-N Ratio
Atl.	(1)	.233	21.626	-.011 (.055)	-.029 (.032)	-.063@@ (.063)	-.152 (.377)	.034 (.963)	1.870
	(2)	.305	37.723	-.019 (.071)	-.085 (.114)	-.098 (.100)	-.180 (.366)	-.117 (.329)	1.760
Quebec	(1)	.466++	29.966	.064 (.095)	-.030 (.126)	-.190 (.261)	-.019 (.256)	.033 (.118)	1.912
	(2)	.477++	5.466	.080 (.095)	.060 (.176)	-.101 (.237)	.058 (.247)	.185 (.341)	2.112
Ont.	(1)	.302	-46.389	.043 (.336)	.170 (.367)	.028 (.259)	.290@@ (.289)	.406@ (.371)	2.303
	(2)	.406@	122.108	.007 (.277)	-.461 (.362)	-.087 (.214)	-.143 (.318)	-1.817++ (1.023)	2.553
Prairie	(1)	.648**	-8.122	.051 (.335)	.241@@ (.226)	-.031 (.089)	.181 (.268)	.041 (.063)	1.880
	(2)	.662**	-55.504	.126 (.303)	.464++ (.270)	.003 (.077)	.266@@ (.277)	.650@@ (.704)	1.985
B. C.	(1)	.639**	7.374	.037 (.071)	.023 (.071)	-.032 (.045)	.262@@ (.290)	-.051 (.071)	1.911
	(2)	.629**	-21.930	.121 (.126)	.045 (.063)	.012 (.071)	.213 (.268)	-.214 (.349)	2.016

Note: 1. Model is fitted with annual data from 1946 to 1962.
2. (1) and (2) indicate equation including productivity variable and time trend variable respectively.
3. Variables interpreted as in the context.
4. Level of significance: * = 1 percent; ** = 5 percent; + = 10 percent; ++ = 20 percent; @ = 30 percent; @@ = 40 percent.

and (2) are not encouraging. The regression coefficients for the farm wage rate (X_1) were neither consistent in sign with a priori expectations[40] in all regions, except the Atlantic, nor significant in all regions for both equations. For other variables, only a few regions were significant at low levels ranging from 20 to 40 percent, but the signs of coefficients were mostly as expected. The coefficient of determination, R^2, is also quite low for each region, ranging from .233 in the Atlantic region to .662 in the Prairie region; it is significant at the five percent level in the Prairie and B.C., 20 percent level in Quebec, and 30 percent level in Ontario. The values of R^2, .662 in the Prairie and .639 in B.C., which are significant at the 5 percent level, indicate that a 66.2 and a 63.9 percent variability in the demand for hired labor in the Prairie and B.C. respectively can be explained by the causal variables involved in their demand functions. In other words, a 33.8 and a 36.1 percent variability in the demand for hired labor in the Prairie and B.C. respectively are caused by other variables not involved in the demand functions studied.

Using Von Neumann's Ratio as a criterion, the null hypothesis of no autocorrleation in the calculated residuals in all regions is not rejected at the five percent level. This absence of autocorrelation in the residuals usually is taken as evidence of a random data and of being unbiased in coefficients for all variables since it indicates that nothing systematic remains in the residuals.

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[40]The signs of the coefficients of the variables in demand function, based on a priori expectations, are expected to be: $X_1 < 0$, $X_2 \geq 0$, $X_3 < 0$, $Y_{t-1} > 0$, and X_4 in (2) < 0, in (1) $> \text{or} \leq 0$.

In examining the distributed lag model, the coefficient of the lagged variable is significant at low levels in Ontario, B. C. and the Prairie, and non-significant in the Atlantic and Quebec. These non-significant or low significant coefficients suggest that the statistical results are not dependent on the presence of lagged dependent variables.

The elasticities of demand for hired labor are presented in Table XI. Excluding those elasticities derived from coefficients that are not significantly different from zero at or below 40 percent level, the short-run elasticity of labor demand with respect to the parity ratio variable was 1.472 in the Prairie. It indicates that, in the past years, as the parity ratio has increased by one percent, ceteris paribus, there has been a corresponding rise of 1.472 percent in the demand for hired labor in the Prairie. It is said to be elastic. This is true because the Prairie is an agricultural region where farmers' income relies largely on sales of farm products, they hire more labor as the prices of farm products rise, and hire less labor as the prices of farm products fall accordingly.

The short-run elasticity of demand for hired labor with respect to farm machinery was -.883 in the Atlantic, and, with respect to productivity, it was 1.119 in Ontario. The negative elasticity with respect to farm machinery indicates that, as the quantity of farm machinery has increased in the Atlantic, there has been an accompanying decrease in hiring farm labor. The elasticity with respect to productivity, 1.119 in Ontario, suggests that a one percent increase in productivity has been associated with a 1.119 percent increase in the demand for hired labor. In connection with the equation including time as a variable, instead of productivity, the estimated

TABLE XI

ESTIMATED DEMAND ELASTICITIES AND COEFFICIENTS OF ADJUSTMENT FOR HIRED LABOR

Variable			Atlantic	Quebec	Ontario	Prairie	B. C.
X_1	S.R.	(1)	-.200	.772	.189	.308	1.033
		(2)	-.347	.965	.031	.762	3.379
	L.R.	(1)	-.236	.784	.268	.375	1.396
		(2)	-.420	1.026	.035	1.040	4.300
X_2	S.R.	(1)	-.315	-.191	.456	.765*	.379
		(2)	-.929	.383	-1.235	1.472*	.741
	L.R.	(1)	-.369	-.198	.640	.933*	.510
		(2)	-1.137	.408	-1.442	2.005*	.939
X_3	S.R.	(1)	-.883*	-1.582	.123	-.188	-1.092
		(2)	-1.383	-.841	-.382	.018	.410
	L.R.	(1)	-1.037*	-1.615	.171	-.230	-1.467
		(2)	-1.693	-.891	-.448	.024	.512
X_4	S.R.	(1)	.307	.197	1.119*	.194	-.747
		(2)	-.104	.096	-.396*	.168*	-.288
	L.R.	(1)	.361	.203	1.576*	.237	-1.011
		(2)	-.127	.102	-.462*	.229*	-.366
b		(1)	.848	.981	.710	.819	.738
		(2)	.820	.942	.857	.734	.787

Note: 1. (1) and (2) indicate equation including productivity variable and time trend variable respectively.

2. S.R. = Short-run; L.R. = Long-run.

3. Variables interpreted as in the context.

4. * denotes elasticities from coefficients that are significantly different from zero at/below 40 percent level.

short-run elasticity of labor quantity with respect to both parity ratio and farm machinery were much higher, being 1.472 in the Prairie and -1.383 in the Atlantic respectively. This is because the time variable really represents technological improvements whereas the productivity which involves weather factor fluctuates from year to year.

The value of long-run elasticities depends on the magnitude of adjustment coefficients. The lower the value of adjustment coefficients, the larger is the magnitude of difference between short- and long-run elasticity, because it indicates that the percentage of discrepancy between actual and equilibrium levels of employment can be removed within one period of time. The estimated coefficients of adjustment ranged in value from .710 in Ontario to .981 in Quebec for equation (1) and from .734 in the Prairie to .942 in Quebec for equation (2). Generally speaking, the coefficients of adjustment estimated from both equations (1) and (2) were quite high in all regions. These high coefficients of adjustment indicate that the rate of adjustment to the equilibrium or desired level of employment is quite rapid.

The Supply Function

On the supply side, the statistical results are also not too favorable, although they are much better than those for the demand function. The hired labor supply functions for all regions are included in Table XII. For the farm wage rate, the regression coefficients were significant at the 40 percent or higher levels in three of the regions. The regions with regression coefficients significant at low levels were B.C., Quebec, and

TABLE XII

REGRESSION COEFFICIENTS, STANDARD ERRORS, AND OTHER STATISTICAL RESULTS FOR HIRED LABOR SUPPLY FUNCTIONS

Region	R^2	Constant	X_1	X_5	Y t-1	X_6	V-N ratio
Atlantic	.411^{++}	18.655	-.026 (.055)	-5.341^{+} (2.653)	-.209 (.298)	-.082 (.110)	2.033
Quebec	.355$^{@}$	-.256	.088^{++} (.063)	-3.375 (7.105)	.191 (.228)	-.189$^{@@}$ (.207)	1.765
Ontario	.336$^{@}$	74.700	-.113 (.176)	-22.394$^{@@}$ (24.550)	.148 (.266)	.265 (.797)	2.108
Prairie	.565**	7.932	.233$^{@}$ (.192)	-27.111 (34.238)	.310$^{@}$ (.303)	-.244 (.974)	1.913
B. C.	.543^{+}	-9.714	.084^{+} (.045)	.413 (2.979)	.485^{+} (.241)	-.255^{++} (.176)	2.002

Note: 1. Model is fitted with annual data from 1946 to 1962.
2. Variables interpreted as in the context.
3. Level of significance: * = 1 percent; ** = 5 percent; + = 10 percent; ++ = 20 percent; @ = 30 percent; @@ = 40 percent.

the Prairie. These significant coefficients were consistently positive in sign. For the "adjusted" non-farm wage rate, the expected sign of the coefficient was obtained in all regions with the exception of B. C., but the coefficients were significant at the 40 percent or higher levels in only two regions, the Atlantic and Ontario.

In evaluating time as a variable indicating technological improvement and to complete the specification of supply functions, the coefficient was significant at low levels in only two regions. Consequently, this variable, as demonstrated in the demand function, is not considered to be a reasonable indicator of changes in technology by region.

The value of R^2 for supply functions in all regions is also quite low, ranging from .336 in Ontario to .565 in the Prairie, and not significant at the five percent or higher levels, with the exception of the Prairie, where a 56.5 percent variability in the supply of hired labor can be explained by the causal variables involved in its supply function.

As an indication of autocorrelation, Von Neumann's Ratio was also computed for each region. Von Neumann's Ratio indicates that calculated residuals are not autocorrelated.

Table XIII shows the estimated supply elasticities and coefficients of adjustment for hired labor. Disregarding the elasticities derived from regression coefficients at low significant levels, the short-run elasticities of labor quantity in respect of the farm wage rate (X_1) varied from 1.062 in Quebec to 2.376 in B.C., and in respect of the "adjusted" non-farm wage rate (X_5) ranged from -.182 in the Atlantic to -.628 in Ontario. The greater responsiveness of the supply of hired labor in B.C. may be explained

TABLE XIII

ESTIMATED SUPPLY ELASTICITIES AND COEFFICIENTS OF ADJUSTMENT FOR HIRED LABOR

Variable		Atlantic	Quebec	Ontario	Prairie	B. C.
X_1	S.R.	-.468	1.062*	-.504	1.416*	2.376*
	L.R.	-.595	1.316*	-.593	2.054*	4.611*
X_5	S.R.	-.182*	-.132	-.628*	-.901	.065
	L.R.	-.230*	-.163	-.737*	-1.305	.127
X_6	S.R.	-.081	-.110*	.065	-.070	-.384*
	L.R.	-.103	-.136*	.076	-.100	-.745*
b		.791	.809	.852	.690	.515

Note: 1. S.R. = Short-run; L.R. = Long-run.

