Regional Disparities of Productivity and Growth in Canada

Ludwig Auer

IIC COUNCIL OF CANADA

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Preface

This is one of several studies that provided background material for *Living Together*, a concensus report on regional disparities published by the Economic Council of Canada in 1976. The present study deals with provincial productivity performance. It examines how much industrial structure, labour quality, capital per worker, and other factors have contributed to provincial differences in labour productivity and industrial growth.

The study benefited from the comments of N. Swan, C. L. Barber, D. Walters and D.W. Henderson. The author wishes to thank all those who assembled the data, contributed to the statistical analysis, and prepared the study for publication.

The views expressed in this study, as well as any errors, are the responsibility of the author.

Summary

Canada's provincial economies have grown and per capita incomes have increased in all provinces, but the ranking order of provincial performance has changed very little. Per capita incomes are well ahead of the Canadian average in British Columbia and Ontario, they are near the average in the Prairie provinces and in Quebec, and they continue to lag behind in the Atlantic provinces.

Given the fact that provincial incomes per worker vary with provincial levels of labour productivity, the central objective of this study is to identify some of the key factors behind these variations in labour productivity and to determine how much they contribute to the differences between provincial and national productivity levels and rates of economic growth.

From international experience, it is known that industry structure, labour quality, capital per worker, and the state of technology are important factors in explaining variations in incomes among nations. The same factors are examined here.

All provincial comparisons are based on industry data of output per worker. Industry-by-industry comparisons show that output per worker in the Atlantic provinces was below the national average in most industries. In Quebec and Manitoba, it was below the national average in all but two industries; in Saskatchewan, it was about half and half and, in Alberta, British Columbia, and Ontario, it was above the Canadian average in most industries.

It is often thought that the economy of a province performs poorly because it has too many of the low-productivity industries, such as textiles, and not enough of the high-productivity industries, such as auto and steel products. Yet an economy may also perform poorly because in most of its industries output per worker is below the national norm. The first is a question of industrial structure, the second one of output per worker.

Results of this study show that, among the Atlantic provinces, an unfavourable industrial structure contributed substantially to a lower productivity rating in Prince Edward Island. Industrial structure also had a strong negative effect on labour productivity in Saskatchewan and, in manufacturing, it lowered the productivity performance of Manitoba and Quebec.

Far more important than industrial structure, however, were the provincial variations in output per worker. On average, output per worker accounted for over 80 per cent of all variations in provincial productivity performance, for somewhat less in the goods-producing industries, and for more in manufacturing.

The provincial variations in productivity performance, measured in terms of dollar values, were also apparent when selected industry outputs were measured in physical terms. In the forest industry, for example, the annual output per worker in logging of British Columbia was over 100,000 cubic feet, in Newfoundland it was about 50,000 cubic feet. In agriculture, dairy cows in British Columbia produced about 12,000 pounds of milk per year; in Ontario they produced 9,000 pounds, and in Quebec 7,000 pounds. Among the food and beverage industries, soft-drink producers in Ontario bottled about 50,000 gallons per man year; in Nova Scotia, they bottled about 30,000 gallons per year.

Even in the public service sector, provincial variations in productivity performance were evident. In the Income Maintenance Branch of the Department of Health and Welfare, which administers 3.5 million family allowance accounts and 2 million old age security accounts, output per worker ranged anywhere from 60 to 110 per cent among the ten provinces.

Similarly, the measured inputs of the key factors of production varied among the provinces. It was found, for example, that educational attainment is significantly higher in the high-income provinces than in the low-income provinces. Among the provinces, Alberta's labour force had the largest share of university graduates and British Columbia's the largest share of high school graduates. Despite great progress since 1960, in 1970 Newfoundland's labour force still had the smallest share of university graduates and Quebec's had still the largest share of wage earners who never went beyond elementary school.

Labour quality variations, as measured by educational attainment and other factors, had a significant and consistent impact on productivity performance.

At times, capital stock had a stronger impact on productivity performance than labour quality. In Alberta and also in Saskatchewan and British Columbia, greater capital inputs raised output per worker above the national average. In three of the four Atlantic provinces, however, where capital inputs per worker were greater than in Ontario, it did not bring output per worker up to the national average. Greater than average capital inputs per worker may increase output per worker, but one should not expect that they will automatically assure a better than average productivity performance.

Aside from industrial structure, labour quality, and capital, provincial productivity performance depends on many other factors. They are not readily identified, are difficult to measure, but are important for productivity. They are very closely correlated with regional variations in productivity and together account for about one-third of them, and in some

provinces, for over half of them. Important factors among them are firm size, adoption of new technology, and management.

It takes a certain minimum plant size before the techniques of mass production can be applied effectively. Ontario may have the advantage here. In manufacturing, it exceeds the other provinces in plant size by a significant margin.

At times, a new technology is so revolutionary that it affects productivity in a major way in all industries. The assembly-line technique is an early example, the computer a more recent one. The first computers were introduced in Canada about 20 years ago. The provinces of Ontario and Quebec adopted them first; the other provinces followed later. Today Ontario still leads the other provinces in computer use (per employed worker). It is followed by the Prairie region, British Columbia, and Quebec. The Atlantic region lags far behind the others.

Ultimately, the decision to adopt new technology must be made by management, and there is evidence that management in Canada fails to capture some of the potential benefits of new production techniques.

A premium is paid for managers in all provinces, but the premium varies among industries. According to the Canadian Census, the most highly educated managers are employed in government administration and the least educated managers in industrial production. On average, the production managers had only half as many years of education as managers in government.

About one-third of Canadian general managers held university degrees in 1970 but, provincially, that proportion ranged from only 18 per cent in Newfoundland to 37 per cent in Alberta. If past experience is any indication, educational attainment of managers in some provinces is lagging years behind that of others.

Altogether, numerous elements contributed to regional variations in productivity performance. A complete summary of these factors suggests that provinces with a strong productivity performance — such as British Columbia, Alberta, and Ontario — not only excelled in labour productivity in most of their industries but did better than other provinces over a wide range of economic activities. This implies that "catching up" will not be easy and will require strong and determined efforts by management, labour, and government in many areas of the economy.

Analysis of the postwar period shows that most of the productivity improvement has come from greater output per worker and little from shifts in industrial structure. Provincially, growth in output per worker was stronger in the western and most of the eastern provinces than in the central region. Generally these trends made for somewhat more uniform levels of labour productivity among provinces. In the goods-producing industries, however, Newfoundland's growth in output was lower than elsewhere and its productivity gap with most other provinces, therefore, widened.

More capital per worker, improvements in labour quality, and more intensive use of machinery and equipment accounted for about 40 per

cent of all growth in output per worker. Management, technology, and other important factors together accounted for 60 per cent of all growth in output. The latter contributed much less in Nova Scotia and Newfoundland than elsewhere. It means that some of those factors, essential for economic growth, were lacking in these provinces.

Unit labour costs have risen all across Canada, adding to inflationary pressures. They have grown faster in Manitoba, Quebec, and the Atlantic provinces than in Ontario, Alberta, and British Columbia. To the extent that slower growth in unit labour costs made for greater returns on investment, entrepreneurs may have found, during the years 1961-73, Ontario, Alberta, and British Columbia increasingly more attractive for investment than Quebec and the Atlantic provinces.

Provinces with the highest per capita incomes had the highest rates of population and employment growth. While they did not have the highest growth in per capita incomes, their economies expanded faster and offered more attractive opportunities to investors, entrepreneurs, and producers.

There are clear indications that Canada's future population growth will not match that of the past. If traditional patterns of demographic development are projected, only two of Canada's five regions, Ontario and British Columbia, will have as much as 2 to 3 per cent annual growth in their working-age populations. Growth of the youngest age group of the working-age population will actually turn negative, predictably more so in Quebec than in other regions of Canada.

A decline in Canadian population growth could lead to a sharp reduction in profits, a reduction in the rate of capital investment, and a decline in economic growth, particularly in those provinces where population will approach zero growth.

Regional Disparities of Productivity and Growth in Canada

1 Introduction

Historically, Canada's economic development did not follow a smooth path of steady growth, nor was it evenly distributed across all provinces. About a hundred years ago, poor earnings in fishing and agriculture, and a decline in shipbuilding and lumbering industries, created severe economic difficulties in the Maritime provinces. Once the centre of a flourishing shipbuilding industry, it had failed to shift from their production of wooden ocean-going sailing ships to steelplated steamships. Their steel industry developed too late. Immigrants could no longer be attracted to the Maritimes. They looked for employment in central Canada where manufacturing industries expanded rapidly. By 1880, Quebec and Ontario were exporting knitting goods and clothing, agricultural implements, and portable steam engines. In the 1890s construction of the railway, and discovery of gold brought a wave of immigrants to British Columbia.

With the opening up of the Prairie provinces and a strong international demand for wheat at the turn of the century, waves of new immigrants leaded there. The momentum of land settlement carried beyond the First World War but came to a halt with the Depression of the 1930s. After the Second World War the share of labour in agriculture declined and most of the new immigrants settled in Ontario and British Columbia. Manufacturing activities continued strong in central Canada, but then the discovery of oil in Alberta, the development of mining in all the western provinces, and the growth of forest industry in British Columbia added a new dimension to the economy of the West.

In view of this regional diversity of economic development it is surprising, perhaps, that the ranking order of economic performance of Canada's five major regions[1] has changed very little. Per capita incomes improved in all regions, but over the past 50 years, their ranking order remained roughly the same. British Columbia and Ontario, the high-income provinces, remained well above the Canadian average while the

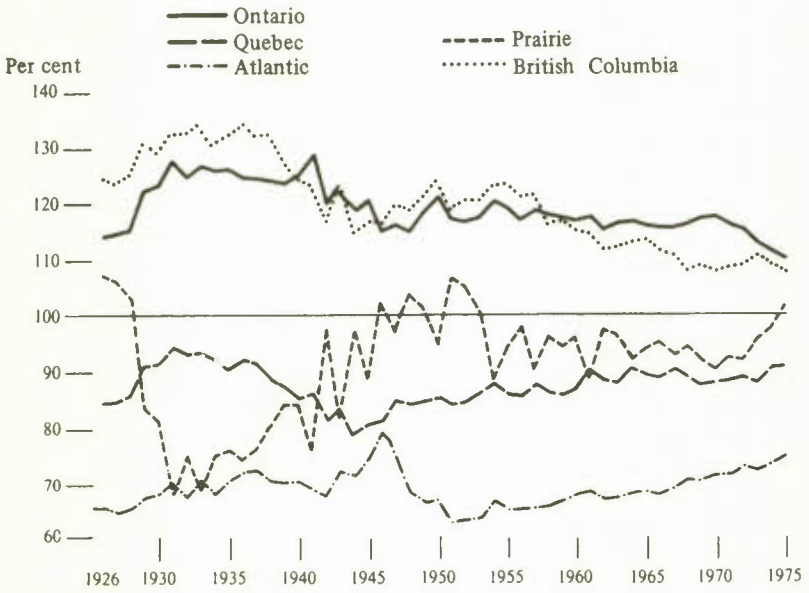
1 That is, the Atlantic provinces of Newfoundland, Prince Edward Island, Nova Scotia, and New Brunswick; Quebec; Ontario; the Prairie provinces of Manitoba, Saskatchewan, and Alberta; and British Columbia. As a rule, the study covers the provinces individually but sometimes it deals only with the larger regional aggregates.

provinces of the Atlantic region stayed behind. The Prairie provinces, after a period of very low incomes during the Great Depression, maintained an intermediate position between the high- and low-income provinces, but had much more instability.

Over the years, the regional disparities have narrowed gradually. Compared with the Canadian average, per capita incomes of Ontario and British Columbia have declined and those of the Atlantic region and Quebec have increased. The trends have not been quite symmetrical however. Income in British Columbia has declined more in relation to the Canadian average than the incomes in the Atlantic provinces and Quebec have risen (Chart 1-1).

Chart 1-1

Personal Income Per Capita as a Percentage of Total for Canada, by Region, 1926-75



Source: Estimates based on data from Statistics Canada.

The narrowing of regional income disparities was painfully slow. After five decades of economic growth, per capita incomes in Quebec and the Atlantic region are still 10 to 30 per cent below the national average and 20 to 40 per cent below the average of Ontario and British Columbia. This despite the fact that interregional migration, changes in regional industrial structure, and government programs should have made for

greater balance among the provinces. Income maintenance programs, equalization payments and investment-incentive programs were aimed, in part, directly or indirectly, at greater equalization of regional incomes. But all this was to little avail, and the slow convergence of regional incomes remains a most perplexing issue — one of Canada's major problems of regional economic development.

To use regional per capita incomes as an indicator of regional variations in welfare is, perhaps, to oversimplify. For a better description of regional variations, income estimates should be surrounded by other economic, social and demographic indicators. Regional economic disparities could be measured, for example, by differences in earned incomes, family or household incomes, labour force participation rates of men and women, employment, job vacancies and unemployment rates. Regional social disparities pertain to the way people feel as individuals and as a community about their way of life, their wants, aspirations, culture and institutions. Regional demographic disparities are related to population growth, net migration rates, and ethnic majorities and minorities. Some of these are measurable, others are not. There are indications that regional disparities would be somewhat less pronounced if not only income per capita but also other measures were used for measuring regional disparities. The general pattern of Canada's regional disparities, however, would probably not be altered dramatically.[2]

The underlying thesis of this study is that regional disparities in per capita incomes in Canada are primarily the results of regional variations in labour productivity. Per capita incomes in the low-income regions are low because labour productivity is low and, vice-versa; per capita incomes in high-income regions are high because labour productivity is high. Therefore, policies directed at greater regional balance will succeed only if they raise the level of labour productivity in the low-income regions. But to improve labour productivity at a more rapid rate may be very difficult. Certainly in the past the low-income provinces have failed to sufficiently improve their productivity levels to raise their incomes to those of other provinces.

Regional differences in labour productivity seem to offer a ready explanation for regional income differences. During the years 1970-73, for example, income and productivity levels were above the national average in British Columbia and Ontario, and well below the national average in the provinces of the Atlantic region. Corresponding estimates for most of the other provinces fell somewhere in between. This correspondence between income and productivity reflects a statistically significant correlation that varies to some extent depending on what measures of comparison are employed, such as, income per capita rather than income per worker, and labour productivity of the total economy rather

2 O.J. Firestone, *Regional Economic Development* (Ottawa: University of Ottawa Press, 1974), chapters 4, 14, and 24.

than that of the goods-producing industries (Table 1-1). While it is evident that this provincial pattern of incomes is roughly in line with the provincial pattern of productivity, some of the exceptions — for example, the estimates for Alberta — cannot be readily attributed to problems of statistical measurement. Other factors are likely to play a role.

Table 1-1

Income and Productivity Levels, Canada and Provinces, 1970-73

(Based on Current Dollars)

	Income[1]		Labour Productivity[2]	
	Per Capita	Per Worker	Total Economy	Goods-Producing Industries
	(Per cent)			
Newfoundland	54	78	91	81
Prince Edward Island	60	n.a.	60	46
Nova Scotia	75	87	77	70
New Brunswick	68	82	82	73
Quebec	88	92	93	86
Ontario	119	110	104	107
Manitoba	94	92	89	82
Saskatchewan	80	83	99	91
Alberta	99	95	114	130
British Columbia	110	108	110	115
Canada	100	100	100	100

1 The income estimates are based on CANSIM data and exclude government transfers to people, e.g., they exclude unemployment insurance benefits and old-age pensions. Estimates of income per worker were obtained by dividing labour-force-survey estimates of employment into provincial incomes.

2 The labour productivity estimates were derived from establishment data by dividing employment into value-added. They correspond to those of Tables 3-1 and 3-2 of Chapter 3 of this study, and are not standardized for provincial variations in industry structure.

Source: Based on data from Statistics Canada.

Comparisons of this sort tell nothing about the sources of provincial productivity differences. They do not tell, for example, whether labour productivity in one province is greater than in another because employment is concentrated in the most productive industries, or because labour is more efficient in each and every industry. They do not tell whether it is greater because the major industries in one province happen to produce the right kind of products — such as cars instead of textiles — or because they produce all kinds of products — including textiles — more efficiently. The first would be a question of industrial structure, the second a

question of output per worker in each industry.[3] And if all the productivity differences came from provincial variations in output per worker in the same industries, simple productivity comparisons would tell little about the underlying causes of these variations. They would not tell, for example, what part of the variations in output per worker comes from provincial variations of investment in machinery and equipment and what part comes from other factors. Nor would they tell how much of the revenue could be expected to go to labour and how much to capital. A better knowledge of the factors behind these provincial variations would be useful for policy formulation.

From international experience, it is known that the stage of economic development and the rate of economic growth of individual countries depend very much on the level of present technology, the rate of adoption of new technology, on capital stock and capital investment in machinery and equipment as well as plant facilities, on the level of education and the quality improvement of the labour force, on productivity in agriculture and manufacturing, on industry structure, on transport costs, and on access to natural resources and world markets.

Rostow, for example, attributes the industrial "take off" of a country to a substantial rise in the rate of capital investment, a surge of technological development in agriculture and industry, a widespread recognition that economic progress is judged to be good, a spirit of entrepreneurship in the private economy, and the emergence to political power of a group prepared to regard modernization as serious, high-order political business.[4]

Denison, in a pioneering study of the sources of postwar economic growth of major industrialized nations, attributes variations in per capita incomes and economic growth to a variety of factors, among them the education of the labour force, the capital investment in plant and equipment, the industrial structure and market demand, and the gains from technology and economies of scale.[5]

While Rostow chooses an economic historian's approach of generalizing from the sweep of industrial history, Denison applies quantitative techniques to analyse the sources of postwar growth in nine advanced industrial countries — eight European countries and the United States.

3 This distinction between industrial structure and output per worker appears to be quite clear. On the conceptual side, however, it raises some questions regarding conditions of optimal resource allocation and differences between marginal and average productivity. Some technical details on this point are given in Appendix A.5.

4 W. W. Rostow, *The Stages of Economic Growth: A Non-Communist Manifesto* (London: Cambridge University Press, 1960), p. 8.

5 Edward F. Denison, assisted by Jean Pierre Poulier, *Why Growth Rates Differ* (Washington, D.C.: Brookings Institution, 1967).

Following the Denison technique, two studies by Walters[6] analyze Canada's economic growth, both dealing with Canada's national economic growth during the postwar period.

Other studies, including the Economic Council of Canada's *Annual Reviews*, have examined the substantial regional disparities in Canadian per capita income and have shown how little — in contrast to the experience in the United States — they have narrowed over the years. One study found that regional variations in per capita income are not so much a result of concentration of employment in some high- or low-income industries — the result of provincial industrial structure — as of higher or lower labour income in most of the industries of a province.[7] Another study found that there are some relationships between per capita income and demographic developments.[8] Population grew faster in the high-income provinces and this growth accelerated their economic growth. Although no study has dealt with economy-wide comparisons of provincial productivity, a comprehensive regional analysis of cereal production in agriculture showed that competitive strength varies greatly among provinces.[9]

The central objective of the present study is to examine Canada's provincial variations in labour productivity, to identify some of the major sources of these variations, and to assess their relative importance as factors accounting for provincial variations in productivity levels and economic growth.[10] In short, it is a quantitative analysis of regional disparities and growth in labour productivity. It concentrates on some of those factors that Denison and Walters found significant in their studies of national economies: industrial structure, labour quality, capital, and technology. Although it is reasonable to assume that these same factors would have a bearing on Canada's regional economic development, questions could be raised why they should. Do not the regional characteristics of industrial structure explain most of the productivity differences between provinces? Do educational standards differ enough among provinces to affect labour productivity in a significant way? Do any of the

6 Dorothy Walters, *Canadian Income Levels and Growth: An International Perspective*, Economic Council of Canada Staff Study 23 (Ottawa: Queen's Printer, 1968); Walters, *Canadian Growth Revisited, 1950-1967*, Economic Council of Canada Staff Study 28 (Ottawa: Queen's Printer, 1970).

7 S. E. Chernick, *Interregional Disparities in Income*, Economic Council of Canada Staff Study 14 (Ottawa: Queen's Printer, 1966).

8 Isabel B. Anderson, *Internal Migration in Canada, 1921-1961*, Economic Council of Canada Staff Study 13 (Ottawa: Queen's Printer, 1966).

9 W. J. Craddock, *Interregional Competition in Canadian Cereal Production*, Economic Council of Canada Special Study 12 (Ottawa: Queen's Printer, 1970).

10 Some of the material in this study was used in preparation of Economic Council of Canada, *Twelfth Annual Review: Options for Growth* (Ottawa: Information Canada, 1975), chaps. 2 and 3; and Economic Council, *Living Together: A Study of Regional Disparities* (Ottawa: Supply and Services Canada, 1977), chap. 5.

low-income, slow-growth provinces really suffer from a pervasive and permanent capital shortage? Do not all of Canada's provinces have access to the same technology?

Unlike the Denison-type study by Walters, which examined Canada's productivity performance in relation to other industrialized nations, the present study does not rely on National Account data but is based entirely on industry data.[11] Following traditional lines of accounting for economic growth, it deals with industrial productivity and growth in Canada's provinces.[12]

The study is limited in scope. A complete analysis of productivity and growth would need to take into account all aspects of demand and supply relationships. This study does not deal with aspects of demand. It ignores questions of domestic or export demand, provincial and national market size, unemployment, transfer payments, incomes and income distributions. It does not consider questions of urbanization and the function of urban centres as development poles.[13] On the supply side, this study ignores questions of transportation and access to natural resources, labour attitudes, and labour-management relations and does not examine very many production factors. Instead, it concentrates on a few aspects of production: industrial structure, output per worker, labour quality, capital per worker, and a broad group of other supply factors, including employment growth, thought to contribute to labour productivity and growth in the provinces. By limiting the study to these aspects, it does not provide the intricate detail needed for most policy decisions but only attempts to show how important certain key factors are in explaining provincial disparities in labour productivity and growth and how they might be related to policy questions.

The results of the analysis are subject to limitations. Data on the industry output, employment, capital stock, education and other labour quality characteristics were collected from a large number of Statistics Canada publications. Although care was taken to obtain comparable data for each industry, a different choice of data — for example, labour force rather than establishment survey data — would have yielded somewhat different results. Also, different estimation techniques based on alternative assumptions would not have yielded exactly the same results.[14] The author believes, however, that the approach used here can provide some useful first insights.

11 National Accounts data are currently being prepared for the provinces within a consistent framework by Statistics Canada. They were not available in time for the preparation of this study.

12 S. Star, "Accounting for the Growth of Output", *American Economic Review*, vol. 74, no. 1 (March 1974), pp. 123-35.

13 François Perroux, "Multinational Investments and Analysis of Development Intergration Poles", *Economies et Sociétés*, Série F, no. 24 (1973), pp. 831-68.

14 Conceptual approach and statistical estimation procedures are described in Appendixes A and B, respectively.

At the time of this study, provincial price indexes of industry inputs or outputs were not available.[15] Therefore, all estimates of industry performance — based on value-added production per worker — were calculated in nominal dollar values and, when necessary, deflated nationally. Value-added measures of production have a quantity and price component. If prices of industry output in one province are higher than in the next, its measured output and productivity performance will also be higher, not because more quantity is produced per unit of labour input but simply because prices are higher. Since transport costs, market demand, and market supply vary among Canada's provinces, it is likely that use of nominal or nationally deflated data of industry output affected, and possibly distorted, the provincial productivity estimates. Although the risk of such a provincial bias in measured productivity performance may not be very serious, it is a shortcoming of this study.[16]

The order of presentation is as follows: following this introductory chapter, provincial variations in industrial structure, labour quality, capital inputs, and technology are described in Chapter 2; their contribution to provincial disparities in labour productivity are estimated in Chapter 3; and their relation to industrial growth is presented in Chapter 4. The study concludes with a summary of findings in Chapter 5 and an epilogue of related policy issues in Chapter 6. To make the text more readable, certain technical details are relegated to appendixes. Appendix A describes research methods; Appendix B some of the underlying statistical analysis; Appendix C gives additional information on background statistics; and Appendix D reviews data sources.

15 Provincial prices indexes of industry inputs and outputs are being prepared by Statistics Canada and should become available in the not too distant future.

16 Some further considerations of this point are given in Appendix D.

2 Key Factors of Productivity

Three major factors known to affect labour productivity are: industrial structure, labour quality, and capital per worker. Economic analysis of international variations in production, productivity, and growth has shown that these three variables are important in explaining variations in incomes among nations. They are examined here to see if they vary significantly among the provinces. Their relationship to provincial variations in labour productivity and labour earnings are analysed later in Chapter 3.

Industrial Structure

Historically, the most important change in industrial structure has been the employment shift from agriculture to manufacturing and other industries. Only 100 years ago, more than three-quarters of Canada's working force were engaged in farming. Today, Canada is predominantly urban and 95 per cent of all employment is in nonfarm activities. This decline in the share of agricultural employment was gradual and has continued right to the present. It was part of a pervasive shift in industry structure — typical of all industrialized nations — from the primary to the secondary and tertiary sectors of production. In Canada today, less than 10 per cent of all employed workers are engaged in agriculture, forestry, fishing and mining — the industries of the primary sector; not quite 40 per cent are employed in manufacturing, construction, transport and utilities — the industries of the secondary sector; and over 50 per cent are employed in finance, trade, community, business and personal services — the industries of the tertiary sector.[1]

The employment shift from industries of the primary sector to those of the secondary and tertiary sectors has occurred in all provinces. Some regional variations in industrial structure have persisted, however. In Prince Edward Island and Saskatchewan, for example, the employment

1 Transport and utilities are included here among industries of the secondary sector. If they were included among those of the tertiary sector, as is often done, its employment share would be closer to 60 per cent.

shares in the primary sector during 1970-73 were larger than anywhere else because a larger share of the labour force was still engaged in agricultural activities. In Ontario and Quebec, the employment share in the secondary sector was large because more people were employed in manufacturing. In all of the provinces, the service industries of the tertiary sector were dominant and, in most of them, they accounted for over half of all employment (Table 2-1).

Table 2-1

Employment Shares, Major Sectors of the Economy, by Province, 1970-73[1]

	Primary Sector	Secondary Sector	Tertiary Sector	Total
		(Per cent)		
Newfoundland	16	33	51	100
Prince Edward Island	25	25	50	100
Nova Scotia	10	31	59	100
New Brunswick	9	35	56	100
Quebec	7	41	52	100
Ontario	6	41	53	100
Manitoba	14	33	53	100
Saskatchewan	31	21	48	100
Alberta	18	28	54	100
British Columbia	8	37	55	100
Canada	9	38	53	100

1 The major sectors of the economy comprise eleven industries. The primary sector includes agriculture, forestry (logging), fishing, and mining; the secondary sector manufacturing, construction, transport and utilities; and the tertiary sector community, business and personal services; finance and trade, and public administration. Had transport and utilities been included in the tertiary sector, as is often done, its share would have been even larger.

Source: Estimates based on data from Statistics Canada.

In some industries, such as agriculture and fishing, average incomes have been traditionally lower than in the manufacturing and service industries. It might be expected, therefore, that a change in industrial structure from industries of the primary to those of the secondary and tertiary sectors would automatically narrow the regional productivity and income differences. This would be entirely true if there were no regional differences in output per worker in individual industries. But there are significant differences. That is one of the reasons why, in spite of fairly uniform trends in regional employment adjustments, the traditional pattern of regional industrial output is still in evidence today. About half

Table 2-2

Shares of Population and Value Added in Goods-Producing Industries, Estimated in Current Dollars, by Province, 1970-73[1]

		Value Added					
	Population	Agri-culture	Forestry	Fishing	Mining	Manu-facturing	Cons-truc-tion
				(Per cent)			
Newfoundland	2	–	3	16	4	1	3
Prince Edward Island	1	1	–	5	–	–	–
Nova Scotia	4	1	2	27	1	2	3
New Brunswick	3	1	5	8	1	1	2
Atlantic Region	10	3	10	56	6	4	8
Quebec	28	13	20	5	11	27	22
Ontario	35	26	14	3	20	54	36
Manitoba	5	10	1	1	5	2	4
Saskatchewan	4	24	1	1	8	1	3
Alberta	8	20	2	–	40	3	12
Prairie Region	17	54	4	2	53	6	19
British Columbia	10	4	52	34	10	9	14
Canada	100	100	100	100	100	100	100

1 Value-added estimates of industry output exclude all material inputs purchased from other industries.
– Less than 0.5 per cent.
Source: Estimates based on data from Statistics Canada.

of Canada's agricultural output is produced in the Prairie provinces, half of Canada's lumber is cut in British Columbia, 90 per cent of the fishing industry's output comes from the Atlantic provinces and British Columbia, about 80 per cent of manufacturing output originates in Ontario and Quebec, and somewhat over half of Canada's construction activity is concentrated in Ontario and Quebec (Table 2-2).[2] With the exception of the construction industry perhaps, this regional pattern of industrial output is very different from the regional distribution of population, and reflects important aspects of regional specialization.

Regional specialization in a particular industry is often thought to be associated with optimal resource use, the highest level of output per worker, and the best returns to labour and capital. This may or may not be so. Grain production in Saskatchewan, for example, may be very efficient whereas fishing in the Atlantic provinces may be very inefficient. A provincial policy aimed at changing the industrial structure by encouraging labour to shift from the primary to the secondary and tertiary sectors may, nevertheless, be successful in Saskatchewan where productivity and income in other industries, such as manufacturing, are also very high. It may accomplish very little, however, in some of the Atlantic provinces where output per worker is below the national average in almost every industry. In the case of the latter, policy incentives directed at productivity improvement in all sectors could be more effective.

For policy design it is useful, therefore, to determine whether regional variations in labour productivity and labour incomes are basically the result of faulty industrial structure or poor productivity performance. This makes it necessary to quantify by how much the factors of production vary among provinces, by how much they differ among industries, and how they compare with the Canadian average.

Labour Quality

It is generally recognized that output per worker in any particular industry and region is not just a question of work effort but depends very much on other economic factors. It depends, for example, on the kind of machinery workers use, the vintage of the machinery and its production capacity; it depends on the working conditions in the plant, the layout of buildings and assembly lines, the management system, market demand, reliability of sources of supply, and labour-management relations. But it is also clear that the performance of the individual worker depends very much on his own motivations, his physical health and energy, mental ability, family background, educational attainment, and on-the-job work experience. This latter set of factors relates mostly to aspects of labour

2 Measured in terms of current-dollar value-added output.

quality. They are difficult to quantify since no precise measures exist to assess their individual importance in a comprehensive manner. Certain proxies for labour quality, however, have been tested successfully in other studies and are used here in place of better measures.

In a market-based system as it exists in Canada today, certain wage differentials may serve as first indicators of labour quality variations.[3] Three characteristics — age, sex and education — are known to be very important determinants of labour earnings.[4] Although age is by no means a precise indicator for work experience, it certainly affects labour income. Given that a person works for 40 to 50 years of his life in a variety of occupations, most of the premium for additional working experience is added to his annual income during the first 20 years in the labour force, that is between his (or her) twentieth and fortieth birthday. In 1970, for example, a man who had completed his high school education and was about 20 years old earned on average $5,543 a year. A man with the same educational background — but 20 years older — averaged about $9,862, or roughly 80 per cent more (Table 2-3). Beyond that age, the labour market paid very little for extra years of experience. Around 50 years of age, the pay averaged $10,111 and only about $250 more than that of a man 10 years younger. And at 60 years of age, earnings were actually less than those of men 10 or 20 years younger.[5]

Although age is probably a good proxy for work experience, it has been shown that market wage rates are not only a function of chronological age but depend as well on work experience and work effort. Lazear found that chronological aging is an important determinant of wage growth for younger workers but that on-the-job experience becomes more important in later years.[6] He estimated that at the age of 19, one year of aging yields about twice as much in higher wage as does one extra year of job experience. He found that this aging effect gradually wears off and that,

3 For an international analysis of this relationship, see E. J. Mitchell, "Explaining the International Pattern of Labour Productivity and Wages: A Production Model With Two Labour Inputs", *Review of Economics and Statistics*, vol. 50, no. 4 (November 1968), pp. 461-69.

4 For Canadian and U.S. examples, see J. R. Podoluk, *Earnings and Education* (Ottawa: Queen's Printer, 1965); Economic Council of Canada, *Second Annual Review: Towards Sustained and Balanced Economic Growth* (Ottawa: Queen's Printer, 1965), chap. 4; and E. Lazear, "Age, Experience, and Wage Growth", *The American Economic Review*, vol. 66, no. 4 (September 1976), pp. 548-58.

5 This finding conforms to that of a statistical analysis of work histories based on a 1973 Survey of Consumer Finances. It showed that Canadian earners achieved an earnings peak after being in the labour force for 27.4 years. With male earners entering the labour force at 19.4 years of age and female earners entering it at 23.4 years, this puts the earnings peak between 45 and 50 years of age for both. See *Earnings and Work Histories of the 1972 Canadian Labour Forces* , Statistics Canada, cat. no. 13-557, Ottawa, October 1976, pp. 12, 14 and 18. Nevertheless, it remains open to question whether cross-sectional data can be used to address a dynamic question adequately.

6 E. Lazear, "Age, Experience, and Wage Growth".

at the age of 25, job experience begins to exceed that of aging per se. He also found that job experience is not just a question of years of employment but that greater work input, measured in terms of hours worked a year, makes for more rapid wage growth.[7]

Women earned substantially less than men.[8] In 1970, women who worked full-time as wage earners earned anywhere from 5 to 50 per cent less than men. Those under 25 years of age and graduates of university, came within 5 per cent of the wage rates for men. They earned $6,157, compared with $6,452 for men. Beyond 25 years of age, the wage differential between women and men widened. It was most unfavourable for older women with little education. Women between 45 and 54 years of age with less than grade 9 education, for example, earned little more than half as much as men of the same age-education group, that is, $3,717 compared with $6,942 for men (Table 2-3).

Table 2-3

Annual Labour Earnings of Men and Women, by Age and Educational Attainment, Canada, 1970

Level of Educational Attainment	Age Group				
	15-24	25-34	35-44	45-54	55-64
Men					
Less than grade 9	4,458	6,366	7,080	6,942	6,498
Grades 9-11	5,049	7,318	8,444	8,445	7,960
Grades 12-13	5,543	8,140	9,862	10,111	9,514
Post-secondary[1]	5,672	8,116	9,652	9,908	9,433
Some university	5,446	8,438	10,826	11,439	10,660
University degree	6,452	10,436	14,761	16,453	16,083
Women					
Less than grade 9	3,002	3,559	3,682	3,717	3,692
Grade 9-11	3,556	4,376	4,530	4,477	4,436
Grades 12-13	4,072	5,029	5,272	5,310	5,271
Post-secondary[1]	4,353	5,607	5,843	5,849	6,017
Some university	4,663	6,223	6,840	6,853	6,923
University degree	6,157	8,002	9,952	10,407	10,266

1 Refers to post-secondary education other than university.

Source: Based on 1971 Census, special tabulation. Relates only to those employees who worked full time in 1970 and reported a wage or salary income.

7 This measure ignores, of course, the possibility that not only working longer but also working harder may lead to a more rapid wage growth.

8 A very comprehensive review of the role of women in the economy is given in H. Kahn, "Economic Perspectives on the Roles of Women in the American Economy", *Journal of Economic Literature*, vol. 13, no. 4 (December 1975), pp. 1249-92.

On average, women earned less than half as much as men. Part of this earnings difference can be explained by the greater part-time employment of women. When only full-time wage earners are considered, women are found to earn 40 per cent less than men. While men tend to be employed in the goods-producing industries — transportation, natural sciences and management — women tend to be employed in the service industries, especially in clerical work, health service, teaching and social sciences. When allowance is made for these occupational differences and for differences in educational attainment, women on average earn 30 per cent less than men.[9]

A good part of the remaining wage differential between men and women — about one-third to one-half of it[10] — can be attributed to the fewer years of work experience that women in the labour force usually have because of their tendency to leave the labour force shortly after marriage and return to work only ten to fifteen years later. Women, therefore, frequently miss out on work experience in the labour force — especially between 25 and 44 years of age — that yields high returns in wages and salaries to men. In 1972, for example, women had less than half as many years of experience in the labour force as men. The number of years varied with the level of educational attainment and age.[11] Women with less than high school education had exactly half as many years of experience as men of the same category. Women with higher levels of educational attainment had up to 63 per cent as many years as men. At 24 years of age, the difference in years in the labour force was very small but it widened with age. Beyond the age of 44, the median number of years of experience of men in the labour force was 34 years but that of women only 18 years.[12]

Some of the other 15 to 20 per cent of the wage differential between men and women may be explained by work attitudes. According to a recent survey, for example, "43 per cent of the women interviewed indicated that they were not ready for any long-term job commitment; many indicated that they were not interested in a career at all. The majority of working women agreed that they would not mind being unemployed for a while...".[13] In line with this attitude is the finding of

9 These estimates were obtained by comparing the annual wage rates women would have earned in 1970, had they been in the same occupations (among 125) and at the same levels of education (among 6) as men, with those actually earned by men.

10 In an analysis of male-female earnings differentials, "years in the labour force" accounted for an estimated 10.5 to 16.5 per cent of it. *Earnings and Work Histories*, 1972, p. 127.

11 Ibid., pp. 76-81.

12 Ibid., p. 15.

13 Economic Council of Canada, *People and Jobs: A Study of the Canadian Labour Market* (Ottawa: Information Canada, 1976), pp. 174-75.

another survey, which indicates that over half the women, compared with only one-third of the men, do not hold a job throughout the year.[14] Also, the dual and supplemental role of women as housewives and members of the labour force affects their attitude towards the type of work sought. They tend to be more concerned than men about amenities and conveniences of their place of work, even if it means somewhat lower wages. Although it is likely that work attitudes account for a good part of the 15 to 20 per cent remainder of the wage differential, it remains unknown how much of it is actually due to such work attitudes and how much of it is attributable to discrimination or other factors.

Education improves incomes of men and women, young and old. University graduates earn the highest incomes, workers with elementary school training the lowest incomes. Below age of 35, men with a university degree earn roughly 50 per cent more than their counterparts with only elementary education. In the group aged 25 to 34 years, for example, men with university degrees in 1970 earned $10,436 while their counterparts with only elementary education earned only $6,366 (Table 2-3). For women, these wage differentials are even greater. Women who had graduated from university earned in 1970 at least 100 per cent more than women with only elementary school education. In the group aged 25 to 34 years, for example, women graduated in 1970 averaged $8,002 compared with earnings of $3,559 for women with only elementary school education. With advancing age, the wage differentials between persons of higher and lower educational attainment widen. In the youngest age groups, university graduates on average earn roughly one-and-a-half time to twice as much as persons with only elementary school; in the oldest age groups, they earn two-and-a-half times as much or more.

Closer examination of wage returns for education suggests that, here too, factors other than education may be involved. While education can improve cognitive or affective skills that in turn yields significant wage gains, educational attainment cannot be readily separated from innate talents, family background, and other factors.[15] Moreover, higher education may at times serve as a credential for admission to highly paid managerial and professional occupations. In the latter case, educational

14 A. M. Young, "Work Experience of the Labour Population in 1972", *Monthly Labour Review*, February 1974, pp. 48-56. This finding was confirmed in Frank T. Denton, Christine H. Feaver, and A. Leslie Robb, *The Short-Run Dynamics of the Canadian Labour Market*, Economic Council of Canada (Ottawa: Supply and Services Canada, 1977). The latter showed that the average duration of employment for women was two months shorter each year than that for men — 8.1 months for women compared with 10.2 months for men.

15 See, for example, G. S. Becker, *Human Capital*, National Bureau of Economic Research (New York: Columbia University Press, 1974); Z. Griliches and W. Mason, "Education, Income and Ability", *Journal of Political Economy*, vol. 80 (1972), pp. 74-104; "Back to Genes", *The Economist*, May 21, 1977; and B. A. Weisbrod and P. Karpoff, "Monetary Returns to College Education, Student Ability, and College Quality", *Review of Economics and Statistics*, vol. 50, no. 4 (November 1968), pp. 461-69.

attainment is primarily a screening device in place of more selective tests for evaluating a complex set of innate talents, skills, aptitudes and attitudes, which could be more costly and yield less reliable results.[16] Although there is some empirical evidence that such screening occurs in certain professions, it is not known at present how widespread this practice is or to what extent it would change productivity, incomes, and returns to education if it did not exist.

From the foregoing discussion, it is clear that age, sex, and education characteristics of the employed labour force reflect certain other factors of labour quality. Chronological age is a proxy for job experience; sex is related to occupation, to years of job experience and work attitudes; and educational attainment may reflect innate ability and job screening practices. Yet, although not an ideal measure, national wage rates based on age, sex and education characteristics can provide a basis for measuring provincial labour quality.

Wage rates in the "richer" provinces are higher than wage rates in the "poorer" provinces. Many factors give rise to these differences, for example, provincial variations in capital per worker, and adoption of new technology, management, market demand and returns to scale, labour demand and supply, natural resources, industrial structure, and employment opportunities in different occupations. Provincial variations in wage rates, therefore, do not only reflect variations in labour quality but also the variations in these other factors.

In order to arrive at a valid measure of provincial variations in labour quality, it is necessary to separate as far as possible the labour quality effects, based on age, education, and sex from "other" provincial effects. This is done by valuing labour employment in each province according to a standard pay scale, such as the set of national wage rates for men and women, of various ages, and of different levels of educational attainment as shown in Table 2-3.[17] The resulting labour quality index measures what wage rates workers would have received in each province and in each industry — in comparison with the overall national average — had they been paid strictly in accordance with their age-sex-education characteristics at the national wage rates.[18] Labour quality in a particular

16 P. Taubman and T. Wales, *Higher Education and Earnings; College as an Investment and a Screening Device* (New York: McGraw-Hill, 1974), chap. 9.

17 In this context, wage rates refer to annual wage and salary incomes of persons employed full-time in 1970. As shown in Table 2-3, the standard pay scale consisted of a set of 60 different wage rates, paid to men and women of five different age groups and six different levels of educational attainment. For more detail on estimation procedures, see Appendix B.1.

18 See Z. Griliches, "Production Functions in Manufacturing: Some Preliminary Results", *The Theory and Empirical Analysis of Production*, ed. M. Brown, National Bureau of Economic Research Studies in Income and Wealth (New York: Columbia University Press, 1967), pp. 275-340, for a cross-sectional production function analysis of U.S. manufacturing.

province is rated higher, for example, if workers are better educated, older, and if the proportion of men relative to women is higher than the Canadian average. This measure of labour quality, therefore, is independent of the wage rates actually paid in the province.

Labour quality measured in this manner varies by as much as 10 per cent among provinces. British Columbia in 1970 ranked highest at 5 per cent above the Canadian average, while Newfoundland ranked lowest at 5 per cent below the Canadian average. The other provinces fell somewhere between. Nova Scotia and Saskatchewan exactly matched the national average (Table 2-4).

Table 2-4

Index of Labour Quality[1] for Men and Women, All Industries, Canada, by Province, 1970

	Men	Women	Average
Newfoundland	93	94	95
Prince Edward Island	97	102	97
Nova Scotia	98	102	100
New Brunswick	96	100	97
Quebec	97	96	97
Ontario	102	101	101
Manitoba	100	99	99
Saskatchewan	100	103	100
Alberta	103	105	103
British Columbia	103	105	105
Canada	100	100	100

1 Estimates are based on national wage rates paid to full-time employees, males and females, of five age groups and six levels of educational attainment. Industry details of labour quality indexes of men, women, and the average of both, are given in Tables C-1, C-2, and C-3, respectively. If, by assumption, male and female workers had been paid exactly the same wage rates, the estimates would change somewhat, but the conclusions would remain essentially the same. For variations in labour quality, based on this alternative assumption, see estimates of Table C-4.

Source: Based on a special tabulation of 1971 Census data, Statistics Canada, 1976.

At first glance, the 1970 range of regional variations in labour quality appears to be quite small. It should be kept in mind, however, that regional differences of 3 or 5 per cent in the labour quality index roughly correspond — in terms of total labour income lost — to regional differences in unemployment rates of 3 or 5 per cent. If, for example, workers in different provinces were paid according to their labour quality ratings of say 97 or 95 per cent, the provincial differences in total labour

income would be about the same as those arising from having an extra 3 or 5 per cent unemployment. The total regional income differences attributable to labour quality are likely to be even greater because unemployed workers receive unemployment insurance payments. Moreover, the significance of regional variations in labour quality is not so much a question of simple percentage differences but rather a question of how much the market system actually pays for labour quality in specific industries.

Among major industries labour quality is low for wage earners in agriculture, fishing, forestry and construction — mostly primary industries — and high in finance, public administration, community, business and personal services — all tertiary industries. The range of the labour quality index across industries is in the neighbourhood of 25 per cent for men, from 89 per cent in manufacturing to 108 per cent in community business and personal services. Actual wage rates vary far more; for men, they range from a low of 57 per cent in agriculture to a high of 120 per cent in finance, insurance and real estate; for women, from a low of 70 per cent in agriculture to a high of 118 per cent in public administration. For male wage earners in agriculture, for example, the pay is "poor" in relation to labour quality whereas, for workers in mining, construction, and finance, the pay is "good". By the same measure, the pay for women is poor in agriculture and trade but good in transport utilities and public administration (Table 2-5).

Variations among industries in labour quality and pay carry over from the national to the provincial side. In all provinces, labour quality and pay for men in 1970 were below average in agriculture and above average in finance, insurance, and real estate. For women the wage rate was "poor" in trade and generally "good" in public administration. In some instances, however, national characteristics of labour and quality are not reflected in all provinces. In mining, workers were generally paid above their labour quality ratings but not in some of the Atlantic provinces. In Nova Scotia, for example, wage earners in the mining industries in 1970 were paid only 79 per cent of the national wage rate, considerably below their labour quality ratio of 92 per cent.[19] Part of this can be explained by the fact that demand for oil, gas, and minerals in the western provinces is generally much stronger than demand for coal in Nova Scotia. Mining revenue in the Prairie provinces and British Columbia increased over the past 15 to 20 years at annual rates of over 10 per cent whereas, in Nova Scotia, mining revenue has grown at only 2 per cent and real output of mining has actually declined.[20] This weakness in demand may well have depressed wage rates of miners in Nova Scotia.[21]

19 For industry detail, see Tables C-1 and C-8.

20 Estimates are based on the years 1957-74.

21 For estimates of wage rates, see Tables C-8 and C-9.

Table 2-5

Indexes of Labour Quality and Annual Wage Rates for Men and Women, Major Industries, Canada, 1970[1]

	Men		Women	
	Quality Index	Wage Rate Index	Quality Index	Wage Rate Index
Agriculture	87	57	91	70
Forestry	91	92	96	99
Fishing and trapping	89	68	100	100
Mining	97	110	103	112
Manufacturing	97	100	89	91
Construction	93	102	99	106
Transport and utilities	98	102	98	112
Trade	96	93	94	85
Finance, insurance & real estate	108	120	97	95
Community, business and personal services	114	102	108	108
Public administration	106	107	106	118
All sectors	100	100	100	100

1 Labour-quality and wage-rate indexes in columns 1 to 4 are based on characteristics of age and education. Provincial details are given in Tables C-1, C-2, C-8 and C-9, respectively. None of the wage rates are adjusted for regional variations of the consumer price index.

Source: Based on 1971 Census data of Statistics Canada.

Among manufacturing industries, labour quality and wage rates in the "traditional" manufacturing activities are lower than in activities of more "advanced" technology. Food and beverage industries, knitting mills, and textile and clothing industries, which emerged from the traditional cottage industries of earlier times, employ labour of below-average quality. By contrast, the electrical-product industries, chemical, petroleum and coal-product industries, which are based on more recent technological developments, employ labour of above-average quality. At the lower end of this industrial wage scale, workers are paid as much as 10 per cent below their quality ratings. At the upper end they are paid as much as 20 per cent above their quality rating (Table 2-6).

This ranking of industrial wage rates according to labour quality suggests that "new-technology" industries employ labour of higher quality and are prepared to pay a premium for it. It suggests that the success of new-technology industries may hinge not only on the market demand for the product but also on the quality of the labour force.[22]

22 It is debatable how much of the wage premium is paid for superior labour quality and how much of it is attributable to other factors associated with higher quality ratings such as occupational characteristics other than education, age, and sex.

Table 2-6

Indexes of Labour Quality and Annual Wage Rates for Men and Women, Manufacturing Industries, 1970[1]

Rank	Manufacturing Industry	Men		Women	
		Quality Index	Wage Rate Index	Quality Index	Wage Rate Index
1	Leather	91	80	93	80
2	Wood	92	85	102	105
3	Furniture and fixtures	93	81	99	95
4	Textiles	95	83	96	93
5	Knitting mills	95	88	94	80
6	Clothing	95	96	93	81
7	Food and beverages	96	91	100	98
8	Rubber	98	97	99	96
9	Nonmetallic products	98	98	103	112
10	Metal fabricating	99	99	103	106
11	Primary metals	99	105	107	124
12	Transportation equipment	100	103	105	121
13	Paper and allied products	100	106	103	109
14	Tobacco products	100	106	98	131
15	Machinery excl. electrical	104	107	107	117
16	Printing and publishing	104	110	107	108
17	Electrical products	107	105	101	107
18	Chemicals	111	113	106	113
19	Petroleum and coal products	114	128	111	132
	Total manufacturing	100	100	100	100

1 Manufacturing industries are listed in this table in ascending order of labour quality of men. Provincial details on labour quality and wage rates are given in Tables C-5, C-6, and C-10, C-11, respectively. None of the wage rates are adjusted for regional variations in the consumer price index.

Source: Based on 1971 Census data of Statistics Canada.

Provincial manufacturing data yield a similar result: a premium is paid for superior labour quality. That is to say, in provinces where labour quality is above the national average, the wage rates exceed the labour quality ratings and, vice versa, in provinces where labour quality is below the national average, the wage rates fall below the quality ratings. As shown in Table 2-7, a 10 per cent difference between provincial and national labour quality roughly corresponds to a 20 per cent difference in wage rates. Labour quality for men in Newfoundland, for example, in 1970 was an estimated 9 per cent below the national average but the wage rate was 19 per cent below the average. By contrast, in British Columbia, labour quality for men in 1970 was 2 per cent above the national average while the wage rate was 6 per cent above.[23]

23 These findings imply that the elasticity of labour quality on wage rates is in the neighbourhood of 2. Further statistical analysis, based on Tables C-5, C-6, C-10, and C-11, shows that for Canada this elasticity is 1.9 and 2.5 for men and women, respectively. For individual provinces, the estimates vary. They are close to the Canadian estimates in the cases of Quebec and Ontario, for example, but differ in some of the other provinces.

Table 2-7

Provincial Variations in Labour Quality and Wage Rates, Manufacturing, Canada, 1970[1]

	Men		Women	
	Quality Index	Wage Rate Index	Quality Index	Wage Rate Index
	(Per cent)			
Newfoundland	91	81	93	73
Prince Edward Island	93	71	100	76
New Brunswick	94	80	100	78
Nova Scotia	97	80	101	75
Saskatchewan	97	91	104	98
Manitoba	98	91	99	88
Quebec	98	94	95	94
Alberta	102	100	105	102
Ontario	102	106	102	106
British Columbia	102	106	107	112
Canada	100	100	100	100

1 Provinces are arranged in this table in ascending order of the Labour Quality Index of men. For industry detail see Tables C-5, C-6, and C-10, C-11. These estimates of labour quality differ from those of Table 2-4 above as they relate to manufacturing industries only.

Source: Estimates based on 1971 Census data of Statistics Canada.

In summary, this evidence suggests that regional variations in labour quality may have a very significant impact on productivity performance of industries and provinces and, in turn, on wages and salaries paid.[24]

Capital

It is a widely held view that labour productivity is not so much a matter of work effort and skill as of capital input per worker.[25] More capital inputs per worker mean better and more efficient machinery and equipment. It appears almost self-evident that workers employed in

24 It is known that legislated labour standards such as minimum wage rates, hours of work, and overtime rates vary among provinces and that provisions in collective agreements differ between industries. See Paul Malles, *Canadian Labour Standards in Law, Agreement, and Practice*, Economic Council of Canada (Ottawa: Supply and Services Canada, 1976), Appendixes A and B. It remains unknown in the present study to what extent labour standards and unionization might have affected the wage differentials among industries and provinces and how they might be related to the factors of labour quality examined here.

25 (Appears on following page).

modern plants equipped with labour-saving machinery can produce more per man-hour than workers in older, poorly organized plants equipped with less efficient machinery. Not only can they produce more, but also they can do it with less effort.

On the surface, this argument seems plausible and, if it were true, government policy implications for Canada's less developed regions would be clear: simply provide funds to those regions that lag behind so that they can invest more in new plants and machinery, through direct investment or subsidies to the private sector, and pay higher wages and salaries. But, as will be shown in Chapter 3, more capital investment in the less developed regions does not automatically assuregreater labour productivity and, indeed, may lead to misallocation of capital.

Among the provinces, capital inputs per worker vary greatly.[26] In 1973, for example, (gross) capital stock per worker ranged from approximately $30,000 in Prince Edward Island to over $50,000 in Alberta. In this case, there was a positive relationship between capital stock and wages and salaries per worker. Capital per worker in 1973 was well below the national average in the low-income province of Prince Edward Island and well above average in the high-income province of Alberta. In some cases, however, this relationship was reversed. In Ontario, for example, capital stock per worker was low — in fact the second lowest of all provinces — yet wages and salaries were above the national average. And in Newfoundland wages and salaries were low but capital stock per worker was high — the third highest among all provinces (Table 2-8). One might have expected that a province with a high level of capital input would also have had a high level of output and income per worker, but that was not so. It appears, therefore, that the relationship between capital stock per worker, output and income per worker is not all that close and that there are other important factors that contribute to regional productivity and income differences.

To some extent, the provincial variations in capital per worker are related to development of natural resources. Canada is rich in mineral resources and exploitation of these resources is capital-intensive. Engineering construction for mining and drilling for oil and gas are costly and often require additional capital inputs for transportation and energy development. As mineral resources are not evenly distributed across Canada's provinces and as capital requirements differ among different kinds of mining, capital inputs per worker in the mining industry vary greatly among provinces. Drilling for oil and gas in Alberta and potash

25 This view was expressed succintly by Donald McPherson, President, General Motors of Canada, when he stated "...You can't increase productivity by asking an employee to work harder. You do it by giving him the tools to do a better job." Cited in "GM President Urges Early End to Controls", *Globe and Mail*, September 15, 1976.

26 Capital inputs, in this context, refer only to man-made capital stocks such as buildings, engineering structures, machinery and equipment and not to land and natural resources. Although statistics on agricultural land values could be obtained, no comparable statistics are published for land values in forestry, mining, and other industries.

Table 2-8

Capital Stock per Worker in Current Dollars, Canada, by Province, 1973[1]

	Dollars	Per cent
Newfoundland	47,928	124
Prince Edward Island	31,132	80
Nova Scotia	36,240	94
New Brunswick	39,341	102
Quebec	34,589	89
Ontario	34,120	88
Manitoba	42,204	109
Saskatchewan	55,963	144
Alberta	55,022	142
British Columbia	46,180	119
Canada	38,742	100

1 Although later in this chapter allowance will be made for industry structure, the capital stock estimates of this table are not corrected for provincial variations in industrial structure. They are simple averages of end-of-year values of gross capital stock and represent the volume of fixed capital investment, accumulated over the years, with an allowance for discards based on the assumption of a fixed average productive lifetime, evaluated in current dollars. They relate to 11 major industries, but exclude the value of land and resources.

Source: Based on data from Statistics Canada.

mining in Saskatchewan are not only more profitable but also require considerably more capital than coal mining in Nova Scotia. During the early 1970s, for example, capital stock in the mining industry exceeded $400,000 per worker in Alberta and Saskatchewan but was only $56,000 per worker in Nova Scotia. With a national average of $182,000 of capital stock per worker the mining industry was much more capital-intensive than any other industry (Table 2-9).

There are also considerable variations in the capital requirements of other industries. Transport and utilities during 1970-73 ranked second, ranging from $171,000 in Saskatchewan to $40,000 in Prince Edward Island. Capital stock per worker in government administration during the same period ranked third with a national average of $67,000 per worker — with a high of $95,000 in Prince Edward Island and a low of $57,000 in Ontario. This level of capital stock per government employee was well above the national average of $34,000 for all industries but included, aside from office buildings and equipment, all highway engineering structures.[27] Corresponding estimates of capital stock per worker in forestry, fishing, finance, insurance and real estate, manufacturing, trade and construction were all below the national average. These estimates

27 For more detail on capital stock of government administration, see the footnote to Table 2-9.

Table 2-9

Gross Capital Stock Per Worker in Current Dollars, Canada, by Industry and Province, 1970-73[1]

	Agri-culture	Forestry	Fishing and Trapping	Mining	Manu-fac-turing	Con-struc-tion	Transport and Utilities	Trade	Finance, Insurance, and Real Estate	Community, Business, and Personal Services	Govern-ment Adminis-tration	All Sectors
	(in thousands of dollars)											
Newfoundland	–	21	8	165	48	5	116	10	23	17	75	40
Prince Edward Island	21	–	6	–	13	4	40	11	41	15	95	28
Nova Scotia	33	21	11	56	43	3	74	10	27	17	63	32
New Brunswick	38	16	7	83	44	3	95	11	31	17	66	36
Quebec	29	25	6	91	22	4	102	9	29	17	69	30
Ontario	37	24	6	97	27	5	111	11	28	16	57	31
Manitoba	40	25	5	105	27	4	105	11	26	16	84	37
Saskatchewan	37	32	2	456	41	7	171	15	23	20	93	50
Alberta	38	31	2	453	39	7	117	10	34	20	83	48
British Columbia	29	44	15	282	42	6	123	11	25	15	84	41
Canada	35	31	9	182	28	5	110	10	28	17	67	34

1 These estimates of gross capital stock correspond to those of Table 2-8 above but are averaged over the years 1970-73. Generally, they include all capital stock in buildings, engineering structures, machinery and equipment. In the case of government administration, they exclude the capital stock of crown corporations, universities, schools and hospitals, which form part of the other industries but include all building and engineering structures, e.g., office buildings, highways, roads and bridges, as well as machinery and equipment of federal, provincial, and local governments. Airports, electric-power facilities, seaports and seaways form part of the capital stock of the transport and utility industry. Universities, schools and hospitals are part of community, business, and personal services. Rented government buildings are part of finance, insurance and real estate. Buildings of national defense are included under government administration but all machinery and equipment of national defense, e.g., tanks, airplanes, computers, are excluded.

Source: Based on data from Statistics Canada.

show not only that capital requirements vary greatly among industries and provinces, but also that it takes on the average three to five times as much capital stock to employ one worker in transport, utilities, and mining as it takes in manufacturing and mosts other industries.

Another interesting indicator of capital use and performance is the ratio of capital per unit of output, or the capital/output ratio. This ratio measures how many dollars of capital stock are required to produce one dollar's worth of output. Historically, capital/output ratios have followed long-term swings. Data available for U.S. manufacturing, for example, show that capital/output ratios rose steadily for 30 to 40 years from 1880 to about 1920, when they reached a high at double their earlier values. Thereafter, they declined for 30 years until they reached a low in 1950, comparable to their 1880 values. During the years of rising capital/output ratios more and more capital was required to produce an extra unit of output, while during the years of decline less capital was required to produce extra output. Rising capital/output ratios can be attributed to capital investments that saved labour and other inputs. Falling capital/output ratios have been attributed to capital innovations that helped to increase output, improve labour productivity, and raise the efficiency of capital inputs.[28]

In Canada, as in the United States, capital/output ratios reached a low around 1951 and have remained (at least in the private sector) at the same low level until the most recent years.[29] Among provinces, the capital/output ratios during recent years are highest in Newfoundland, Prince Edward Island and Saskatchewan and lowest in Ontario and Quebec.[30] As shown in Table 2-10, during 1970-73, it required $4.69 of capital stock to produce one dollar's worth of output in Newfoundland but only $2.64 in Ontario.

Among industries, capital/output ratios during 1970-73 were high in transport and utilities, mining, and government administration — the same industries that had very high capital costs per employee. But the capital/output ratio of agriculture was also very high. To produce a unit of output in agriculture required a capital stock of almost five dollars, compared with less than two dollars in manufacturing. In some of the provinces, where agriculture and mining dominated the industrial structure, as in the Prairie provinces, it raised overall capital requirements.

Although it is not clear at this point which provinces and which industries use their capital most efficiently, it is known that Canadian

28 D. Creamer, S. P. Dobrovolsky, and I. Borenstein, *Capital in Manufacturing and Mining: Its Formation and Financing*, National Bureau of Economic Research Studies in Capital Formation and Financing 6 (Princeton: Princeton University Press, 1960), pp. 38ff.

29 See Economic Council of Canada, *First Annual Review: Economic Goals for Canada to 1970* (Ottawa: Queen's Printer, 1964), p. 72; and *Eleventh Annual Review: Economic Targets and Social Indicators* (Ottawa: Information Canada, 1974), p. 182.

30 The current-dollar value of farm production was unusually low in Saskatchewan during the early 1970s and this had the effect of raising its capital/output ratio to some extent.

Table 2-10

Capital/Output Ratios, Canada, by Province, 1970-73

	Capital/Output Ratio[1]
Newfoundland	4.69
Prince Edward Island	4.67
Nova Scotia	3.69
New Brunswick	3.94
Quebec	2.94
Ontario	2.64
Manitoba	3.72
Saskatchewan	4.63
Alberta	3.80
British Columbia	3.43
Canada	3.09

1 Based on the ratio of gross capital stock to value-added output. Capital stock refers here to man-made capital, i.e., buildings, engineering structures, machinery and equipment, and does not include land and natural resources. For limitations of this measure see Economic Council of Canada, *Eleventh Annual Review: Economic Targets and Social Indicators* (Ottawa: Information Canada, 1974), p. 181.

Source: Based on data from Statistics Canada.

capital requirements are high. To produce one unit of output in Canada requires roughly twice as much capital as in the United States.[31] There are some obvious reasons for this. Canada's climate is less favourable and buildings cost more; Canada is less densely populated and the overhead costs of transportation are higher; exploration and development of the country's mining resources is capital-intensive; and construction of large-scale energy projects is costly. All these factors contribute to higher construction costs. In addition, machinery and equipment is higher-priced than in the United States and this increases the overall capital costs in Canada.[32]

There are other important factors that contribute to higher capital/output ratios in Canada.[33] Production runs in manufacturing are, as a

31 Based on an international comparison of (net stock) capital/output ratios, as described in Appendix B.2.

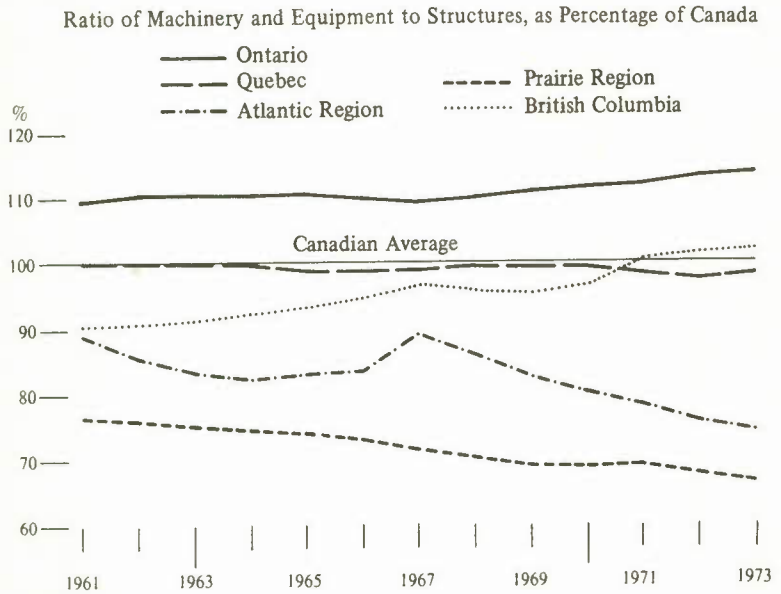
32 According to one study, depending on the item, equipment and machinery prices in Canada were significantly higher than in the United States because of tariffs, difference in exchange rate, and Canadian federal sales tax. See Dorothy Walters, *Canadian Income Levels and Growth: An International Perspective*, Economic Council of Canada Staff Study 23 (Ottawa: Queen's Printer, 1968), p. 275.

33 Economic Council of Canada, *Looking Outward: A New Trade Strategy for Canada* (Ottawa: Information Canada, 1975), chap. 3.

rule, shorter in Canada than in the United States. Shorter production runs mean less specialization, more frequent periods of "down time" to adjust machinery and equipment for different product runs, lower capacity utilization and higher capital/output ratios. Evidence is also accumulating to indicate that the average manufacturing plant in Canada is significantly smaller than that of some of the other industrially advanced countries. Operating below world competitive levels of scale adds to capital costs per unit of output. With current levels of Canadian tariff protection, these higher costs translate into higher-priced output and that in turn adds again to costs of capital goods.

Chart 2-1

Ratio of Capital Stock in Machinery and Equipment to Structure,[1] Manufacturing, Canada, by Region, 1961-73



1 Estimates of end-of-year gross capital stock in current dollars.
Source: Based on data of Statistics Canada and estimates by the Economic Council of Canada.

In Canada, approximately three out of every ten dollars invested in capital stock are for machinery and equipment. In manufacturing, this ratio is twice as large — six out of every ten dollars invested in capital stock are for machinery and equipment.[34] Statistical analysis shows that,

34 Based on current-dollar estimates of gross capital stock averaged over the years 1970-73.

dollar for dollar, the machinery and equipment component of capital stock contributes more than the structure component to labour productivity in the manufacturing industries and in some of the major goods-producing industries.[35] It also shows that there are considerable regional variations in the ratios of capital stock in machinery and equipment to capital stock in structures. In manufacturing, for example, Ontario has invested more in machinery and equipment relative to structures while the Atlantic and Prairie provinces have invested less (Chart 2-1). This has helped to improve labour productivity in Ontario and adversely affected it in some of the other provinces.

Technology, Management, and Other Factors

From international analysis of economic growth, it is known that the state of technology, management expertise, and other factors are important elements of production efficiency. A recent study of Japan's economic growth, for example, found that, as late as 1970, gross domestic product per person employed was 45 per cent lower in Japan than in the United States.[36] Roughly one-half of this percentage gap can be attributed to differences in characteristics of labour, capital, and industrial structure and the other half to a lag in the application of knowledge and general efficiency. The gap was found to be so large that, even under favourable conditions, it would take at least until the year 2000 to close it. In a similar comparison between the United States and European countries, Denison found that the 1960 percentage gap attributable to a lag in application of knowledge and general efficiency accounted for 24 percentage points of a 41 per cent difference in national income per person employed.[37] That is to say, aside from inputs of labour and capital, industrial structure and certain other factors, the lag in application of knowledge accounted for 24 of the 41 per cent difference. That is comparable to 26 of a 45 per cent difference between Japan and the United States in 1970, or roughly one-half of the gap in both comparisons.

In the context of regional productivity analysis, these international findings raise the question of whether or not lags in application of knowledge and gaps in efficiency can also explain a good part of the productivity differences among Canada's provinces. This is a question that cannot be readily answered but will be considered in the next chapter.

35 This conclusion is based on regression estimates of regional production functions. As shown in Appendix B.4, Table B-3, the ratio of gross capital stock in machinery and equipment to structures tested statistically significant at the 1 per cent level, indicating that additional machinery and equipment increased the productivity of capital stock per worker.

36 Edward F. Denison and W. K. Chung, *How Japan's Economy Grew So Fast* (Washington, D.C.: Brookings Institution, 1967), chap. 11.

37 Edward F. Denison, *Why Growth Rates Differ* (Washington D.C.: Brookings Institution, 1967), p. 332.

3 Sources of Regional Productivity Differences

Having examined some key factors of production, it appears that all of them, and perhaps others, could have a bearing on provincial variations in labour productivity. In contributing to better or poorer productivity performance, some are likely to be more important than others. Unfortunately, no estimation techniques exist that would tell exactly how much each one of them contributes to provincial variations in labour productivity. Some first approximations, however, can be made. If it is assumed, for example, that all factors of production are paid roughly in accordance with their productivity,[1] it is possible to estimate how much each of them contributes to provincial productivity differences. This is done by comparing the provincial labour productivity with the Canadian average, by relating the production factors to labour productivity, and by comparing their provincial values with those of Canada.

All provincial comparisons are based on industry data of output per worker, defined in terms of value added per worker.[2] As shown in Table 3-1, some of the provincial disparities in output per worker are quite striking. In the Atlantic provinces, for example, output per worker during 1970-73 was below the national average in most industries. In Quebec and in Manitoba, it was below average in all but two industries. In Saskatchewan, it was about half and half, and in Alberta, British Columbia, and Ontario, it was above the Canadian average in most industries. These variations among provinces in industry output per worker are reflected in the aggregate measure of provincial labour

1 More precisely, marginal productivity. Research methodology and empirical estimation are described in Appendixes A and B, and the underlying equilibrium conditions in Appendix B.3.

2 In national accounting, double counting is avoided by entering only the final product, e.g., the automobile, since this value includes all the raw materials, labour and other services embodied in it. In this study production of all primary industries, i.e., agriculture, forestry, fishing and mining, is included but the output of each industry is measured in terms of census value added. This value is smaller than the value of shipments and excludes all costs of materials, supplies, goods for resale, electricity, fuel. In aggregate, therefore, it does not double count the intermediate inputs. For more detail see Appendix D.

Table 3-1

Output Per Worker and Labour Productivity, Canada, by Province, 1970-73

	Output Per Worker in 11 Major Industries[1]											
	Agriculture	Forestry	Fishing	Mining	Manufacturing	Construction	Transport and Utilities	Trade	Finance	Community, Business, and Personal Services	Government	Provincial Labour Productivity
	(Per cent of Canadian average)											
Newfoundland	–	100	22	275	106	122	144	52	n.a.	n.a.	108	91[2]
Prince Edward Island	42	–	35	–	91	90	84	46	n.a.	n.a.	117	60[2]
Nova Scotia	50	79	52	110	100	104	116	52	74	47	101	77
New Brunswick	59	102	33	166	107	86	133	52	75	47	104	82
Quebec	43	112	18	184	119	115	146	60	84	60	111	93
Ontario	65	125	35	248	148	120	159	61	85	61	116	104
Manitoba	74	106	18	295	110	102	142	58	77	52	123	89
Saskatchewan	88	124	–	682	145	99	185	58	72	49	126	99
Alberta	68	136	–	952	144	129	157	62	83	58	122	114
British Columbia	60	197	66	378	147	135	169	68	80	60	126	110
Canada	65	145	37	371	135	118	153	60	83	59	115	100

– Negligible.
n.a. Not available.
1 Data for service industries are based on estimates of labour and capital inputs. For corresponding estimates of employment and employment shares, see Table C-19.
2 Adjusted for missing data.
Source: Based on data from Statistics Canada. For details see Appendix D.

productivity — the sum of industry outputs per worker weighted by provincial employment shares. Provinces with the highest labour productivity during 1970-73 — that is Alberta, British Columbia, and Ontario — had an above-average performance in most industries; those with the lowest labour productivity had a below-average performance in most industries.[3]

Comparing a provincial economy with the national average is somewhat like comparing a particular city with an average city. One could compare, for example, the total metropolitan area, a city district, or perhaps, a particular industrial park. The results would probably vary with each comparison. Similarly, in comparisons of the provincial economy to the national economy, the results are likely to vary if, in one case, the comparison relates to the whole provincial economy and, in the other, only to the goods-producing industries or manufacturing. In this context, all three aspects of the provincial economies will be examined: the aggregate of all industries, the goods-producing industries, and manufacturing. The all-industry aggregate for the total economy consists of 11 major industries:

- Agriculture;
- Forestry;
- Fishing;
- Mining;
- Manufacturing;
- Construction;
- Transport and utilities;
- Trade;
- Finance, insurance and real estate;
- Community, business and personal services; and
- Public administration.

3 To distinguish between industry output per worker and aggregate output per worker, the former is arbitrarily termed "output per worker" and the latter "labour productivity".

It is composed of the goods-producing sector — the first six of the 11 industries — and of the service sector — the remaining five industries.