2. Variables interpreted as in the context.

3. * denotes elasticities from coefficients that are significantly different from zero at/below 40 percent level.

by the fact that B. C. is the region where hired labor constitutes the highest percentage of the total farm labor among the five regions.[41] The supply of hired labor in the Prairie is more sensitive to changes in the farm wage rate because there are few off-farm income opportunities in this region.

The adjustment coefficients, which differentiate the magnitude of short- and long-run elasticities, ranged in value from .515 in B. C. to .852 in Ontario. These results suggest that B. C. has been slower than other regions in adjusting to sustained price changes. It may be true because there were not enough job opportunities available in non-agricultural industries to accommodate so many hired labor migrated from farming.

The structural relationship under equilibrium conditions

From the short-run demand and supply functions for hired labor, the long-run demand and supply functions are derived by dividing by their corresponding coefficients of adjustment. The long-run demand and supply functions for each region are included in Table XIV and Table XV respectively. Since the models are based on the recursive system, structural demand and supply relations can be equated accordingly, and reduced in terms of the quantity of hired labor requirements and the rate of farm wage offering. The reduced-form equations for hired employment and the farm wage rate for each region are presented in Tables XVI and XVII respectively.

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41 See Appendix XII.

TABLE XIV

REGRESSION COEFFICIENTS AND OTHER STATISTICAL RESULTS
FOR LONG-RUN DEMAND FUNCTIONS FOR HIRED LABOR

Region		Constant	X_1 t-1	X_2 t-1	X_3 t-1	X_4 t-1
Atlantic	(1)	25.502	-.013	-.034	-.074	.040
	(2)	46.004	-.023	-.104	-.120	-.143
Quebec	(1)	30.546	.065	-.031	-.194	.034
	(2)	5.803	.085	.064	-.107	.196
Ontario	(1)	-65.337	.061	.239	.039	.572
	(2)	142.483	.008	-.538	-.102	-2.120
Prairie	(1)	-9.917	.062	.294	-.038	.050
	(2)	-75.619	.172	.632	.004	.886
B. C.	(1)	9.992	.050	.031	-.043	-.069
	(2)	-27.865	.154	.057	.015	-.272

TABLE XV

REGRESSION COEFFICIENTS AND OTHER STATISTICAL RESULTS FOR LONG-RUN SUPPLY FUNCTION FOR HIRED LABOR

Region	Constant	X_1	X_5	X_6
Atlantic	23.584	-.033	-6.752	-.104
Quebec	- .316	.109	-4.172	-.234
Ontario	87.676	-.133	-26.284	.311
Prairie	11.496	.338	-39.291	-.354
B. C.	-18.862	.163	.802	-.495

TABLE XVI

REGRESSION COEFFICIENTS AND OTHER STATISTICAL RESULTS FOR REDUCED-FORM EQUATIONS FOR HIRED FARM LABOR EMPLOYMENT

Region		Constant	X_2 t-1	X_3 t-1	X_4 t-1	T	X_5	X_6
Atlantic	(1)	26.749	-.056	-.122	.066		4.389	.068
	(2)	97.570	-.343	-.396		-.472	15.530	.239
Quebec	(1)	76.138	-.077	-.481	.084		6.163	.346
	(2)	27.474	.291	-.486		.890	14.776	.829
Ontario	(1)	-17.225	.164	.027	.392		-8.264	.098
	(2)	139.373	-.508	-.096		-2.000	-1.491	.018
Prairie	(1)	-14.727	.360	-.047	.061		8.826	.080
	(2)	-165.883	1.287	.008		1.761	40.711	.367
B. C.	(1)	22.759	.045	-.062	-.1000		-.355	.219
	(2)	-181.916	1.032	.272		-4.926	-13.723	8.470

Note: 1. (1) and (2) denote the reduced-form equation number.

2. Variables interpreted as in the context.

TABLE XVII

REGRESSION COEFFICIENTS AND OTHER STATISTICAL RESULTS FOR REDUCED-FORM EQUATIONS FOR EQUILIBRIUM HIRED FARM WAGE RATE

Region		Constant	X_2 t-1	X_3 t-1	X_4 t-1	T	X_5	X_6
Atlantic	(1)	- 95.900	1.700	3.700	-2.000		-337.600	-5.200
	(2)	-2,242.000	10.400	12.000		14.300	-675.200	-10.400
Quebec	(1)	701.409	-.705	-4.409	.773		94.818	5.318
	(2)	254.958	2.667	-4.458		8.167	173.833	9.750
Ontario	(1)	788.727	-1.232	-.201	-2.948		-135.485	1.603
	(2)	-388.702	3.816	.723		15.035	-186.411	2.206
Prairie	(1)	-77.583	1.065	-.138	.181		142.359	1.283
	(2)	-524.789	3.807	.024		5.337	236.693	2.133
B. C.	(1)	255.345	.274	-.381	-.611		-7.097	4.381
	(2)	-1,000.333	6.333	1.667		-30.222	-89.111	55.000

Note: 1. (1) and (2) denote the reduced-form equation number

2. Variables interpreted as in the context.

B. Farm Family Labor Market

The demand function

Two experiments have also been performed on the family labor demand function for each region; one includes the productivity variable as an alternative to time trend, and in another the time variable is included; the former is denoted by equation (1) and the latter by equation (2). The statistical results of both estimated equations are summarized in Table XVIII, while the elasticities of demand for family labor, with respect to the variables indicated, are included in Table XIX. The values of R^2, coefficient of determination, are quite high in all regions, ranging from .862 to .988 in equation (1) and from .828 to .987 in equation (2). In both equations the values of R^2 are significant at the one percent level in all regions. Thus, both equations (1) and (2) appear to be a meaningful and useful expression of the demand for family labor.

In examining the individual variables, the regression coefficients for the farm wage rate were consistently negative in sign and significant at the 20 percent or higher levels in all regions, with the exception of the Prairie. The regions with regression coefficients significant at the one percent level for equation (1) include the Atlantic, Quebec and B. C., and only B. C. for equation (2). The demand for family labor in the Prairie does not respond to the farm wage rate at all probably because it is an agricultural region where family labor employment usually constitutes a high percentage of the total farm labor. For regions with regression coefficients significant at the five percent or higher levels, the short-run elasticities

TABLE XVIII

REGRESSION COEFFICIENTS, STANDARD ERRORS, AND OTHER STATISTICAL RESULTS FOR FAMILY-LABOR DEMAND FUNCTIONS

Region		R^2	Constant	X_1	X_2 t-1	X_3	Y t-1	$X_{4(i)}$ or T (2)	V-N Ratio
Atlantic	(1)	.974*	-50.940	-.151*	.130@@	.032	.898*	.591*	2.362
				(.045)	(.122)	(.095)	(.141)	(.138)	
	(2)	.965*	182.254	-.089+	-.233@	-.592**	.062	-2.997*	2.622
				(.045)	(.173)	(.207)	(.266)	(.889)	
Quebec	(1)	.963*	-11.741	-.663*	.820++	.160	.602*	.380	2.389
				(.184)	(.534)	(.677)	(.167)	(.590)	
	(2)	.966*	55.681	-.466+	.680@	.484@@	.298@@	-3.657@	2.147
				(.219)	(.530)	(.527)	(.316)	(3.095)	
Ontario	(1)	.962*	2.783	-.257++	.585@	.015	.735*	-.026	2.049
				(.167)	(.481)	(.205)	(.170)	(.630)	
	(2)	.978*	260.987	-.252+	-.224	-.085	.170	-7.162**	1.935
				(.114)	(.457)	(.152)	(.239)	(2.590)	
Prairie	(1)	.988*	46.743	.057	-.129	-.077@	.943*	-.112@@	1.750
				(.095)	(.510)	(.063)	(.122)	(.126)	
	(2)	.987*	30.978	-.005	.026	-.068	.908**	-.139	1.959
				(.063)	(.498)	(.095)	(.308)	(3.222)	
B. C.	(1)	.862*	-4.540	-.188*	.324*	-.014+	-.227@	.153++	1.637
				(.032)	(.063)	(.000)	(.184)	(.095)	
	(2)	.828*	16.442	-.143*	.200++	-.010@	-.106	-.127	1.748
				(.032)	(.126)	(.000)	(.219)	(.297)	

Note: 1. Model is fitted with annual data from 1946 to 1962.

2. (1) and (2) indicate equation including productivity variable and time trend variable respectively.

3. Variables interpreted as in the context.

4. Level of significance: * = 1 percent; ** = 5 percent; + = 10 percent; ++ = 20 percent; @ = 30 percent; @@ = 40 percent.

TABLE XIX

ESTIMATED DEMAND ELASTICITIES AND COEFFICIENTS OF ADJUSTMENT FOR FAMILY LABOR

Variable			Atlantic	Quebec	Ontario	Prairie	B. C.
X_1	S. R.	(1)	-.325	-.456	-.152	.021*	-.914
		(2)	-.191	-.321	-.149	-.002*	-.695
	L. R.	(1)	-3.184	-1.147	-.573	.369*	-1.182
		(2)	-.204	-.457	-.180	-.020*	-.778
X_2	S.R.	(1)	.292	.532	.366	-.046*	1.788
		(2)	-.524	.441	-.140*	.009*	1.104
	L.R.	(1)	2.867	1.337	1.382	-.803*	2.312
		(2)	-.558	.629	-.169*	.100*	1.236
X_3	S.R.	(1)	.093*	.137*	.016*	-.052	-.160
		(2)	-1.720	.414	-.088*	-.046*	-.115
	L.R.	(1)	.912*	.344*	.059*	-.920	-.206
		(2)	-1.833	.589	-.106*	-.503*	-.137
X_4	S.R.	(1)	1.088	.356*	-.017*	-.055	.750
		(2)	-.547	-.193	-.365	-.004*	-.057*
	L.R.	(1)	10.669	.894*	-.063*	-.965	.970
		(2)	-.583	-.275	-.439	-.044*	-.064*
b		(1)	.102	.398	.265	.057	.773
		(2)	.938	.702	.830	.092	.894

Note:
1. (1) and (2) indicate equation including productivity variable and time trend variable respectively.
2. S. R. = Short-run; L. R. = Long-run.
3. Variables interpreted as in the context.
4. * denotes elasticities from coefficients that are not significantly different from zero at/below 40 percent level.

were estimated at the mean to be low, ranging from -.152 in Ontario to -.914 in B. C. for equation (1), and from -.149 in Ontario to -.695 in B. C. for equation (2). These low price elasticities indicate that the increase (or decrease) in demand for family labor was not proportional to the decrease (or increase) in farm wage rate in the past years. However, the price elasticities were much higher in the long-run for equation (1). It suggests that the demand for family labor, ceteris paribus, is much more responsive to the farm wage rate in the long-run than in the short-run because operators may have enough time for adjustment. For the parity ratio and the farm machinery variables, their coefficients were significant at five percent or higher levels in only one region, the former was in B. C. for equation (1) and the latter in the Atlantic for equation (2). But the signs of regression coefficients for these two variables in both equations were correct. The elasticity of family labor demanded with respect of the parity ratio is estimated in B. C. to be high, 1.788 in the short-run and 2.312 in the long-run, which is much higher. It suggests that a one percent increase in the parity ratio (index of prices received by farmers, deflated by index of prices paid by farmers for items used in production) ceteris paribus, has been associated with a 1.788 percent increase in the demand for family labor in the short-run period and 2.312 percent in the long-run period. The elasticity of demand quantity with respect of the farm machinery is, in the Atlantic, valued at -1.720 in the short-run and at -1.833 in the long-run. This high elasticity indicates that with continuous development of land consolidation, the demand for family labor has been replaced by farm machinery and thus rapid migration of family workers has taken place in

periods of ample non-farm employment opportunities[42] even though the return to labor in agriculture has been high or has temporarily increased relative to non-farm wage returns.