Since productivity of the goods-producing industries, and especially that of the manufacturing industries, can be measured more accurately than that of the service industries, productivity estimates of the goods-producing industries may well give a better indication of provincial performance than productivity estimates of all 11 industries. It should be kept in mind, however, that the goods-producing industries account for less than one-half, and the manufacturing industries for less than one-quarter, of all employment in the Canadian economy.[4] Productivity estimates for these two aggregates, therefore can only provide an indication and not a comprehensive measure of provincial productivity performance.

Labour productivity comparisons are presented in the following Table 3-2. They relate to three industry aggregates: the total economy, the goods-producing industries, and the manufacturing industries. For all three industry aggregates, labour productivity of Alberta, British Columbia, Ontario and Saskatchewan ranks highest, while labour productivity in the four Atlantic provinces ranks lowest. As indicated by the percentage differences between provincial and national labour productivity, some of the provincial variations in labour productivity are enormous. In Prince Edward Island, for example, labour productivity in the goods-producing industries during 1970-73 was very low, less than half as much as that of Alberta, British Columbia, and Ontario. Variations among the other provinces during the same period were less striking, but even the much smaller difference in labour productivity between Ontario and Quebec — in the neighbourhood of 20 per cent — was roughly equivalent to the difference in labour productivity between the United States and Canada at that time.

The differences may be caused in part by differences in industrial structure, labour quality, and capital inputs, as discussed in Chapter 2. The question here is, how much of the difference between provincial and national labour productivity — shown in column 3 of Table 3-2 — can be accounted for by differences in these and possibly other factors of production? As a first step, the provincial productivity differences can be broken down into two main factors: industrial structure and output per worker (Table 3-3). Then, the part of labour productivity difference that comes from provincial variations in output per worker can be attributed to variations in labour quality, capital per worker, and other factors (Table 3-7). Among the goods-producing industries of Prince Edward Island, for example, of the total difference between provincial and national labour productivity in 1970-73, estimated at −54 per cent, about −35 per cent of it is attributed to an unfavourable provincial

4 Employment estimates are given in Tables C-19 and C-20.

Table 3-2

Differences Between Provincial and National Labour Productivity Levels, Three-Industry Aggregates, by Province, 1970-73

	Provincial and National Labour Productivity in Value Added Per Worker		Difference Between Provincial and National Labour Productivity
	(Dollars)		(Per cent)
Total economy[1]			
Newfoundland	10,187	91	- 9
Prince Edward Island	6,716	60	-40
Nova Scotia	8,615	77	-23
New Brunswick	9,138	82	-18
Quebec	10,362	93	- 7
Ontario	11,680	104	4
Manitoba	9,980	89	-11
Saskatchewan	11,056	99	- 1
Alberta	12,792	114	14
British Columbia	12,283	110	10
Canada	11,194	100	0
Goods-producing industries			
Newfoundland	11,599	81	-19
Prince Edward Island	6,619	46	-54
Nova Scotia	10,065	70	-30
New Brunswick	10,340	73	-27
Quebec	12,318	86	-14
Ontario	15,295	107	7
Manitoba	11,668	82	-18
Saskatchewan	13,061	91	- 9
Alberta	18,602	130	30
British Columbia	16,316	115	15
Canada	14,253	100	0
Manufacturing			
Newfoundland	11,856	78	-22
Prince Edward Island	10,155	67	-33
Nova Scotia	11,171	74	-26
New Brunswick	11,925	79	-21
Quebec	13,315	87	-13
Ontario	16,562	109	9
Manitoba	12,309	81	-19
Saskatchewan	16,346	108	8
Alberta	16,068	106	6
British Columbia	16,477	109	9
Canada	15,168	100	0

Note: Estimates for the total economy relate to 11 major industries: agriculture; forestry; fishing; mining; manufacturing; construction; transport and utilities; trade; finance, insurance, and real estate; community, business and personal services; and public administration. Those for the goods-producing industries relate to agriculture, forestry, fishing, mining, manufacturing and construction; and those for manufacturing, to 20 manufacturing industries. None of these estimates is adjusted for provincial variations in industry structure.

1 Columns 1 and 2 correspond to provincial labour productivity estimates in Table 3-1.

Source: Based on data from Statistics Canada.

industrial structure and −19 per cent to lower output per worker (Table 3-3). The productivity difference that is due to lower output per worker is then broken down further to show the percentage attributable to less capital stock per worker, to less labour quality, and to all other factors (Table 3-7).

Contribution of Industrial Structure

Much public discussion assumes that industrial structure is a very important element in regional productivity variations and that changes in industrial structure could solve most of the provincial productivity and income problems. It is often thought that a province performs poorly because it has too many of the low-productivity industries and not enough of the high-productivity industries. In short, it performs poorly because it is a province with a poor industrial structure. Yet a province may also perform poorly because in most of its industries "output per worker" is below the national norm. In the first case, a provincial productivity below par could be primarily "explained" by a weakness in industrial structure and in the second by a poor productivity performance. Depending on the main cause, policies to raise the level of labour productivity would need to focus mostly on industrial structure or on raising the level of output per worker in individual industries.

Empirical estimates[5] of industrial structure and output per worker show that industrial structure has had a somewhat one-sided effect on provincial productivity. It has not added much to better performance but at times it has contributed to poorer performance. A look at the provincial economies shows that industrial structure has had unfavourable effects on labour productivity in some of the Atlantic and Prairie provinces. Among the Atlantic provinces, for example, the industrial structure of Prince Edward Island contributes substantially to a lower labour productivity rating. In that case, 16 percentage points of the 40 per cent difference between the provincial and national labour productivity came from industrial structure. The other 24 percentage points came from a lower level of output per worker in individual industries. Industrial structure also has a very negative effect on labour productivity in Saskatchewan and, in 1970-73, it would have lowered average labour productivity relative to the Canadian average by 12 per cent had it not been for a superior performance in output per worker (Table 3-3).

Major weaknesses in provincial industrial structure can be traced to the goods-producing industries.[6] Provincial variations of labour productivity around the national average are quite small in the service industries

5 Because this kind of analysis bristles with conceptual problems, it is not possible to provide any precise estimates but only some first examinations. Aspects of research methodology and empirical estimation are described in Appendixes A and B. Industrial structure is considered in Appendix A.3 and B.5.

6 This conclusion is based on industry detail given in Table C-13.

Table 3-3

Contributions of Industrial Structure and Output Per Worker to Variations in Labour Productivity, by Province, 1970-73

	Contribution[1]		
	Industry Structure	Output per Worker	Difference Between Provincial and National Labour Productivity[2]
	(Percentage difference between province and Canada)		
Total economy			
Newfoundland[3]	6	-15	- 9
Prince Edward Island	-16	-24	-40
Nova Scotia	- 1	-22	-23
New Brunswick	1	-19	-18
Quebec	1	- 8	- 7
Ontario	1	3	4
Manitoba	- 3	- 8	-11
Saskatchewan	-12	11	- 1
Alberta	- 4	18	14
British Columbia	1	9	10
Canada	0	0	0
Goods-producing industries[4]			
Newfoundland	- 2	-17	-19
Prince Edward Island	-35	-19	-54
Nova Scotia	- 1	-29	-30
New Brunswick	- 1	-26	-27
Quebec	2	-16	-14
Ontario	3	4	7
Manitoba	- 7	-11	-18
Saskatchewan	-27	18	- 9
Alberta	- 7	37	30
British Columbia	3	12	15
Canada	0	0	0
Manufacturing[5]			
Newfoundland	2	-24	-22
Prince Edward Island	2	-35	-33
Nova Scotia	1	-27	-26
New Brunswick	- 1	-20	-21
Quebec	- 6	- 7	-13
Ontario	3	6	9
Manitoba	- 8	-11	-19
Saskatchewan	2	6	8
Alberta	2	4	6
British Columbia	0	9	9
Canada	0	0	0

1 For industry details, see Tables C-13 to C-18. Estimation procedures are described in Appendix A-3 and B-3.

2 Corresponds to third column in Table 3-2 above.

3 Estimates for the total economy relate to 11 major industries: agriculture, forestry, fishing, mining, manufacturing, construction, transport and utilities; trade; finance insurance, and real estate; community, business and personal services; and public administration.

4 Goods-producing industries include agriculture, forestry, fishing, mining, manufacturing and construction.

5 Based on analysis of 20 manufacturing industries.

Source: Based on data from Statistics Canada.

compared with those of the goods-producing industries. Among the six major goods-producing industries, agriculture, fishing, mining, and manufacturing individually contribute more to weakness or strength of industrial structure than either the forestry or the construction industries. In provinces where employment is concentrated in agriculture and fishing — that is, in low-productivity industries — an unfavourable structure lowers the level of labour productivity relative to Canada's. In provinces where employment is concentrated in mining and manufacturing — that is, in high-productivity industries — a favourable industrial structure raises the level of labour productivity relative to the national one.[7]

In Prince Edward Island, for example, a good part of employment is concentrated in agriculture and fishing, but very little in manufacturing, and none in mining. In the Prairie provinces, especially in Saskatchewan, much of the employment is in agriculture rather than in manufacturing. This weakness in industrial structure of the goods-producing industries shows up in Table 3-3 as negative values for the Atlantic and Prairie provinces. In Prince Edward Island and Saskatchewan, the unfavourable industrial structure reduces labour productivity in the goods-producing industries by an estimated 35 and 27 per cent, respectively.[8]

When the focus of the analysis is shifted from the total economy and the goods-producing industries to the manufacturing industries, industrial structure affects labour productivity primarily in two of the ten provinces — Manitoba and Quebec. As shown in Table 3-3 above, industrial structure accounted for nearly half of the below-average performance of these two provinces: −8 percentage points of the −19 per cent in Manitoba and −6 percentage points of the −13 per cent in Quebec. In Manitoba, manufacturing is still involved in the processing of primary resources such as lumbering, flour milling, and meat packing. In Quebec, manufacturing is quite heavily concentrated in the food and fibre industries, especially in the textile industry, where productivity is relatively low. But, in both provinces, there has been some expansion of manufacturing into areas of transportation equipment and electrical products. Most provinces do not have a strong metal fabricating industry. In Ontario, however, it contributes to better industrial structure and above average productivity performance.[9]

Contribution of Output Per Worker

Far more important than provincial variations in industrial structure are those in output per worker within each industry (Table 3-3). In most

7 Conclusion based on Table C-15.

8 Based on industry details of goods-producing industries given in Table C-15. For employment data see Table C-19.

9 Industry-specific comments are based on estimates summarized in Table C-17. For employment data see Table C-20.

cases, they contribute substantially more to the provincial productivity performance than industrial structure. On average, output per worker during 1970-73 accounted for over 80 per cent of all variations in labour productivity of the provincial economies, for somewhat less in the goods-producing industries and for more in manufacturing.[10] In the Atlantic provinces, Quebec, and Manitoba, a below-average performance in output per worker in most of the industries lowered the provincial levels of labour productivity. In Ontario, Alberta, and British Columbia, an above-average performance in output per worker lifted provincial labour productivity above the national average.

Among the eleven major industries, the performance of three goods-producing industries — agriculture, mining, and manufacturing — is crucial. Among the Atlantic provinces, a low output per worker in agriculture in Prince Edward Island, in mining in the other three provinces, and in manufacturing in all four provinces, contributed most to the poor productivity performance. In Quebec and Manitoba, output per worker in manufacturing industries was below par. In Ontario, it was above par. High output per worker in Alberta came primarily from the mining and oil and gas industries and, in British Columbia, from manufacturing and several other sectors. Saskatchewan was an unusual case. It achieved above-average levels of output per worker in agriculture, mining, and manufacturing, but this was not quite enough to overcome the negative effects of an unfavourable industrial structure. Had it been possible to eliminate all effects of industry structure, four provinces — Ontario, Saskatchewan, Alberta and British Columbia — would have had better-than-average labour productivity. They would have achieved greater output per worker in the total economy, the goods-producing industries and manufacturing (Table 3-4).[11]

Some more specific examples may further illustrate the existence of provincial variations in output per worker. Unlike the more comprehensive dollar measures for the three industry aggregates, they deal only with certain aspects of production. In agriculture, for example, regional variations in farm acreage suggest that farms were more commercialized in the West than in the Atlantic region. Where the average farm operator in Nova Scotia worked on 64 acres of improved farmland, his counterpart in the Prairie provinces worked on 300 to 600 acres. This enabled Prairie farmers to produce grain more efficiently at lower cost.[12] There were also marked differences in livestock production. Where the average dairy cow in Quebec produced annually about 7,000 pounds of milk, dairy cows in

10 These estimates are based on simple averages of the ten provinces and are not weighted by size of the provincial economies. For details, see Table C-22.

11 More details on the effects of output per worker and industrial structure, disaggregated by industry, are given in Tables C-13, C-15, and C-17.

12 For some indication in variations of grain harvesting costs by farm size, see Appendix C.4.

Table 3-4

Variations in Output per Worker, Standardized for Industrial Structure,[1] by Province, 1970-73

	Total Economy	Good-Producing Industries	Manufacturing Industries
		(Per cent)	
Newfoundland	85	83	76
Prince Edward Island	76	81	65
Nova Scotia	78	71	73
New Brunswick	81	74	80
Quebec	92	84	93
Ontario	103	104	106
Manitoba	92	89	89
Saskatchewan	111	118	106
Alberta	118	137	104
British Columbia	109	112	109
Canada	100	100	100

1 Estimates standardized for industrial structure are derived from the percentage differences (between provinces and Canada) attributed to variations in output per worker in Column 2 of Table 3-3. The 85 per cent estimate for the total economy of Newfoundland, for example, corresponds to the −15 per cent estimate in Table 3-3.

Ontario produced 9,000 pounds and in British Columbia around 12,000 pounds.[13] In forestry, another primary industry, the annual output per worker ranged from less than 500 cunits[14] in Newfoundland to well over 1,000 cunits in the Prairie provinces and British Columbia. Among the food and beverage industries, soft drink manufacturers in Ontario and breweries in Quebec and Ontario produced more gallons per worker than those in other provinces. In the textile industry, output per worker was greater in Ontario than elsewhere and it exceeded that of Quebec by 15 and 20 per cent (Table 3-5).

The steel industry is a very important sector of Canadian manufacturing. It is not evenly distributed across Canada but is concentrated in Ontario, which produces about three-quarters of all Canadian steel output. The success of the Ontario steel industry can be attributed to a variety of factors. It has easy access to U.S. iron ore and coke; it is close to Canadian and U.S. markets; it improves its productivity performance over the years; and, until very recently, it was able to maintain a sharp, competitive edge. Measured in tons, steel output per worker was higher in

13 This difference in productivity of dairy cows will be further examined in Chapter 5.

14 A cunit equals 100 cubic feet of solid wood.

Table 3-5

Provincial Variations in Physical Indicators of Productivity, Selected Industries, Canada, by Province, 1970-73

	Agriculture		Forestry[2]	Manufacturing		
				Annual Shipments		Value Added Per Worker
	Improved Acres per Farm Operator[1]	Annual Milk Production Per Dairy Cow[2]	Annual Logging Output per Worker	Soft Drink Manufacturers	Breweries	Textiles[4]
	(Acres)	(Pounds)	(Cunits)[3]	(1,000 gallons per employee)		
Newfoundland	19	–	480	–	–	–
Prince Edward Island	109	7,400	–	–	–	–
Nova Scotia	64	8,300	900	29	–	10,338
New Brunswick	89	7,300	790	34	–	–
Atlantic Region	–	–	–	–	50	–
Quebec	105	6,900	820	47	82	10,745
Ontario	115	9,000	850	56	83	12,884
Manitoba	366	7,900	1,380	50	46	7,438
Saskatchewan	605	7,200	1,680	35	54	11,288
Alberta	455	8,300	1,800	45	67	11,839
British Columbia	96	12,300	1,270	46	66	10,294
Canada	296	8,000	1,020	48	72	11,574

1 Estimates refer to the year 1971. Improved farm acreage includes cropland, improved pasture, summer fallow, farm yard and lanes, but excludes woodland, native pasture, hayland, bush pasture and wasteland that has not been cultivated.
2 Estimates refer to the year 1973.
3 A cunit equals 100 cubit feet of solid wood. Estimates may overstate the provincial differences to the extent that sawmills in some provinces purchased logs from each other more often than in others. It is not likely, however, that that would affect the range of estimates significantly.
4 Textile industries, as defined by Statistics Canada, include industries 181 to 189 of the Standard Industrial Classification. For industry data in related areas, i.e., knitting mills and clothing industries, see Tables C-20 and C-21.
Source: Based on data from Statistics Canada.

Ontario than in Quebec (Table 3-6). The Quebec steel industry, however, has increased its output per worker substantially during recent years and there is evidence that Quebec and the western provinces have increased their ability to compete with Ontario in meeting some of their own steel requirements.[15] In a time of energy shortage, the abundance of hydro-electric power in Quebec and easy access to natural gas in the West may strengthen their relative competitiveness further.

Table 3-6

Regional Variations in Annual Output per Worker, Steel Industry, Ontario and Quebec, 1970-73[1]

	Net Tons per Worker		
	Ontario	Quebec	Canada
		(Tons)	
1970	339	106	320
1971	337	130	318
1972	359	185	340
1973	379	215	356
1970-73	353	159	333

1 Corresponding data are not available for other provinces.
Source: Statistics Canada, *Iron and Steel Mills*, cat. no. 41-203.

Contribution of Labour Quality

Getting ahead in North American society has long been thought to depend on a combination of inherited traits such as brains, good health, and motivation — and simply luck. In the past century, and more so in recent years, one's level of education has been added to the list of qualifications. Today, education has become part of the human-capital approach. Governments can influence and, if deemed necessary, change the rate of investment in education. It is of interest, therefore, to examine if and to what extent provincial variations in educational attainment contributed to provincial variations in labour productivity. As shown in Table 3-7, regional variations in labour quality contributed roughly 20 per cent of all the provincial differences in output per worker.[16] To determine how much education contributed to it, wage rates can be related to the educational attainment of the work force while taking into account the effects of age, sex, industrial structure, and other regional variables.

15 F. Martin et al, *The Interregional Diffusion of Innovations in Canada*, Economic Council of Canada (forthcoming).

16 This estimate is based on simple averages of the ten provinces and not weighted by the size of the provincial economies.

Table 3-7

Contribution of Capital, Labour Quality and Other Factors to Variations in Output per Worker, by Province, 1970-73

	Contribution[1]			Difference Between Provincial and National Output per Worker
	Labour Quality	Capital Stock per Worker	Management, Technology, and Other Factors	
	(Percentage difference between province and Canada)			
Total Economy				
Newfoundland	-6	0	- 9	-15
Prince Edward Island	-4	-14	- 6	-24
Nova Scotia	-2	- 5	-15	-22
New Brunswick	-4	- 3	-12	-19
Quebec	-3	- 6	1	- 8
Ontario	1	- 3	5	3
Manitoba	-2	- 2	- 4	- 8
Saskatchewan	-1	13	- 1	11
Alberta	3	16	- 1	18
British Columbia	6	9	- 6	9
Canada	0	0	0	0
Goods-producing industries				
Newfoundland	-3	- 2	-12	-17
Prince Edward Island	-3	-14	- 2	-19
Nova Scotia	-1	- 6	-22	-29
New Brunswick	-3	- 3	-20	-26
Quebec	-4	-12	0	-16
Ontario	1	- 5	8	4
Manitoba	-2	- 6	- 3	-11
Saskatchewan	-2	15	5	18
Alberta	4	31	2	37
British Columbia	7	18	-13	12
Canada	0	0	0	0
Manufacturing				
Newfoundland	-3	69	-90	-24
Prince Edward Island	-6	-24	- 5	-35
Nova Scotia	4	28	-59	-27
New Brunswick	-4	70	-86	-20
Quebec	-1	- 7	1	- 7
Ontario	0	1	5	6
Manitoba	-1	8	-18	-11
Saskatchewan	-2	28	-20	6
Alberta	4	7	- 7	4
British Columbia	6	6	- 3	9
Canada	0	0	0	0

1 All estimates are standardized for industrial structure. They only relate to factors contributing to regional variations in output per worker. The sum of the first three columns of this table equals the fourth column, and this column corresponds to the "output per worker" column in Table 3-3 above. Footnotes in Table 3-3 give information on industry details. Estimation procedures are described in Appendix A.3 and B.3.

Source: Based on data from Statistics Canada.

Results of this analysis show that education has a greater regional impact than provincial variations in age, or the proportion of women in the work force. Had it not been for some compensatory variations in age and lower participation rates of women in the Atlantic provinces, the variations in labour quality would have been even more pronounced (Table 3-8). This implies that provincial variations in educational attainment alone contribute more to variations in output per worker than the variations in measured labour quality would suggest.[17]

Table 3-8

Variations in Educational Attainment, Age and Sex of Full-Time Employees, Manufacturing, Canada, by Province, 1970-73

	Educational Attainment	Age	Proportion of Women
	(Years)		(Per cent)
Newfoundland	8.9	38	10
Prince Edward Island	9.8	37	21
Nova Scotia	9.7	40	15
New Brunswick	9.6	38	14
Quebec	9.6	38	23
Ontario	10.8	39	21
Manitoba	10.3	40	22
Saskatchewan	10.5	38	14
Alberta	11.2	38	16
British Columbia	11.2	39	12
Canada	10.4	39	20

Source: Based on 1970 Census of Statistics Canada.

Among labour force participants aged 25 to 34 years and employed in 1970, about one in ten had a university degree, one in four had graduated from high school and had taken some additional training, one in two had at least some high school, and fewer than one in five had never gone beyond elementary school.

Educational attainment is generally higher in the West than in the East (Table 3-9). In most of the western provinces, a larger proportion of workers aged 25 to 34 years had graduated from university or received some post secondary training, and a smaller proportion have received only elementary education, than in the eastern provinces. Among all provinces, Alberta has the highest proportion of university graduates and

17 Estimates of the contributions to regional disparities in labour productivity of education, age and sex, based on regression analysis, are shown in Table B-8.

British Columbia has the highest proportion of workers with high school education, with or without post-secondary training. In spite of significant progress during the 1960s, Newfoundland still has the smallest share of university graduates and Quebec still has the largest share of young wage earners who never went beyond elementary school.

Table 3-9

Educational Attainment of Wage Earners Aged 25 to 34 Years, Canada, by Province, 1970[1]

	University Degree	Post Secondary	High School	Elementary School	Total
			(Per cent)		
Newfoundland	7	26	51	16	100
Prince Edward Island	10	28	46	16	100
Nova Scotia	9	26	48	17	100
New Brunswick	9	25	46	20	100
Quebec	10	27	39	24	100
Ontario	11	25	49	15	100
Manitoba	11	27	48	14	100
Saskatchewan	12	28	47	13	100
Alberta	13	30	47	10	100
British Columbia	12	31	55	2	100
Canada	11	27	46	16	100

1 In this table post-secondary education includes also some university education. High school education refers to grades 9 to 13, and elementary school refers to less than 9 years of education. The table covers the educational attainment of wage earners who worked 40-52 weeks full time in 1970 and reported wage and salary income.
Source: Based on 1971 Census, special tabulation.

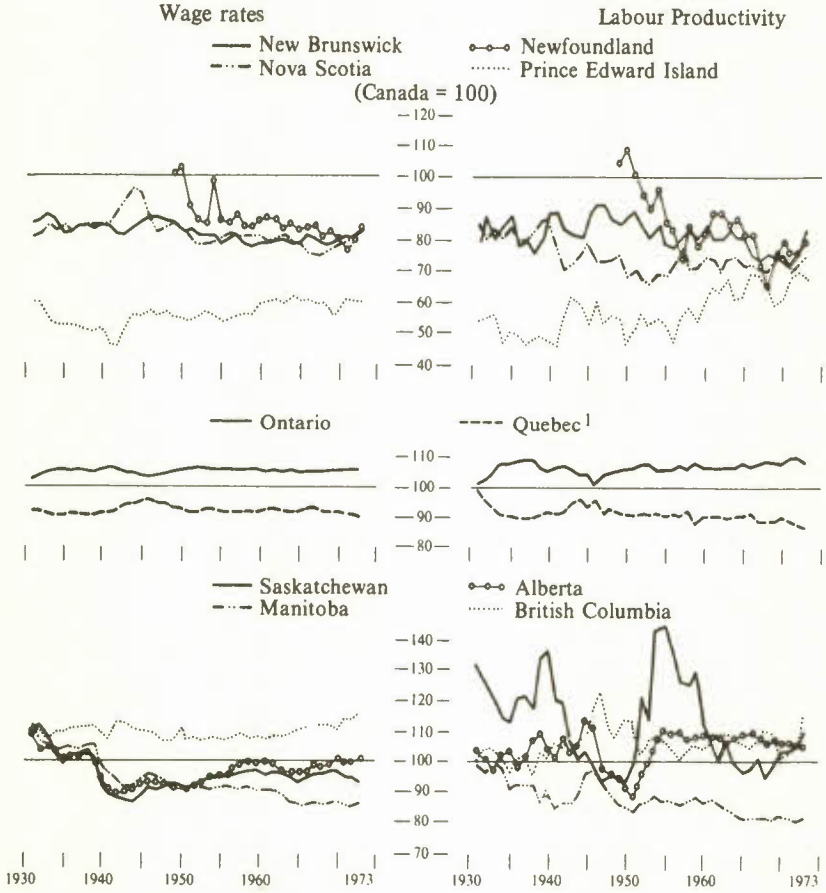
Wage Rates

While quality and competence of the labour force can contribute to better or poorer productivity performance, they are not the only important elements of the provincial labour markets. Sometimes a low-quality labour market, suitably priced, can be more attractive than a high-quality market that is overpriced. Some indication of how labour markets are priced can be derived from data of the manufacturing industries.

Historical records of provincial manufacturing show that there exists a long-term correspondence between wage rates and output per worker. In Ontario and Quebec, which account for 80 per cent of Canadian manufacturing output, the correspondence is strikingly close. Over the past 45 years, the annual wage rates of manufacturing in Ontario have been

Chart 3-1

Annual Wage Rates and Labour Productivity, Manufacturing, Canada and Provinces, 1931-73[1]



1 Based on current dollars.
Source: Based on data from Statistics Canada.

about 5 to 10 per cent above the Canadian average while those of Quebec have been 5 to 10 per cent below average — approximately the same as the percentage difference in output per worker. In the Atlantic provinces, the wage rates and output per worker converge towards a level of 70 to 85 per cent of the national average, with Newfoundland's rates declining and those of Prince Edward Island rising. Over the same period of years, wage rates have been generally below the national average in the Prairie provinces and above average in British Columbia (Chart 3-1).

The comparison of provincial with national estimates shows that levels of wage rates and productivity are not exactly identical. In Newfoundland, for example, wage rates declined relatively less than labour productivity. In Prince Edward Island, labour productivity increased relatively more than wage rates. In Ontario, the level of labour productivity was somewhat higher than that of the wage rate. The opposite was true for Quebec, its level of labour productivity was below the level of wage rates. In the Prairie provinces, labour productivity levels were generally higher than wage rates, except for Manitoba where both the level and the trend of labour productivity fell below that of the wage rates. As suggested by these disparities, some of the provincial labour markets are higher-priced than others. One would expect, therefore, that demand for labour would be somewhat stronger where wage rates, relative to labour productivity, are lower. Further analysis shows that unemployment rates tend to be highest in some of those provinces where labour is overpriced relative to its productivity.[18]

Contribution of Capital Per Worker

The impact of capital on labour productivity performance can be evaluated by relating the provincial variations in capital per worker to the output per worker in each industry. Since there are such enormous variations in capital per worker among provinces, it is not surprising that there are also substantial variations in its contributions to output per worker (Table 3-7 above).[19] Certainly, in the case of Saskatchewan, Alberta, and British Columbia, the estimated contribution of capital is very large. In these provinces, capital stock per worker more than any other factor accounts for better-than-average labour productivity in the economy as a whole, in the goods-producing industries, and in the manufacturing industries.

18 This conclusion is based on comparisons of production-function estimates of marginal-value productivities of labour and observed wage rates. The empirical analysis is described in Appendix B.6.

19 Estimates of provincial and industrial variations in capital stock per worker are given in Table 2-9.

In all other provinces, the contributions of capital to labour productivity are far less consistent and, for the most part, negative. Compared with the national average, it appears that a shortage of capital weakens the productivity performance of Manitoba and all provinces to the east except Newfoundland. By and large, this is true for the provincial economies as a whole and for the goods-producing industries. The estimated impact of this shortfall, however, varies greatly. Only in the cases of Quebec and Prince Edward Island do lower capital stock per worker account for a large part of the poorer productivity performance; in other provinces, it contributes only marginally to lower output per worker.

In manufacturing, the lack of correspondence between capital and output per worker is even more pronounced. Above-average capital stock per worker helped to raise productivity to above-average levels in three of the four western provinces, but it failed to do so in three of the four Atlantic provinces. In Quebec and Prince Edward Island, a shortfall of capital contributed significantly to below-average productivity performance.[20] Because of this uncertain response to higher or lower capital stock per worker, one cannot expect that directing more capital investment into manufacturing will automatically improve the productivity performance of the low-income provinces (Table 3-7).

Regional variations in the ratios of capital stock in machinery and equipment to structures contributed significantly to variations in output per worker, but that did not help explain the uncertain response of provincial labour productivity to additional inputs of capital.[21] Hence, it appears that, at times, other factors are more important.

Returns to Capital

In a primarily market-based economy, prices and resource productivities generally tend to serve as relevant indicators for efficient resource allocation. One would expect, therefore, that capital expenditures should depend largely on the economic incentives provided by the returns from such expenditures. Analysis of productivity and rates of return to capital, applied to manufacturing, suggests that in recent years the economic incentives for capital investments were relatively strong in Prince Edward Island, Quebec, and Ontario, medium in the western provinces, and weak in three of the four Atlantic provinces.

There are some striking differences, however, between investment incentives and actual capital stock per worker. In Newfoundland and Nova Scotia, for example, the economic incentive to invest was very weak but capital stock per worker was high. It appears that capital stock per

20 A shortfall of capital was estimated when the provincial ratio of capital cost to marginal value product exceeded the Canadian average. For details see Appendix B.6.

21 Details on this point are given in Appendix B.4.

worker in manufacturing was adequate and at times even plentiful. In some of the Atlantic provinces, therefore, capital in manufacturing appeared to be invested beyond the point of adequate returns.[22] By contrast, in Prince Edward Island and Quebec, the economic incentive to invest was strong but capital stock per worker was low. One might have expected a much closer alignment of economic incentives for investment and the amount of capital invested per worker; that is, more investment in provinces where the incentives were strong and less where they were weak.

Implicitly or explicitly, the estimated incentives for capital investment in manufacturing are based on a variety of factors. They take into account the amount of capital per worker already invested, the proportions of capital invested in machinery and structures, the quality rating of labour, the wage rate, the degree of returns to scale, the cost of fuel and electricity, the cost of materials and supplies, and the market price for manufactured goods. While all these factors are likely to influence investment decisions, there are some others that may explain the apparent discrepancy between the economic incentives for investment and the actual level of investment.

Provincial market size, resource and energy developments, government policy, and other institutional factors are likely to play a role in capital investments. The small size and seasonal nature of the local market may be the reason for investments below estimated levels in Prince Edward Island. Resource and energy developments are likely to raise capital investments well above average levels in the western provinces. Government support to manufacturers probably helps expand capital investments beyond the level of market incentives in some of the Atlantic provinces. But in Quebec, actual investment per worker is well below the national average, even though the estimated economic incentive for additional investment is high. This discrepancy cannot be readily explained in terms of market size, resource and energy developments, or a lack of government support to manufacturers. It suggests that some other factors may have an unfavourable effect on capital investment in Quebec.

According to economic theory, a higher level of risk and uncertainty requires, *ceteris paribus*, a higher rate of return on capital investments. If risk and uncertainty in the province of Quebec are indeed significantly higher than in Ontario, for example, it follows that money for investment will go to Ontario before it goes to Quebec. In that case, it would require investment projects that yield higher returns — such as hydro-electric power projects, a significant improvement in labour productivity, perhaps a willingness to pay more for capital at the expense of labour, government guarantees, or government intervention in money markets — to change the direction of the natural flow of investment.

22 Empirical estimates are given in Table B-9 of Appendix B.6.

Management, Technology, and Other Factors

One of the objectives of this study is to determine how much of the regional variations can be explained by conventional factors, such as industrial structure, labour quality, and capital, and how much must be attributed to other factors. The contributions of the latter to regional variations in output per worker were estimated "residually" and are quantified under the heading "Management, Technology, and Other Factors" in Table 3-7 above. As a glance at these estimates may reveal, they account for approximately one-third of the regional variations in output per worker of the provincial economies and goods-producing industries, and for a much larger share of the variations in manufacturing.[23] They represent a broad group of factors, somewhat outside the areas of industry structure, capital per worker, and labour quality, but not unrelated. Some of them, like firm size, adoption of new technology, capacity utilization, management training, and research and development, will be considered here briefly.[24]

Plant Size

Ever since Henry Ford cut production time of the Model-T car from one-and-a-half days to one-and-a-half hours, and raised productivity and wage rates to the highest level in the industry, the assembly-line technique has become the key to mass production and automation.[25] Although assembly-line techniques have been applied to a wide range of industries, it takes a certain minimum plant size before they can be applied effectively. As plants grow larger, returns to scale are likely to increase further, until eventually they become exhausted. This permits a great number of firms to compete in the market over a wide range of plant sizes. In this setting, problems of production efficiency are more likely to

23 This estimate is based on simple averages of the ten provinces and not weighted by the size of the provincial economies. Details are given in Table C-19.

24 By necessity, the treatment here can only be tangential. It merely illustrates that regional variations in factor productivity can be reflected in many ways, such as plant size, adoption of new technology, capacity utilization, management training, and research and development. Other factors, such as attitudes and aptitudes of the labour force, local and export market demand, agressiveness of management in seeking markets, natural resource endowment, urbanization, and environment for manufacturing and service activities, are not examined.

25 It is interesting to note that the assembly-line technique in automobile factories did not, as often thought, originate with Henry Ford. It was R. E. Olds of Oldsmobile who first cut production time to one-fifth by passing wooden platforms on casters between lines of workmen who added parts until the car was completed. Ford introduced the conveyor belt system, in which conveyors brought the various parts to the main production line, itself kept in motion by a belt. While this cut the production time to one-tenth, his contribution was a major improvement of Olds's idea, but not an original one. T. Burnam, *Dictionary of Misinformation* (New York: Thomas Y. Crowell Co., 1975), p. 12.

arise at the lower end of the scale, where firms are not quite large enough to take advantage of assembly-line techniques, than at the upper end. This may have some regional implications inasfar as the market potential of a particular region may not be large enough to let many plant operate above the minimum scale, and perhaps not large enough to let even one single plant operate at optimal size.

During the years 1970-73, the average Canadian manufacturing establishment employed 53 workers and produced a "value-added" output of $803,000 (Table 3-10). Average plant size varied from a low of 17 employees in Prince Edward Island, with a value-added output of $172,000, to a high of 65 employees in Ontario, with a value added of $1,082,000. Ontario's considerable margin comes partly from its auto industry, yet other provinces also have some large industries. In Newfoundland, the average plant in the food and beverage industry is larger than those in other provinces; in Nova Scotia, it is the electrical products industry, in New Brunswick, the knitting industry; in Quebec, the tobacco and textile industries; in Manitoba, the clothing industry; and, in British Columbia, the wood industry. Ontario, however, leads the other provinces in plant size in a number of industries — leather, primary metals, machinery, transport equipment, nonmetallic minerals, petroleum, and coal. To the extent that there are returns to size, Ontario may well have an advantage over other provinces.

Table 3-10

Size of Manufacturing Plants, Canada, by Province, 1970-73[1]

	Number of Employees per Establishment		Value Added per Establishment	
	(Number)	(Per cent)	($'000)	(Per cent)
Newfoundland	52	98	619	77
Prince Edward Island	17	32	172	21
Nova Scotia	44	82	488	61
New Brunswick	49	92	581	72
Quebec	52	97	686	85
Ontario	65	123	1,082	134
Manitoba	38	71	465	58
Saskatchewan	22	41	357	44
Alberta	29	56	474	59
British Columbia	41	77	673	84
Canada	53	100	803	100

1 Estimates are not standardized for industrial structure. Industry details are given in Tables C-22 and C-23.

Source: Based on data from Statistics Canada.

Adoption of New Technology

At times, a new technology is so revolutionary that it affects productivity in all industries. The assembly-line is an early example, the computer is a more recent one. Computers appear in many areas: in accounting, production control, inventory control, investment analysis, and research. They are used in all industries, the goods-producing as well as the service industries, and the private as well as the public sector.

In 1956, there were only four computers in Canada. During the next six years, their number doubled each year. By 1973, there were more than 5,000 computers in Canada. Although more than 75 per cent of all computers were manufactured by only three companies — IBM, Honeywell, and Univac — a great variety of computers have been marketed and today over 300 types of computers of 50 different trademarks are in use. Computers are applied primarily to management functions, production, and marketing controls. Among the major industries, manufacturing, governments, transport, and utilities account for over half the computer use.

The first computers were installed in Ontario and Quebec in 1956; other provinces followed one to four years later. The initial lead of Ontario and Quebec gradually diminished, from 76 per cent of the computer use in 1963 to 71 per cent in 1973. Each of the other regions gained ground. Today, roughly one-half of all computers are located in Ontario, less than one-quarter are in Quebec, while the remainder are divided about equally among the Prairie provinces and the rest of Canada (Table 3-11).

Table 3-11

Number of Computers, Canada, by Region, 1963 and 1973

	1963		1973	
	Number	Per cent	Number	Per cent
Atlantic region	10	2	321	6
Quebec	117	25	1,271	22
Ontario[1]	239	52	2,809	49
Prairie region	61	13	833	14
British Columbia	37	8	499	9
Canada	464	100	5,733	100

1 Includes computers of the federal government.

Source: *Census of Computers*, Canadian Information Processing Society. Data for 1963 are based on the calendar year, data for 1973 are based on the twelve-month period of May 1 to April 30.

Ontario not only led the other provinces in numbers of computers but also used more computers per worker. For every one million workers employed in 1973, for example, Ontario used 771 computers. That was roughly 20 per cent more than the Canadian average. The Prairie region was closest to the average and was followed by Quebec and British Columbia. The Atlantic region trailed all others; with 475 computers per million workers, it was about 25 per cent below the Canadian average (Table 3-12).

Table 3-12

Number of Computers per Million Workers, Canada, by Region, 1963 and 1973

	1963		1973	
	Number	Percentage of Canadian Average	Number	Percentage of Canadian Average
Atlantic region	19	28	475	75
Quebec	66	96	540	86
Ontario[1]	94	136	771	122
Prairie region	54	78	584	93
British Columbia	65	94	533	84
Canada	69	100	630	100

1 Excluding computers used by the federal government in Ottawa.

Source: Based on "Les aspects régionaux de la diffusion de la technologie au Canada, le cas des ordinateurs" by Richard Beaudry, Economic Council of Canada, Discussion Paper 50, February 1976, p. 44.

Although only one example of the regional pattern of the adoption of new technology has been given here, other areas have been explored. It has been found, for example, that in retail trade the adoption of shopping-centre marketing followed the regional pattern of income levels and population growth quite closely. The high-income provinces of Alberta, British Columbia, and Ontario were first in building the larger shopping centres; the others followed later. In the pulp and paper industry, by contrast, the adoption of newsprint technology did not follow a consistent pattern of leads and lags. While some regions started out with the latest technology, others lagged behind but eventually surpassed them. In this industry, the quality of resources, growth of markets, and possibly the imposition of pollution controls may have played a role in the adoption of new technology.[26]

26 Economic Council of Canada, *Living Together: A Study of Regional Disparities* (Ottawa: Supply and Services Canada, 1977), pp. 87-92.

In spite of some inconsistencies, however, it is likely that leads and lags in the adoption of new technology are a major factor in regional disparities.[27]

Capacity Utilization

Better use of plant capacity makes for higher returns to capital, gives rise to new investment for plant expansion, and accelerates adoption of new technology; less use makes for lower returns, discourages investment, and retards adoption of new technology. Variations in capacity utilization are normally associated with short-term fluctuations of the economy, but there is some evidence that regional differences in capacity utilization do exist. Should capacity utilization in some provinces be permanently lower than in others, it could also affect the regional distribution of capital investment.[28]

Unfortunately, provincial data on capacity utilization are very meager and the examples given here can only illustrate the existence of regional variations. In the meat processing industry, capacity utilization in 1974-75 ranged from a low of 25 per cent in British Columbia to a high of 81 per cent in Ontario. The low rate of capacity utilization in the western provinces has been attributed to a sharp decline in hog production.[29] Over the past two years, Canadian hog production dropped by 20 per cent and that of western Canada by 37 per cent, partly as the result of import competition: pork imports during 1976 were four times as high as the 10-year average. As well, in response to better grain prices, farmers in the West have shifted to grain production at the expense of livestock production. Depending on future grain/livestock price ratios, the low rates of capacity utilization in the western slaughter industry may be temporary or long-term. It is noteworthy, however, that in the Atlantic provinces and Quebec, where grain production is a less important factor, the capacity utilization is also quite low, lower than the Canadian average and significantly lower than in Ontario (Table 3-13).

There were sizable differences in the capacity utilization of the steel industry among regions too. It was highest in Ontario, average in the Prairie provinces, and low in British Columbia and Quebec. In this industry, capacity utilization in Quebec has lagged behind other regions for years but, over the past decade, the situation appears to have

27 Martin, *The Interregional Diffusion of Innovations*.

28 Chenery, and subsequently Kuh and Meyer, found that their "capacity models" provided a better explanation of fluctuations in investment than the usual accelerator model; see E. Kuh and J. R. Meyer, "Correlation and Regression Estimates When the Data Are Ratios", *Econometrica*, vol. 23, no. 3 (July 1955), pp. 400-16, cited in M. K. Evans, *Macroeconomic Activity: Theory, Forecasting, and Control* (New York: Harper and Row Publishing Co., 1969), p. 82ff.

29 James Rusk, "West Urged to Increase Hog Output", *Globe and Mail*, February 8, 1977.

Table 3-13

Capacity Utilization in Meat-Processing Plants, Canada, by Region, 1974-75[1]

	Percentage of Slaughter Capacity Used	
	Cattle	Hogs
Atlantic Region	52	49
Quebec	66	66
Ontario	77	81
Manitoba	56	32
Saskatchewan	43	52
Alberta	67	42
British Columbia	44	25
Canada	65	54

1 Relates to the period January 1974 to July 1975.
Source: J. L. Morris and D. C. Iler, *Processing Capacity in Canadian Meat Packing Plants*, Food Prices Review Board, Ottawa, August 1975.

improved. In British Columbia, by contrast, it seems to have deteriorated (Table 3-14).

Table 3-14

Capacity Utilization in the Steel Industry, Canada and Regions, 1961-73

	Annual Production as a Percentage of Capacity[1]				Four-Year Average
	1961	1966	1971	1973	
Atlantic Region	52	64	79	63	64
Quebec	37	44	56	61	50
Ontario	84	87	90	98	90
Prairie Region	73	72	88	109	86
British Columbia	69	61	51	36	54
Canada	76	82	86	92	84

1 Annual production of steel ingots and steel castings as a percentage of steel furnace capacity. According to Statistics Canada, estimates of steel furnace capacity are subject to large error variances.
Source: Based on Statistics Canada, *Iron and Steel Mills*, Cat. No. 41-203, December 1967, December 1971 and February 1976.

Considering that underutilization of production capacity can be inefficient and costly, it is an area that deserves much closer examination than has been possible in the context of this study. At present, lack of information prevents any thorough study of this important question. For most industries, no data on capacity utilization are available. Those published for the steel industry are thought to be subject to large error and those for the meat packing industry were only recently collected by the Food Prices Review Board. Aside from that, nationwide estimates of capacity utilization[30] have been prepared on the basis of capital/output ratios, but none are available for provinces.

Management

Ultimately it is management that must plan operations and decide when to adopt new technology. There is evidence that management in Canada fails to capture some of the potential benefits of new production techniques.

In the area of numerical control of the machine tool industry, for example, Canada was among the first to adopt the new technology but failed to follow it up. In 1965, Canada was at par with the United States; in both countries roughly 5 per cent of the industry had adopted numerical-control techniques. In 1968, it was 10 per cent for Canada compared with 20 per cent for the United States. Today, Canada uses 1,500 such machines when, according to one estimate, it should be using 4,000.[31] Slow adoption of this production technique — essential for effective competition in domestic and export markets — may be explained by the small size of Canadian firms, their lack of specialization or short production runs. But it can be argued that the Canadian machine-tool industry has greater justification for the adoption of numerically controlled machines, precisely because production runs are shorter in Canada than in the United States.

Other factors may be related to the reluctance to adopt such technology more rapidly in Canada. Managers of nonuser firms may be unfamiliar with the new production technology, maintenance service may be unreliable, or firms may be unable to finance the required investment. More importantly perhaps, tardiness in adoption of new technology may reflect a weakness that might be overcome by better training in business management.

Despite great strides made in education, Canada still has a way to go in order to catch up with levels of education attained by managers in other countries. According to the 1970 Census of Canada, for example,

30 They are based on minimum capital/output ratios of the preceding period. See Statistics Canada, *Capacity Utilization Rates in Canadian Manufacturing*, cat. no. 31-003, 1977.

31 S. Globerman, "Technological Diffusion in the Canadian Tool and Die Industry", *Review of Economics and Statistics*, vol. 57, no. 4 (November 1975), pp. 428-34; "Manufacturing Unwilling to Modernize Machine Tools", *Financial Times*, October 25, 1976.

30 per cent of all Canadian managers that year held university degrees. In the United States, however, the proportion of all managers who had achieved this level of education had already passed 35 per cent by 1960 and kept on growing.

Breaking down the management category into government, general, financial, sales, and production management reveals that, nationally, the best-educated managers are employed in government administration and the least-educated ones in production (Table 3-15). The same trend holds true in all provinces. For example, on average, Canadian production managers in 1970 had only half as many years of education as government administrators. These findings leave open the question whether this distribution of managerial talent is appropriate for optimal economic performance.

Table 3-15

Educational Attainment of Five Management Categories,[1] Canada, by Province, 1970

	Government	General	Financial	Sales	Production
	(Years of education)				
Newfoundland	17	17	14	11	9
Prince Edward Island	17	17	14	9	10
Nova Scotia	18	17	14	12	10
New Brunswick	18	16	14	12	10
Quebec	18	17	14	12	9
Ontario	18	17	15	12	10
Manitoba	18	17	14	11	9
Saskatchewan	17	17	14	12	9
Alberta	18	17	15	12	9
British Columbia	18	17	15	12	10
Canada	18	17	15	12	9

1 These five categories do not comprise all management occupations, and refer to men only. All figures are rounded.
Source: Based on 1970 Census data of Statistics Canada, special tabulation.

Among the five different management categories, "general managers" have probably the most pervasive influence in the private sector of the economy. On average, 32 per cent of Canadian general managers held university degrees in 1970. Provincially, the level of educational attainment is far from uniform. In 1970, it ranged from 18 per cent in Newfoundland to 37 per cent in Alberta (Table 3-16). If Canada's past performance is an indication, these regional statistics imply that educational standards of managers in some provinces lag years behind those of others.

Table 3-16

Educational Attainment of General Managers, Canada, by Province, 1970[1]

	University Degree	High School and Post-Secondary	Less Than High School Completed	Total
		(Per cent)		
Newfoundland	18	58	24	100
Prince Edward Island	25	50	25	100
Nova Scotia	31	47	22	100
New Brunswick	27	45	28	100
Quebec	31	47	22	100
Ontario	32	49	19	100
Manitoba	29	50	21	100
Saskatchewan	26	52	22	100
Alberta	37	47	16	100
British Columbia	31	48	21	100
Canada	32	48	20	100

1 Refers to one of the five management categories in Table 3-15. General managers are responsible for senior levels of managerial and administrative work concerned with planning, organizing, directing and controlling on owners' or own behalf, an industrial, commercial, or other enterprise, establishment or organization. It is defined in the 1970 Canadian Classification of Occupations as unit group 1130.

Source: Based on data of Statistics Canada, special tabulation.

Canada's business schools have grown over the past ten years as full-time student enrolment has tripled and faculty membership has quadrupled. Despite the growing recognition of the value of highly educated management in Canadian society, Canadian business schools are short of funds compared with other faculties. In 1974-75, for example, their student/teacher ratio was 31, compared with 14 for all disciplines.

Research and Development

While the potential benefits of a more rapid adoption of existing technology are significant, indigenous development of new production techniques and products is also needed. By international standards, Canada ranks low in Research and Development (R&D) expenditures. Whereas France, Japan, and Sweden spend about 1.5 per cent of their gross national expenditures on R&D, and Germany, the United Kingdom, and the United States spend about 2.0 per cent or more, Canada's share has been declining since 1969 and is now little over 1.0 per cent.[32]

32 Statistics Canada, *Research and Development Expenditure in Canada*, Statistics Canada, cat. no. 13-403, Ottawa, 1976.

Provincially, about one-half of all intramural R&D expenditure is spent in Ontario, a quarter in Quebec, and the remainder in the other provinces. Compared with total regional economic activities, this distribution is probably not conducive to more balanced regional economic development.

The National Research Council of Canada is the principal agency of the federal government with responsibility for scientific activities. Engineering research, staff, and facilities of the National Research Council of Canada are ready to help companies with problems of a technical nature. Contacts with firms are established through meetings with industries in different parts of Canada each year, through publications describing the research activities within various divisions, through newsletters, and through direct requests from companies for technical assistance. Most of the contacts with private industry come from Ontario and Quebec. In 1975, for example, these two provinces alone accounted for over 80 per cent of all contacts. British Columbia ranked third, the Prairie provinces fourth, and the Atlantic provinces last (Table 3-17). This would suggest that management in some regions of Canada may not be fully aware of the need for such activities and/or that the National Research Council may not be able to provide the needed research.

Table 3-17

Research and Development Contacts of Private Companies with the National Research Council of Canada, Canada, by Province, 1975[1]

	Area of Technology				
	Transport	Manufacturing	Standards	Computers	Total
	(Number)				
Newfoundland	0	0	0	0	0
Prince Edward Island	0	0	0	0	0
Nova Scotia	1	0	0	1	2
New Brunswick	0	0	0	0	0
Quebec	7	18	1	6	32
Ontario[2]	16	24	3	7	50
Manitoba	2	0	0	0	2
Saskatchewan	0	0	0	0	0
Alberta	2	1	0	0	3
British Columbia	2	6	0	0	8
Canada	30	49	4	14	97

1 Excludes all contacts of federal departments and head-office contacts of large Canada-wide corporations.
2 Excludes contacts of companies located in Ottawa.
Source: Based on material provided by the National Research Council, Division of Mechanical Engineering.

There are indications that the National Research Council (NRC) is at times hindered in delivering assistance to Canadian industry. According to a NRC report, staff in the Division of Mechanical Engineering has been seriously reduced from 380 in 1967 to 324 in 1975. During this period, operating funds have been reduced by 20 per cent when, at the same time, costs for equipment and supplies have sharply risen. As a result, there is a definite lack of expertise in certain fields, such as numerical analysis, to undertake projects requested by private industry. Some of the projects are now being sent out to foreign countries and Canada is paying for this foreign development of expertise and knowledge.[33]

33 Based on *Material Concerning Questions From the Senate Special Committee on Science Policy*, Division of Mechanical Engineering of National Research Council, March 1976.

4 Regional Growth

This analysis parallels the earlier examination of the sources of regional disparities of productivity levels, but concentrates on regional disparities in economic growth. As in previous chapters, the analysis is couched in terms of supply variables. First, demographic developments are considered. Then, employment growth is related to growth in production and productivity. Finally, provincial disparities in growth in capital stock per worker are related to improvement in labour quality and other factors affecting growth.

Demographic Developments

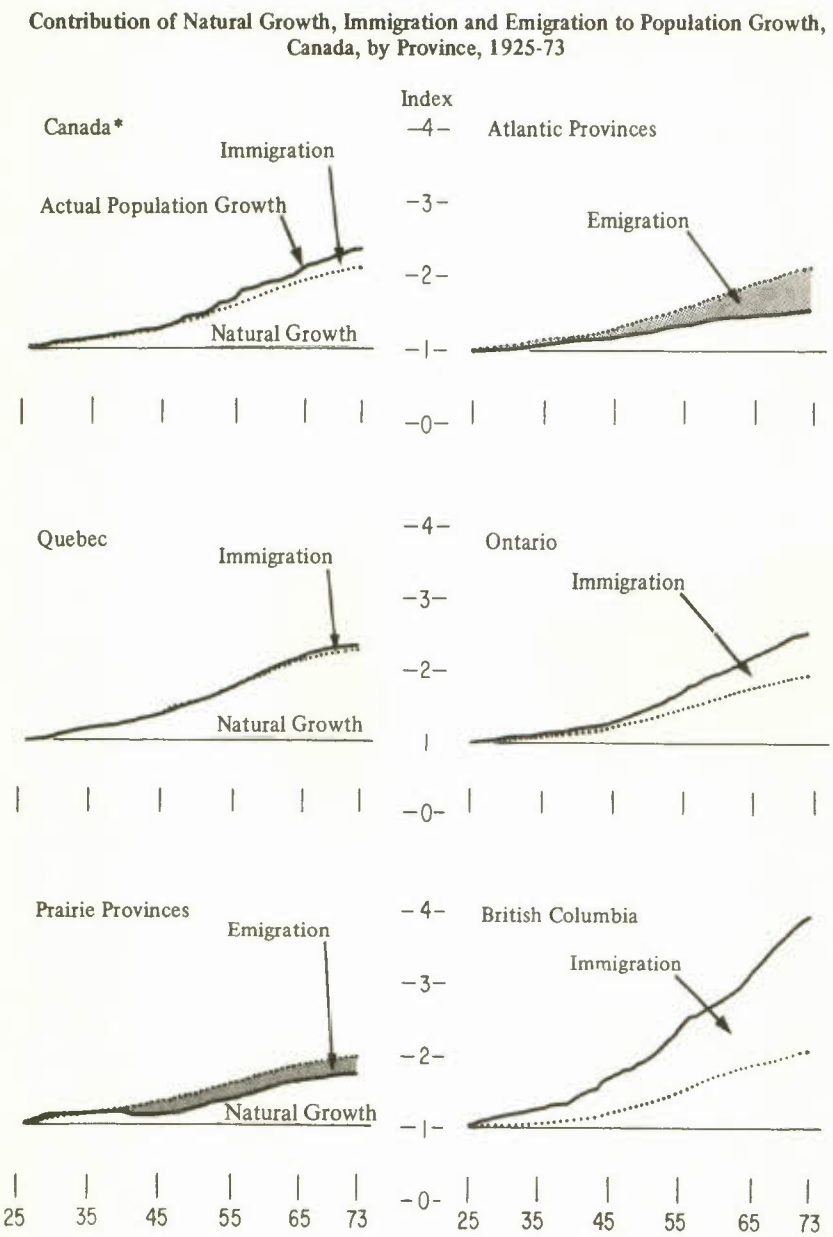
Over the past five decades, Canada's population has grown rapidly — from 10 million people in 1926 to 23 million people in 1976. This growth has not been uniform across the country. Regional variations have arisen from regional differences in both migration and natural population growth. The Atlantic and the Prairie provinces have suffered losses through emigration. By contrast Ontario and especially British Columbia have gained from immigration while Quebec has gained from natural growth (Chart 4-1).

Different patterns of population growth could have changed provincial developments dramatically. Had Ontario, for example, since 1926 experienced the same rate of natural growth as Quebec, Ontario's population today would be 1.5 million larger. Or, had Quebec experienced the same rate of immigration relative to its natural growth as Ontario, Quebec's population today would be about 3 million larger.

To some extent, the uneven geographic distribution of immigrants to Ontario and Quebec is probably related to the national origin of newcomers. During the postwar years, for example, immigrants from the United Kingdom and the United States accounted for more than 30 per cent, whereas immigrants from France accounted for less than 3 per cent of all immigrants (Table 4-1). If facility of language induced English-speaking immigrants to settle among Canadian anglophones and French-speaking immigrants to settle among Canadian francophones, the relatively small share of immigrants from France did not make for a very high rate of immigration to Quebec.

Chart 4-1

Contribution of Natural Growth, Immigration and Emigration to Population Growth, Canada, by Province, 1925-73



*The index measures by how much the population has increased since 1927. An index number of 2, for example, implies that the population has doubled. The broken line shows how much the population would have grown without migration, the solid line shows how much it has grown with migration.

Source: Based on data of Statistics Canada.

Table 4-1

Immigration to Canada, by Country of Last Permanent Residence, 1946-73

	Average Annual Immigration	
	Number	Per Cent
United Kingdom*	36,453	26.5
Italy	16,570	12.1
United States	13,719	10.0
Germany	11,251	8.2
Netherlands	6,343	4.6
Greece	4,137	3.0
Portugal	3,987	2.9
France	3,940	2.9
All Others	40,849	29.8
Total	137,249	100.0

*Including Ireland.
Source: Estimates based on CANSIM data of Statistics Canada.

Language facility of immigrants, however, is only part of the explanation for the lower rate of immigration to Quebec. Just as immigration to Canada depends on economic and social conditions of Canada in relation to other countries, so immigration to a particular region within Canada depends on economic and social conditions of that region in relation to others. Without identifying the economic and social conditions underlying migration, the attractiveness of one region over others can be measured to some extent by comparing foreign immigration to net migration figures.[1]

For Canada as a whole, net migration was about one-third smaller than its foreign immigration; that is to say, for every 100 immigrants entering Canada, 35 migrants left for other countries. The rate of net migration per 100 immigrants, therefore, was 65. Compared with this national average, Ontario, with a net migration rate of 79, did somewhat better than average. Quebec, with a net migration rate of 29, did worse. In British Columbia, the net rate of immigration exceeded 100; that is to say, for every 100 immigrants from foreign countries another 88 entered from other Canadian regions. This is in sharp contrast to the Prairie and Atlantic provinces where net migration rates were negative (Table 4-2).

1 Estimates of foreign immigration to Canada's provinces are published by Statistics Canada. Regional estimates of net migration are derived by subtracting natural population growth, i.e., births minus deaths, from total population growth. Regional estimates of net migration include migration to other provinces as well as other countries.

Table 4-2

Average Annual Migration, Canada, by Province and Territory, 1946-73

	Foreign Immigration	Net Migration	Net Migration 100 Immigrants
Atlantic provinces*	3,272	-8,812	-269
Quebec	27,032	7,940	29
Ontario	72,632	57,494	79
Prairie region	18,009	-6,821	-38
British Columbia	15,698	29,536	188
Canada	137,249	88,670	65

*Excluding Newfoundland.
Source: Estimates based on CANSIM databank.

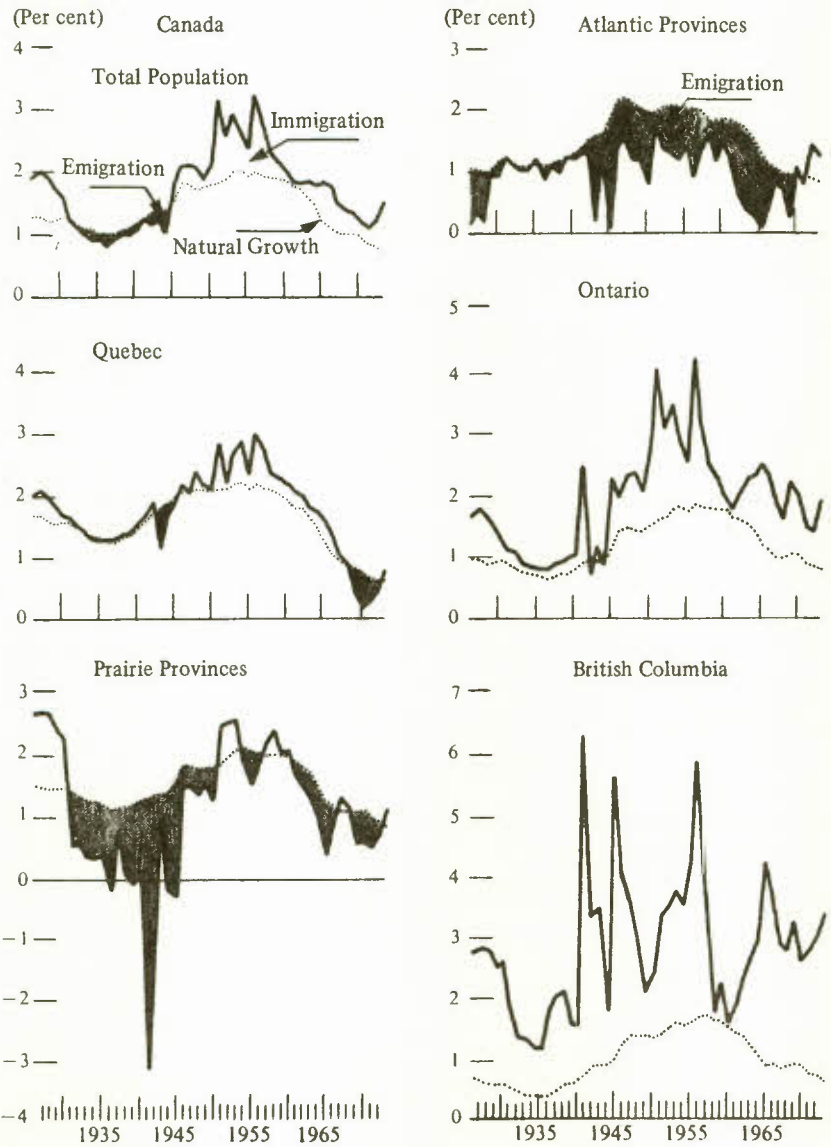
At times, migration has strongly reinforced the trends in natural and regional population growth. The decline in natural growth from the mid-1920s to the late 1930s was reinforced by a decline in immigration (Chart 4-2). The decline was greatest in the Prairie provinces, where low farm prices, drought conditions, and very low farm incomes led to net emigration and less population growth than in other provinces. The subsequent reversal and acceleration of natural growth during the late 1940s and 1950s was reinforced by very high rates of immigration. Both the natural rate of population growth and the rate of immigration reached their peaks in the 1950s. This was true for most provinces. The exceptions were the Atlantic provinces where emigration restricted population growth for almost five decades and where the natural rate of growth began to decline shortly after the Second World War.

Although waves of natural growth and immigration tend to reinforce each other, immigration has a more immediate impact upon the labour market. Immigrants of working age are ready to join the labour force at the time of their arrival in Canada. Native-born Canadians have years before they reach working age or complete the educational requirements for labour force participation. Over time, both natural growth and immigration combine to contribute to yearly growth and variations in the working-age population among provinces and age groups.

Generally speaking, over the past two decades, British Columbia and Ontario, the provinces with the highest rates of immigration and population growth, also had the greatest fluctuation in these rates. Together they accounted for more than 90 per cent of the total. In all provinces, the burden of adjustment fell on the younger age groups. Whereas persons aged 20 to 24 years accounted for only 10 per cent of the working-age population, they accounted for most of the fluctuations in population growth across Canada. They were also more mobile than other age groups and participated strongly in interprovincial migration (Chart 4-3).

Chart 4-2

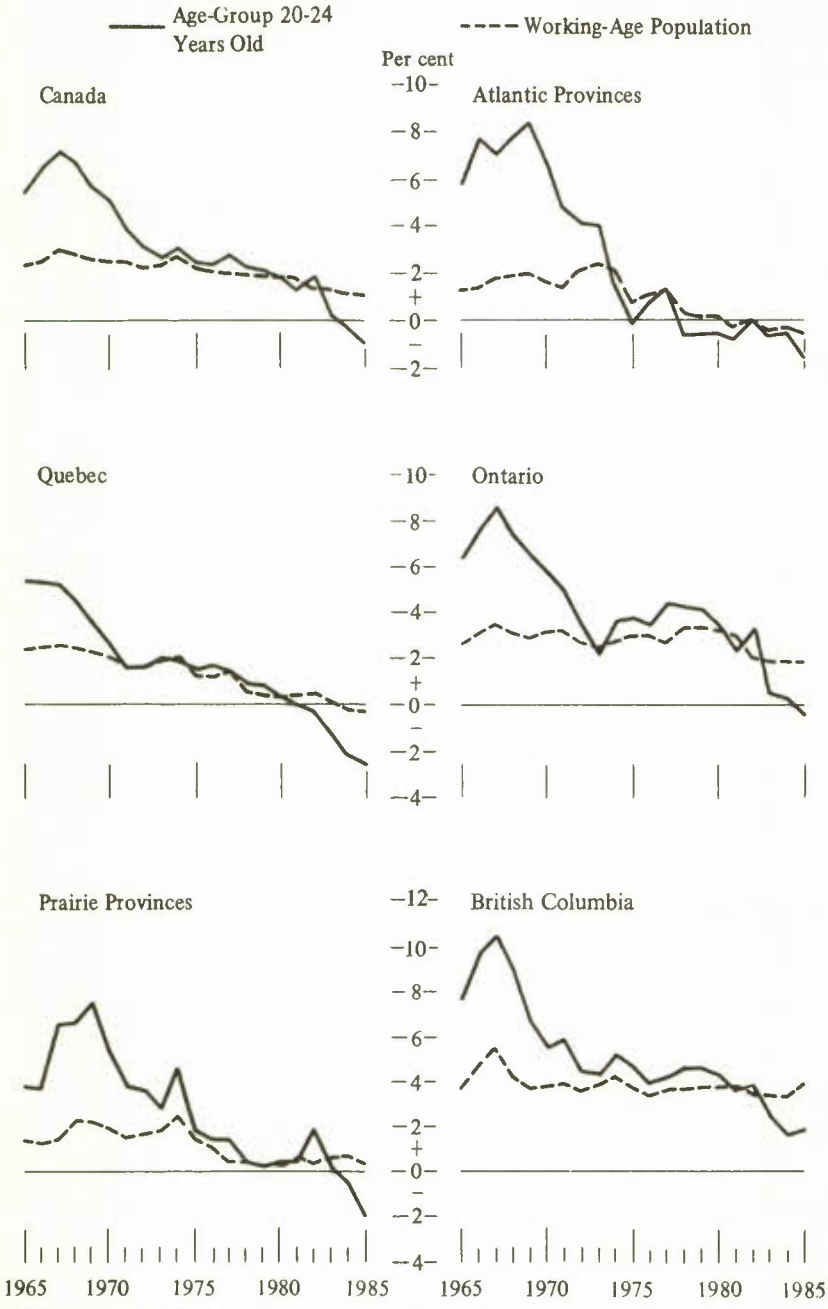
Annual Rates of Population Growth, Natural Growth and Migration, Canada, by Province, 1925-73



Source: Based on data of the CANDIDE-R databank.

Chart 4-3

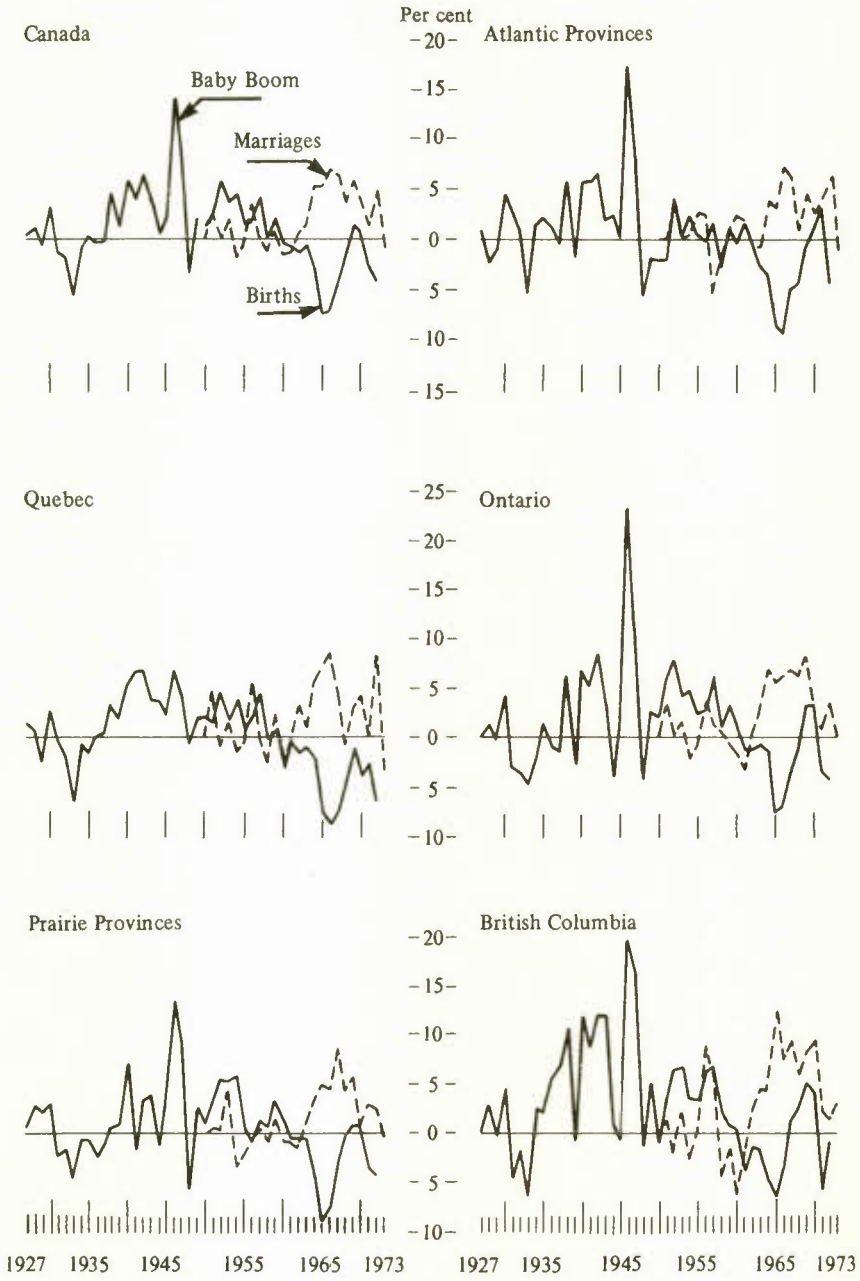
Annual Growth Rates of the Working-Age Population and the 20 to 24 Year Old Age Group, Canada, by Province, 1952-73



Source: Based on data from Statistics Canada.

Chart 4-4

Annual Growth Rates of Births and Marriages, Canada, by Province, 1927-73



Source: Based on CANSIM data bank of Statistics Canada.

Although immigration and interregional migration have contributed much to instability of population growth, the swings in the natural rate of growth are equally important. The sizable long-run swings in the natural rate of growth over the past five decades have contributed about as much to instability of population growth as migration. The postwar baby boom was followed, predictably, by a marked increase in the working-age population many years later, which accounted for the instability of the growth rate among persons aged 20 to 24 years (Chart 4-4). This trend reached its peak between 1965 and 1970. It was predictably accompanied by a marked increase also in marriage rates during the same period, which led to new family formation in excess of earlier rates and increased the demand for housing. Probably part of the rise in housing prices and rents over the past decade can be attributed to this "excess" demand over supply of housing.

Just as the rise in birth rates of the 1940s affected the economy in more recent years, the decline in birth rates in the late 1960s will affect the economy in future years. Aside from minor variations the annual percentage change in births has fallen since the late 1940s, turned negative around 1960, and dropped to a record low in the mid-1960s — lower than during the Great Depression. It can be expected, therefore, that the growth of the working-age population, especially among those aged 20 to 24 years will decline and reach new lows in the late 1980s. Although immigration from foreign countries may modify these expectations somewhat, actual data for recent years and simulation of the Canadian economy for future years broadly confirm them. Some implications of this future decline in population growth and labour force will be examined in Chapter 6.

Growth in Employment, Production, and Productivity

National Growth

Between 1947 and 1973, Canada's gross national product — measured in constant dollars — has grown by 5 per cent a year (Table 4-3). Since population has grown at the same time, production and income per capita have increased more slowly — at 3 per cent a year — which is less than that for most other highly developed nations.[2]

During these years, the share of employment shifted from agriculture and other primary industries, where productivity and wage rates were low, to industries where they were high and helped improve the productivity performance of the Canadian economy. This shift of employment offered those who left the opportunity to earn more and often helped those who stayed behind to improve their incomes. In agriculture, for

2 For some international comparisons of Canadian productivity performance, see Economic Council of Canada, *Looking Outward: A New Trade Strategy for Canada*, (Ottawa: Information Canada, 1975), pp. 26ff.