In all regions except B. C., the regression coefficients of the lagged dependent variable were significant at the one percent level for equation (1), indicating that the statistical results estimated would depend heavily on the presence of this variable. In other words, the quantity of family labor demanded in the current year affects the quantity demanded in the succeeding year. This is the reason why adjustment of family labor to the equilibrium level of employment should take a long period of time.

The regression coefficients of productivity variable or time variable were significant at the five or higher levels in only two regions, the Atlantic and Ontario. For the Atlantic region with regression coefficient highly significant, the elasticity of labor demand with respect of the productivity variable is 1.088 in the short-run and 10.669 in the long-run. The latter is ten times larger than the former.

The coefficient of adjustment estimated from equation (1) is lower than that from equation (2). On the basis of equation (1), it varies from .057 to .773 among regions, while on the basis of equation (2) it ranges from .092 to .938. The difference implies that the fluctuation of productivity from year to year resulted in eliminating the discrepancy between actual and equilibrium employment requires a longer period of time.

Finally, Von Neumann's Ratio shows that no autocorrelation exists in

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[42] In the Atlantic region, the number of farm family labor has declined from 80 thousand persons in 1946 to 36 thousand persons in 1962.

the residuals in all regions. The residuals from the dynamic models tend to have no autocorrelation, indicating more adequate statistical results.

The supply function

The statistics shown in Table XX are the results estimated from the supply function for family labor. The value of the coefficient of determination, R^2, is high and significant at the one percent level in all regions, with the exception of B. C. Thus, the supply function for family labor also seems to be meaningful. However, statistical tests of significance as applicable to the individual variables are not so encouraging. The regression coefficients for the farm wage rate are consistently positive in only two of the regions, and not significant in all regions but the Atlantic at the 10 percent level. For the "adjusted" non-farm wage rate, the expected sign of the coefficients are obtained in all regions but significant at the five percent or higher levels in the Atlantic only. The positive sign and significance of the farm wage rate coefficient, taken alone, indicates that, as the wage rate has risen, there has been an accompanying net return of labor to farms. Similarly, the negative and significant coefficient of the "adjusted" non-farm wage rate variable indicates that, as this variable increased in value in the previous year, there was an accompanying net migration from farms. With respect to the lagged variable, the regression coefficients were highly significant in the Atlantic and the Prairie, and significant only below the 40 percent level in Ontario. The highly significant coefficients mean that the distributed lag model appears to be a useful formulation of the supply function for family labor. Similarly for the time

TABLE XX

REGRESSION COEFFICIENTS, STANDARD ERRORS, AND OTHER STATISTICAL RESULTS FOR FAMILY LABOR SUPPLY FUNCTIONS

Region	R^2	Constant	X_1 t-1	X_5	Y t-1	X_6	V-N Ratio
Atlantic	.967*	23.808	.079^{+} (.045)	-21.657* (6.295)	.676* (.158)	-1.207^{+} (.601)	2.029
Quebec	.950*	224.591	.093 (.259)	-20.666 (38.896)	.083 (.336)	-7.827** (2.653)	2.203
Ontario	.962*	148.051	-.031 (.179)	-11.011 (47.441)	.425$^{@@}$ (.436)	-4.255$^{@@}$ (4.006)	1.531
Prairie	.988*	37.684	-.029 (.045)	-44.368 (55.801)	.964* (.197)	1.627 (2.248)	1.999
B. C.	.495^{+}	34.334	-.056 (.063)	-4.151 (5.248)	-.024 (.489)	-.572^{++} (.366)	1.313

Note: 1. Model is fitted with annual data from 1946 to 1962

2. Variables interpreted as in the context.

3. Level of significance: * = 1 percent; ** = 5 percent; + = 10 percent; ++ = 20 percent; @ = 30 percent; @@ = 40 percent.

variable, the coefficient was significant at five percent or higher levels in Quebec only. It indicates that, except in Quebec, the supply of family labor in all regions has, other things being equal, not declined in the passage of time.

In all supply functions, the Von Neumann's Ratio also shows that no autocorrelation is present. The absence of autocorrelation indicates that these supply functions are adequate for all regions.

The supply elasticities of family labor with respect to the relevant variable are summarized in Table XXI. The price elasticity in the Atlantic, where the coefficient was significant at the 10 percent level, is .174 in the short-run, and .538 in the long-run--both of them being less than unity. For the "adjusted" non-farm wage rate, whose coefficient is significant at the one percent level in the Atlantic region, the short- and long-run cross elasticities are low, being -.152 and -.470 respectively. It suggests that as the "adjusted" non-farm wage rate rose by 10 percent in the past, there was a concurrent net decrease of 1.52 percent in family labor in the short-run, and of 4.70 percent in the long-run. Those family workers migrated from farming to take jobs in the manufacturing industries where there was a higher income relative to farming.

The coefficient of adjustment is low in those regions where agriculture is more dominant, especially in the Prairie, and high in the industrial regions. It is evident that elimination of the discrepancy between actual and equilibrium level of employment requires a longer period of time in the agricultural regions than in the industrial regions, because farmers in the agricultural regions usually consider farming as a way of life and

TABLE XXI

ESTIMATED SUPPLY ELASTICITIES AND COEFFICIENTS OF ADJUSTMENT FOR FAMILY LABOR

Variable		Atlantic	Quebec	Ontario	Prairie	B. C.
X_1	S. R.	.174	.063*	-.018*	-.011*	-.281*
	L. R.	.538	.068*	-.031*	-.304*	-.286*
X_5	S. R.	-.152	-.082*	-.072*	-.165*	-.218*
	L. R.	-.470	-.090*	-.125*	-4.579*	-.224*
X_6	S. R.	-.268	-.462	-.226	.034*	-.287
	L. R.	-.760	-.503	-.393	1.074*	-.294
b		.324	.917	.575	.036	.976

Note: 1. S. R. = Short-run; L. R. = Long-run.

2. Variables interpreted as in the context.

3. * denotes elasticities from coefficients that are not significantly different from zero at/below 40 percent level.

do not have alternative income opportunities.

The structural relationship under equilibrium conditions

Similarly, the long-run supply and demand functions for family labor (Table XXII and Table XXIII) are obtained from short-run supply and demand functions by dividing by their corresponding adjustment coefficients for each region. Based on the recursive system, supply function can be equated demand function under equilibrium conditions. Thus the equilibrium employment of family labor and equilibrium farm wage rate for family labor are derived for each region. The reduced-form equations are included in Table XXIV and Table XXV respectively.

TABLE XXII

REGRESSION COEFFICIENTS AND OTHER STATISTICAL RESULTS FOR LONG-RUN SUPPLY FUNCTION FOR FAMILY LABOR

Region	Constant	$X_{1\ t-1}$	X_5	X_6
Atlantic	73,481	.244	-66.843	-3.725
Quebec	244.919	.101	-22.537	-8.535
Ontario	257.480	-.054	-19.150	-7.400
Prairie	1,064.778	-.806	-1,232.444	45.194
B. C.	35.178	-.057	-4.253	-.586

TABLE XXIII

REGRESSION COEFFICIENTS AND OTHER STATISTICAL RESULTS FOR LONG-RUN DEMAND FUNCTIONS FOR FAMILY FARM LABOR

Region		Constant	X_1	$X_{2\ t-1}$	X_3	X_4
Atlantic	(1)	-499.412	-1.480	1.275	.314	5.794
	(2)	194.301	-.095	-.248	-.631	-3.195
Quebec	(1)	-29.500	-1.666	2.060	.402	.955
	(2)	79.318	-.664	.969	.689	-5.209
Ontario	(1)	10.502	-.970	2.208	.057	-.098
	(2)	314.442	-.304	-.270	-.102	-8.629
Prairie	(1)	820.052	1.000	2.263	-1.351	-1.965
	(2)	336.717	-.054	.283	-.739	-1.511
B. C.	(1)	-5.873	-.243	.419	-.018	.198
	(2)	18.391	-.160	.224	-.012	-.142

TABLE XXIV

REGRESSION COEFFICIENTS AND OTHER STATISTICAL RESULTS FOR REDUCED-FORM EQUATIONS FOR FARM FAMILY LABOR EMPLOYMENT

Region		Constant	$X_{2(t-1)}$	X_3	X_4	T	X_5	X_6
Atlantic	(1)	-7.600	.181	.044	.820		-57.383	-3.198
	(2)	160.443	-.179	-.454		-2.300	-18.732	-1.044
Quebec	(1)	229.389	.118	.023	.055		-21.249	-8.047
	(2)	230.055	.128	.091		-.688	-19.562	-7.408
Ontario	(1)	272.040	-.130	-.003	.006		-20.279	-7.836
	(2)	245.176	.058	.022		1.864	-23.286	-8.998
Prairie	(1)	945.593	-1.010	-.603	-.877		-682.417	25.025
	(2)	285.729	.303	-.792		-1.619	88.500	-3.245
B. C.	(1)	47.758	-.128	.006	-.061		-5.556	-.766
	(2)	44.486	-.124	.007		.079	-6.607	-.910

Note: 1. (1) and (2) denote the reduced-form equation number.