Table 4-3

Growth of Gross National Product and Disposable Income, Canada, 1947-73

	Level		Average Annual Growth Rate
	1947	1973	
	(In 1961 dollars)		(Per cent)
Gross National Product			
Total (billions)	21	76	5.0
Per capita	1,702	3,455	2.8
Disposable Income			
Total (billions)	15	53	5.0
Per capita	1,208	2,393	2.7

Source: Estimates based on CANDIDE 1.2 databank.

example, incomes were low, demand for agricultural products was weak, and the adoption of labour-saving and yield-increasing technology was doing little to solve the farm income problem. Instead, the new technology generated underemployment of farm labour and depressed farm incomes and farm wages. Many had to leave the farm but those who stayed behind were often the more productive farmers, who invested in machinery and equipment and expanded their farms in size. By doing so, they managed to increase their incomes and raise the level of productivity in agriculture. Hence, over the past two decades, some of the highest gains in real output per worker were achieved in agriculture, mining, and forestry — all primary industries with declining employment shares. Some of the lowest gains were achieved in community, business, and personal services — all tertiary industries with rapidly growing employment shares (Chart 4-5).[3]

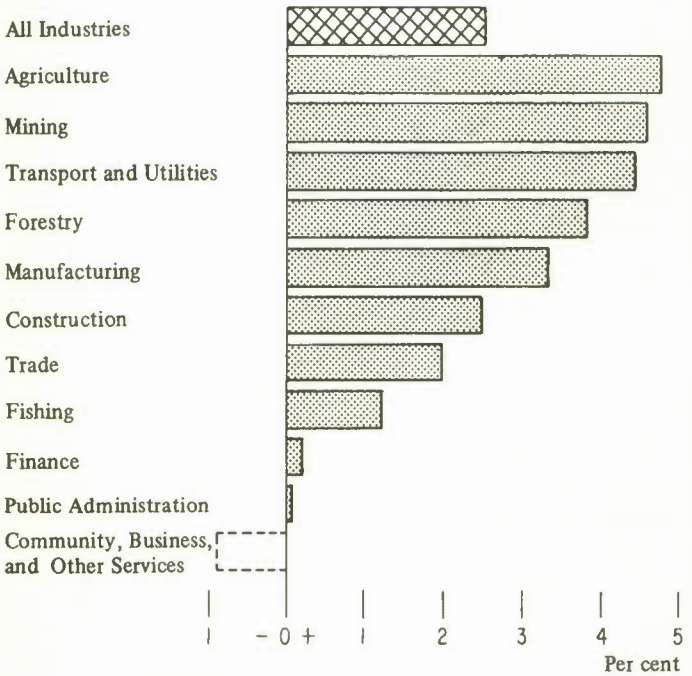
The more rapid improvement in output per worker in low-productivity, low-income industries such as agriculture has contributed to a narrowing

3 The apparent slowness of productivity growth in the service industries may be partly attributable to problems with data. These estimates are based on real domestic product data. As it is difficult to measure the output of certain service industries, their productivity growth may not have been accurately measured. To estimate the output of service industries, it was assumed that labour and capital were paid according to current wage and interest rates; that investments in machinery, equipment, and buildings were depreciated according to service lives; and that the total costs were equal to the total value of output. This could result in an underestimation or an overestimation of real productivity. It has recently been estimated, for example, that growth of real output of the life insurance industry in Canada more than kept pace with production of the total economy; see R. Hirshhorn and R. Geehan, "Measuring the Real Output of the Life Insurance Industry", *Review of Economics and Statistics*, vol. 59, no. 2 (May 1977), pp. 211-19. This, however, is only one small segment of the service industry and is not necessarily representative of the other service industries.

Chart 4-5

Average Annual Growth Rates of Real Output Per Worker, by Industry, 1947-73

(Based on 1961 dollars)



Source: Estimates based on CANDIDE 1.2 databank.

of the productivity gap between primary and tertiary sectors. As employment shifted from low- to high-income industries, the productivity gaps among sectors narrowed and the potential for further productivity gains from such shifts in industrial structure diminished.

Analysis of the entire postwar period shows that over half of Canada's growth in production came from additional employment and less than half from improvement in labour productivity. It shows that most of the productivity improvement came from greater output per worker and a much smaller part from shifts in industrial structure. Moreover, a projection for the years 1975-85 suggests that the rate of economic growth will slow down to 4.7 per cent a year from 5.5 per cent a year during 1961-71 as the rate of growth in employment declines during the next decade and as unfavourable changes in industrial structure reduce productivity growth (Table 4-4).

Table 4-4

Contributions of Employment Growth, Improvement in Output Per Worker and Changes in Industry Structure to Growth in Production, 1951-85

	1951-61	1961-71	1975-85
		(Per cent)	
Employment growth	1.7	2.9	2.5
Productivity growth	2.4	2.6	2.2
Output per worker	1.9	2.5	2.7
Industry structure	.5	.1	-.5
Total economic growth	4.1	5.5	4.7

Source: Based on CANDIDE 1.2 databank and projections by the Economic Council of Canada. For more details on the prospects of Canada's economic growth during the years 1975-85, see Economic Council *Twelfth Annual Review: Options for Growth* (Ottawa: Information Canada, 1975), chap. 3.

This estimate is based on the assumption that future gains in output per worker will be greater than in the past and will increase from 2.5 per cent during 1961-71 to 2.7 per cent during 1975-85 (Table 4-4).[4] Considering that the gains in productivity from 1961-71 were high compared with those of earlier years, this projected gain in output per worker may well be too optimistic. Should it fail to materialize and growth in output per worker falls to only 1.9 per cent — the level reached during the slow-growth years of 1951 to 1961 — then the projected growth of the Canadian economy to 1985 would be reduced to 3.9 per cent a year, which is lower than that reached between 1951 and 1961.

Regional Growth

Population growth is an important element of regional economic growth, but its economic significance can be easily overstated. It is often thought that population growth and income growth go together and that one reinforces the other. A more rapidly expanding population requires more consumer goods, more residential housing, more schools and more services. Population growth, therefore, strengthens market demand. In meeting this growing demand, more money is invested in new plants, machinery, and equipment, more people are employed, and more income is generated. Population growth, therefore, leads to an expansion of market demand and production and creates a favourable environment for capital investment growth.

4 It is important in this context to distinguish clearly between the various concepts of economic growth. As shown in Table 4-4, economic growth is composed of employment growth and productivity growth. The two major components of productivity growth, in turn, are output per worker and industry structure. The various components are regionalized in subsequent tables of this chapter.

Empirical estimates suggest that there is a loose but not inconsistent relationship between growth in population, employment growth, and growth of the economy. British Columbia, Ontario, and Alberta — the provinces with the strongest population growth — had better-than-average growth in provincial production. All the other provinces had below-average population growth as well — that is population growth translated into employment growth and economic growth (Table 4-5).

Table 4-5

Average Annual Growth of Population, Employment, Labour, Productivity, and Total Economy, Canada, by Province, 1961-73[1]

	Population	Employment	Labour Productivity	Total Economy
		(Per cent)		
Newfoundland	1.3	2.3	4.7	7.0
Prince Edward Island	.6	−1.8	6.3	4.5
Nova Scotia	.7	1.3	3.8	5.1
New Brunswick	.6	2.1	3.8	5.9
Quebec	1.2	2.8	2.9	5.7
Ontario	2.1	3.3	3.1	6.4
Manitoba	.6	1.5	1.8	3.3
Saskatchewan	−.1	.5	4.5	5.0
Alberta	1.9	2.7	4.0	6.7
British Columbia	3.1	4.4	3.4	7.8
Canada	1.6	2.8	3.4	6.2

1 Estimates of growth rates will vary with estimation procedures. In this table the growth rates for the total economy (col. 4) are average annual growth rates, and those for employment and labour productivity (cols. 2 and 3) are growth-rate components which together account for this growth. They are not quite consistent with the 1961-71 national estimates of Table 4-4 because they cover the years 1961-73 and are based on industry employment data rather than labour-force employment survey data.

Source: Estimates based on data from Statistics Canada.

There is also a belief that more rapid growth of the economy, generated by population and employment growth, contributes to greater labour productivity and raises the level of per capita incomes. In such a Keynesian world, greater market demand would generate new investments, give rise to further investment, and raise the level of productivity and, as a result, every worker would produce more and earn more than

before. If this were true, regional growth in labour productivity and labour incomes would depend to a large extent on population and employment growth. Provinces with higher rates of population and employment growth would show greater gains in labour productivity than regions with lower rates of growth.

However, empirical evidence does not lend much support to this belief. Among the provinces with the highest rates of population growth, only Alberta had a better-than-average rate of growth in labour productivity; British Columbia's rate was just average, while Ontario's was below average. In the four Atlantic provinces, by contrast, population growth was slow but, in all four, growth in labour productivity was above the national average. This is significant because it shows that labour productivity and, therefore, per capita income in a province can be improved even if its population and employment growth are slow.[5]

To gain some further insight, provincial economic growth can be broken down into major industry groups — the industries of the primary, secondary, and tertiary sectors.[6] Overall, the contribution to growth was split roughly half and half between employment and labour productivity. The rates varied greatly among provinces, and there were some clearly defined industry trends as well. In all provinces, the employment share in the industries of the primary sector decreased, primarily because of agriculture and fishing, but greatly increased in the service industries of the tertiary sector (Table 4-6). Labour productivity, by contrast, improved most in the goods-producing industries of the primary and secondary sectors but to a lesser extent in the service industries of the tertiary sector. It means that employment turned away from the goods-producing industries of the primary and secondary sectors where growth in labour productivity was strong towards the service industries where it was weak. If this employment drift away from the goods-producing industries towards the service industries continues into the future — and if the underlying assumptions of this analysis hold[7] — it will reduce the growth of labour productivity, retard economic growth, and lower the growth in per capita and family incomes (Table 4-6).

It is possible to identify some of the major sources of productivity growth in the goods-producing industries. On average, changes in industry structure contributed very little to growth in labour productivity. Nationally, they accounted for only six-tenths of a percentage point of

5 As shown in Table 4-5, Manitoba was the only exception. In that province, all three growth rates, i.e., of population, employment and labour productivity, were below the national average.

6 The primary sector is composed of agriculture, forestry, fishing, and mining; the secondary sector of manufacturing, construction, transport and utilities; and the tertiary sector of education, health, and all other public and private service industries.

7 As indicated earlier, the apparent slow growth of labour productivity in the service industries could also be the result of measurement problems. For some further comments on this point see footnote 2 of Table 4-6.

Table 4-6

Contribution of Employment and Labour Productivity to Growth of Primary, Secondary, and Tertiary Sectors, Canada, by Province, 1961-73

	Contributions to Growth by Sector			11 Major[2] Sectors
	Primary	Secondary	Tertiary[1]	
	(Per cent)			
Employment				
Newfoundland	−.1	1.2	1.2	2.3
Prince Edward Island	−3.3	.7	.7	−1.8
Nova Scotia	−.8	.4	1.7	1.3
New Brunswick	−.7	.6	2.1	2.1
Quebec	−.2	1.1	1.9	2.8
Ontario	−.2	1.1	2.4	3.3
Manitoba	−.7	.3	1.9	1.5
Saskatchewan	−.7	.0	1.2	.5
Alberta	−.4	.7	2.5	2.7
British Columbia	−.0	1.4	3.0	4.4
Canada	−.3	.8	2.3	2.8
Labour productivity				
Newfoundland	1.4	3.0	.3	4.7
Prince Edward Island	3.9	1.9	.5	6.3
Nova Scotia	.9	2.7	.2	3.8
New Brunswick	1.3	2.7	−.1	3.8
Quebec	.4	2.5	.0	2.9
Ontario	.3	3.4	−.6	3.1
Manitoba	1.7	.4	−.3	1.8
Saskatchewan	3.4	1.4	−.3	4.5
Alberta	3.0	1.6	−.8	4.0
British Columbia	1.0	3.2	−.9	3.4
Canada	.9	2.9	−.5	3.4
Total growth				
Newfoundland	1.3	4.2	1.5	7.0
Prince Edward Island	.6	2.7	1.2	4.5
Nova Scotia	.1	3.1	1.9	5.1
New Brunswick	.6	3.3	2.0	5.9
Quebec	.2	3.6	1.9	5.7
Ontario	.1	4.5	1.8	6.4
Manitoba	1.0	.7	1.6	3.3
Saskatchewan	2.7	1.4	.9	5.0
Alberta	2.6	2.3	1.7	6.7
British Columbia	1.0	4.6	2.1	7.8
Canada	.6	3.7	1.8	6.2

1 The estimated negative contribution of labour productivity in the tertiary sector could be the result of measurement problems. The actual contribution of the service sector might well be positive but it is likely to be smaller than it is for the goods-producing industries. Recent studies of the U.K. service sector and of the U.S. federal government sector, for example, suggest that productivity gains in these sectors lagged behind those of manufacturing and the private economy, respectively. See G. Briscoe, "Recent Productivity Trends in the U.K. Service Sector", Oxford Bulletin of Economics and Statistics, vol. 38, no. 4, November 1976, pp. 265-80; and U.S. Congress Joint Financial Management Improvement Program, *Current Efforts and Future Prospects*, vol. 1, Productivity Programs in the Federal Government (Washington, D.C.: Government Printing Office, 1975), pp. 24, 133.

2 Provincial estimates of employment and labour productivity growth add to total growth, and the contributions of primary, secondary and tertiary sectors add to those of the 11 major industries. The primary sector is composed of agriculture, forestry, fishing, and mining; the secondary sector of manufacturing, construction, transport and utilities; and the tertiary sector of trade, finance; community, business and personal services; and public administration.

Source: Estimates based on data from Statistics Canada.

the 5.6 per cent growth rate. Regionally, they made sizable contributions in the Atlantic and Prairies provinces, where the potential for employment shifts out of primary industries was still large. Growth in output per worker was also greater in British Columbia and the Prairie provinces, and in most Atlantic provinces than in Ontario and Quebec. Regionally, these shifts in industrial structure and improvements in output per worker made for more uniform levels of labour productivity. Quebec and Newfoundland were the exceptions. Quebec's growth in output per worker was just about the same as that of Ontario and, as a result, the productivity gap between the two provinces remained as wide as ever. In Newfoundland, growth in output per worker was slower than elsewhere and its productivity gap with most other provinces, therefore, widened (Table 4-7).

Table 4-7

The Contribution of Industrial Structure and Output per Worker to Growth of Labour Productivity, Goods-Producing Industries,[1] Canada, Province, 1961-73

	Contribution to Growth[2]		Growth in Labour Productivity
	Industry Structure	Output per Worker	
		(Per cent)	
Newfoundland	1.3	3.5	4.8
Prince Edward Island	3.1	6.3	9.4
Nova Scotia	1.2	5.4	6.6
New Brunswick	1.4	5.5	6.9
Quebec	.5	4.4	4.9
Ontario	.3	4.5	4.8
Manitoba	1.3	5.7	7.0
Saskatchewan	1.2	7.1	8.3
Alberta	1.7	5.3	7.0
British Columbia	.6	5.3	5.9
Canada	.6	5.0	5.6

1 In this table, the goods-producing industries include agriculture, forestry, fishing, mining, manufacturing, and construction but not transport and utilities.
2 Based on methods and estimation procedures described in Appendixes A-4 and B-4.
Source: Estimates based on data from Statistics Canada.

More capital per worker, improvements in labour quality, and more extensive use of machinery and equipment accounted for about 40 per cent of all growth in output per worker (Table 4-8). Capital input improved the level of output per worker in the Atlantic and Prairie

provinces, but did less for Ontario, Quebec and British Columbia. The improvement in labour quality was slow and contributed more in the high-income provinces of Ontario, Alberta, and British Columbia than in most of the low-income provinces. This uneven improvement came primarily from regional variations in educational attainment and preference of better educated employees to work in the service sector, and it actually worked against regional convergence. Management, technology, and other important factors, measured together, accounted for roughly 60 per cent of all growth in output per worker. They contributed far less in Nova Scotia and nothing at all in Newfoundland. It means that capital invested there since the early 1960s could not have been put to as good a use as in most other provinces because some other factors essential for growth in output per worker were lacking.

Table 4-8

Contribution of Some Key Factors to Growth in Industry Output per Worker, Goods-Producing Industries, Canada, by Province, 1961-73

	Contribution to Growth[1]				
		Capital Stock		Management, Technology[2] and Other	Industry Output per Worker
	Labour Quality	Structures	Machinery		
Newfoundland	.2	3.5	−.2	.0	3.5
Prince Edward Island	−.1	3.0	−.1	3.5	6.3
Nova Scotia	.0	2.7	.4	2.2	5.4
New Brunswick	.3	1.5	.4	3.3	5.5
Quebec	.2	1.0	.2	3.0	4.4
Ontario	.3	.9	.3	3.0	4.5
Manitoba	.2	1.9	.2	3.4	5.7
Saskatchewan	.0	3.1	.4	3.6	7.1
Alberta	.3	2.1	.0	2.9	5.3
British Columbia	.4	1.3	.4	3.3	5.3
Canada	.3	1.5	.2	3.0	5.0

1 Column 5 of this table corresponds to column 2 in Table 4-7. Industry composition and technical references are the same as in Table 4-7. A summary of all major factors of productivity growth is given in Table C-24.

2 It is often thought that new technology is "embodied" in new capital. If so, part of its contribution should be included in this table under the heading Capital. Empirical evidence on this point is difficult to come by and not conclusive; see M. I. Nadiri, "Some Approaches to the Theory and Measurement of Total Factor Productivity: A Survey", *Journal of Economic Literature*, vol. 8, no. 4 (December 1970), pp. 1137-59. An earlier study of Canadian manufacturing industries has lent no support to the embodiment hypothesis; see N. H. Lithwick, G. Post, and T. K. Rymes, "Postwar Production Relationships in Canada", *The Theory and Empirical Analysis of Production*, ed. M. Brown, National Bureau of Economic Research Studies in Income and Wealth 31 (New York: Columbia University Press, 1967), pp. 139-273.

Source: Estimates based on data from Statistics Canada.

Productivity, Wages, and Incomes

In an economy based primarily on a free market system, wage rates should generally tend to serve as relevant indicators of labour productivity.[8] It could be expected, therefore, that the provinces with lower rates of growth in output per worker would also have lower rates of growth in wage rates. If this were not so and if wages in some of the provinces grew much faster, returns to capital would automatically decline because of interregional competition in product prices. While faster growth in wages may be attractive to labour, it could discourage the inflow of capital and, eventually, discourage labour from staying in that region.

It is customary to compare growth in wage rates with growth in output per worker and to measure the difference between the two in terms of unit labour cost (Table 4-9).[9] Unit labour costs will grow if wage rates rise faster than output per worker and will fall if wage rates grow slower than output per worker. On average, wage rates in Canada have grown since 1961 at an annual rate of 6.7 per cent while output per worker has grown at only 3.6 per cent. This means that wage-rate gains have outstripped gains in output per worker by 3.1 per cent and, as a result, unit labour costs have grown at 3.1 per cent a year. While unit labour costs have risen all across Canada (adding to existing and causing more inflationary pressures), they have grown faster in Manitoba, Quebec, and the Atlantic provinces than in Ontario, Alberta, and British Columbia. This holds true for all industries of the economy as well as for the goods-producing industries. To the extent that slower growth in unit labour costs have brought greater returns on investment, entrepreneurs have found Ontario, Alberta, and British Columbia increasingly more attractive for investment than Quebec and the Atlantic provinces.[10]

So far, we have examined productivity and wage rates; it remains to show the relationship between productivity and per capita incomes (Chart 4-6). This match is by no means perfect, but the variations from the overall pattern can be explained. In the Atlantic provinces, labour productivity and wage rates in the goods-producing industries were below the national average. Over the years, both increased relative to Canada, but wage rates gained faster than labour productivity. The rise in income per capita was somewhat slower because unemployment rates, substantially higher in the Atlantic provinces, tended to lower per capita incomes

8 Stated more precisely, wage rates should tend to be proportionate to the marginal-value productivity of labour, a measure that reflects labour's contribution to productivity net of capital's contribution.

9 U.S., Congress, Joint Economic Committee, *Productivity, Prices and Incomes*, (Washington, D.C.: Government Printing Office, 1967), pp. 47ff.

10 It should be kept in mind, however, that the analysis here relates to the years 1961-73 and that changes in the provinces' wage and production trends could alter this pattern over the years.

Table 4-9

Average Annual Growth of Wages per Worker, and Unit Labour Costs, Total Economy and Goods-Producing Industries, Canada, by Province, 1961-73[1]

	Wage Rate	Output per Worker	Unit Labour Cost
Total economy			
Newfoundland	8.0	4.0	4.0
Prince Edward Island	8.2	3.7	4.5
Nova Scotia	7.3	3.6	3.7
New Brunswick	7.4	3.6	3.8
Quebec	6.7	2.9	3.8
Ontario	6.5	3.5	3.0
Manitoba	6.7	1.8	4.9
Saskatchewan	7.7	4.5	3.2
Alberta	6.7	3.7	3.0
British Columbia	6.8	3.7	3.1
Canada	6.7	3.6	3.1
Goods-producing industries[2]			
Newfoundland	8.7	3.8	4.9
Prince Edward Island	10.0	6.6	3.4
Nova Scotia	7.8	5.4	2.4
New Brunswick	7.9	5.6	2.3
Quebec	6.7	4.4	2.3
Ontario	6.5	4.6	1.9
Manitoba	7.8	5.6	2.2
Saskatchewan	10.6	7.3	3.3
Alberta	7.3	5.3	2.0
British Columbia	7.4	5.5	1.9
Canada	7.0	5.0	2.0

1 Estimates are adjusted for provincial variations in employment structure.
2 The composition of the goods-producing industries is the same as Table 4-7.
Source: Estimates based on data from Statistics Canada.

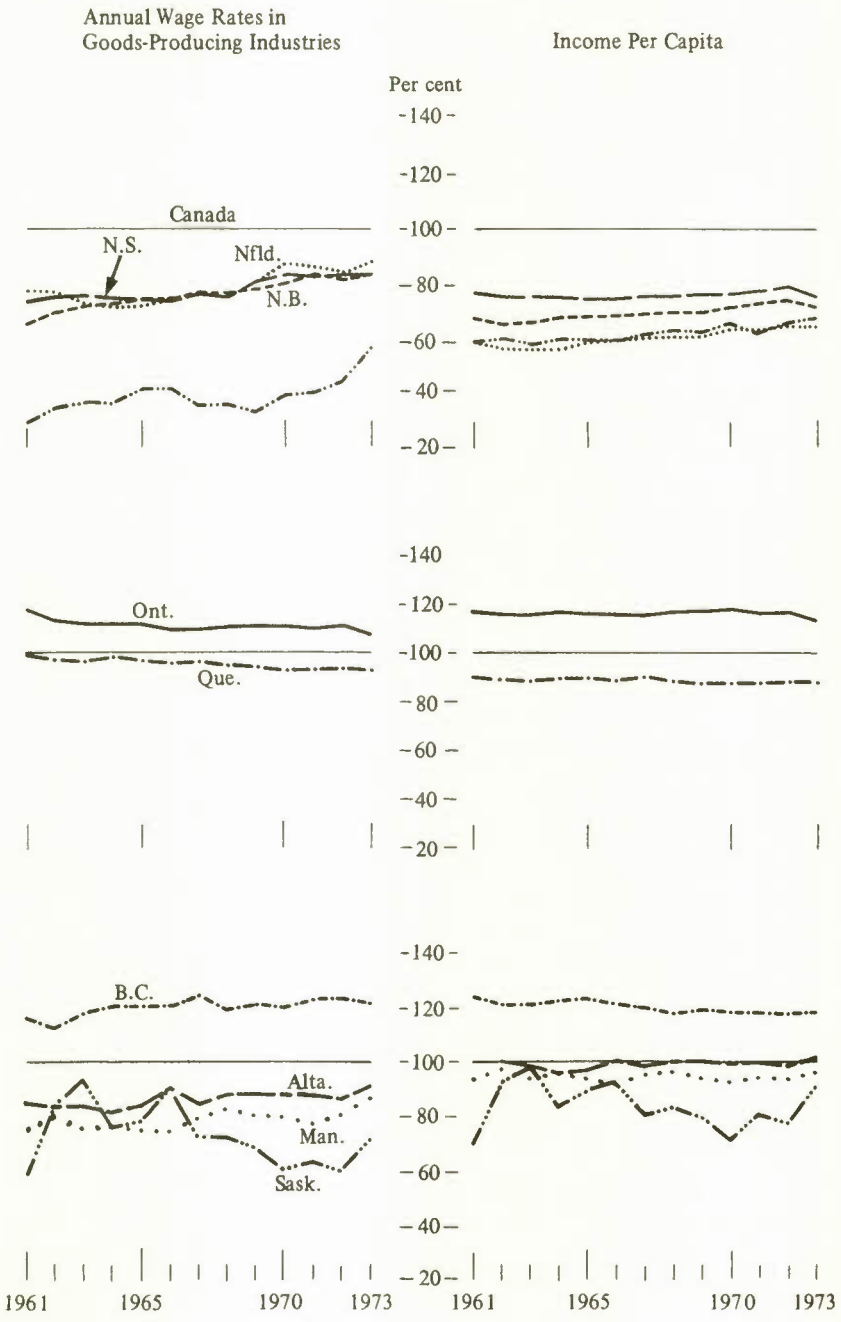
and would have lowered them further had it not been for unemployment insurance and welfare benefits. The fact that per capita income in Prince Edward Island was, relative to Canada, substantially higher than wage rates in the goods-producing industries of that province could be attributed, in part, to higher wage rates in a relatively large service sector.

The wage rate differentials between Quebec and Ontario persisted, but the per capita income differentials were greater and converged over the years, primarily because the participation rate of the labour force was lower and unemployment higher in Quebec.

In British Columbia and the Prairie provinces, per capita incomes came closer to the national average than wage rates, again because pay in the service sector was relatively better than in the goods-producing industries but also because a good part of the income was received in the form of corporation and dividend incomes.

Chart 4-6

Annual Wage Rates in the Goods-Producing Industries and Per Capita Incomes, Canada and Provinces, 1961-73



5 Conclusions

The objective of this study was to examine provincial variations in productivity performance and to determine the major sources of these variations. The findings of the analysis lead to the following conclusions:

- Most of the differences in levels of labour productivity between the provinces and the Canadian average did not come from industrial structure but from lower or higher levels of output per worker in each industry.

  With minor exceptions, the same was true for manufacturing, the goods-producing industries and the provincial aggregates. Only in Prince Edward Island and Saskatchewan did an unfavourable industrial structure contribute in a major way to below-average productivity performance of the goods-producing industries, and only in Manitoba and Quebec did an unfavourable industry structure contribute to below-average performance in the manufacturing industries.

- Output per worker was substantially lower in the Atlantic region than in most other provinces. It was below-average in Quebec, but above-average in Ontario and in three of the four western provinces. Among the western provinces, only Manitoba's output per worker was below the national norm.

- In some provinces, greater output per worker in one or two major industries contributed much to overall output per worker of the provincial economy. In Ontario, for example, the manufacturing sector was efficient, in Saskatchewan agriculture was very productive, in Alberta it was the oil and gas industry, and in British Columbia it was the forest industry.

- In provinces where productivity performance was below the national norm, the poor performance was not concentrated in one or two sectors of the economy but was evident in many sectors.

- Labour quality, especially higher educational attainment, raised the level of productivity performance in British Columbia, Alberta, and Ontario. Significantly, in all provinces where educational attainment was below the Canadian average — that is, in the Atlantic provinces, Quebec and Manitoba — output per worker was also below average.

- Higher productivity relative to wage rates and lower unit labour costs made Ontario, Alberta, and British Columbia more attractive than other provinces for investment in manufacturing and some of the other goods-producing industries.

- Capital stock per worker ranged widely among provinces. In Saskatchewan, Alberta, and British Columbia, ample capital accounted for better-than-average performance in all sectors of the economy. In Quebec and Prince Edward Island, a lack of it contributed to below-average performance.

- In most provinces, capital stock per worker was adequate, at times even plentiful. Indeed, in some of the Atlantic provinces, capital in manufacturing appeared to be invested beyond the point of adequate market returns.

- In general, the variations in capital stock per worker were not nearly as closely related to provincial variations in labour productivity as were variations in labour quality.

- There were indications that other factors contributed to regional differences in labour productivity. New technology was generally adopted in the Atlantic provinces later than elsewhere. More capital was invested in machinery and equipment relative to buildings in Ontario than in most other provinces. Ontario's firms operated on a larger scale and there were some indications that capacity utilization was higher as well. Also, variations in managerial quality may have affected productivity performance.

- Provincial variations in industrial structure accounted for about 20 per cent of the disparities in levels of labour productivity. Education and capital were more important factors and together they accounted for about half of the disparities. Other factors, not individually identified, made up the remaining 30 per cent.

- Provinces with a strong population growth — British Columbia, Alberta, and Ontario — have also had strong employment growth. This more rapid growth did not automatically lead to a more rapid productivity and per capita income growth. Among the three provinces, only Alberta had a better than average rate of growth in labour productivity.

- Nationally, the growth in labour productivity of the goods-producing industries has primarily come from improvements in output per worker in each industry and not from shifts in industrial structure. Industrial structure made sizable contributions only in some of the Atlantic and Prairie provinces, where the potential for employment shifts out of the primary industries was still large.

- Improvements in output per worker and industrial structure among the goods-producing industries made for more uniform levels of labour productivity across Canada. Quebec and Newfoundland were the exceptions. Quebec's growth in output per worker was just about the same as that of Ontario and therefore the productivity gap between the two provinces did not narrow. In Newfoundland, growth in output per worker was slower than elsewhere and its productivity gap with most other provinces therefore widened.

- Greater capital inputs per worker and improvements in labour quality accounted for 40 per cent of the gains in output per worker of the goods-producing industries while better management, technology, and other factors together accounted for the remaining 60 per cent of the gains. In Nova Scotia and Newfoundland, these latter factors contributed far less. This implies that capital invested there since the early 1960s was less productive because some of these other factors, so essential for economic growth, were lacking.

- Gains in wage rates have outstripped gains in productivity in all provinces and, as a result, unit labour costs have increased everywhere. They have grown faster in Manitoba, Quebec, and the Atlantic provinces than in Ontario, Alberta, and British Columbia. To the extent that slower growth in unit labour costs made for greater returns on investment, entrepreneurs found Ontario, Alberta, and British Columbia more attractive for investment than Quebec and the Atlantic provinces.

Since numerous factors account for the provincial disparities in productivity levels and growth, catching up will be difficult and will require strong and determined efforts by management, labour, and others in many areas of the economy. To be effective, they need to be based on a better understanding of all aspects of production and productivity.

On the basis of these findings, the Economic Council made a number of policy recommendations.[1] They were aimed at raising the level of education in those provinces where attainment was below the national average; at examining in more detail why productivity in some provinces

1 Economic Council of Canada, *Living Together: A Study of Regional Disparities* (Ottawa: Supply and Services Canada, 1976), pp. 61-98; recommendations pp. 216-29.

is much lower than in others; at finding ways of encouraging adoption of the best applicable technology in each industry; at expanding the formal training in management techniques; and at gradually moving to a more realistic alignment of minimum wage rates as well as government wage rates with economic conditions prevailing in the provinces.

6 Epilogue: Some Policy Considerations

Aside from the conclusions of the previous chapter, the analysis can provide background material for a variety of policy questions. As an illustration, some are put forth below under the headings of population growth, industrial structure, output per worker, labour quality, and capital per worker.

Population Growth

The analysis in Chapter 4 shows that the provinces with the highest per capita incomes have the highest rates of population and employment growth. While they do not have the highest rate of growth in per capita incomes, their economies expand faster and offer more attractive opportunities to investors, entrepreneurs, and producers.

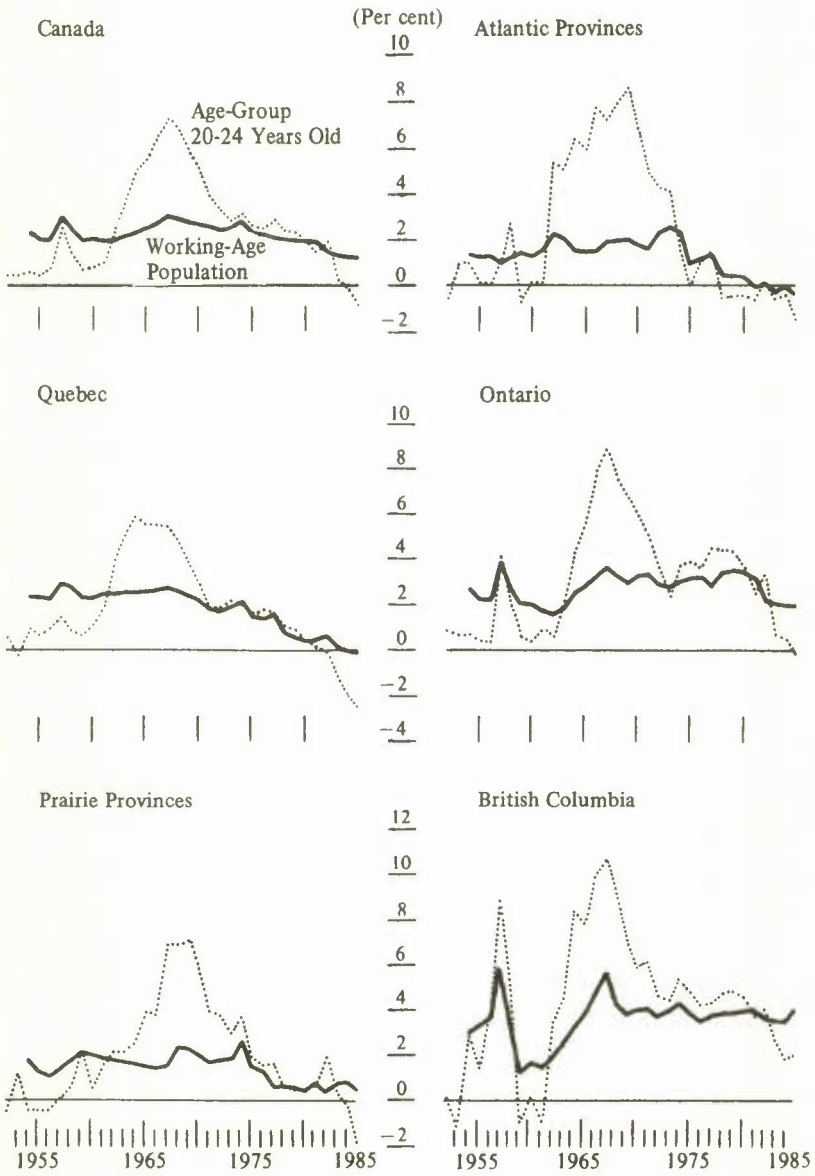
There are clear indications that Canada's future population growth will not match that of the past. The decline in the rate of population growth has started already and is expected to accelerate in the early 1980s (Chart 6-1). Depending on related economic developments, this could have very serious repercussions. A decline to zero population growth, for example, could lead to a reduction in Canada's economic growth from 5 to 3 per cent a year. It could lead to a sharp reduction in the rate of profits and a reduction in the rate of capital investment of 40 per cent or even more. It could be the beginning of a period of secular stagnation. Some economists have expressed doubt that the capitalist economic system could survive in its present form under those conditions. Others are more optimistic.[1] It will very much depend on whether sufficient capital investment will be forthcoming to keep the economy growing at an acceptable level of employment.[2]

1 See, for example, C. L. Barber, "Some Implications of the Move Towards Zero Population Growth in Developed Countries Upon the Level of Capital Expenditures", Economic Council of Canada Discussion Paper 19, Ottawa, 1975.

2 A further rise in energy prices could lead to heavy investment in energy development during the 1980s and provide not only a solution to what now looms ahead as an energy crisis but also compensation for the expected decline of investment demand arising from the reduced growth of the working population.

Chart 6-1

Annual Growth Rates of the Working-Age Population and the 20-24 Year Old Age-Group, Canada and Regions, 1965-85



Source: Estimates based on CANDIDE-R projections.

Whatever the outcome of a change in population growth may be, regionally its economic impact is likely to be greatest where the reduction in the rate of population growth is most pronounced.[3] If traditional patterns of demographic development are projected, regions in Canada which in the past could rely more heavily on immigration than natural growth will be favoured. Projections based on traditional patterns of migration flows suggest that, by 1985, only two of Canada's five regions, Ontario and British Columbia, will have as much as 2 to 3 per cent annual growth in their working age populations. The Atlantic and Prairie provinces and Quebec will approach zero growth. Growth of the youngest age group of the working age population will actually turn negative and — because of the sharp decline in Quebec's birth rate during the 1960s — predictably more so in Quebec than in the other regions of Canada (Chart 6-1).[4]

In view of these potential demographic and economic developments, it could be useful to study the provincial economic impact of current federal and provincial policies of immigration and capital investment more carefully.

Industrial Structure

The transition from a mainly agricultural society of 100 years ago to the post-industrial society of today was a gradual process and has continued right up to the present. Over the past decades, employment in agriculture declined from about 20 per cent in 1950 to less than 5 per cent in 1975. Over the same period of years, the employment share of major service sectors — that is, trade, finance, community, business and personal services, and public administration — increased from one-third to over one-half (Chart 6-2).

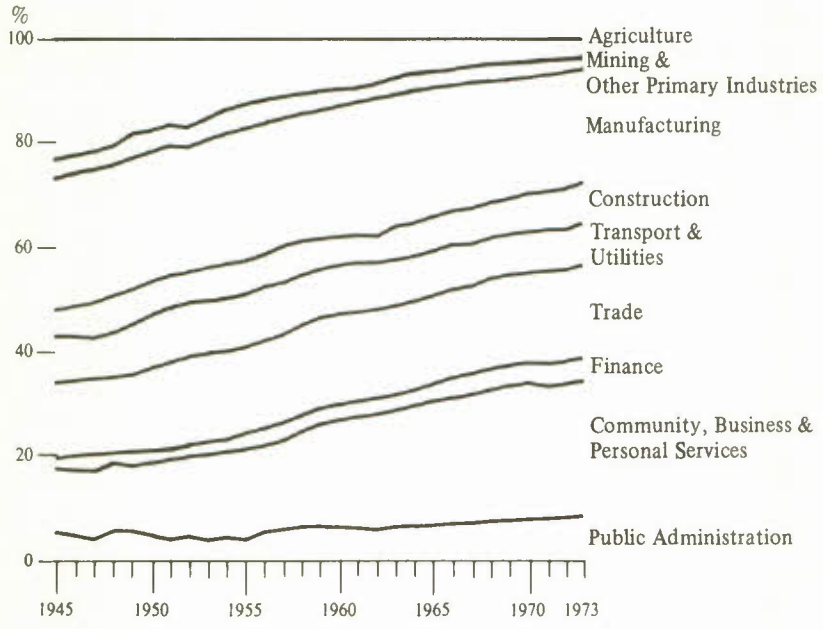
In this shift away from agriculture towards other industries, labour and capital did not move together. Farmers who remained on their farms invested heavily in machinery and equipment. And while more and more people found employment in the service industries, a major share of new capital investment went into mining, oil and gas development, hydroelectric utilities, and pipeline, air, and seaway transport. Probably because of greater capital inputs, some of the highest gains in real output per worker were achieved in agriculture, mining, transport, and utilities, and some of the lowest gains in community, business, and personal services. As well, the service industries provided more attractive employment opportunities

3 In the projection of the traditional pattern, it was assumed that the average percentage distribution of immigrants among regions for the years 1959-71 would continue into the future unchanged.

4 The projections were based on CANDIDE-R simulations. It is likely that there will be considerable variations among provinces within the same region, e.g., Alberta's rate of growth is likely to differ from that of the other Prairie provinces, but CANDIDE-R does not provide a provincial breakdown of demographic and economic developments. A short description of CANDIDE is given in Appendix B.7.

Chart 6-2

Employment Shares of Major Industries, Canada, 1947-75



Source: Estimates based on data of Statistics Canada.

for women and, therefore, had better access to lower-priced female labour than the primary and secondary sectors. An excess supply of this lower-priced labour may have delayed mechanization and automation in some of the service industries as it made the substitution of capital for labour less profitable.

It has been suggested that economic growth and development of a post-industrial society like Canada's depends to some extent on certain propulsive service industries of the tertiary sector.[5] This belief might stem from the fact that unemployment rates in Canada, as in the United States, have gradually risen and that the tertiary sector provided more employment opportunities than either the primary or secondary sector. Results of this study show that labour productivity improved strongly in the primary and secondary sectors but not in the tertiary sector. As mentioned earlier, this could be the result of problems in statistical measurement.[6] Better measures might lead to estimates of continuous

5 Fernand Martin, *Regional Aspects of the Evolution of Canadian Employment*, Economic Council of Canada (Ottawa: Information Canada, 1976), pp. 19-20.

6 This point was raised, for example, in connection with Table 4-6.

productivity growth in the service sector but would probably not make it a propulsive sector. Had the service industries of the tertiary sector been truly "propulsive" industries, they should have captured the largest employment shares in the highest income provinces, but this was not so. The employment shares of the tertiary sector are practically the same in all provinces. Indeed, the industrial structure of the low-income provinces of the Atlantic region is "...the most tertiarized of Canada, exceeding by far the Canadian norm".[7]

While growth in labour productivity of the service industries fell short of that of other industries, wages and salaries in these industries have grown. Had wage rates grown in line with productivity, the labour cost per unit of (real) output would have remained unchanged. In practice, however, unit labour costs have risen at a national rate of about 3 per cent. Most of this increase has come from the service sector, much less from the goods-producing sectors.

Within the tertiary sector, about half of the increase in unit labour costs came from one subsector: community, business and personal services. In this subsector, the share of education, health and welfare services has expanded and now accounts for over half of the total. Business services have maintained their 10 per cent share and personal services, recreation, and others have lost part of their share (Chart 6-3). These developments in the tertiary sector suggest that a good part of the wage increase and the rise in unit labour costs have come from services whose real output is difficult to measure.

In the present study, output of the service industries was measured by dollar estimates of labour and capital inputs. Although this approach is quite commonly used, it is not a very good procedure for estimating productivity performance. In view of the overwhelming size of the service industries, there is an urgent need for better measures.

The federal public service has made significant progress in this area. In 1969, the Treasury Board Secretariat started to work with a few departments and agencies to develop, test, and install systems for measuring performance. Approved in concept by 1973, the ministers of the Treasury Board directed in early 1976 that the work be accelerated and issued the following policy statement:

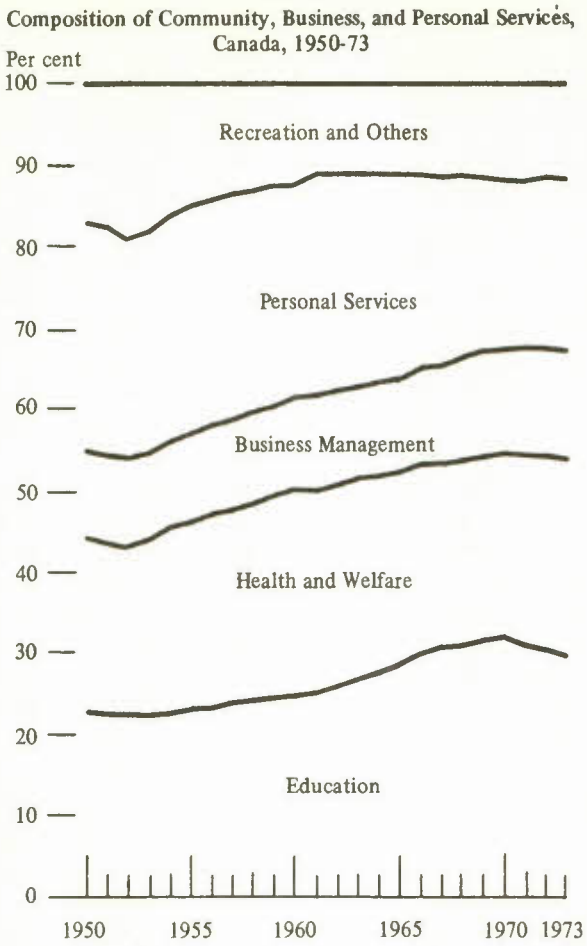
> "Departments and agencies of the federal government whose programs are subject to Treasury Board review will, wherever feasible, regularly measure the ongoing performance of their operations in terms of the effectiveness with which their objectives are being achieved and the efficiency with which they are being administered."[8]

7 Martin, *Regional Aspects*, p. 35.

8 Treasury Board, *A Manager's Guide to Performance Management* (Ottawa: Supply and Services Canada, 1976), p. 7.

Chart 6-3

Composition of Community, Business, and Personal Services, Canada, 1950-73



Source: Estimates based on data of Statistics Canada.

In the context of this study, its regional application is of special interest. The Income Maintenance Branch of the Department of Health and Welfare, for example, has offices in each province. It administers the family allowance, old age security, guaranteed income supplement and spouse allowance programs which provide for transfer payments in excess of $6.5 billion annually. Over 3.5 million family allowance accounts and 2 million old age security accounts are administered by this branch, an organization that is completely decentralized, with a small head office in Ottawa and 95 per cent of the staff located in ten regional and four district offices. In 1976-77, its operating budget was $31.6 million and 2,076 man-years.[9]

9 Ibid.

Efficiency and service measures have been established for about 85 per cent of the operations. Measured performance is reported monthly, its data collection and analysis requires annually only three man-years to maintain. The measurement system has a standard structure with a maximum of eight measurable operations in the regional offices. Each measurable operation has an efficiency index and there are two main categories of operations: processing and client services. In total, there are some 26 performance indicators for the eight measurable operations. Some typical indicators are: the average time required to process applications for benefits; the percentage of cheques returned; processing error rates; average waiting time for a client interview; and average response time for a field visit. Data collected in this manner are summarized monthly and provide performance measures to which regional and head office management can react. By doing so, management can achieve efficiency goals while maintaining an adequate level of services.

Analysis of these performance measures shows that, over the four-year period 1971-72 to 1975-76, the measured workload of the Income Maintenance Branch increased by 9.5 per cent while labour input in man-years decreased by 3.1 per cent. This resulted in an efficiency improvement of 12.8 per cent, or roughly 3 per cent a year. Over the same period of years, the level of service has been improved. Between 1973-74 and 1975-76, for example, the average response time for processing new applications of family allowance was reduced from 11.4 to 5.8 days, an improvement of nearly one-half.

Provincially, the productivity performance varied. The performance ratings were below the national average in three of the four Atlantic provinces, in Quebec, Manitoba, and Saskatchewan. They were above the national average in Ontario, Alberta, and British Columbia. In general, the productivity performance ratings conformed to those of the goods-producing industries provided in Chapter 3 of this study.[10] The exception was Nova Scotia. Its effeciency rating exceeded that of most other provinces and nearly matched that of Ontario (Table 6-1).

This example of productivity performance in the public service sector demonstrates that productivity performance can be measured quite accurately in selected areas of the service industries, that productivity improvements in the service industries are feasible, and that significant variations exist in provincial productivity performance of the service industries just as they exist in the manufacturing industries, the goods-producing industries, and the provincial economies.

It also has some policy implications. If a policy of decentralization of federal services is instituted — that is, if federal offices located today in Ottawa are moved to other provinces — it is possible that their productivity performance will change. If it declines, the move will add to the taxpayers' costs. Would it not be in the interest of Canadians, therefore,

10 Differences between national and provincial levels of the goods-producing industries are summarized in Table 3-3 of Chapter 3. The estimates in the last column of Table 3-3 correspond to those of the last column of Table 6-1.

Table 6-1

Measured Productivity Performance of Regional Operations of the Income Maintenance Branch, Department of Health and Welfare, Canada, by Province, 1972-73

Province	Relative Productivity Rating for Maintaining Accounts	Productivity Difference
	(Per cent)	
Newfoundland	85	-15
Prince Edward Island	58	-42
Nova Scotia	109	+ 9
New Brunswick	84	-16
Quebec	93	- 7
Ontario	111	+11
Manitoba	93	- 7
Saskatchewan	94	- 6
Alberta	102	+ 2
British Columbia	101	+ 1
Canada	100	0

Source: Data provided by the Income Security Programs Branch, Department of Health and Welfare, Ottawa, 1977.

to take into account the regional variations in productivity performance and locate them where productivity is at par or can be readily brought up to par?

Since government administration accounts for only about one-tenth of all employment[11] in the service industries, it would be useful to develop similar measures of productivity performance for the private sector of the economy. Although some progress has been made in the area,[12] little is known about any regional variations. Yet, if regional economic performance in some of the low-income regions is to improve, would it not be of paramount importance to concentrate on the service sector where most of the people are employed today?

11 Excluding Crown Corporations.

12 Measuring the real output of the life insurance industry is one example; see R. Hirshhorn and R. Geehan, "Measuring the Real Output of the Life Insurance Industry", *Review of Economic and Statistics*, vol. 59, no. 2 (May 1977), pp. 2ll-19. Measuring the efficiency in delivery of health services is another; see H. P. Bone and L. C. Allen, "The Outputs of the Hospital Industry: A Proposal for Their Identification and Measurement", Paper Presented at the Annual Meeting of the Allied Social Science Association Session: Economics of Health, 29 December 1973, New York. Also, it is noteworthy that Statistics Canada is currently developing productivity measures for a variety of government services.

Output Per Worker

Estimates in this study suggest that about 80 per cent of all regional variations come from variations in output per worker and the remainder from variations in industrial structure. It is often thought that changes in industrial structure, say, from textile industries to other industries, are very difficult to make because of required changes in investment, production technology, occupational skills of the labour force, and market development. It would be wrong to believe, however, that changes in output per worker could be accomplished more easily. After all, over the past 20 years, the industrial structure has changed in all provinces but the rankings of provincial productivity performance have remained practically the same. Part of the reason for this inertia to change is probably founded in long-term historical developments and part stems from the complexity and interrelations of the many factors contributing to better or poorer productivity performance. Two examples may illustrate this; the first relates to the history of the Canadian steel industry, the second is an example from agriculture.

Steel

The Canadian steel industry is nearly 100 years old.[13] Although there were some earlier attempts to establish steel mills — based on small blast furnaces using local ore in Nova Scotia, Ontario and Quebec — all of them were financially unsuccessful. It was not until after 1879, when a national policy of protective tariffs was established, that the first successful blast furnaces were built in Nova Scotia and Ontario. By 1905, Canada's annual steel production had reached 450,000 tons, with Nova Scotia producing two-thirds and Ontario one-third. While tariff protection of the steel industry was reduced from time to time,[14] the steel industry continued to prosper and grow. Over the next five decades, Canadian steel production increased tenfold, from 450,000 tons in 1905 to over 4.5 million tons in 1955. With Ontario taking the lead as early as 1910, the regional shares shifted over the years and by 1955 roughly four-fifths of all Canadian steel was produced in Ontario, less than 15 per cent in Nova Scotia, and the remaining 5 per cent in other Canadian provinces.

The remarkable success of Ontario's steel industry can be attributed to a variety of factors. At the outset, American businessmen sponsoring the steel enterprise were provided with free plant sites, long-term exemptions from local taxes, and a cash bonus if plant facilities were in place at a certain date. More importantly, perhaps, the industry had easy access to U.S. sources of iron ore and coking-coal of good quality, it was close to

13 W. K. Buck and R. B. Elver, "The Canadian Steel Industry: A Pattern of Growth", *Mineral Information Bulletin MR 70*, Ottawa, Department of Mines and Technical Surveys, November 1963.

14 For example, the tariff schedule was reviewed and modified in 1906 and, in 1912, all forms of bounty were withdrawn.

the central market, and this market, in both Canada and the United States, was expanding rapidly. From 1905 to 1955, the Ontario steel industry grew, widened its product range, improved its productivity and maintained its competitive edge (Table 6-2).

Table 6-2

Regional Shares of Canadian Steel Ingot and Casting Production, 1905-75

	Atlantic	Quebec	Ontario	West	Canada	
		(Per cent)			(Per cent)	(Million tons)
1905	67	–	33	–	100	0.5
1910[1]	43	2	55	–	100	0.8
1925	33	1	63	3	100	0.8
1935	31	4	63	2	100	1.1
1945	20	4	74	2	100	2.9
1955	13	2	82	3	100	4.5
1965	8	3	84	5	100	10.1
1975	5	8	80	7	100	15.0

1 Data for 1915 not available.

Source: Shares prior to 1965 are based on actual production of crude steel in Canada as estimated by W. K. Buck and R. B. Elver, *The Canadian Steel Industry: A Pattern of Growth*, Department of Mines and Technical Surveys, Mineral Information Bulletin MR 70, November 1973. Data for 1975 are based on estimates in *Iron and Steel Mills*, Statistics Canada, catalogue no. 41-203.

Over the past two decades, Canada's steel production has tripled again and is now 15 million tons of steel per year. During this period, two kinds of technology have emerged: the basic oxygen process and the improvement of the electrical process.[15] The basic oxygen process has some major advantages over the traditional open-hearth process: processing time is reduced from as much as ten hours to less than one hour, labour costs are cut by one-third, and capital costs are reduced by one-half. These cost advantages, however, can only be realized from large-scale operations. In small operations, the electric process is more advantageous. Based on electric furnaces, using only scrap metal, it does not require blast-furnace facilities and can be put in operation near the source of its raw material, at any large metropolitan centre.

The basic oxygen process has replaced much of the traditional open-hearth production. In 1956, it accounted for 10 per cent of Canadian capacity in steel production; in 1975, it accounted for over 50 per cent.

15 There were other important technological changes affecting the production of steel: the pelletization of iron ore, the process of direct reduction, continuous casting, and the implementation of computer controls. Data on the adoption of these processes are not as readily available as for the two major technologies described here.

Adoption of this very efficient process was relatively slow partly because the efficiency of the older open-hearth furnaces has been improved by oxygen-lanced devices and partly because the conversion from the open-hearth to the basic oxygen process is costly and therefore more readily accommodated in a region of growing market demand. This explains, in part, why the Atlantic region with its slowly expanding market has not yet adopted it.

The electric-furnace technology is a more costly process but has an economic advantage in producing smaller quantities of speciality steels at a distance from the centre of steel production. With ongoing improvements in the electric reduction method, this technology has expanded its market share over the past ten years and today accounts for over 20 per cent of Canadian steel capacity. By now, Quebec, the Prairie provinces, and British Columbia have all shifted away from the other processes and rely exclusively on the process of electric reduction. Only the Atlantic region has adhered to traditional production methods and has lost part of its regional share to Quebec and the West.

By taking advantage of the electric reduction method, Quebec and the West have increased their ability to compete with Ontario in meeting some of their own steel requirements. It is quite possible that their share will expand further and that eventually the electric reduction process will pose serious competition to the basic oxygen process. The Sidbec operation in Quebec, for example, is designed to be a fully integrated, primary steel producer based on electric reduction technology. In a world of energy shortage, the development of the enormous potential of hydroelectric power in Quebec will give support to this enterprise. As well, it is likely that easy access to natural gas will give greater strength to the steel industry of the western provinces.

All this shows that development of an industry is not independent of the random events of history. But it also shows that the course of history is not irrevocable, and the question arises why in some cases action was not taken much sooner.

At the turn of the century, for example, the Atlantic region accounted for two-thirds of all Canadian steel output; today it accounts for only 5 per cent. Considering that this region was once the centre of a flourishing shipbuilding industry, why did it fail to shift from its production of wooden ocean-going ships to steelplated steamships? Was it because of a decline in cargo when the then accessible forest resources became depleted, when demand for coal from the United States diminished, when the traditional markets for dried fish in the West Indies became depressed?[16] Was it because of a national policy of building a transcontinental railway that helped open up the West and that favoured the manufacturing industries of central Canada? Or was it because of a reluctance on the part of management and labour in the Maritime provinces to welcome

16 F. T. Walton, "Canada's Atlantic Region: Recent Policy for Economic Development", Paper prepared for the Northeast Regional Science Association Meetings, 28-30 May 1977, Halifax, p. 4.

technological change and to accept new challenges: when meat canning and refrigeration first cut into the traditional markets for fish, or when heavy capital investments in manufacturing were not followed up by an agressive expansion of trade with the New England and New York markets, or when ocean-going trawlers of other countries demonstrated how fishing techniques could be improved?

These and many more questions need to be explored in more depth to isolate those elements that made for success or failure. They might well provide the answers to problems of the Maritime industries today.

Dairy Production

In Chapter 3 of this study, some statistics were given on provincial variations in milk production per cow.[17] The estimates of annual production range from about 7,000 pounds of milk per cow in Quebec and Saskatchewan to 12,000 pounds in British Columbia. Had the estimate been averaged over several years (corresponding estimates of Quebec and British Columbia for the years 1970-75, for example, would be 7,140 pounds and 12,140 pounds, respectively) they would differ somewhat, but not change the order of magnitude greatly. Both Quebec and British Columbia are major dairy producers: the question remains as to why cows in British Columbia yield so much more milk than cows in Quebec?

Some would argue that the answer is very simple: dairy farmers in British Columbia cater strictly to the fluid milk market while the production system in Quebec is geared to the sale of milk for industrial uses. The two systems operate very differently. "British Columbia's dairy industry is based on Holstein cows, whose ability to yield milk exceeds that of the Canadian breed popular in Quebec by 50 per cent."[18] In British Columbia, the city dairies insist on year-round delivery of milk and lower prices to producers if they over-produce during the summer months and cut them off if they under-produce during the winter months. In Quebec, farmers take advantage of their summer pasture by having their cows "freshening" in early spring and by "drying them up" for the winter. This has been a tradition in Quebec for many years and, even today, the milk processing industry does not provide strong incentives or disincentives to alter this seasonal pattern. Dairy farmers in Quebec, therefore, follow the conventional route of letting their cows produce most of the milk when the pasture is good, while dairy farmers in British Columbia try to keep production at the same high level all year round (Table 6-3).

Other factors are also involved. Dairy farmers in British Columbia tend to be younger and more progressive in adopting the latest technological advances in milk production than their Quebec counterparts. And since technological progress is generally correlated with superior management ability, it would be reflected in higher yields per cow. The climate

17 Estimates of milk production per cow are listed in Table 3-5.

18 Agriculture Canada Letter, March 24, 1977.

Table 6-3

Average Daily Milk Production per Cow Milked, January and June, Canada, by Province, 1966 and 1976

	1966		1976	
	January	June	January	June
Prince Edward Island	22	38	28	40
Nova Scotia	25	32	32	36
New Brunswick	22	34	29	39
Quebec	21	33	28	34
Ontario	29	38	35	42
Manitoba	28	33	31	36
Saskatchewan	27	35	30	34
Alberta	27	35	32	36
British Columbia	32	37	42	43
Canada	26	35	32	37

Source: *The Dairy Review*, Statistics Canada, cat. no. 23-001, (monthly).

in British Columbia is relatively mild and more favourable for pasturing cows, but these climatic differences are believed to have only marginal effects. Also, the British Columbia Milk Board has created a favourable milk price situation for dairy farmers, intended in part to offset the high costs of feeding dairy cows in that province, and this has permitted dairy farmers to feed at a higher plane of nutrition, thereby realizing more fully the genetic potential of cows to produce milk. By contrast, Quebec dairy farmers have been recovering an average of one dollar less per 100 pounds of milk, so that diminishing returns of milk to feed input take effect at a lower nutritional plane for them.[19]

Higher prices for dairy products may lead to more milk production but they do not assure greater production efficiency. If anything, they may lead to inefficiencies. Support prices for dairy products are generally higher in western Europe than in Canada, and they are higher in Canada than in the United States. Yet, annual milk production per cow is lowest in Europe and highest in the United States (Table 6-4). In the early 1960s, supplementary payments for dairy production in Canada amounted to $3 million per year; by 1974, they had risen to over $200 million. During the same period, milk production per cow in Canada increased from about 6,300 pounds to 8,000 pounds, while, in the United States, it increased from 7,760 pounds to 10,300 pounds.[20] That means the productivity gap between Canada and the United States has widened. Over the

19 Ibid.

20 *Dairy Facts and Figures at a Glance* (Ottawa: Dairy Farmers of Canada, 1976), pp. 32 and 37.

years, support prices for dairy products have increased more in Canada than in the United States. In 1965-66, for example, support prices for industrial milk in Canada were not quite 10 per cent higher than in the United States; by 1975, they were over 40 per cent higher.[21]

Table 6-4

Support Prices for Butter and Milk Production per Cow, International Comparison, 1974

	Support Price Per Pound of Butter	Annual Milk Production Per Cow
	(Cents per pound)	(Pounds)
Western Europe	.87	7,167
Canada	.77	8,022
United States	.60	10,287

Source: *Dairy Facts and Figures at a Glance*, (Ottawa: Dairy Farmers of Canada, 1976), pp. 28, 37, 42 and 43.

It has been estimated that the United States' dairy-price support programs over the 1949-73 period totaled $7 billion and, after allowance for free-market price adjustments, entailed a loss in welfare of nearly $3.5 billion.[22] At 1975 dairy-support levels (of $260 million per year)[23] it will take Canada less than 5 years to amass the same per capita welfare loss that has been accumulated in the United States over the past 25 years.[24]

In 1977, the Canadian Minister of Agriculture announced a new policy that could increase dairy subsidies to $477 million a year. Farmers who produce more than their alloted quota would be penalized at the rate of $7 per hundredweight. As yet, Ottawa and the provinces have not been able to agree on this latest support program.[25] If it is approved, it will raise the level of subsidies even higher.

In the past, the largest share of the dairy supplementary payment has gone to Quebec. In 1975, for example, Quebec received $127 million, Ontario $84 million, and British Columbia $8 million.[26] That means the

21 V. McCormick, "A Comparison of the Dairy Industries in Canada and the United States", *Canadian Farm Economics*, vol. 9, no. 6 (December 1974), p. 6.

22 D. Heien, "The Cost of the U.S. Dairy Price Support Program: 1949-74", *Review of Economics and Statistics*, vol. 59, no. 1 (February 1977), p. 3.

23 *Dairy Facts and Figures*, p. 32.

24 This estimate is based on the fact that milk production in Canada is about 15 per cent as large as that of the United States (see McCormick, "A Comparison of Dairy Industries", p. 3), and on the assumption that the ratio of support-price costs to welfare loss is roughly 2:1 and is about the same in both countries.

25 "Butter Up 10 Cents in New Dairy Policy", *Globe and Mail*, April 5, 1977.

26 *Dairy Facts and Figures*, p. 30.

greatest part of the subsidies went to the province that ranked among the lowest in the performance rating of milk production per cow. It is a policy question whether the Canadian system of subsidy payments could not be modified, at no extra cost to the taxpayer, so as to encourage the less efficient dairy farmers in each province to improve the productivity of their herds.

Labour Quality

Estimates of provincial variations in labour quality and of their contribution to provincial differences in productivity performance were based in this study on variations in age, sex, and education characteristics of the full-time employed labour force. Of the three characteristics, education is most amenable to government policy.[27]

Greater interest in education has been a common experience among nations during the postwar period and, like others, Canada has greatly increased its expenditures on education. During the past decade, Canada roughly quadrupled its budget for education and today spends well over $1,000 per student a year. It means that Canada spends just about as much on education per student as the United States, over twice as much as France and nearly three times as much as Japan. Expenditures on education accounted for over 8 per cent of Canada's gross national product and over 20 per cent of all government expenditures.

Education in Canada is almost exclusively a provincial and municipal responsibility. Perhaps it is for this reason that there are considerable variations among provinces in expenditures on education. In Prince Edward Island and Newfoundland, for example, the expenditure share of education was in the neighbourhood of 20 per cent; in Ontario and Alberta it exceeded 30 per cent. Over the years, the changes in expenditure shares did not always make for greater regional uniformity. Between 1960 and 1970, for example, the shares in Newfoundland and Prince Edward Island remained unchanged while those in Ontario increased from 28 to 34 per cent. But over the same period of years, New Brunswick, Quebec, Saskatchewan, Alberta, and British Columbia came closer to the national average (Table 6-5).

The provincial spending patterns on education were reflected in expenditures per student. In 1971-72, for example, the average cost of education per student in Canada was $1,174 and ranged, roughly in line with the expenditure shares allocated in provincial budgets to education, from a low of $827 in Newfoundland to a high of $1,440 in Ontario. To the extent that expenditure per student was an indication, the quality of education was significantly below the national average in the Atlantic

27 Legislation related to equal opportunity, equal pay for women, and retirement age may affect participation rates of women and older members of the working-age population. This makes sex and age characteristics amenable to government policy too but its potential impact on provincial productivity variations would probably be quite small.

Table 6-5

Expenditure Shares Allocated by Provincial-Municipal Governments to Education, Canada, by Province, 1960-61 and 1970-71

	1960-61	1970-71
	(Per cent)	
Newfoundland	23	23
Prince Edward Island	23	22
Nova Scotia	28	29
New Brunswick	25	27
Quebec	29	29
Ontario	28	34
Manitoba	28	27
Saskatchewan	30	28
Alberta	31	31
British Columbia	26	28
Canadian average	27	28

Source: Based on *Survey of Education Finance*, 1969, 1970, Statistics Canada, cat. no. 81-208, pp. 26-27; and *Decade of Education Finance, 1960-69*, Statistics Canada, cat. no. 81-560, July 1974, pp. 58, 60, 62 and 64.

provinces and well above average in Ontario and Alberta. It was below average in spite of the fact that the low-income Atlantic provinces spent, relative to personal income, more on education than most other provinces (Table 6-6).

A policy to give every child in Canada the same quality of education would, of course, be desirable but also would necessitate greater expenditures in provinces that lag behind. If better education were to be financed through provincial-municipal channels, it would require substantially higher tax rates in the less-advanced regions. To bring education in Newfoundland, for example, up to the national average would require raising the level of education expenditures from $827 to $1,174, or from the present level of 12.5 per cent of personal income in Newfoundland to 17.7 per cent. That would push the rate of expenditures on education in Newfoundland to twice the current rate of British Columbia. Since per-capita income in Newfoundland is much lower than the national average, such a rate of education expenditure would probably go beyond the financial capacity of Newfoundland and make it very difficult to close the education gap between a low-income province, such as Newfoundland, and other high-income provinces. Budget restrictions are likely to perpetuate the inadequacy of education in the low-income provinces.

Implicitly this assumes that education expenditures are directly related to the quality of education: the higher the expenditures per student, the better the quality of education. It is necessary to qualify this assumption.

Table 6-6

Selected Ratios of Education Expenditures, Canada, by Province, 1971-72

	Education Expenditures	
	Per Student	As Per Cent of Personal Income
	(Dollars)	(Per cent)
Newfoundland	827	12.5
Prince Edward Island	1,049	14.5
Nova Scotia	1,091	12.3
New Brunswick	1,099	13.2
Quebec	1,265	12.4
Ontario	1,440	10.6
Manitoba	1,267	11.2
Saskatchewan	1,124	11.8
Alberta	1,388	12.0
British Columbia	1,186	8.6
Canadian average	1,174	11.9

Source: Based on Data from *Advance Statistics of Education*, Statistics Canada, cat. no. 81-220, pp. 54, 55.

A part of the provincial differences in education expenditures might have to be attributed to higher salaries for the same teaching quality in the richer provinces. It is likely, however, that the richer provinces are also willing to spend more on school facilities, such as more books per library and better equipment in laboratories. Perhaps in contrast to belief, research of the late 1960s and early 1970s seemed to show that per pupil expenditures are not very closely related to later achievement if social background, attitudes of other students, and peer pressure are taken into account.[28] More recent work suggests again that school and college investment expenditures do have a significant effect on lifetime earnings and that skills and attitudes produced in elementary or high school have a lasting effect on productivity.[29]

Some evidence is also accumulating to suggest that returns to higher education may be diminishing. In the United States, for example, the job market for college graduates has diminished since the early 1970s. It has been estimated that the real rate of returns to college education of young male graduates has dropped by 2 to 4 percentage points and that this decline cannot be readily attributed to cyclical changes. This trend

28 Vernon Henderson, Peter Mieszkowski, and Yvon Sauvageau, *Peer Group Effects and Educational Production Functions*, Economic Council of Canada (Ottawa: Supply and Services Canada, 1976), p. 7.

29 P. Wachtel, "The Effect on Earnings of School and College Investment Expenditures", *Review of Economics and Statistics*, vol. 58, no. 3 (August 1976), pp. 326-331.

conforms to the fact that, in the United States from 1973 to 1975, the earnings of college graduates aged 25 to 29 years increased less than those of male high school graduates.[30]

It is not clear at this point whether there has been a corresponding decline in returns to university training in Canada. However, some questions are being raised as to priorities, set directly or indirectly by government funding, in the Canadian educational system. It is being said...."that Canada's educational system has provided us with an overabundance of highly educated people, and an insufficient number of people with on-the-job skills that are immediately useful to industry."[31] Considering that Canada is trying to support a higher and faster growing level of service industries with a lower and declining level of manufacturing activities than most other industrialized nations, would it not be useful to reassess national and provincial policies in the areas of secondary and university training? Could the training of students at the secondary and university levels be redesigned to accommodate more nearly the needs of industry?

Capital Per Worker

In Chapter 3 of this study, it was shown that variations in capital stock per worker account for some of the productivity differences between provinces. It was also shown that higher levels of capital investment do not automatically lead to higher levels of productivity.

Governments can encourage economic developments that are sound and viable but they...."may often be under pressure to prop up and support industries and areas which have little economic future."[32] Alternatively, one might suggest that capital investment and labour should follow the free-market forces and go to those provinces that can provide greater returns to both. It is likely, however, that the costs of using either one of these alternatives alone is too high, and that a more efficient combination can be found between these two extremes.

The case can be made that government-subsidized investment contributes less to the development of areas of economic stress than the investment that would have been undertaken without the subsidy program.[33] In a more cheerful vein, the same view has been expressed by the American economist H. Houthakker, when he spoke in support of the

30 R. B. Freeman, "The Decline in the Economic Rewards to College Education", *Review of Economics and Statistics*, vol. 59, no. 1 (February 1977), p. 29.

31 Edward Clifford, "Innovators and Risk Takers Sought from Post-Secondary Graduates", *Globe and Mail*, April 26, 1977.

32 C. L. Barber, "Comments to 'Policy for Declining Regions: A Theoretical Approach'", *Areas of Economic Stress in Canada* (Kingston: Queen's University Press, 1965), pp. 93-98.

33 D. Usher, "A Critique of the Canadian Program of Subsidizing Investment in Less-Developed Regions", Queen's University Discussion Paper 145, Kingston, 1974, pp. 54-56.

subsidies and tax loopholes to a Joint Economic Committee of the United States Congress.

> "...we are gradually moving toward a situation where everybody is subsidizing everybody else. Most economists will condemn this trend because it is not likely to promote the efficient allocation of scarce resources, but it should be realized that from the political point of view, it may have positive aspects. As we all know from birthdays and Christmas Eves, the exchange of gifts, even rather useless gifts, frequently helps stimulate goodfellowship and a sense of community. One could be more sanguine about this trend, however, if it did not contain an element of selfdeception, in the sense that the beneficiaries of any particular program feel they are getting something for nothing."[34]

A less tolerant view was expressed by David Lewis, the former leader of Canada's New Democratic Party, when he said that it is simply unfair for governments to give hand-outs to private enterprise.[35]

For more effective government policies, it may be necessary to provide incentives to those areas of growth, within each province, where jobs can be created at reasonable costs, where the workers will want to work, and where the prospects for continuous economic development are favourable. Recognizing that economic growth and social development do not occur evenly throughout the province, the provincial government of Ontario, for example, has initiated a program of regional economic development that is based on comprehensive development strategies. It should enable each of Ontario's economic regions to share more fully in the expanding economy of the province.

In evaluating the growth prospects of the various regions, numerous measures of growth potential were applied to each and then selections of growth centres made on the basis of average rankings. The growth orientation of each selection was further evaluated in terms of future potential in anticipated growth industries, its capacity of attracting new employment, and its capacity to absorb further population growth, to meet housing and schooling requirements, to provide the necessary transportation network, communication, cultural and recreational services. Then, development strategies were designed for each.[36]

34 H. Houthakker, "The Control of Special Benefit Programs", *The Economics of Federal Subsidy Programs*, a staff study, Part I, U.S., Congress, Joint Economic Commission, (Washington D.C.: Government Prington Office, 1972) cited in D. Usher, "A Critique of the Canadian Program", p. 57.