2. Variables interpreted as in the context.

TABLE XXV

REGRESSION COEFFICIENTS AND OTHER STATISTICAL RESULTS FOR REDUCED-FORM EQUATIONS FOR EQUILIBRIUM FAMILY FARM LABOR WAGE RATE

Region		Constant	$X_{2(t-1)}$	X_3	X_4	T	X_5	X_6
Atlantic	(1)	-332.305	.740	.182	3.361		38.772	2.161
	(2)	356.401	-.732	-1.861		-9.425	197.177	10.988
Quebec	(1)	-155.302	1.166	.228	.540		12.754	4.830
	(2)	-216.472	1.267	.901		-6.809	29.460	11.157
Ontario	(1)	-269.627	2.410	.062	-.107		20.906	8.079
	(2)	227.848	-1.080	-.408		-34.516	76.600	29.600
Prairie	(1)	125.540	1.253	.748	1.088		-682.416	25.024
	(2)	944.230	-.376	.983		2.009	-1,638.888	60.098
B. C.	(1)	-220.704	2.253	-.097	1.065		22.866	3.151
	(2)	-162.981	2.175	-.117		-1.379	41.291	5.689

Note: 1. (1) and (2) denote the reduced-form equation number

2. Variables interpreted as in the context.

CHAPTER VI

PREDICTIONS AND THEIR IMPLICATIONS

This chapter intends to describe probable future trends in the employment of hired and family labor in agriculture. Projection of these trends is carried up to the year 1970. The reduced-form equations derived from the estimated long-run supply and demand relations for hired and family labor in Chapter V will be used as bases for predicting their equilibrium levels of employment in each region. The aggregation of all regions is for Canada as a whole. Since the demand functions for hired and family labor in each region were given two experiments which were composed of different combinations of causal (or independent) variables, it is necessary to set up a few criteria as guides to select the most adequate demand function for a reliable prediction. These criteria are:

1. The number of significant independent variables and the levels of their significance--on a statistical basis, the higher significance of the individual regression coefficients indicates that the independent variables X_i are of greater importance in estimating the dependent variable Y.

2. The magnitude and significant level of the multiple coefficient of determination, R^2--in case two demand functions have the same number of significant indpendent variables and those variables are significant at the same level, then the multiple coefficient of determination is taken into consideration. The value of R^2 gives the approximate proportion of variability in the dependent variable accounted for by the independent (or causal) variables involved in the function. The higher and significant the value of R^2, the more meaningful and useful is the function.

3. The size of the standard error--the standard error of estimate gives an idea about the dispersion around the regression line. The smaller the standard error of estimate, the higher is the degree of congruence between the actual and estimated regression lines.

On the basis of these criteria, the reduced-form equation (1) was chosen for predicting the equilibrium employment of hired labor in B. C. and of family labor in the Atlantic and B.C.; the reduced-form equation (2) was selected for predicting the equilibrium levels of both hired and family labor employment in the remaining regions.

A. A comparison of equilibrium levels of employment with actual levels of employment.

The distributed lag models were used in this study for the purpose of identifying long-run relationships of the demand and supply of the labor force. Consequently, it is possible to compute the historical long-run equilibrium levels of hired and family employment from their respective chosen reduced-form equation for each region. This comparison of long-run equilibrium levels of employment with actual levels of employment will illuminate directly the dynamics of the agricultural labor market, especially in the context of a market receiving continuous impetus to change from exogenous forces. It is noted that the long-run equilibrium concept indicates the quantity of labor supplied and demanded if agricultural firms and members of the labor force took current information about causal variables involved in the reduced-form equation and adjusted completely to them. This concept does not involve any proposition of normative or economic efficiency at all.

Comparisons of the equilibrium level of hired and family labor employment with the actual levels of hired and family labor employment in the period of analysis are shown in Figures 4 and 5[43] respectively. The results indicate that, through most of the period, the actual level of hired farm employment was less than the equilibrium level in all regions and Canada as a whole, especially in the Atlantic and Ontario, whereas the reverse was the case for the family labor employment. The equilibrium level of hired labor employment was higher than the actual level in those years when both demand and supply forces were at work. The decline in the "adjusted" non-farm wage rate and farm wage rate was the main force which caused an increase in hired labor employment.

In view of the average disequilibrium for the entire period, the hired labor employment was deficient in all regions and Canada as a whole. The average disequilibrium rate[44] for the entire period is presented in Table XXVI.

TABLE XXVI

AVERAGE DISEQUILIBRIUM RATE IN HIRED LABOR EMPLOYMENT, 1947-1962

Canada	Atlantic	Quebec	Ontario	Prairie	B. C.*
		--Percentage--			
-13.06	-18.94	-.40	-24.09	-1.50	-2.88

*Estimated on the basis of reduced-form equation(1)

[43]Actual figures are given in Appendix IX and Appendix X respectively.

[44]Disequilibrium rate is measured as the percentage discrepancy between the equilibrium level of employment and the actual level of employment at a point of time, with equilibrium employment as the base.

Fig. 4

ACTUAL HIRED-LABOR EMPLOYMET COMPARED TO EQUILIBRIUM HIRED-LABOR EMPLOYMENT IN AGRICULTURE, 1947-1962

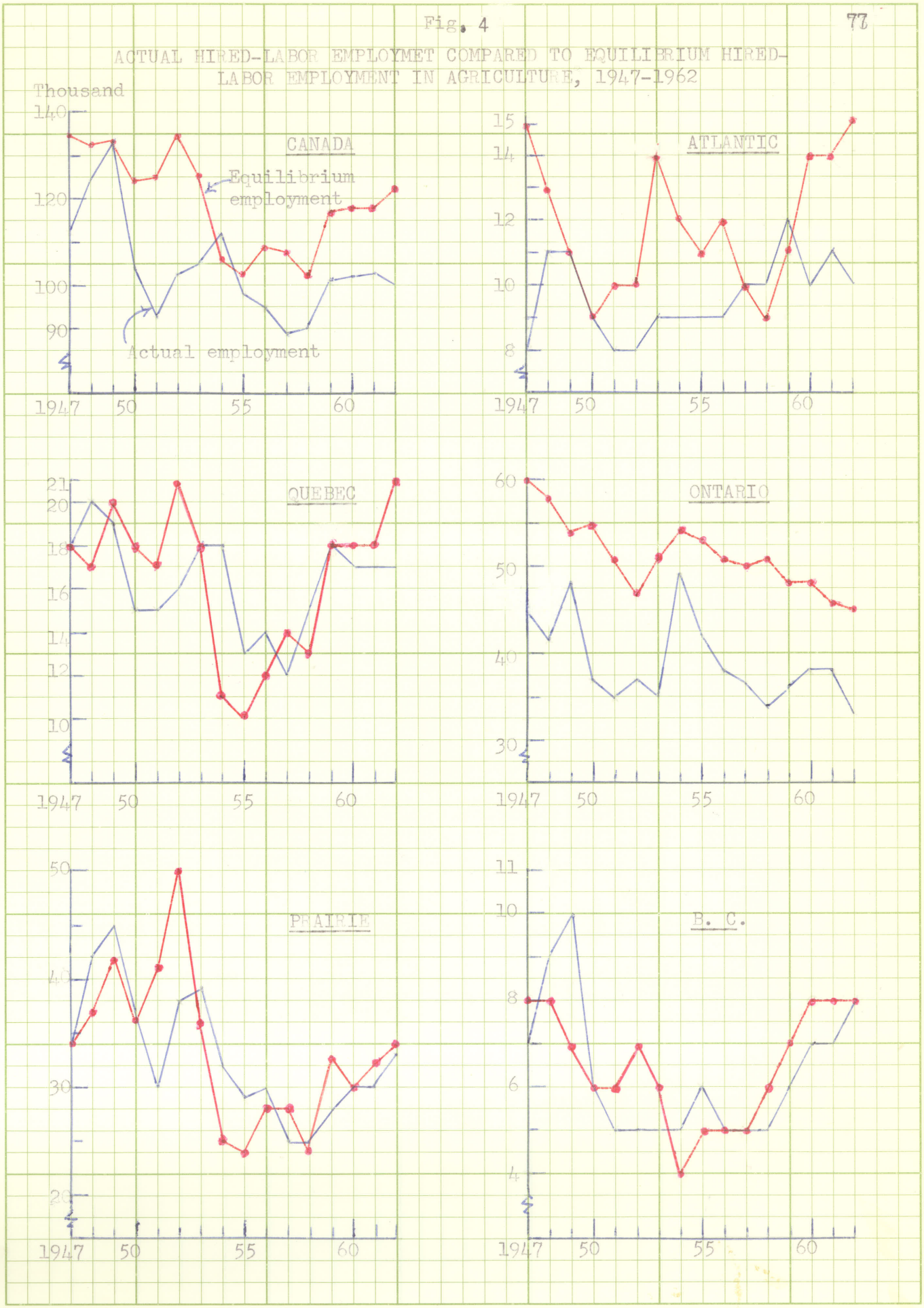
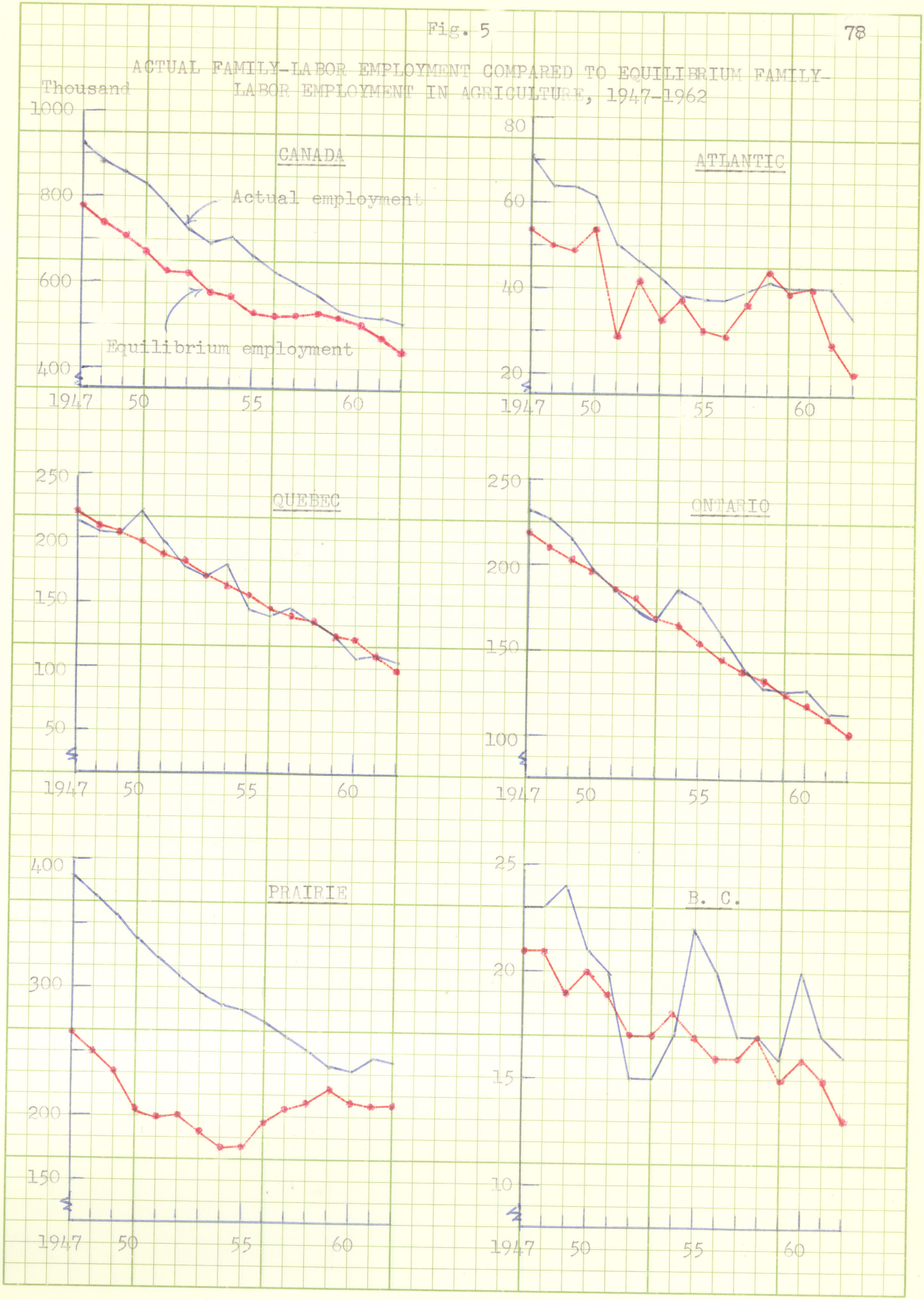