35 David Lewis, *Louder Voices: The Corporate Welfare Bums* (Toronto: James Lewis and Samuel, 1972).

36 Ontario, Department of Treasury and Economics, Regional Development Branch, "Design for Development, Northwestern Ontario Region, Phase 2: Policy Recommendations", Toronto, October 1970, p. 52. In the Design for Development, Phase l: Analysis series, see also "Niagara (Southern Ontario) Region", June 1970; "Midwestern Region", July 1970; and "Northeastern Ontario Region", January 1971.

The essential difference between this and other approaches is that it does not concentrate on problem areas but sets out strategies for all major regions of the province. It is based on a philosophy that government must work towards an optimum development of all regions of the province. Ontario's development program was initiated in 1966 and has been modified over the years, but the initial objectives and policies continue to apply. Among others, the development program is based on principle: to encourage, wherever consistent with other government policies, the clustering of industrial growth; to pay attention to the human resources of the area and give assistance to local enterpreneurial talent; and to locate large manufacturing undertakings, as opposed to resource-based activities, in larger centres.[37] Since the province's urban system is at present focused very much on Toronto, several subsystems are encouraged to develop around regional centres, among them the areas around London, Kingston, Ottawa, and Thunder Bay. Within each of the subsystems (six in total), certain cities and towns are selected to serve a larger role as subregional service centres. All are subject to detailed regional studies and plans.[38]

This kind of development program encourages growth in those regional centres that have demonstrated a potential for economic growth in the past. It is based on criteria of success rather than failure and may serve well in reducing regional disparities and accelerating economic progress.

37 The Honourable W. D. McKeough and A. R. Dick, *Design for Development, Ontario's Future: Trends and Options* (Toronto: Ministry of Treasury, Economics and Intergovernmental Affairs, 1976), pp. 31-32.

38 Ibid., pp. 43-44. In the Design and Development series (Toronto: Ministry of Treasury, Economics and Intergovernment Affairs, 1976), see also *Northeastern Ontario Regional Strategy; Renfrew County Development Strategy; The Durham Subregion: A Strategy for Development to 1986;* and *Toronto-Centred Region Program Statement.*

Appendixes

A Research Methodology

This study deals with various aspects of production, productivity, and economic growth. The conceptual approach is based on traditional methods of production function analysis. Major elements of productivity performance are examined on a provincial and national basis and an attempt is made to measure what the differences are among regions and what changes have taken place over time. For expository purposes, aspects of growth are examined first, those of regional productivity comparisons later.

Production functions specify the relationships between resource inputs and industry output. In a general way a production function is represented by (1) where Y denotes industry output in time period t and $X_{1t}, X_{2t}, \ldots X_{nt}$ denote the various inputs of production such as labour, capital, and their quality characteristics.

$$(1) \quad Y_t = f(X_{1t}, X_{2t}, \ldots X_{nt})$$

Assuming that function (1) has finite and continuous derivatives of all orders, a Taylor expansion yields (2) and, after rearrangement of terms (3). According to (3) a change in output ΔY is imputed to changes in each of n factors or resource inputs $\Delta X_1, \Delta X_2, \ldots \Delta X_n$. Relation (3) holds true for a great variety of functional forms. The applications below illustrate how the technique was used for the derivation of empirical estimates in this study.

$$(2) \quad \Delta Y = \sum_i^n \Delta X_i \left(\frac{\partial Y}{\partial X_i}\right)_t + \frac{1}{2!} \sum_i^n \sum_j^n \Delta X_i \Delta X_j \left(\frac{\partial^2 Y}{\partial X_i \, \partial X_j}\right)_t + \frac{1}{3!} \ldots + R,$$

This technique makes it possible to estimate to what extent changes in each of n different variables X_i contribute to the changes in variable Y.

$$(3)\quad \Delta Y = \Delta X_1 \left\{ \left(\frac{\partial Y}{\partial X_1}\right)_t + \frac{1}{2!} \sum_j^n \Delta X_j \left(\frac{\partial^2 Y}{\partial X_1\, \partial X_j}\right)_t + \frac{1}{3!} \cdots \right.$$

$$\vdots$$

$$\left. \Delta X_n \left\{ \left(\frac{\partial Y}{\partial X_n}\right)_t + \frac{1}{2!} \sum_j^n \Delta X_j \left(\frac{\partial^2 Y}{\partial X_n\, \partial X_j}\right)_t + \frac{1}{3!} \cdots + R, \right.\right.$$

where $\Delta Y = Y_{t+1} - Y_t$

$\Delta X_i = X_{t+1,\,i} - X_{t,\,i}$

$\Delta X_j = X_{t+1,\,j} - X_{t,j}$

and R is a remainder.

As will be shown later,[1] its main advantage is that at times it makes for accuracy not afforded by the conventional approach.

Although the Taylor expansion is applicable to a wide range of different types of production functions, it is applied here to a very simple exponential function, the well-known Cobb-Douglas production function. This type of function was used in the context of this study for the empirical estimates and it serves to illustrate the approach to productivity analysis. Four different areas are described:

- Growth in productivity of individual industries over time;
- Regional differences in productivity levels of individual industries;
- Regional differences in productivity levels of groups of industries; and
- Regional differences in productivity growth of groups of industries.

Descriptions of each of the four areas are given under the same headings below.

1 In text related to Table A-1 below.

A.1 Growth in Productivity of Individual Industries Over Time

In terms of a Cobb-Douglas function, industrial production can be quantified as in (4) where Q denotes industry output, K is capital stock, L is labour, Lq is labour quality, and A is a "catch-all" for all other factors that affect industry output.

$$(4) \quad Q = A\ K^{k}\ L^{\ell}\ Lq^{m}$$

$$(5) \quad \frac{Q}{L} = A \left(\frac{K}{L}\right)^{1-\ell} Lq^{m}$$

where

Q = industry output
K = capital stock
k = production elasticity of capital
L = labour
ℓ = production elasticity of labour
Lq = labour quality
m = production elasticity of labour quality.

Assuming constant returns to scale, an assumption that could be relaxed without altering the overall approach, production function (4) can be transformed into productivity function (5). Function (5) describes labour productivity, i.e., output per worker, as a function of capital per worker, labour quality, and other factors.

$$(6) \quad \frac{Q}{L}t+1 - \frac{Q}{L}t = \left\{\frac{Q/L}{A}\right\}_t \left(A_{t+1} - A_t\right) + (1-\ell)\left\{\frac{Q/L}{K/L}\right\}_t \left\{\frac{K}{L}t+1 - \frac{K}{L}t\right\}$$

$$+ m\left\{\frac{Q/L}{Lq}\right\}_t \left(Lq_{t+1} - Lq_t\right) + \cdots$$

The central objective of this study is to estimate how much each of the resource inputs contributes to changes in output per worker from one point in time to the next. To facilitate the analysis, output per worker of each industry and all industry inputs are dated. This is indicated by adding subscript t or $t+1$ to all variables. The change in output per

worker between time t and $t+1$ can then be estimated by applying Taylor expansion (3) above to productivity function (5). A first-term expansion yields (6) and is converted into annual growth rates as in (7).

$$(7) \quad \frac{\overset{*}{Q}}{L} = \overset{*}{A} + (1 - \ell) \frac{\overset{*}{K}}{L} + m \overset{*}{Lq} + \ldots$$

where

$$\frac{\overset{*}{Q}}{L} = \left(\frac{Q}{L}t+1 - \frac{Q}{L}t\right) \div \frac{Q}{L}t$$

$$\overset{*}{A} = \left(A_{t+1} - A_t\right) \div A_t$$

$$\frac{\overset{*}{K}}{L} = \left(\frac{K}{L}t+1 - \frac{K}{L}t\right) \div \frac{K}{L}t$$

$$\overset{*}{Lq} = \left(Lq_{t+1} - Lq_t\right) \div Lq_t$$

In (7) the rate of change in labour productivity between time t and $t+1$ is measured (approximately) by the corresponding changes in capital per worker, labour quality and in all other factors, i.e., factor productivity, each weighted by its production elasticity. As long as the rates of change are quite small, this approximation by a first-term Taylor expansion is quite adequate and, indeed, yields exactly the same result as the widely used procedure of differentiating each variable with respect to time.[2]

A.2 Regional Differences in the Level of Output Per Worker of Individual Industries

The estimation procedure is an extension of the method described under A.1 above. It is assumed that all regions have the same industry production function and that only the levels of resource inputs, including factor productivity, differ among them. Instead of dating the labour productivity and resource inputs as in (6) above, they are identified with subscripts for each region. All comparisons are between a selected

2 T. K. Rymes, *On Concepts of Capital and Technical Change* (Cambridge, 1971), pp. 53-59.

subregion and a base or average region, as, for example, between a province and Canada. The fact that regional differences in labour productivity and levels of resource inputs are quite substantial at times is recognized explicitly by modifying the estimation procedure to include all second-order terms of the Taylor expansion. Assuming that Equation (4) above represents an industry production function common to all regions, a second-term Taylor expansion yields (8) where regional (provincial) values are denoted by subscript r and the average value of the state (Canada) by s. Since the second-term expansion contains a vector F common to each input variable, as indicated in (9), it can be evaluated as in (10). Rewriting (9), as in (11), yields (12). Thus Equation (12) states that differences between provincial and national levels of labour productivity are attributable to differences between provincial and national levels of resource inputs. Specifically, the differences in output per worker $\overset{*}{Q}/L$ are attributed to differences in $\overset{*}{K}/L$, labour quality $\overset{*}{Lq}$ and all other factors $\overset{*}{A}$. It also states that the differences in levels of resource inputs need to be weighted by their respective production elasticities, i.e., the exponents in production function (4), and their respective adjustment factor F_i . The adjustment implies that all of the remainder terms R of the Taylor expansion are allocated according to the first- and second-order terms of the expansion. This yields more appropriate estimates than a first-term expansion, especially since regional differences in resource inputs are frequently quite large.

$$
\begin{aligned}
(8)\quad \frac{\overset{*}{Q}}{L} &= \overset{*}{A}\left\{1+\frac{1}{2}\left\{(1-1)\overset{*}{A}+(1-\ell)\frac{\overset{*}{K}}{L}+m\,\overset{*}{Lq}\right\}\right. \\
&\quad +(1-\ell)\frac{\overset{*}{K}}{L}\left\{1+\frac{1}{2}\left\{\overset{*}{A}+[(1-\ell)-1]\frac{\overset{*}{K}}{L}+m\,\overset{*}{Lq}\right\}\right. \\
&\quad +\quad m\,\overset{*}{Lq}\left\{1+\frac{1}{2}\left\{\overset{*}{A}+(1-\ell)\frac{\overset{*}{K}}{L}+[m-1]\overset{*}{Lq}\right\}\right. + \ldots \\
&= \overset{*}{A}\left\{1+\frac{1}{2}\left\{\overset{*}{A}+(1-\ell)\frac{\overset{*}{K}}{L}+m\,\overset{*}{Lq}\right\}\right\}-\frac{1}{2}(\overset{*}{A})^2 \\
&\quad +(1-\ell)\frac{K}{L}\left\{1+\frac{1}{2}\left\{\overset{*}{A}+(1-\ell)\frac{\overset{*}{K}}{L}+m\,\overset{*}{Lq}\right\}\right\}-\frac{1}{2}(1-\ell)\left(\frac{\overset{*}{K}}{L}\right)^2 \\
&\quad +\quad m\,\overset{*}{Lq}\left\{1+\frac{1}{2}\left\{\overset{*}{A}+(1-\ell)\frac{\overset{*}{K}}{L}+m\,\overset{*}{Lq}\right\}\right\}-\frac{1}{2}m(\overset{*}{Lq})^2+\ldots
\end{aligned}
$$

where

$$\overset{*}{\frac{Q}{L}} = \left(\frac{Q}{L}r - \frac{Q}{L}s\right) \div \frac{Q}{L}s$$

$$\overset{*}{A} = (Ar - As) \div As \text{ and}$$

$$\overset{*}{\frac{K}{L}} = \left(\frac{K}{L}r - \frac{K}{L}s\right) \div \frac{K}{L}s$$

letting $F = \left\{ 1+\frac{1}{2} \left\{ \overset{*}{A} + (1-\ell) \overset{*}{\frac{K}{L}} + m \overset{*}{Lq} \right\} \right\}$ as above, (8) can be rewritten as in

$$(9) \quad \overset{*}{\frac{Q}{L}} = \overset{*}{A}F - \frac{1}{2}(\overset{*}{A})^2 + (1-\ell)\overset{*}{\frac{K}{L}}F$$

$$- \frac{1}{2}(1-\ell)\left(\overset{*}{\frac{K}{L}}\right)^2 + m \overset{*}{Lq}F$$

$$- \frac{1}{2}m(\overset{*}{Lq})^2 + \ldots + R$$

and ignoring the remainder term R of third and higher order derivations, F can be evaluated as in

$$(10) \quad F = \left\{ \overset{*}{\frac{Q}{L}} + \frac{1}{2}(\overset{*}{A})^2 + \frac{1}{2}(1-\ell)\left(\overset{*}{\frac{K}{L}}\right)^2 + \frac{1}{2}m(\overset{*}{Lq})^2 \right\}$$

$$\div \left\{ \overset{*}{A} + (1-\ell)\overset{*}{\frac{K}{L}} + m \overset{*}{Lq} \right\}$$

Then letting

$$(11)\quad F_1 = F - \frac{1}{2}\overset{*}{A}$$

$$F_2 = F - \frac{1}{2}\frac{\overset{*}{K}}{L}$$

$$F_3 = F - \frac{1}{2}\overset{*}{Lq}$$

it follows from (9) and (10), that

$$(12)\quad \frac{\overset{*}{Q}}{L} = \overset{*}{A}F_1 + (1-\mathfrak{q})\frac{\overset{*}{K}}{L}F_2 + m\overset{*}{Lq}F_3$$

Equation (12) corresponds to the conventional form in (7) above, except for the adjustment factors F_i. In most interregional comparisons they can be expected to have values close to unity, but sometimes they differ from it significantly.

Assuming that the parameters of the postulated production function(s) are given,[3] this technique assigns interregional differences, e.g., between a province and the state, in output per worker $\overset{*}{Q}/L$ of individual industries to interregional differences in capital per worker $\overset{*}{K}/L$, labour quality $\overset{*}{Lq}$, and a set of all other factors $\overset{*}{A}$.

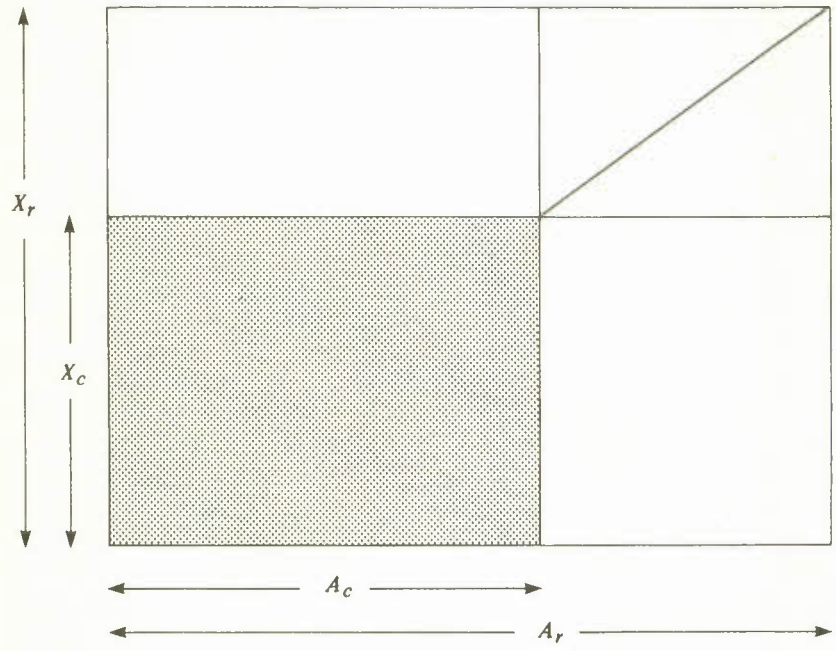
To give some intuitive meaning to this estimation procedure, a simplified hypothetical example may be useful. Suppose output per worker, say Q/L, of a particular industry can be described as a function of two factors of production: the level of technology A, and a set of other factor inputs X. Assuming further that the productivity function is of a simple multiplicative form, such that $Q/L = A \cdot X$, and that it adequately describes the production process of the same industry in different regions, then differences in productivity levels can be illustrated diagramatically.

As shown in Chart A-1 the smaller shaded rectangle represents output per worker $(Q/L)_c$ as the product of A_c and X_c for one region, say Canada. The larger rectangle describes output per worker $(Q/L)_r$ for another region, say a province. In this case, it is assumed that output per worker in the region is greater than that of Canada. The difference in productivity levels between the two regions equals the difference in size of the two rectangles.

3 Statistical estimation procedures for the production parameters are described in Appendix B.3 below.

Chart A-1

Regional Differences in Productivity Levels, Hypothetical Example



If a Taylor expansion, as in (2) above, were applied to this very simple function of the variables A and X, it would converge to zero after a second-order expansion.[4] The value of this expansion would correspond exactly to the unshaded area of the rectangle in Chart A-1. The first-order expansion would measure the area $(A_r - A_c)X_c$ as the contribution of the difference in technology A between the region and Canada, and the area $(X_r - X_c)A_c$ as that of the difference in factor inputs X. The second-order expansion would augment each of these contributions by one-half of the "corner area" $(A_r - A_c)(X_r - X_c)$. As long as the differences in productivity levels are small, these "second-order differences" are likely to be very small, and can be ignored. If the differences are large, however, the second-order differences are likely to be larger and need to be taken into account. An appropriate allowance can be made by redistributing the second-order differences among the various input variables in a symmetrical fashion. If the production process can be

4 For an analogous application of a Taylor expansion to a multiplicative function of two variables, see Equations (13) to (15).

Table A-1

Contribution of Factor Productivity, Capital Per Worker, and Labour Quality Differences in Output Per Worker between Ontario and Canada, by Industry, with Adjustment Factors for Second-Order Differences, 1970-73

	Contribution			Difference in Labour Productivity	Adjustment Factors for "Second-Order" Differences		
	Factor Productivity $\overset{*}{A}F_1$	Capital Per Worker $(1-\ell)(\overset{*}{K}/L)F_2$	Labour Quality $mLqF_3$	$(\overset{*}{Q}/L)$	F_1	F_2	F_3
	(Per cent)				(Ratios)		
Agriculture	- 3.7	2.8	.5	- .4	1.02	.98	.99
Forestry	- 2.0	-11.0	- 1.0	-14.0	.95	1.06	.95
Fishing	15.5	-14.9	- 3.4	- 2.8	.71	1.00	.86
Mining	8.7	-41.0	- .8	-33.1	.84	1.13	.91
Manufacturing	9.3	- 1.7	1.6	9.2	1.00	1.06	1.03
Construction	2.6	- 1.6	.3	1.4	.99	1.04	1.00
Transport and utilities	2.4	.4	.8	3.6	1.01	1.01	1.01
Trade	- .2	.2	.7	.8	1.00	.99	1.00
Finance, insurance and real estate	1.0	.0	1.5	2.5	1.01	1.01	1.00
Community, bus. and pers. services	1.9	- .8	2.2	3.2	1.01	1.04	1.00
Public administration	4.0	- 5.8	2.2	.4	.94	1.03	.94

described in terms of a function that has finite and continuous derivatives of all orders, a Taylor expansion will serve this purpose.[5]

The advantage of using a Taylor expansion is that it applies to a variety of production functions and is computationally quite manageable, even if the functional forms become more complex. If instead of a two-variable production function, for example, a Cobb-Doublas type production as in (5) is used, the same technique yields the first- and second-order expansions as described in Equations (8) to (12). Equation (12) implies that the first-order contributions of each production factor need to be adjusted individually to allow for second-order effects for each industry separately.

Statistical estimates of this sort are presented in Table A-1. They are based on 11 production functions, one for each of the major industries. As shown in the centre column of this table, the difference in labour productivity between Ontario and Canada is negative in the four primary industries and positive in the other secondary and tertiary industries. The differences are very small — less than 1 per cent, in the case of agriculture and trade. They are large in the case of forestry and mining. Correspondingly, the second-order adjustment factors (F_1, F_2, and F_3) are quite small, 2 per cent or less of the productivity difference in the case of agriculture and trade, and 5 per cent or more in the case of forestry and mining. This correspondance between productivity difference and second-order adjustment, however, is not always that close. In manufacturing, for example, the productivity difference is quite large while the adjustment factors are small whereas, in fishing, the productivity difference is quite small while the adjustment factors are large. It is precisely because of these irregularities that a method like the Taylor expansion is useful for "second-order" adjustments.

A.3 Regional Differences in Productivity Levels of Groups of Industries

Labour productivity of groups of industries can be evaluated like that of individual industries except that regional differences in industrial structure need to be measured at the same time. Industrial structure can be represented by the employment shares in individual industries. Estimates of output per worker, weighted by industry-employment shares, can be added across industries and yield estimates of aggregate labour productivity of all industries included in the group. In Equation (13), for

5 An alternative method would be an approximation by finite differences to the total differential, a method that has been applied by M. Brown, *On the Theory and Measurement of Technological Change* (Cambridge, 1966), pp. 199ff, and yields nearly the same results as those obtained by the Taylor expansion.

example, aggregate labour productivity Q/L is represented as the weighted sum of individual industry-employment shares L_i/L, and estimates of output per worker Q_i/L_i, measured dollar value added per man-year, of each industry.

$$(13)\quad \frac{Q}{L} = \sum_i \frac{L_i}{L}\frac{Q_i}{L_i}$$

$$(14)\quad \Delta\frac{Q}{L} = \sum_i \frac{\partial\frac{Q}{L}}{\partial\frac{L_i}{L}}\Delta\frac{L_i}{L} + \frac{1}{2}\Delta\frac{L_i}{L}\Delta\frac{Q_i}{L_i}\frac{\partial^2\frac{Q}{L}}{\partial\frac{L_i}{L}\partial\frac{Q_i}{L_i}}$$

$$+ \sum_i \frac{\partial\frac{Q}{L}}{\partial\frac{Q_i}{L_i}}\Delta\frac{Q_i}{L_i} + \frac{1}{2}\Delta\frac{L_i}{L}\Delta\frac{Q_i}{L_i}\frac{\partial^2\frac{Q}{L}}{\partial\frac{L_i}{L}\partial\frac{Q_i}{L_i}}$$

$$= \sum_i \frac{Q_i}{L_i}\Delta\frac{L_i}{L} + \frac{1}{2}\Delta\frac{L_i}{L}\Delta\frac{Q_i}{L_i}$$

$$+ \sum_i \frac{L_i}{L}\Delta\frac{Q_i}{L_i} + \frac{1}{2}\Delta\frac{L_i}{L}\Delta\frac{Q_i}{L_i}$$

where

$$\Delta\frac{Q}{L} = \left(\frac{Q}{L}r - \frac{Q}{L}s\right)$$

$$\Delta\frac{L_i}{L} = \left(\frac{L_i}{L}r - \frac{L_i}{L}s\right)$$

$$\Delta\frac{Q_i}{L_i} = \left(\frac{Q_i}{L_i}r - \frac{Q_i}{L_i}s\right)$$

and r,s denote subscripts for region and state, i.e., province and Canada, respectively.

(15) Letting

$$\left(\Delta\frac{Q}{L}\right) \div \frac{Q}{L} = \frac{\overset{*}{Q}}{L}$$

$$\left(\Delta\frac{L_i}{L}\right) \div \frac{L_i}{L} = \frac{\overset{*}{L}_i}{L}$$

$$\left(\Delta\frac{Q_i}{L_i}\right) \div \frac{Q_i}{L_i} = \frac{\overset{*}{Q}_i}{L_i}$$

$$\frac{\overset{*}{Q}}{L} = \left\{\sum_i \frac{\overset{*}{L}_i}{L}\frac{L_i}{L}\frac{Q_i}{L_i} + \frac{1}{2}\frac{L_i}{L}\frac{Q_i}{L_i}\frac{\overset{*}{L}_i}{L}\frac{\overset{*}{Q}_i}{L_i}\right.$$

$$\left. + \sum_i \frac{L_i}{L}\frac{Q_i}{L_i}\frac{\overset{*}{Q}_i}{L_i} + \frac{1}{2}\frac{L_i}{L}\frac{Q_i}{L_i}\frac{\overset{*}{L}_i}{L}\frac{\overset{*}{Q}_i}{L_i}\right\} \div \frac{Q}{L}$$

$$= \sum_i \frac{\overset{*}{L}_i}{L}\frac{Q_i}{Q} + \frac{1}{2}\frac{\overset{*}{L}_i}{L}\frac{\overset{*}{Q}_i}{L_i}\frac{Q_i}{Q}$$

$$+ \sum_i \frac{\overset{*}{Q}_i}{L_i}\frac{Q_i}{Q} + \frac{1}{2}\frac{\overset{*}{L}_i}{L}\frac{\overset{*}{Q}_i}{L_i}\frac{Q_i}{Q}$$

Applying a Taylor expansion as in (3) to (13) yields (14) and can be rewritten as in (15).[6] The second part of (15) states that the difference in aggregate labour productivity of a group of i industries between region r (province) and the state s (Canada), equals the sum of the differences in employment structure $\overset{*}{L}/L$, output per worker in individual industries $\overset{*}{Q}_i/L_i$, and an interaction term, each weighted by the national output

6 In this case, the Taylor expansion converges to zero after the second-order term. Equations (14) and (15), therefore, are not approximations but equalities.

share Q_i/Q of the respective industries. To give a meaningful interpretation to (15), it is rewritten in (16) and (17).[7]

$$(16)\quad \frac{\overset{*}{Q}}{L} = \sum_i \left(\frac{L_i}{L} r - \frac{L_i}{L} s\right)\left(\frac{Q_i/Q}{L_i/L} s\right) + \sum_i \left(\frac{Q_i}{L_i} r - \frac{Q_i}{L_i} s\right)\left(\frac{Q_i/Q}{Q_i/L_i} s\right)\left(1 + \frac{\overset{*}{L}_i}{L}\right)$$

$$(17)\quad \frac{\overset{*}{Q}}{L} = \sum_i \left(\frac{L_i}{L} r - \frac{L_i}{L} s\right)\left(\frac{Q_i/Q}{L_i/L} s - 1.0\right) + \sum_i \frac{\overset{*}{Q}_i}{L_i} (L_i/L) r \frac{Q_i/Q}{L_i/L} s$$

According to (17), industrial structure contributes to productivity differences between a region (province) and state (Canada) whenever the regional employment share differs from the national employment share, but only if the national output per worker of that industry is above or below the labour productivity of all industries. The contribution of output per worker is the sum of productivity differences in each of the industries, weighted more heavily if its national productivity performance is above average and its regional employment share exceeds the national share.

Some hypothetical examples may illustrate how the estimation procedure works. If, for example, there is no difference between the regional and national employment share of an industry, the first factor of the structure term (the first summation term in (17)) becomes zero and nothing of the difference between national and regional labour productivity is attributed to industrial structure. Even if the regional and national employment shares differ, nothing is attributed to industrial structure, unless the industry performs above- or below-average productivity at the national level and the ratio $Q_i/Q \div L_i/L$ differs from unity. This is as it should be because, if a region has a larger or smaller employment share in an average-productivity industry, it cannot claim a structural advantage or disadvantage. If it does better or poorer than the national average, the advantage or disadvantage must be solely attributed to differences in output per worker.

Should an industry be missing in a region altogether, nothing is attributed to differences in output per worker of that industry because the employment share $(L_i/L)r$ of the second summation in (17)

7 The author is indebted to Dr. N. Swan for formulating the first part of summation (17).

becomes automatically zero. All the contribution of a missing industry to the overall productivity difference will be attributed to structure. The structural effect of a missing industry on regional productivity performance will be negative if it nationally performs above average, it will be positive if it performs nationally below average, and have no effect if it performs nationally at average. That is to say, if a region misses out on a particular industry, it can only have a negative effect on the productivity performance of that region if it is a better-than-average industry. Indeed, it would have a positive effect if a region missed out on a poorer-than-average industry.

In most cases, output per worker of a regional industry will have some effect on the overall productivity difference between region and nation. An industry will have a positive (negative) effect on the regional productivity if its regional level of output per worker is greater (smaller) than its national level. It will have no effect if its productivity level is exactly the same as its national level. In that case, the factor (Q_i^*/L_i) in the second summation of (17) becomes zero. Some extra weight $(Q_i/Q)/(L_i/L)$ is given, over and above the regional employment share L_i/L_r, if an industry performs nationally better than average, or subtracted if it performs nationally below average. That is to say, the productivity performance of each industry in each province is measured in two steps: first, provincial output per worker is compared with national output per worker of the same industry and, second, the national performance of that industry is compared with the national output per worker of all industries. By this method, the provincial level of output per worker in each industry is compared with the national average of all industries, a result that follows directly from the application of a Taylor expansion to (13) yielding (17).

Formulation (17) attributes differences in regional and national productivity levels to only two factors: industrial structure and output per worker in individual industries. Yet it was shown earlier that differences in output per worker of individual industries come from a variety of factors. In Equation (12) above, for example, they are attributed to factor productivity, capital per worker, and labour quality. These factors can be incorporated in (17) as shown in (18), making it possible to estimate how much industrial structure and each of the other factors contribute to the overall difference between the regional and national levels of labour productivity. The first summation in (18) represents the structural effects, and the second, third, and fourth represent the effects of factor productivity, capital input per worker, and labour productivity, respectively. It means that all regional inputs are compared with national inputs and then weighted, industry by industry, to arrive at the labour productivity difference between regional and national groups of industries.

$$(18)\quad \frac{\overset{*}{Q}}{L} = \sum_i \left(\frac{L_i}{L} r - \frac{L_i}{L} s\right)\left(\frac{Q_i/Q_s}{L_i/L} - 1.0\right)$$

$$+ \sum_i \overset{*}{A}_i \, F_{1i} \, w_i$$

$$+ \sum_i (1-\ell)_i \left(\frac{\overset{*}{K}}{L}\right)_i F_{2i} \, w_i$$

$$+ \sum_i m_i \left(\overset{*}{L}_q\right)_i F_{3i} \, w_i$$

where

$$w_i = (L_i/L)_r \, \frac{Q_i/Q}{L_i/L} s$$

A.4 Regional Differences in Productivity Growth of Groups of Industries

Just as disparities in regional performance in labour productivity can, at a given point in time, be attributed to regional differences in industrial structure, and capital per worker to labour quality and to other factors of production, so can changes over the years be attributed to these same factors of production. Productivity improvements of any one region, averaged over a period of years, can be compared with the average of all regions, e.g., Canada, and also related to the regional disparities that existed between the region, e.g., the province, and the average of all regions, e.g., Canada.

This approach follows directly from that outlined under A.3 and requires only a minor modification. The switch from comparisons between regions, e.g., a province and Canada, to changes over time requires only that all references to regions in (18), i.e., r and s, are replaced by references to points in time, i.e., t+1 and t. Accordingly, (18) becomes (19)

$$(19)\ \frac{\overset{*}{Q}}{L} = \sum_i \left(\frac{L_i}{L}t+1 - \frac{L_i}{L}t\right)\left(\frac{Q_i/Q_s}{L_i/L} - 1.0\right) + \sum_i \overset{*}{A_i} F_1 w$$

$$+ \sum_i (1-b)\frac{\overset{*}{K}}{L} F_2 w + \sum_i m \overset{*}{Lq} F_3 w$$

where

$$\frac{\overset{*}{Q}}{L} = \left(\frac{L_i}{L}t+1 - \frac{L_i}{L}t\right)\left(\frac{Q_i/Q}{L_i/L}t\right)$$

$$\overset{*}{A} = (A_{t+1} - A_t) \div A_t$$

$$\frac{\overset{*}{K}}{L} = \left(\frac{K}{L}t+1 - \frac{K.}{L}t\right) \div \frac{K}{L}t$$

$$\overset{*}{Lq} = (Lq_{t+1} - Lq_t) \div Lq_t$$

where F_1, F_2, and F_3 follow from (11),

$$w = (L_i/L)_{t+1}\left(\frac{Q_i/Q}{L_i/L}\right)t \quad \text{and}$$

where the first summation attributes changes over the years to improvements in industrial structure and the other summations attribute them to changes in capital inputs per worker, labour quality, and other factors.

Improvements in provincial or national labour productivity over the years are attributed to changes in industrial structure if output per worker in the i^{th} industry was better than average and employment increased, or if output per worker in the i^{th} industry was poorer than average and employment declined. Nothing is attributed to changes in industry structure if the employment share of the i^{th} does not change at all or if its performance in output per worker is not any better or poorer than but exactly equal to average. Improvements are attributed to factors affecting output per worker in the i^{th} industry if the input levels increase over the years.

A.5 Limitations

On the conceptual side, the distinction between industrial structure and output per worker raises some problems. In comparing the productivity performance of a province with that of Canada, it is implicitly assumed that the Canadian average represents a standard against which the performance of the provinces could and should be compared. If, for example, in a particular province, the proportion of employment in a high productivity industry was above the national average, it would reflect a good industrial structure or, vice versa, if its employment share in a low-productivity industry was above the national average, it would imply a poor industrial structure. On theoretical grounds, this conclusion is untenable.

Suppose a province is well endowed with high-quality farmland so that it has a natural advantage in agricultural production. Would it be best if it reduced its employment share in agriculture to the national average or would it be better if it exploited its natural endowment? From a theoretical point of view, employment would be optimally allocated if the ratio of marginal value product to marginal labour cost would be the same in all industries of that province. Depending on resource endowments, this ratio could vary greatly among provinces and, therefore, lead to very different optimal employment shares among provinces.

One might argue, therefore, that the industrial structure, measured by employment shares in different industries, cannot be good or bad in comparison with Canada but only in comparison with a standard that takes into account the regional differences in the marginal productivity and cost conditions. Empirical estimation of such a standard of optimal resource allocation is conceivable but, from past experience, it is known that results obtained in this manner may not be "robust" enough to yield reliable estimates without extensive experimentation.[8] As a shortcut, therefore, the Canadian average was taken as a standard of comparison.

8 Some results of an alternative approach, applied to a Canada-U.S. comparison of the Canadian agricultural industry, are described in L. Auer, *Canadian Agricultural Productivity*, Economic Council of Canada Staff Study 24 (Ottawa: Queen's Printer, 1970), pp. 48ff.

B Statistical Estimation

B.1 Labour Quality Index

For provincial comparisons of labour quality, labour inputs in all provinces and in each industry were valued according to one national pay scale, based solely on criteria of age, sex, and education. This measure of labour quality was obtained by multiplying the national wage rates, listed in Table 2-3 of the text, by the employment shares in each industry of each province, and by dividing this weighted sum by the corresponding sum of the national economy.

The labour quality index X_{ij} of the i^{th} industry in the j^{th} province was evaluated as in

$$X_{ij} = \sum_k p_{ijk} \; w_k / \sum_k p_k \; w_k$$

where p_{ijk} is the proportion of workers in industry i and province j of the age-sex-education category k, p_k is the Canadian proportion of all workers, and w_k is the average Canadian wage rate, both in the same category k. The labour quality index was estimated on the basis of five age, two sex, and six education categories, i.e., 60 categories for each of 11 major industries and 20 manufacturing industries, in each province. The numerical values of these indexes are listed in Tables C-1 to C-7

B.2 Canada-U.S. Comparison of Capital/Output Ratios

Although it is well-known that capital requirements in Canada are higher than in the United States, little is known about the sources of these differences. D. A. White found that "...Canada's investment programme was apparently proportionately far larger than those being undertaken in the major western countries. The reasons for this are not completely understood, but a significant contribution seems to have been made by the heavy investment associated with development in Canada. This appears, in turn, to be related to Canada's continuing historical

evolution as a resource-oriented complement to the populous manufacturing complexes of the United States, the United Kingdom, Europe and Japan."[1] White went on to show that Canada's investment in machinery and equipment as well as in nonresidential construction, as a percentage of GNP, was markedly higher and, in nonresidential construction in 1957, more than double that of the United States. A later study showed that it was 50 per cent higher when averaged over the years 1948-70.[2]

Results of the present study broadly confirm these earlier findings. They are based on capital/output ratios of five major industries and an industry aggregate. The U.S. estimates are derived from the data bank of the Klein-Wharton Model, while the Canadian estimates are based on data from Statistics Canada. As shown in Table B-1, on average the Canadian capital/output ratios are approximately twice as large as the U.S. ratios. While they are only about one-quarter higher in manufacturing, they are three to four times as high in mining and agriculture. Except for mining, the Canadian capital/output ratios have declined relative to those of the United States, but they are still very high in some of the industries, so high that their validity might be questioned.