Fig. 5

ACTUAL FAMILY-LABOR EMPLOYMENT COMPARED TO EQUILIBRIUM FAMILY-LABOR EMPLOYMENT IN AGRICULTURE, 1947-1962



The numerical result illustrates that the actual hired labor employment in the Atlantic and Ontario regions was seriously short as compared with their equilibrium levels. The average disequilibrium rates were -24.09 percent in the Ontario region and -18.94 percent in the Atlantic region. This situation may be realistic because the majority of farms in these two regions were operated on a part-time basis. The farm income was often supplemented by income from other types of activity such as logging, fishing, and trapping in the Atlantic, and trade, finance, and manufacturing in Ontario. As the size of farms became larger and larger,[45] the more hired labor would be needed accordingly.[46]

In contrast to hired labor, the actual levels of family labor employment were in excess of the equilibrium levels in all regions and Canada as a whole, especially in the Prairie and Atlantic regions, throughout the analysed period. This surplus of family labor in agriculture fully reflects the difficulties in mobility and lack of job opportunities in non-agricultural industries. The average disequilibrium rate for the entire period in each region and Canada as a whole is shown in Table XXVII.

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[45] See Appendix XI.

[46] See Appendix XII.

TABLE XXVII

AVERAGE DISEQUILIBRIUM RATE IN FAMILY LABOR EMPLOYMENT, 1947-1962

Canada	Atlantic	Quebec	Ontario	Prairie	B. C.*
		--Percentage--			
16.91	21.53	.51	4.33	39.81	9.39

*Estimated on the basis of reduced-form equation (1).

Among the regions, the highest average disequilbrium rate, 39.81 percent, was in the Prairie where family labor employment constitutes a high percentage of the total farm labor and there were scarce non-farm job opportunities so that a large quantity of surplus family labor was expected as the application of farm mechanization developed. The second high average disequilibrium rate, 21.53 percent, was in the Atlantic region where non-farm job opportunities were also not plentiful; the continuous development of farm consolidation, accompanied by the application of mechanization, naturally resulted in the surplus of family labor. The average disequilibrium in family labor employment also happened in other regions, but was not so serious because there were more non-farm job opportunities.

B. Projections of hired and family labor requirements for 1965 and 1970.

Since the future employment of labor resources will be influenced very considerably by those which preceded it, the logical step in an attempt to forecast the future is to base the forecast on the past and current trends formulated in demand and supply relations. However, it is realized that

errors might arise from failure to include some non-economic variables relating to future structural changes in specification of labor demand and supply relations. These non-economic variables falling outside the realm of time series measurement will possibly have an important bearing on the employment pattern of labor resources. Therefore, it is necessary to make the following assumptions on which the projections are made.

1. The observed rate of change in the basic parameters prior to 1962 will continue to be carried up to the year 1970.

2. There will be no particular economic, political, or social upheavals to distort the normal situation of farm labor employment.

With these assumptions, it is possible to make projections of hired and family labor requirements for 1965 and 1970 by extrapolating the trend variable of time (t) in certain types of function which are based upon the data from 1946 to 1962 in different regions. Table XXVIII presents the types of function to be used to fit the 1946-1962 data of each variable.

TABLE XXVIII

TYPES OF FUNCTION USED TO FIT VARIOUS VARIABLES IN DIFFERENT REGIONS

Variable	Atlantic	Quebec	Ontario	Prairie	B. C.
X_2	L.	L.	L.	L.	L.
X_3	S.R.	L.	L.	S.R.	L.
X_4	L.	-	-	-	L.
X_5	L.	L.	L.	L.	S.R.

Note: L.: $\hat{X} = a + bt$; S.R.: $\hat{X} = a + bt + c\sqrt{t}$ where t is time.

By using such curve-fitting, the regression coefficients for time (or trend) are of a minimum variance and with a high level of significance. Thus, it is possible to have highly confident and reliable projected results, ceteris paribus, since the trends may be regarded as the bases for projections.

Table XXIX summarizes the projections of farm labor requirements for 1965 and 1970 which indicate a sizeable reduction in all regions. In Canada as a whole, the projected family labor employment is 413 thousand man-equivalents in 1965 and 294 thousands in 1970, or about 18 and 42 percent declines respectively as compared to the 1962 level; the projected hired labor employment is 118 thousand man-equivalents in 1965 and 114 thousands in 1970, or approximately 18 and 14 percent increases in the respective years. The annual rate of decline in family labor will be much higher in the eight years following 1962 than that experienced during the 1946-1962 period. In view of the decline in annual absolute number, however, the former will be smaller than the latter. For hired labor, it is projected to be moderately increasing, with an annual rate of 1.8 percent in the period from 1962 to 1970. This would likely be the case because of the continuous economic development on the one hand and the consolidation of farms on the other.

On a regional basis, the projected family labor is to decline about 91 percent in the Atlantic, 65 percent in Quebec, 63 percent in Ontario, 15 percent in the Prairie, and 56 percent in B.C. in the eight years after 1962. Among the regions, the highest percentage of decline in the Atlantic would be mainly due to the continuous development of land consolidation

TABLE XXIX

PROJECTIONS OF EQUILIBRIUM LEVELS OF HIRED AND FAMILY LABOR EMPLOYMENT FOR 1965 and 1970

		Canada	Atlantic	Quebec	Ontario	Prairie	B.C.
		--Thousands of man-equivalents--					
Family labor							
Actual 1962 level		507	32	104	112	243	16
Projected 1965 level		413	20*	76	80	227	10*
1965 as percent of 1962	(%)	81.5	62.5	73.1	71.4	93.4	62.5
Annual rate of change	(%)	- 6.2	- 12.5	- 9.0	- 9.5	- 2.2	-12.5
Projected 1970 level		294	3*	36	41	207	7*
1970 as percent of 1962	(%)	58.0	9.4	34.6	36.6	85.2	43.8
Annual rate of change	(%)	- 5.3	- 11.3	- 8.2	- 7.9	- 1.9	- 7.0
Hired labor							
Actual 1962 level		100	10	17	33	32	8
Projected 1965 level		118	23	17	44	27	7*
1965 as percent of 1962	(%)	118.0	230.0	.0	133.3	84.4	87.5
Annual rate of change	(%)	+ 6.0	+ 43.3	.0	+ 11.1	- 5.2	- 4.2
Projected 1970 level		114	26	17	40	24	7*
1970 as percent of 1962	(%)	114.0	260.0	.0	121.2	75.0	87.5
Annual rate of change	(%)	+ 1.8	+ 20.0	.0	+ 2.7	- 3.1	- 1.6

*Estimated on the basis of reduced-form equation (1).

accompanied by the extensive use of machinery and of other types of activity such as logging, fishing, etc., which can absorb a lot of surplus family labor, while the lowest percentage of decline in the Prairie would be possibly because of the lack of non-farm job opportunities. It is quite consistent with the trends in the analysed period. For hired labor, it is projected to decline at a moderate rate in the Prairie and B. C. and to have no changes in Quebec; whereas in the Atlantic and Ontario, it is projected to increase to 26 and 40 thousand man-equivalents respectively for 1970 as compared to 10 and 33 thousands in 1962. The increase in hired labor can be explained with the same reasons as for the decline in family labor in the Atlantic region. Hired labor is projected to increase in Ontario, likely also because of the development of non-agricultural activities such as trade, finance, manufacturing, etc.

If these projections were realized, 199 thousand man-equivalents of farm labor would likely have to find jobs in other industries during the period from 1962 to 1970. On an average, off-farm migration would amount to 25 thousands annually.

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

The analysis of hired and family labor markets in agriculture by using the regression approach brings forth the following conclusions:

1. The demand for hired labor was apparently not responsive to the farm wage rate in all regions, but it was slowly responsive to other variables including the parity ratio, farm machinery, and productivity. On the supply side, hired labor also was not or less responsive to the variables considered in all regions, with the exception of the farm wage rate in B. C. and the "adjusted" non-farm wage rate in the Atlantic. Both variables were statistically significant at the 10 percent level. This non-response or less response implies that hired labor did not play an important role in agricultural production in past years. It was not important, partly because hired labor constituted only a small portion of the total farm labor employment,[47] and partly because most of the hired labor was employed on a part-time basis. In 1961, for instance, the paid year-round workers, as percent of the total hired labor employment, were: 28 in the Atlantic, 41 in Quebec, 45 in Ontario, 48 in the Prairie, 40 in B. C., and 42 in Canada as a whole.[48]

2. In more than 90 percent of the cases analysed, the price elasticity of demand for family labor was negative and significant in all regions, with the exception of the Prairie, where the agricultural industry was dominant

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[47] See appendix XII.

[48] Census of Canada, 1961, Dominion Bureau of Statistics.

and the family labor employment constituted a high percentage of the total farm labor. The negative and highly significant price elasticity suggests that a one percent increase in the farm wage rate is most likely to bring about reductions in the demand for family labor at varying degrees in different regions. The price elasticity of demand for family labor was low in the short-run and much higher in the long-run. It was so because: (1) Habit and inertia are important components of farm operators' behavior, (2) changes in the farm wage rate may be considered to be only temporary and the costs involved in adjustment and re-adjustment may more than offset the gains from maintaining a continuous position of equilibrium, (3) certain resources, including the organization of the firm, are of a durable nature. Adjustments in the demand quantity for family labor may be delayed because of complementarities among these durable goods, and (4) previously signed contracts may commit a farm operator to a given production pattern despite the fact that the current farm wage rate has changed.

The results also show that the income elasticity of demand for family labor[49] was significant at the five percent level or higher levels in B. C. only, while the cross elasticity[50] of demand for family labor was significant at the five percent or higher levels in the Atlantic alone. These two elasticities were estimated to be high in the short-run and even higher in in the long-run. The demand for family labor in B. C. was highly responsive to the parity ratio because the dominance of dairying, market gardening, and

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[49]Income elasticity here is defined as demand for family labor with respect to the parity ratio.

[50]Cross elasticity here is defined as demand for family labor with respect to farm machinery.

fruit growing activities require high labor inputs. The demand for family labor in the Atlantic was highly sensitive to farm machinery because of the continuous development of farm land consolidation that needs to accompany the application of mechanization by which a lot of family labor can be replaced. While the high price elasticity in B. C. indicates that a given percentage rise in the parity ratio is associated with a larger percentage increase in the demand for family labor, the reverse is the case for the high cross-elasticity in the Atlantic.

The elasticity of demand for family labor with respect to the productivity was significant at the five percent or higher levels also in the Atlantic only. It was estimated to be elastic, 1.088, in the short run, and highly elastic, 10.669, in the long-run. This may be due to the fluctuation of the productivity so that farm operators dare not adjust their demand for family labor instantaneously.

On the supply side, however, both the price elasticity and the alternative price elasticity of family labor[51] were consistent in sign with a priori expectations[52] in the Atlantic only, and they were significant at the 10 and five percent levels respectively. The supply of family labor was responsive to both the farm wage rate and the "adjusted" non-farm wage rate in this region because other types of activity such as logging and fishing, etc., were developing in the past years.

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[51] Alternative price elasticity here is defined as the supply of family labor with respect to the "adjusted" non-farm wage rate.

[52] The signs of the coefficients of variable in the supply function, based on a priori expectation, are expected to be: $X_1 > 0$, $X_5 < 0$, and $X_6 > 0$.

3. The adjustment coefficients were much higher for hired labor than for family labor. This adjustment coefficient indicates that a certain percentage of the discrepancy between actual and equilibrium levels of employment can be removed in one time period. The higher the value of the adjustment coefficient, the more rapid is the rate of adjustment to the equilibrium level of employment. The results suggest that family labor has been slower than hired labor in adjusting to sustained price changes. It may be true because family labor usually constitutes a high percentage of the total farm labor and they have difficulties in disposing of their fixed assets.

The rate of adjustment was different among regions for hired and family labor. The adjustment coefficient for both supply and demand for family labor in the Prairie region was particularly low, being .092 and .036 respectively. It implies that the elimination of the discrepancy between actual and equilibrium levels of employment requires a longer period of time.

4. The predicted equilibrium level of hired labor employment was greater than the actual level through most of the period from 1947 to 1962 in all regions and Canada as a whole, particularly in the Atlantic and Ontario. In view of the average disequilibrium for the entire period, the hired labor employment was also deficient in all regions. The two top average disequilibrium rates were -24.09 percent in the Ontario region and -18.94 percent in the Atlantic region. This situation may be realistic because the majority of farms in these two regions were operated on a part-time basis. The farm income was often supplemented by income from other

types of activity such as logging, fishing, and trapping in the Atlantic, and trade, finance, and manufacturing in Ontario. Moreover, the employment of farm labor in agriculture was subject to a high degree of seasonal variation.[53] The number of persons employed in the peak month of August was more than one-third higher than in the slack period in February.[54] Judging from this point, the shortage of hired labor would most likely occur during the months of peak activity.

5. In contrast, the predicted equilibrium level of family labor was still less than the actual level throughout the period in most of the regions and Canada as a whole, even though it has declined steadily. The highest average disequilibrium for the entire period was found in the Prairie and the Atlantic, being surpluses of 39.81 and 21.53 percent respectively. The surplus of family labor in the Prairie would be possibly realistic because it constituted a high percentage of the total farm labor and there were scarce non-farm job opportunities. In the Atlantic, the high percentage of surplus family labor would likely result from the continuous development of farm consolidation accompanied by the application of mechanization. Generally, this surplus of family labor in agriculture fully reflects the difficulties in mobility and the lack of job opportunities in non-agricultural industries.

6. Extending 1947-1962 trends, sizeable reductions in farm labor employment in all regions are projected for 1970. In the eight years after

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[53] See Appendix XIII.

[54] cf. data from 1953 to 1958 inclusive, Labor Force Surveys, Dominion Bureau of Statistics.

1962, in Canada as a whole hired labor is forecast to increase by 14 percent whereas family labor is projected to decline by 42 percent. It is quite consistent with past tendencies if farm consolidation and the application of farm mechanization continue on one hand, and the development of the general economy accelerates on the other.

On a regional basis, the highest percentage of decline in family labor is projected to be in the Atlantic, Quebec, and Ontario regions, where there would be plentiful non-farm job opportunities to accommodate farm labor migrating from farming. In view of the decline in the absolute number, the three regions with the largest employment of family workers, i.e., Quebec, Ontario, and the Prairie, account for about 82 percent of the total decline in the eight years after 1962.

For hired labor, it is projected to be declining in the Prairie and B. C. regions, increasing in the Atlantic and Ontario, and constant in Quebec, during the 1962-1970 period. All of these predictions are nearly compatible with past trends.

In view of the foregoing conclusions, some recommendations may be made:

1. Judging from the non-significant price elasticities of the hired labor supply in the Atlantic and Ontario regions, modest efforts through farm programs to raise the farm wage rate will not materially attract more hired labor available in these two regions. In order to increase the supply quantity to meet the deficits, policies may be focussed on some non-economic aspects such as furnishing adequate housing, providing fringe benefits, and limiting working hours, etc.

2. Price elasticities of demand for family labor were low in the short-run and much higher in the long-run. Thus, programs to raise the farm wage rate, in terms of residual farm income, on the long-term basis, may be effective for off-farm migration of family labor in all regions.

3. The measures required to increase the mobility of farm labor generally include the following:

(a) More vocational education is needed in order to increase the skills of rural youth in non-farm jobs and to increase their understanding of the total economy and of society.

(b) More adequate information about non-farm job opportunities should be available. This information should be of a general nature, dealing with the level of earnings in various jobs and occupations in terms of probable life-time earnings, the type of training required, and the capacities required for the various jobs and occupations.

(c) For those who wish such assistance, employment agencies should be in a position to help individuals locate a suitable job.

(d) Subsidies or loans may be necessary to help farm labor move to non-agricultural sectors.

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A P P E N D I X

APPENDIX I

CHANGES IN TOTAL AND RURAL POPULATION, AND RURAL AS PERCENTAGE OF TOTAL, CANADA AND REGIONS, 1901-1961*

		Canada[a]	Atlantic	Quebec	Ontario	Prairie	B. C.
		--Thousands of persons--					
1901	Total	5,371	894	1,649	2,183	420	179
	Rural	3,357	672	995	1,247	316	89
	%	62.5	75.2	60.3	57.1	75.6	49.7
1911	Total	7,207	938	2,006	2,527	1,328	393
	Rural	3,934	637	1,039	1,199	859	189
	%	54.6	67.9	51.8	47.4	64.7	48.1
1921	Total	8,788	1,000	2,361	2,934	1,956	525
	Rural	4,436	630	1,038	1,227	1,253	277
	%	50.5	63.0	44.0	41.8	64.1	52.8
1931	Total	10,377	1,009	2,875	3,432	2,354	695
	Rural	4,805	628	1,061	1,336	1,468	300
	%	46.3	62.2	39.6	38.9	62.4	43.2
1941	Total	11,507	1,130	3,332	3,788	2,422	818
	Rural	5,254	695	1,222	1,449	1,498	374
	%	45.7	61.5	36.7	38.3	61.8	45.7
1951	Total	14,009	1,257	4,056	4,597	2,548	1,165
	Rural	6,068	764	1,327	1,844	1,305	550
	%	43.3	60.8	32.7	40.1	51.2	47.2
1961	Total	18,238	1,440	5,259	6,236	3,179	1,629
	Rural	7,169	822	1,359	2,615	1,211	847
	%	39.3	57.1	25.8	41.9	38.1	52.0

*Source: Census of Canada, 1961, Dominion Bureau of Statistics, Ottawa.

[a]1951-1961 includes Newfoundland, and all years include the Yukon and North West Territories.

APPENDIX II

AGRICULTURAL LABOR FORCE, CANADA AND REGIONS, ANNUAL AVERAGES,[a] 1901-1963*

Year	Canada[b]	Atlantic[b]	Quebec	Ontario	Prairie	B. C.
			--Thousands of persons--			
1901	717	125	196	306	80	10
1911	934	114	205	307	283	25
1921	1,035	114	218	294	374	35
1931	1,128	108	228	305	443	44
1941	1,084	96	255	270	421	42
1946	1,191	93	278	321	468	31
1947	1,125	86	253	301	451	34
1948	1,100	82	246	290	446	36
1949	1,083	82	243	286	435	37
1950	1,023	79	255	255	405	29
1951	943	62	231	239	383	28
1952	895	59	209	229	377	21
1953	862	57	203	221	360	21
1954	884	51	215	254	340	24
1955	825	49	174	238	333	31
1956	781	50	166	215	324	26
1957	751	55	173	193	307	23
1958	725	58	165	178	299	25
1959	703	58	157	177	286	25
1960	689	58	139	180	282	30
1961	691	58	142	167	295	29
1962	667	47	135	161	296	28
1963	655	37	127	173	298	20

*Source: Ninth Census of Canada, and Labor Force Surveys, Dominion Bureau of Statistics, Ottawa.

[a]Averages for 1953 to 1963 are based on monthly surveys, while before 1953 averages are based on quarterly surveys. 1901-1941 are census data.

[b]Newfoundland included from 1950.

APPENDIX III

TOTAL LABOR FORCE, CANADA AND REGIONS, ANNUAL AVERAGES,[a] 1901-1963*

Year	Canada[b]	Atlantic[b]	Quebec	Ontario	Prairie	B. C.
			--Thousands of persons--			
1901	1,783	302	512	754	134	81
1911	2,724	325	653	991	549	206
1921	3,164	348	781	1,117	698	220
1931	3,922	353	1,022	1,346	895	306
1941	4,196	369	1,189	1,455	869	314
1946	4,829	415	1,337	1,702	969	406
1947	4,942	428	1,357	1,759	971	427
1948	4,988	426	1,385	1,776	968	433
1949	5,055	427	1,423	1,815	953	437
1950	5,163	524	1,433	1,826	951	429
1951	5,223	512	1,462	1,870	948	431
1952	5,324	502	1,504	1,908	964	446
1953	5,397	506	1,538	1,948	956	449
1954	5,493	499	1,562	2,022	949	461
1955	5,610	511	1,591	2,059	969	480
1956	5,782	520	1,615	2,147	997	503
1957	6,003	541	1,675	2,234	1,015	538
1958	6,127	544	1,730	2,255	1,046	552
1959	6,228	553	1,752	2,290	1,071	562
1960	6,403	567	1,796	2,367	1,099	574
1961	6,518	592	1,812	2,393	1,135	586
1962	6,608	600	1,841	2,412	1,156	599
1963	6,737	602	1,892	2,464	1,163	616

*Source: Ninth Census of Canada, and Labor Force Surveys, Dominion Bureau of Statistics, Ottawa.

[a]Averages for 1953 to 1963 are based on monthly surveys, while before 1953 averages are based on quarterly surveys. 1901-1941 are census data.

[b]Newfoundland included from 1950.

APPENDIX IV

PERCENTAGE DISTRIBUTION OF LABOR FORCE AMONG PRINCIPAL COMPONENTS, CANADA AND REGIONS, 1901-1961*

	Classification	1901	1911	1921	1931	1941	1951	1961
		--Percentage--						
Canada[b]	Total labor force[a]	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Agricultural	40.2	34.3	32.7	28.8	25.8	16.0	10.0
	Manufacturing and Mechanical	16.8	13.7	12.9	12.6	16.9	18.9	16.1
	Trade and Finance	5.6	8.1	9.2	9.0	8.8	10.1	15.4
	Construction and Transportation	9.6	11.4	11.4	12.5	12.5	12.5	12.9
	Mining, Logging, Fishing and Trapping	4.0	5.1	3.7	3.8	4.9	3.8	2.8
	Services	23.8	27.4	30.1	33.3	31.1	35.7	42.8
Atlantic	Total labor force	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Agricultural	41.4	35.1	32.8	30.6	26.0	14.9	7.6
	Manufacturing and Mechanical	11.2	10.5	9.2	8.2	10.0	12.5	11.8
	Trade and Finance	5.3	6.2	7.5	7.2	7.6	9.2	14.2
	Construction and Transportation	9.3	9.5	11.2	11.6	13.8	16.3	14.5
	Mining, Logging, Fishing and Trapping	9.9	13.8	10.6	11.0	13.6	12.0	7.6
	Services	22.9	24.9	28.7	31.4	29.0	35.1	44.3
Quebec	Total labor force	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Agricultural	38.3	31.4	27.9	22.3	21.4	13.2	7.5
	Manufacturing and Mechanical	18.7	17.3	16.0	15.4	20.4	22.1	19.1
	Trade and Finance	5.7	8.9	9.3	9.1	8.4	9.2	14.5
	Construction and Transportation	10.0	10.9	111.4	13.0	13.0	15.8	13.6
	Mining, Logging, Fishing and Trapping	1.7	3.2	2.4	2.7	4.1	3.7	2.7
	Services	25.6	28.3	33.0	37.5	32.7	36.0	42.6
Ontario	Total labor force	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Agricultural	40.6	31.0	26.3	22.7	18.6	10.8	7.2
	Manufacturing and Mechanical	17.8	17.7	17.0	16.6	22.1	23.3	18.4
	Trade and Finance	6.9	8.6	10.1	10.0	9.7	10.6	16.3
	Construction and Transportation	10.1	11.3	12.7	13.9	13.1	15.6	11.9
	Mining, Logging, Fishing, and Trapping	1.6	3.1	1.7	2.2	3.1	2.2	1.7
	Services	23.0	28.3	32.2	34.6	33.4	37.5	44.5
Prairie	Total labor force	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Agricultural	59.7	51.5	53.6	49.5	48.4	35.3	24.5
	Manufacturing and Mechanical	5.2	5.3	5.1	5.7	7.1	9.3	9.2
	Trade and Finance	5.2	7.5	8.3	7.7	7.9	10.0	14.3
	Construction and Transportation	8.2	11.1	8.6	9.2	9.2	13.4	12.2
	Mining, Logging, Fishing and Trapping	1.5	2.0	1.7	2.3	2.9	2.0	1.6
	Services	20.2	22.6	22.7	25.6	24.5	30.0	38.2
B. C.	Total labor force	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Agricultural	12.3	12.1	15.9	14.4	13.4	6.3	4.1
	Manufacturing and Mechanical	11.1	10.2	10.9	11.4	15.0	16.9	14.9
	Trade and Finance	8.6	8.7	10.5	10.2	10.5	11.7	17.8
	Construction and Transportation	16.0	16.5	14.5	16.0	15.6	18.2	14.4
	Mining, Logging, Fishing and Trapping	23.6	15.6	12.8	10.8	11.1	7.2	4.0
	Services	28.4	36.9	35.4	37.2	34.4	39.7	44.8

*Source: Computed from Ninth Census of Canada and Census of Canada, 1961, Dominion Bureau of Statistics.

[a]Ten years and over in 1901, 1911; fourteen years and over in 1921, 1931, 1941, 1951; fifteen years and over in 1961.

[b]Excluding the Yukon and North West Territories. Newfoundland included only in 1961.

APPENDIX V

MECHANIZATION IN AGRICULTURE, CANADA AND REGIONS, 1931-1961*

Year	Canada	Atlantic	Quebec	Ontario	Prairie	B. C.
			Automobiles (in thousands)			
1931	321	25	27	126	133	10
1941	315	21	27	129	128	10
1951	330	19	42	115	141	13
1956	352	22	53	117	145	15
1961	358	18	56	111	159	14
			Tractors (in thousands)			
1931	105	1	2	19	82	1
1941	160	3	6	35	113	3
1951	400	13	32	105	237	13
1956	500	19	54	136	276	15
1961	550	21	71	150	291	17
			Motor Trucks (in thousands)			
1931	48	3	5	15	21	4
1941	77	5	7	18	43	4
1951	196	12	19	42	114	9
1956	277	16	29	58	162	12
1961	302	15	26	63	186	12
			Grain Combines (in thousands)			
1931	9	-[b]	-[b]	-[b]	9	x[a]
1941	19	x[a]	x[a]	1	18	x[a]
1951	91	x[a]	x[a]	10	79	1
1956	137	1	1	17	117	1
1961	156	2	3	22	127	1
			Electric Motors (in thousands)			
1931	19	1	3	10	4	1
1941	58	3	8	40	5	2
1951	197	9	45	85	53	4
1956[c]	..	..	..	..	..	..
1961	445	17	73	140	202	13

*Source: Census of Canada, 1961, Dominion Bureau of Statistics, Ottawa.

[a]Less than 500.

[b]Zero.

[c]Data not available.

APPENDIX VI

INCOME ELASTICITY COEFFICIENTS FOR SELECTED AGRICULTURAL PRODUCTS AND CONSUMER PRODUCT CLASSES

Product (Product Class)	Coefficient
All cereals[a]	- 2.33
Red meats[a]	+ 0.34
Composite dairy products[a]	+ 0.30
Poultry meats[a]	+ 1.12
Lettuce[a]	+ 2.09
Tomatoes[a]	+ 1.14
Food[b]	+ 0.50
Housing[b]	+ 0.80
Clothing[b]	+ 1.00
Automobile and travel[b]	+ 1.30
Recreation[b]	+ 1.30
Education[b]	+ 1.60

[a]Source: M. L. Beckford, Consumer Demand for Agricultural Commodities in Canada, unpublished Ph. D. thesis, University of Manitoba, 1964. These estimates are based on 1949 to 1962 data.

[b]Source: R. P. Mack, "The Direction of Change of Income and the Consumption Function in the United States," Review of Economics and Statistics, 30: 239-258, 1948. These estimates are based on the 1935-36 purchase survey.

APPENDIX VII

INDEX OF PER CAPITA INCOME,[a] CANADA AND REGIONS, 1926-1962*
(1935-1939=100)

Year	Canada[b]	Atlantic	Quebec	Ontario	Prairie	B. C.[c]
1926	100.1	94.4	94.0	91.2	135.3	94.9
1927	105.1	98.7	99.4	96.6	140.8	99.2
1928	110.3	102.5	105.6	101.6	143.5	104.5
1929	108.3	106.8	109.9	105.6	115.6	108.0
1930	100.8	98.4	102.8	99.3	104.9	99.6
1931	91.7	89.3	97.0	93.8	81.5	93.2
1932	83.1	79.6	86.5	83.1	79.7	84.2
1933	79.7	77.9	82.9	81.6	71.0	82.1
1934	87.6	84.7	90.0	88.6	83.5	87.2
1935	92.2	91.4	92.7	93.2	89.1	92.1
1936	94.7	97.9	97.0	95.2	89.1	96.7
1937	102.9	104.9	103.6	103.2	102.7	103.1
1938	102.4	100.9	101.2	102.0	104.7	103.1
1939	107.8	104.9	105.6	106.4	114.5	105.1
1940	117.6	114.6	112.1	118.0	123.7	111.9
1941	130.5	124.1	125.8	134.7	126.1	122.8
1942	156.0	144.0	141.1	149.8	192.0	139.8
1943	164.2	163.4	152.8	162.0	171.2	154.8
1944	177.8	176.1	157.7	169.3	217.9	154.5
1945	179.9	192.0	161.3	173.7	202.5	160.4
1946	182.5	200.4	165.1	167.9	234.4	161.9
1947	174.2	185.5	164.3	161.6	216.7	156.6
1948	171.0	167.5	159.3	157.0	225.2	156.9
1949	168.0	169.4	156.5	159.6	217.4	156.5
1950	169.9	171.3	161.1	163.7	205.1	163.5
1951	177.6	168.3	161.9	166.0	246.9	165.4
1952	184.6	179.6	169.4	172.4	253.6	172.0
1953	191.0	180.7	179.8	180.0	247.5	178.8
1954	185.3	185.0	180.8	177.3	210.7	177.4
1955	193.0	187.7	182.9	184.1	233.3	184.5
1956	205.9	202.0	193.1	192.4	262.9	197.3
1957	204.6	199.8	196.0	194.9	237.9	195.4
1958	206.4	205.8	196.4	195.2	250.9	189.4
1959	210.3	214.9	198.4	199.3	254.9	194.2
1960	214.3	224.9	203.0	200.8	265.8	194.2
1961	216.0	224.9	211.7	203.2	249.1	196.3
1962	226.9	232.2	219.2	210.2	287.3	200.5

*Source: National Account--Income and Expenditure.

[a]1949 constant dollars; [b]Newfoundland included from 1949, the Yukon and North West Territories from 1926 to 1950.

[c] The Yukon and North West Territories included from 1926 to 1950.

APPENDIX VIII

UNEMPLOYMENT RATE OF LABOR FORCE, CANADA AND REGIONS, ANNUAL AVERAGES,[a] 1946-1963*

Year	Canada[b]	Atlantic[b]	Quebec	Ontario	Prairie	B. C.
			--Percentage--			
1946	3.4	5.5	4.0	3.0	2.3	3.2
1947	2.2	4.7	2.4	1.7	1.5	2.8
1948	2.3	4.5	2.5	1.8	1.6	3.2
1949	2.8	4.9	3.3	2.3	1.9	3.4
1950	3.6	7.8	4.4	2.4	2.2	4.2
1951	2.4	4.3	2.9	1.7	1.6	3.5
1952	2.9	4.8	3.7	2.2	1.8	3.8
1953	3.0	5.5	3.8	2.1	1.9	3.8
1954	4.6	6.6	5.9	3.8	2.5	5.2
1955	4.4	6.7	6.2	3.2	3.1	3.8
1956	3.4	6.0	5.0	2.4	2.2	2.6
1957	4.6	8.5	6.0	3.5	2.7	5.0
1958	7.1	12.5	8.8	5.4	4.0	8.5
1959	6.0	10.9	7.9	4.5	3.3	6.4
1960	7.0	10.6	9.1	5.4	4.2	8.7
1961	7.2	11.2	9.3	5.5	4.6	8.5
1962	5.9	10.7	7.5	4.3	3.8	6.8
1963	5.5	9.6	7.4	3.8	3.6	6.3
1954-63 average	5.57	9.33	7.31	4.18	3.40	6.18

*Computed from: Labor Force Surveys, Dominion Bureau of Statistics, Ottawa.

[a]Averages for 1953 to 1963 are based on monthly surveys, while averages before 1953 are based on quarterly surveys.

[b]Newfoundland included from 1950 to 1963.

APPENDIX IX

ACTUAL EMPLOYMENT OF HIRED LABOR COMPARED TO EQUILIBRIUM EMPLOYMENT OF HIRED LABOR IN AGRICULTURE, 1947-1962

Year	Canada		Atlantic		Quebec		Ontario		Prairie		B. C.	
	Actual	Equil.	Actual	Equil.	Actual	Equil.	Actual	Equil.	Actual	Equil.	Actual	Equil.[a]
	---Thousands of man-equivalents---											
1947	112	135	2	15	18	18	45	60	34	34	7	8
1948	124	133	11	13	20	17	42	58	42	37	9	8
1949	133	134	11	11	19	20	48	54	45	42	10	7
1950	104	124	9	9	15	18	37	55	37	36	6	6
1951	93	125	8	10	15	17	35	51	30	41	5	6
1952	103	135	8	10	16	21	37	47	38	50	5	7
1953	105	125	9	14	18	18	35	51	39	36	5	6
1954	112	106	9	12	18	11	49	54	32	25	5	4
1955	98	103	9	11	13	10	42	53	29	24	6	5
1956	95	108	9	12	14	12	38	51	30	28	5	5
1957	89	107	10	10	12	14	37	50	25	28	5	5
1958	90	103	10	9	15	13	34	51	25	24	5	6
1959	101	117	12	11	18	18	36	48	28	33	6	7
1960	102	118	10	14	17	18	38	48	30	30	7	8
1961	103	118	11	14	17	18	38	46	30	32	7	8
1962	100	123	10	15	17	21	33	45	33	34	8	8

[a]Estimated on the basis of reduced-form equation (1).

APPENDIX X

ACTUAL EMPLOYMENT OF FAMILY LABOR COMPARED TO EQUILIBRIUM EMPLOYMENT OF FAMILY LABOR IN AGRICULTURE, 1947-1962

Year	Canada		Atlantic		Quebec		Ontario		Prairie		B. C.	
	Actual	Equil.	Actual	Equil.[a]	Actual	Equil.	Actual	Equil.	Actual	Equil.	Actual	Equil.[a]
	---Thousands of man-equivalents---											
1947	924	780	71	54	214	221	231	218	386	266	23	21
1948	888	745	64	50	205	212	226	211	372	251	23	21
1949	862	714	64	49	203	205	215	204	358	237	24	19
1950	836	673	62	54	218	199	197	196	339	204	21	20
1951	781	622	50	29	197	188	186	187	329	199	20	19
1952	726	621	46	42	178	181	175	179	314	202	15	17
1953	694	581	43	33	170	171	169	170	297	190	15	17
1954	705	569	38	37	180	164	186	164	286	176	17	18
1955	664	537	37	30	146	156	178	155	282	179	22	17
1956	628	532	37	29	139	145	160	146	274	196	20	16
1957	603	534	39	36	146	138	141	139	262	205	17	16
1958	573	539	41	44	134	134	128	134	253	210	17	17
1959	543	524	40	39	124	124	126	125	239	221	16	15
1960	526	506	40	40	108	118	127	119	233	213	20	16
1961	524	473	40	27	110	110	113	111	246	210	17	15
1962	507	445	33	20	105	98	113	102	243	212	16	13

[a]Estimated on the basis of reduced-form equation (1).

APPENDIX XI

PERCENTAGE OF FARMS CLASSIFIED BY TOTAL ACREAGE, 1956 and 1961*

Canada & Region	1956			1961		
	50 acres and less	200 acres and less	201 acres and over	50 acres and less	200 acres and less	201 acres and over
	--Percentage--					
Canada	13.8	59.8	40.2	11.1	53.5	46.5
Atlantic	24.1	86.0	14.0	15.3	76.5	23.5
Quebec	10.7	85.0	15.0	8.2	81.1	18.9
Ontario	19.2	83.3	16.7	17.6	79.8	20.2
Prairie	4.1	25.5	74.5	3.3	21.3	78.7
B. C.	64.4	85.0	15.0	59.9	80.7	19.3

*Source: Census of Canada, 1961, Dominion Bureau of Statistics, Ottawa.

APPENDIX XII

PERCENTAGE OF AGRICULTURAL LABOR CLASSIFIED BY EMPLOYMENT STATUS, ANNUAL AVERAGE,[a] 1946, 1956 AND 1962*

Canada & Region	1946		1956		1962	
	Family	Hired	Family	Hired	Family	Hired
			--Percentage--			
Canada[b]	87.61	12.39	86.86	13.14	83.46	16.54
Atlantic[b]	86.96	13.04	81.63	18.37	76.26	21.74
Quebec	90.25	9.75	90.91	9.09	86.26	13.74
Ontario	82.19	17.81	80.75	19.25	77.07	22.93
Prairie	91.20	8.80	90.09	9.91	88.05	11.95
B. C.	67.74	32.26	80.77	19.23	65.38	34.62

*Source: Computed from data directly supplied by the Dominion Bureau of Statistics, Ottawa.

[a]Average for 1946 is based on quarterly surveys, while, for 1956 and 1962, it is based on monthly surveys.

[b]Newfoundland is included in 1956 and 1962.

APPENDIX XIII

SEASONAL INDEXES FOR FARM LABOR EMPLOYMENT, 1953-58* AVERAGES, CANADA, QUEBEC, ONTARIO, AND PRAIRIE REGIONS

Month	Canada	Quebec	Ontario	Prairie
January	88.3	87.3	91.9	86.7
February	86.5	91.8	87.1	84.1
March	89.1	96.8	88.3	85.9
April	96.1	100.6	94.6	95.7
May	104.3	105.3	98.9	107.3
June	104.3	104.4	104.5	106.4
July	118.0	119.6	116.6	116.5
August	119.6	115.0	122.2	119.3
September	107.7	102.2	105.9	111.5
October	101.0	97.9	98.0	105.0
November	94.3	90.4	96.3	94.0
December	90.8	88.7	95.9	89.1

*Source: Dominion Bureau of Statistics' Labor Surveys. Seasonal indexes calculated by ratio-to-moving average method using three term moving average.

APPENDIX XIV

Discussions in the literature which are related to the present study are focussed in this appendix on certain of the assumptions, statistical results, and policy implications of the main body of my thesis.

With regard to the assumption of homogeneous agricultural labor, D. Gale Johnson in his article "Comparability of Labor Capacities of Farm and Nonfarm Labor" pointed out that there was no important difference to be attributed to the region of origin in the occupational experience of migrants. Farm migrants to non-farm areas represent a random sample of the parent farm population with respect to characteristics other than age, sex, and color. This is evidenced by the fact that the education level of farm migrants was almost identical to that of the farm population with the same sex groups and same age intervals, and that the distribution of farm migrants by the region of origin does not indicate that the farm migrants came predominantly from either the high or low farm income regions. In this regard, Dorothy S. Thomas and Sorokin and Zimmerman also arrived at the same conclusions from a review and analysis of the literature that migration to the cities is unselective. As compared to non-farm people of the same age and sex, however, farm people have a labor capacity of approximately 90 percent in terms of occupational experience and wage or salary income. Some of this difference is related to the relatively short period of adjustment permitted the farm migrants and the remainder might well be attributed to difference in education. If the situation prevailing in Canada is similar to that in the United States, then the assumption that agricultural labor

is homogeneous would well be justified.

The statistical results showing surplus labor force in Canadian agriculture are consistent with what Lowell E. Gallaway indicated in his article "Labor Mobility, Resource Allocation, and Structural Unemployment." Simon Goldberg's "Long-Run Changes in the Distribution of Income by Factor Shares in Canada" as well as D. Gale Johnson's "The Functional Distribution of Income in the United States" and Irving B. Kravis's "Relative Income Shares in Fact and Theory" reveal that, while the property share remained unchanged in the past decades, the wage share rose considerably as a percentage of the total national income. A large portion of this observed increase in the over-all wage share resulted from the shifts of labor among industries, reflecting the gap between farm and non-farm labor income. The wage share, by such a shift, has been much higher than had been imputed to farmers and unpaid family workers, however, it still is somewhat less than in the rest of the economy. For reasons why wage convergence failed to appear, George H. Borts in his article "The Equalization of Returns and Regional Economic Growth" pointed out that low prices of agricultural products were the obstacles to capital formation and movement of capital which, in turn, affected the marginal physical product of labor, and that migration was not sufficient to raise farm wage relative to non-farm wage.

The disparity of wage share between farm and non-farm labor has significant policy implications. George H. Borts indicated that those states which enjoyed the greatest increase of service price relative to manufacturing prices appear to have undergone a re-allocation of resources yielding an increase in the capital-labor ratio and an increase in the marginal product

of labor. The prospects for wage convergence depend on: (1) a continuation of migration from farm to non-farm sector; (2) an elimination of the major driving force behind migration, namely, the high population reproduction rate in farm sector; and (3) the direction of capital formation to the farm sector. The chief influence favorable to the increase in wages appears to be the movement of capital. Whether or not labor migrates, capital movements would produce an eventual elimination of sectorial differences in resource endowment, in the real wage, and in the marginal product of capital.

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