Table B-1

Comparison of Capital/Output Ratios Between Canada and the United States, 1963-73[1]

	Capital/Output Ratios				Capital/Output Ratios of Canada as a Percentage of United States	
	Canada		United States			
	1963	1973	1963	1973	1963	1973
Agriculture	2.6	3.0	.9	1.0	382	304
Mining	2.5	3.2	.8	.7	314	424
Manufacturing	1.2	1.0	1.0	.9	123	115
Utilities	8.6	7.8	4.4	5.0	196	155
Transportation and communications	3.2	2.6	1.6	1.6	195	161
Other industries	1.9	1.9	.5	.6	379	334
Industry aggregate	2.1	2.1	.8	.9	251	229

1 Comparison is based on 1961 net capital stock data and not adjusted for the Canada-U.S. exchange rate.
Source: Estimates based on data of the CANDIDE and Wharton Models.

1 D. H. White, *Business Investment to 1970*, Economic Council of Canada Staff Study 5 (Ottawa: Queen's Printer, 1964), pp. 15-16.

2 Ludwig Auer, *Construction Instability in Canada*, Economic Council of Canada (Ottawa: Information Canada, 1975), pp. 110-11.

It is known that capital stock data of Canada and the United States are not strictly comparable. D. Walters attributed the difficulties of comparison partly to differences in the underlying service-life assumptions and partly to the use of net rather than gross capital stock data. Evidently the net-gross capital stock ratio is significantly higher in Canada than in the United States. Also prices for capital inputs tend to be higher in Canada than in the United States. Both have the effect of raising the capital/output ratios of Canada relative to the United States.[3]

It is likely that the same factors have affected the estimates in Table B-1 but not enough to change the overall capital/output ratios dramatically. It is probably fair to say, therefore, that the capital/output ratios are significantly higher in Canada than in the United States, perhaps not quite as high as the estimates in Table B-1 would suggest for agriculture or mining, but at least as high as those for the manufacturing industries.

B.3 Estimation of Industry Production Functions

Estimates of industry production functions were obtained by the method of "equilibrium factor shares", under which the production elasticities of capital and labour are assumed to be equal to the "factor shares" of capital and labour in output. If in a particular industry the share of labour wages in output is, for example, three times as large as that of capital, it implies that in the analysis of regional differences its contribution is weighted three times as heavily as that of capital. In reality, the weighting procedure is not quite as straightforward but depends on a variety of assumptions. These assumptions, and related aspects of the estimation procedure, are described below.

Assuming that the typical firm of an industry operates under free competition and has no influence on product or factor prices, production of each industry can be described as a function of capital and labour as indicated in (1), where

$$(1) \qquad Q = Q(K, L)$$

$$(2) \qquad \pi = Q P_q - K P_k - L P_\ell$$

$$(3) \quad F(Q,K,L) = Q P_q - K P_k - L P_\ell + \lambda [Q - F(K,L)]$$

$$F_Q(Q,K,L) = -P_q - \lambda = 0 \therefore \lambda = -P_q$$

3 Dorothy Walters, *Canadian Income Levels and Growth: An International Perspective*, Economic Council of Canada Staff Study 23 (Ottawa: Queen's Printer, 1968), p. 217.

$$F_K(Q,F,L) = -P_k - \lambda f_k = 0 \therefore f_k = \frac{P_k}{P_q}$$

$$F_L(Q,K,L) = -P_\ell - \lambda f_\ell = 0 \therefore f_\ell = \frac{P_\ell}{P_q}$$

where Q is industry output, K is capital stock, L is labour, and P_q, P_k, P_ℓ are their prices, respectively. Maximizing profit π as in (3), yields optimal output when the marginal productivity of capital and labour equal their factor-product price ratios P_k/P_q and P_ℓ/P_q.[4] Applied to a Cobb-Douglas production function as in (4), it follows that, under

(4) $Q = A K^k L^\ell$

(5) $f_k = k\frac{Q}{K} = \frac{P_k}{P_q} \therefore \bar{k} = \frac{P_k K}{P_q Q}$

$$f_\ell = \ell\frac{Q}{L} = \frac{P_\ell}{P_q} \therefore \bar{\ell} = \frac{P_\ell L}{P_q Q}$$

the marginal productivity conditions f_k and f_ℓ of profit maximization, the production elasticities k and ℓ equal the shares of capital and labour in total value product as in (5). Assuming firms operate under these profit maximizing conditions and have the same production elasticities in all regions, their production can be estimated as in (6), and functions for output per worker as in (7). Equation (8) describes regional factor productivity A_r. The production elasticity $\bar{k}$ in (7) is estimated by subtracting the national wage share $\bar{\ell}$ from 1.0, and the regional factor productivity A_r in (8) by entering the regional "value added" for Q, gross capital stock for K, and man-years of labour for L.

(6) $Q_r = A_r K_r^{\bar{k}} L_r^{\bar{\ell}}$

where, it is assumed in addition,[5] that

4 T. K. Rymes, *On Concepts of Capital and Technical Change* (Cambridge, 1971).

5 This additional assumption implies constant returns to scale. Under constant returns to scale the second-order conditions in (5) fail. This can be avoided if an overall constraint, e.g., a capital restriction, is imposed. Then $\bar{k}$ and $\bar{\ell}$ in (5) will not be equal but proportionate to the capital and labour output ratios, and this will not invalidate the general approach.

$$\bar{k} + \bar{\ell} = 1.0$$

$$(7) \quad \frac{Q}{L}r = A_r \frac{K^{\bar{k}}}{L}r$$

$$(8) \quad \frac{Q}{L}r / \frac{K}{L}^{1.0-\bar{\ell}} = A_r$$

Production function (4) can be modified to allow for regional variations in labour quality. Assuming that labour is not homogeneous but consists of distinct categories, for example, one with a low level and the other with a high level of educational attainment, production function (4) can be rewritten as in (9), where the symbols are the same as before but L_1 and L_2 denote two different kinds of labour inputs, e.g., employment numbers of two categories with educational attainment levels 1 and 2. To transform

$$(9) \quad Q = A K^k \ (x_1 L_1 + x_2 L_2)^{\ell}$$

these two labour inputs into one homogeneous labour input, they need to be weighted by some as-yet-unknown factor x_1 and x_2. The size of these weights can be determined as in (12) by assuming that the same profit maximizing conditions prevail as in (3) and (5), by determining the new marginal productivity conditions f_{ℓ_1} and f_{ℓ_2} as in (10), and by imposing the side conditions in (11) to assure that the weighted labour inputs equal the total labour input and that its production elasticity remains unchanged. According to (12),

$$(10) \quad f_{\ell_1} = \left(\frac{\ell Q}{x_1 L_1 + x_2 L_2} \right) x_1 = \frac{P_1}{Pq}$$

$$f_{\ell_2} = \left(\frac{\ell Q}{x_1 L_1 + x_2 L_2} \right) x_2 = \frac{P_2}{Pq}$$

$$(11)\quad L = x_1 L_1 + x_2 L_2$$

$$\bar{\ell} = \frac{L P_\ell}{Q Pq}$$

$$(12)\quad \frac{\bar{\ell} Q}{L} x_1 = \frac{P_1}{Pq} \therefore x_1 = \frac{P_1 L}{\ell Q Pq} = \frac{P_1}{P_\ell}$$

$$\frac{\bar{\ell} Q}{L} x_2 = \frac{P_2}{Pq} \therefore x_2 = \frac{P_2 L}{\ell Q Pq} = \frac{P_2}{P_\ell}$$

the labour quality weights x_1 and x_2 are the labour price ratios P_1/P_ℓ and P_2/P_ℓ. They are the wage rates of each labour quality group divided by the average wage rate of all labour. Substituting these weights into (9) yields production function (13) and, by assuming constant returns to scale, can be transformed into (14).

$$(13)\quad Q = A\ K^k \left(\frac{P_1\ L_1}{P_\ell} + \frac{P_2 L_2}{P_\ell}\right)^\ell$$

$$= A\, k^k\, L^\ell \left(\frac{P_1 L_1 + P_2 L_2}{P_\ell L}\right)^\ell$$

$$(14)\quad \frac{Q}{L} = A \left(\frac{K}{L}\right)^{1.0-\ell} \left(\frac{P_1 L_1 + P_2 L_2}{P_\ell L}\right)^\ell$$

In contrast to the earlier specification in (7), productivity function (14) describes output per worker not as a function of two but of three variables: factor productivity A, capital per worker K/L, and labour quality $\Sigma P_i L_i / P_\ell L$. Given regional data for industry output per worker, capital per worker, labour wages and salaries, and an appropriate measure for labour quality, factor productivity can be estimated for each industry and each region as indicated earlier in (8).

Provincial "Census value added" data were used as a measure of industry output, end-of-year values of gross capital stock as a measure of capital inputs, and annual employment data for labour inputs. A measure

of labour quality was derived from the labour quality indices listed in Tables C-1 to C-7. These indices were based on the labour quality characteristics of men and women in each industry and province. The estimation procedure for these indices is described in Appendix B.l above.

Before using the labour quality indices for production function estimates of regional productivity differences, their values were compared with industry variations in wage rates. This was done by regressing the observed wage rates in Tables C-1 and C-2.

Table B-2

Regression Estimates of Wage Rates on Labour Quality Index, Based on Provincial Industry Data, 1970

Regression Variables	Parameter	Estimate
Canada	c	−1.07*
Atlantic region	d_1	− .13*
Quebec	d_2	− .02
Ontario	d_3	.05
Prairie region	d_4	− .09
British Columbia	d_5	.00
Labour-quality index	α	2.05*
Correlation coefficient	$\bar{R}^2$	.64
Degrees of freedom	df	114

*Regression coefficient tested statistically significant at the 1 per cent level.

The regression was specified as in (15)

$$(15)\quad W_{ij} = c\, d_1 \ldots d_5\, Q_{ij}{}^{\alpha} \epsilon^{u}$$

where W_{ij} is the (annual) wage rate of the i^{th} industry in the j^{th} province, c is a constant term,[6] $d_1 \ldots d_5$ are dummy variables for the Atlantic region, Quebec, Ontario, the Prairie region, and British Columbia, Q_{ij} is the labour quality index of the i^{th} industry in the j^{th} province, α is the relevant regression parameter, and ϵ^{u} is the usual error term. As shown in Table B-l, only the constant c, the variable d_1 for the Atlantic region and the coefficient α of the labour quality index Q_{ij} tested statistically significant. These results imply that, aside from a negative wage-lowering effect in the Atlantic region, provincial variations in labour quality "explain" most of the variations in wage rates. In addition, the parameter estimate of $\alpha = 2.05$ implies that, for every 1 per cent change in the labour quality index Q_{ij}, the wage rate W_{ij} varies by 2 per cent.

6 The term c also represents a dummy variable for Canada, a specification analogous to that of Equation (16) below.

In view of these results, the labour quality indices in Table C-1 were adjusted so that their values more nearly approached the values of relative wage rates $P_i L_i / P_Q L$ in Equation (14) above. This was done by allowing the "final" labour quality variable *Lq* to vary by 2 per cent for every 1 per cent variation in the "original" labour quality index of Table C-3. If, for example, the original value of a labour quality index was 1.04, the final value of the labour quality *Lq* variable was set at 1.08; if the original value was .97, the final value was set at .94.

To obtain estimates of the "sources" of provincial disparities in industry output per worker, factor productivity, capital per worker, and labour quality were analysed as described in Appendix A. Based on parameter estimates of function (5) in Appendix A, regional differences in the level of output per worker of individual industries, for example, were imputed according to Equation (12) of Appendix A and regional differences in productivity levels of groups of industries according to (18) of Appendix A.

The derivation of estimates for factor productivity A and production elasticities k and ℓ have already been described in Equations (6), (7), and (8). It is noteworthy, perhaps, that the contribution of provincial variations in labour quality to variations in output per worker were further modified by a factor m as shown in Equation (18) of Appendix A. According to (14) of Appendix B, this factor m happens to equal ℓ, the factor share of labour. On average this value was in the neighbourhood of 0.75 but varied from one industry to the next and lowered the contribution of labour quality by roughly 25 per cent. Roughly, this means that an "original" quality index of, say, 1.04 was first adjusted to 1.08 and then reduced to 1.06. This downward adjustment is based on the theory that output per worker depends partly on capital inputs per worker and that productivity and wage rate gains from better labour quality cannot be fully realized unless capital inputs are added too.

As shown in Appendix A.3 and A.4, essentially the same approach could be applied to analysis of regional disparities in levels of output per worker as to growth of output per worker. When applied to disparities in levels, all data inputs relating to the years 1970-73 represent four-year averages. This was done to avoid distortions of estimates by business-cycle effects that could have put this or that province at a disadvantage relative to others. When applied to regional disparities in growth rates, the analysis covered the years 1961 to 1973, probably not an ideal period, since it began at a low point of the business cycle and ended at a high point, but it was the longest period for which comparable data could be obtained.

All growth rates were based on year-to-year changes and the results averaged over the years. Production elasticities and factor productivity were based, in this case, on time-series regression estimates of the goods-producing industries. Their estimation is described in Appendix B.4 below.

B.4 Regression Estimates of Regional Production Functions

Regional production functions were estimated to identify the major sources of economic growth. They were estimated by ordinary least-squares (OLS) procedures and, therefore, were free of some of the constraints imposed by the equilibrium share analysis of the preceding section. Also, some additional variables were added: the ratio of capital stock in machinery and equipment to structures as a variable of the quality of capital, the number of workers per establishment as a variable of returns to scale, a national variable of capacity utilization as a variable of cyclical variations in economic activity, and a time trend variable as a measure of productivity improvement over time. In addition, regression estimates of three labour quality variables for age, sex, and education were obtained from a separate OLS regression analysis and incorporated in the final function.

All time series regression estimates were based on data of the six goods-producing industries. They were not only used to identify the major sources of productivity growth, but also served as a basis of comparison for the results obtained by the "equilibrium shares" method of the preceding section. Specifications of the functional forms and the estimated regression parameters are described next; results of the two estimation techniques are compared later in Appendix B.5.

Cobb-Douglas type production functions were fitted by OLS regressions to regional time-series data. To incorporate regional variations, dummy variables were included as in

$$(16)\quad \frac{Q}{L}/L_q = c\, d_1\, d_2\, d_3\, d_4\, d_5 \left(\frac{K}{L}\right)^{\alpha} \left(\frac{ME}{ST}\right)^{\beta} (CU)^{\gamma} R^{\delta} t^{\zeta} u^{\epsilon}$$

where

Q/L = real value added per worker

L_q = provincial labour quality variable based on age, sex, and education characteristics (based on regression estimates as described below)

c = dummy variable for Canada

d_1 = dummy variable for Atlantic region

d_2 = dummy variable for Quebec

d_3 = dummy variable for Ontario

d_4 = dummy variable for Prairie region

d_5 = dummy variable for British Columbia

K/L = gross capital stock per worker

ME/ST = ratio of gross capital stock in machinery and equipment to structures

CU = capital utilization rate
R = returns to scale
t = time-trend variable
u = residual error term, and
$\alpha, \beta, \gamma, \delta, \epsilon, \zeta$ = regression coefficients and error term.

The constant term c and the dummy variables were set up in such a way that the regional differences in factor productivity could be tested for statistical significance. In matrix D, the variable c is represented by elements of the first column vector. The other five vectors are the regional dummy variables.

$$D = \begin{bmatrix} 1 & & & 0 & \\ 1 & 1 & & & \\ 1 & & 1 & & \\ 1 & & & 1 & \\ 1 & 0 & & & 1 \\ 1 & & & & 1 \end{bmatrix}$$

Each entry on the diagonal of D represents a vector of ones, with the number of elements corresponding to the number of years for which data were available. If, in the regression analysis, any one of the five dummy variables tested statistically significant from zero, it implied that the level of factor productivity of that region differed from the Canadian average.

Aside from the regional dummy variables, capital per worker, the ratio of machinery and equipment to structures, capacity utilization,[7] returns to scale[8] and the time trend were tested for statistical significance. The

7 The concept of capacity utilization follows the work of Creamer, adopted by the National Wealth and Capital Stock Section of Statistics Canada. It is based on the notion that minimum capital/output ratios pinpoint historical capacity peaks and that interpolation of output between years of capacity peak provides a measure of potential output. Estimates of capacity utilization are then derived by comparing actual with potential output.

8 Estimates of returns to scale are based on a variable of firm size, the number of employees per establishment. Use of this variable conforms to the Cobb-Douglas production function. If production output of the establishment is described by function (a),

$$\text{(a)} \quad \frac{Q}{n} = a \frac{K^k}{n} \frac{L^\ell}{n} \quad \text{where } k + \ell = r$$

$$\text{(b)} \quad \frac{Q}{nL} = a \frac{K^{1-k}}{n} \frac{L^{k+\ell-1}}{n}$$

conversion to output per worker yields (b), and provides a convenient measure of returns to scale r. The estimated coefficient of $-.19$ in Table B-3 implies a rate of returns to scale $r = .81$. For an earlier application of this technique of estimating returns to scale in manufacturing, see Z. Griliches, "Production Functions in Manufacturing: Some Preliminary Results", *The Theory and Empirical Analysis of Production*, ed. M. Brown, National Bureau of Economic Research Studies in Income and Wealth 31 (New York: Columbia University Press, 1967), pp. 275-340.

Table B-3

Regression Coefficients[1] of Labour Productivity in Six Goods-Producing Industries, Canada and Regions, 1961-73

		Agriculture	Forestry	Fishing	Mining	Manufacturing	Construction
Canada	c	−4.40**	7.21**	− .63	2.37**	4.77**	6.33**
Atlantic region	d_1	− .23**	.17	.09	− .25**	− .33**	− .14*
Quebec	d_2	− .08	.13	− .38**	− .03	− .03	.05
Ontario	d_3	− .03	.41**	.02	.02	.10**	.07
Prairie region	d_4	− .03	− .27**	− .31**	.20**	− .15**	− .12†
British Columbia	d_5	.29**	.20**	− .13	− .20**	− .12**	− .01
Capital per worker	α	.90**	.23**	.98**	.67**	.23**	.24**
Ratio of machinery to structures	β	.43**	.37**			.19**	.19*
Capacity utilization	γ	.86*	− .03**			.66**	
Time trend	ζ					3.0 **	
Returns to scale	δ					− .19**	
$\bar{R}^2$		.87	.66	.88	.94	.94	.31
df		121	101	136	123	123	135

1The regression coefficients are based on exponential production functions of the form $\frac{Q}{L} = a\frac{K^{1-k}}{L} \prod x^b$ which describe output per worker as a function of factor productivity, capital per worker, and a number of other factors. Details are described in the text.

**, *, †, regression coefficients tested statistically significant at the 1, 5 or 10 per cent levels, respectively.

Source: Based on data from Statistics Canada.

Table B-4

Regression Coefficients of Labour Quality Characteristics in Six Goods-Producing Industries, Canada and Regions, 1961-73[1]

		Agriculture	Forestry	Fishing	Mining	Manufacturing	Construction
Canada	c	−3.27**	−2.08**	−2.85**	−1.72**	−2.20**	−2.17**
Atlantic region	d_1	− .26**	− .33**	− .21*	− .16**	− .19**	− .19**
Quebec	d_2	− .02	− .06	− .16	− .00	.00	− .04
Ontario	d_3	.03	.02	− .03	.03	.02	.05
Prairie region	d_4	− .11*	− .22**	− .20	− .04	− .07**	− .09*
British Columbia	d_5	.04	.08†	.19**	− .02	.02	.01
Age	α	.83**	.48**	.70**	.38**	.49**	.63**
Age squared	β	− .09**	− .04**	− .07**	− .04**	− .05**	− .06**
Education	ϵ	.78**	.53**	.79**	.50**	.61**	.45**
Sex	σ	.41**	.45**	.30**	.50**	.57**	.52**
Multiple correlation	$\bar{R}^2$	.64	.69	.52	.73	.89	.69
Degrees of freedom	df	476	331	190	478	616	541

1 Regression estimates of wage rates are based on exponential functions with regional dummy variables $c, d_1, \ldots, d_5$, and variables for age, age squared, education and sex. The symbols **, *, †, denote statistical significance at the 1, 5 or 10 per cent levels, respectively. Wage rate and labour quality characteristics are based on five age, two sex, and six education categories. Estimation of the labour quality index is described in Appendix B-1.

Source: Based on special data tabulation of Statistics Canada.

estimated production function parameters are represented in Table B-3 below. These estimates show that capital per worker, the ratio of machinery and equipment, and the time-trend variable usually tested statistically significant. Variables of capacity utilization and returns to scale tested less significant. Statistical tests also show that, given the regional differentials in the other variables, output per worker in British Columbia and Ontario was usually better than average and that of the Atlantic region below average.

Incorporated in the regression estimates of Table B-3 was a labour quality variable (*Lq* in (1) above) that was also estimated by OLS regression procedures. It was obtained by analysis of the 1971 wage differentials of full-time employees of each of the six goods-producing industries. It provided the parameter estimates $\alpha, \beta, \epsilon, \sigma$, in Table B-4 for estimating the contribution of age, education, and sex to regional variations of labour productivity shown in Table B-8 below. In estimating the contributions of the labour quality characteristics, each of the parameter estimates was adjusted (reduced) by the average annual 1961-73 factor shares of labour wages in value-added output.

B.5 Limitations of Estimation Procedures

The regional comparisons of productivity levels, as described in Chapter 3 (Tables 3-3 and 3-7), are subject to two major limitations: the results are dependent upon the degree of industry disaggregation and they are based on equilibrium factor shares. The industries of the provincial economies were disaggregated into three groups: the eleven major industries, the six goods-producing industries, and the twenty manufacturing industries. It is likely that different results for the effects of industrial structure and output per worker would have been obtained if the industries had been further disaggregated, say, for example, into 100 manufacturing industries instead of only 20. Also if the estimates had been obtained by regression analysis rather than equilibrium shares, the estimates of the contribution of the various factors of regional productivity might have been altered. Both kinds of limitations are examined next.

In this study, provincial disparities in levels and growth rates of labour productivity were attributed to provincial variations in industry structure and output per worker. Although the procedures employed here differ from those of "Shift and Share" analysis,[9] they are not immune to the same criticisms of aggregation bias. How much of the provincial disparities is attributable to industrial structure and how much to output per worker depends to some extent on how many industries are considered and how they are grouped together. If they were grouped into low- and

9 For an example of an application of "Shift and Share" analysis to regional employment growth in Canada, see Fernand Martin, *Regional Aspects of the Evolution of Canadian Employment* (Ottawa: Supplies and Services Canada, 1976).

high-productivity industries, shifts in employment from one group to another could make sizable contributions to the overall improvement in labour productivity. If a different kind of grouping were applied, let us say that agriculture was combined with the service industries and separated from other goods-producing industries, the estimated contribution of structure could be quite insignificant because employment shifts between the agriculture-service group and all other industry groups would be negligible.

At the other extreme, under complete disaggregation, a much greater share of the regional productivity differences might be attributed to industrial structure. Suppose all industries producing essentially the same product were disaggregated according to production technology, then regional differences in productivity would be reflected in differences of employment shares and most, if not all, of the productivity differences would be attributable to industrial structure.

In practice, however, analysis of the effects of industrial structure on productivity is not carried out at these borderlines of the extreme but somewhere in between. While this might alleviate some of the problems, it would help little if the estimates varied substantially between one level of aggregation and the next, and if further disaggregation sharply increased the importance of industrial structure as a factor in explaining productivity differences. As shown in Table B-5, an analysis of regional variations in labour productivity based in one case on 20 manufacturing industries and in the other on 123, shows fairly similar results. In both cases, over half of all variations in productivity differences were attributed to variations in output per worker and less than half to industry

Table B-5

Provincial Differences in Labour Productivity Attributed to Output Per Worker and Industry Structure, Two Levels of Aggregation, Manufacturing, Quebec and Ontario, 1970-73

	Contribution		Difference Between Provincial and National Labour Productivity
	Industry Structure	Output Per Worker	
	(Per cent)		
20 manufacturing industries			
Quebec	−5.7	−6.7	−12.4
Ontario	+2.9	+6.2	+ 9.1
123 manufacturing industries			
Quebec	−6.0	−6.4	−12.4
Ontario	+3.6	+5.5	+ 9.1

Source: Based on Tables B-6 and B-7. Table B-6 shows the industry detail of 20 manufacturing industries and Table B-7 shows it for 123 industries.

structure. In the case of Ontario, further disaggregation to 123 manufacturing industries increased the estimated contribution of industrial structure from +2.9 to +3.6 percentage points and that of Quebec from −5.7 to −6.0 per cent. These changes do not alter the basic conclusion, however, that in manufacturing differences in output per worker account for a substantial part of the differences in labour productivity between Ontario and Quebec.

A comparison of two different estimation techniques of the contribution of various factors to provincial variations in labour productivity of the same six goods-producing industries is presented in Table B-8. The estimates in the upper panel of this table are based on regression analysis, those in the lower panel on factor share analysis. The estimates of the effects of industrial structure, output per worker, and of the differences between provincial and national productivity levels are identical. The estimates of labour quality, capital stock, and other factors differ. Generally the regression estimates give less weight to labour quality, although further allowance for education, age, and sex differences readjust the estimated contribution of education upwards again. The regression estimates also give somewhat less weight to capital stock. Together this has the effect of leaving the estimates for other factors fairly similar (Table B-8).

The major exceptions to these general observations are Quebec, Alberta and British Columbia. According to the regression estimates, the lack of capital stock in Quebec is less important and that of other negative factors more important; capital in Alberta is estimated to be less important and that of other positive factors more important; and, in British Columbia, capital is estimated to be less important and other factors not as negative as suggested by the equilibrium factor share analysis.

It is possible that the estimates of the regression analysis are more realistic than those of the more mechanistic procedures of the equilibrium factor share analysis. They are less constrained by assumptions and more closely linked to reality by the correlations between regional variations in output per worker and in factor inputs. It would be interesting to ascertain how "robust" these estimates are in comparison to other specifications, but this question was not examined in this study.

B.6 Marginal Value Productivities of Labour and Capital in Manufacturing

Regional estimates of labour demand and the economic incentives for investment were obtained by analysis of marginal productivities of manufacturing. The provincial marginal value productivities for labour were derived from the production function of manufacturing listed in Table B-2 above, as shown in (17).

Table B-6

Contribution of Output Per Worker and Industrial Structure to Variations in Provincial Labour Productivity of Manufacturing, Based on 20 Manufacturing Industries, Quebec and Ontario, 1970-73

Industries	Quebec			Ontario		
	Industrial Structure	Output per Worker	Productivity Difference	Industrial Structure	Output per Worker	Productivity Difference
Food and beverages	- .13	- .14	- .27	- .22	1.61	1.39
Tobacco products	.37	- .22	.15	- .10	.19	.09
Rubber	.00	- .21	- .21	- .01	.24	.23
Leather	- .45	- .04	- .49	.05	.02	.07
Textiles	- .72	- .40	- 1.12	.16	.27	.43
Knitting mills	- .62	.09	- .53	.25	- .04	.21
Clothing	-3.25	- .06	- 3.31	1.59	.06	1.65
Wood	.21	- .67	- .46	.46	- .21	.25
Furniture and fixtures	- .25	- .18	- .43	.04	.12	.16
Paper and allied products	.09	- .49	- .40	- .17	- .45	- .62
Printing, publishing, and allied products	.04	.06	.10	- .01	.09	.08
Primary metals	- .27	.02	- .25	.23	.28	.51
Metal fabricating (except machinery and transportation)	.06	- .50	- .44	- .06	.35	.29
Machinery (except electrical machinery)	- .00	- .45	- .45	.00	.53	.53
Transportation equipment	- .77	-2.34	- 3.11	.73	2.76	3.49
Electrical products	.07	.09	.16	- .20	.14	- .06
Nonmetallic products	- .08	- .20	- .28	.02	- .01	.01
Petroleum and coal products	- .32	.56	.24	.10	- .86	- .76
Chemicals and chemical products	.25	-1.15	- .90	.21	.72	.93
Miscellaneous manufacturing	.05	- .50	- .45	- .13	.39	.26
Total of 20 manufacturing industries	-5.72	-6.73	-12.45	2.94	6.20	9.14

Source: Based on data from Statistics Canada.

Table B-7

Contribution of Output Per Worker and Industrial Structure to Variations in Provincial Labour Productivity of Manufacturing, Based on 123 Manufacturing Industries, Quebec and Ontario, 1970-73

Industries	Quebec			Ontario		
	Industrial Structure	Output per Worker	Productivity Difference	Industry Structure	Output per Worker	Productivity Difference
Food and beverage industries	.28	− .55	− .27	.31	1.08	1.39
Slaughtering and meat processors	.02	− .01	.02	.02	− .02	.00
Poultry processors	− .02	− .02	− .04	.06	.02	.08
Fish products industry	.32	− .03	29	.39	.02	.41
Fruit and vegetables processors	.04	.00	.04	− .01	.06	.04
Dairy products industry	.01	.42	.42	.01	− .03	− .02
Flour and breakfast cereal products industry	− .03	− .06	− .09	.00	.09	.09
Feed industry	.00	− .05	− .05	− .02	.04	.02
Biscuits manufacturers	− .03	.00	− .03	.01	.02	.03
Bakeries	− .04	− .05	− .10	.12	.05	.18
Confectionary manufacturers	.00	− .03	− .03	− .01	.06	.04
Soft drink manufacturers	.01	− .06	− .05	− .02	.05	.04
Distilleries	− .05	− .24	− .29	.08	.21	.29
Breweries	.08	− .26	− .18	− .27	.34	.07
Other food and beverages	− .02	− .16	− .18	− .07	.18	.11
Tobacco products industries	.37	− .22	.15	− .10	.19	.09
Rubber and plastics products industries	− .02	− .19	− .21	.00	.23	.23
Rubber products	− .03	− .19	− .22	.06	.24	.29
Plastic fabricating	.01	.01	.02	− .05	− .01	− .06
Leather industries	− .45	− .03	− .48	.05	.02	.07
Shoe factories	− .34	.01	− .33	.04	.00	.03
Leather glove factories	− .03	.00	− .03	.02	.00	.02
Boot and shoe	− .04	− .01	− .05	.01	.00	.02
Other leather	− .04	− .04	− .08	− .02	.02	.00
Textile industries	− .71	− .41	− 1.12	.17	.25	.42
Wool loom and cloth mills	− .09	.02	− .07	.01	− .01	.01
Cotton and jute bags manufacturers	− .01	.00	− .01	.01	.00	.01

(cont'd)

Table B-7 (cont'd)

Industries	Quebec			Ontario		
	Industrial Structure	Output per Worker	Productivity Difference	Industry Structure	Output per Worker	Productivity Difference
Canvas products manufacturers	.03	.00	.02	.00	- .01	.00
Narrow fabric mills	- .08	.01	- .07	.03	- .01	.02
Embroidery pleating and hemstitching	- .03	.00	- .03	.01	.00	.02
Textile dyeing and finishing plants	- .08	.01	- .07	.03	.00	.03
Miscellaneous textile industries	- .09	.04	- .05	.03	.00	.03
Other textile	- .35	- .49	- .84	.05	.27	31
Knitting mills	- .62	.09	- .53	.25	- .04	.21
Clothing industries	-3.35	.04	- 3.31	1.63	.02	1.65
Men's clothing factories	- .59	.06	- .54	.36	- .03	.34
Men's clothing contractors	- .52	.01	- .51	.27	.00	.27
Women's clothing factories	- .89	.06	- .83	.45	- .01	.44
Hat and cap industries	- .03	.00	- .03	.01	.00	.01
Other clothing	-1.32	- .09	- 1.41	.54	.06	.60
Wood industries	.12	- .52	- .46	.34	- .08	.26
Sawmills and planing mills	.06	- .29	- .22	.13	- .06	.07
Veneer and plywood mills	.05	- .08	- .03	.09	- .06	.03
Sash door and other mill work plants	.00	- .07	- .07	.05	.03	.08
Hardwood flooring plants	- .02	- .01	- .03	.00	.01	.01
Manufacturers of prefab buildings	.00	- .02	- .01	.02	.00	.02
Wooden box factories	.01	- .02	.00	- .01	.01	- .02
Coffin and casket industries	- .02	.00	- .02	.01	.00	.01
Other wood	.02	- .10	- .08	.05	- .01	.04
Furniture and fixtures industries	- .27	- .16	- .43	.05	.11	.16
Furniture reupholstery and repair shops	.00	- .01	- .01	.01	.00	.01
Household furniture manufacturers	- .18	- .03	- .20	.02	.02	.04
Office furniture manufacturers	- .02	- .04	- .06	- .01	.02	.01
Miscellaneous furniture and fixtures manufacturers	- .04	- .09	- .13	.01	.06	.07
Electric lamp and shade manufacturers	- .04	.00	- .04	.01	.00	.02

Paper and allied industries	.23	− .63	− .40	− .49	− .13	− .62
Pulp and paper mills	.20	− .49	− .29	− .43	− .15	− .58
Asphalt roofing manufacturers	.02	− .04	− .02	− .02	.02	.00
Folding carton and set-up box	.00	− .02	− .02	− .02	− .01	− .02
Corrugated box manufacturers	.01	− .01	− .01	.00	− .04	− .04
Paper and plastic bag manufacturers	− .01	.00	− .01	.01	.00	.00
Miscellaneous paper converters	.02	− .06	− .05	− .03	.05	.02
Printing, publishing, and allied industries	− .03	.07	.10	− .05	.12	.07
Commercial printing	.02	− .08	− .06	− .04	.08	.04
Platemaking, typesetting, etc.	− .01	− .03	− .04	.00	.03	.02
Publishing only	.03	.17	.21	.00	− .06	− .06
Publishing and printing	− .02	.01	− .01	.00	.07	.07
Primary metal industries	− .38	.12	− .26	.32	.19	.51
Iron and steel mills	− .46	− .46	− .92	.41	.62	1.03
Iron foundries	.03	− .04	− .01	− .03	.03	− .01
Smelting and refining	.09	.61	.70	− .09	− .40	− .49
Aluminum rolling and casting, etc.	.00	.01	.01	.00	− .01	− .02
Other primary metals	− .05	.00	− .04	.03	− .03	.00
Metal fabricating industries	.05	− .50	− .45	− .05	.34	.29
Boiler and plate works	.00	.01	.01	.00	.02	.02
Fabricated structural metal industry	− .02	− .09	− .11	− .02	.06	.05
Metal door and window manufacturers	.00	− .01	− .01	.01	.01	.02
Ornamental and architectural metal	.00	− .08	− .08	.00	.07	.07
Metal coating industry	.01	− .03	− .02	− .02	.02	− .01
Metal stamping and pressing industry	− .03	− .03	− .06	.04	− .02	.02
Wire and wire products	.00	.02	.02	.00	− .02	− .02
Hardware tools and cutlery	.04	− .08	− .04	− .05	.05	− .01
Heating equipment manufacturers	.00	− .03	− .03	.00	.03	.02
Machine shops	.01	− .05	− .03	.04	.00	.04
Miscellaneous metal fabricating	.03	− .13	− .09	− .04	.12	.08
Machinery industries	− .01	− .44	− .45	.00	.53	.53
Miscellaneous machinery equipment	.01	− .21	− .21	− .01	.17	.16
Other machinery	− .02	− .22	− .24	.01	.36	.38
Transportation equipment industries	−1.03	−2.07	− 3.10	1.03	2.46	3.49
Aircraft and aircraft parts	− .10	− .13	− .23	.02	.09	.11
Truck body manufacturers	.02	.00	.03	.02	.02	.05
Noncommercial trailer	.02	.00	.01	.04	.00	.04

(cont'd)

Table B-7 (concl'd)

Industries	Quebec			Ontario		
	Industrial Structure	Output per Worker	Productivity Difference	Industry Structure	Output per Worker	Productivity Difference
Motor vehicle parts	- .43	- .06	- .50	.44	.07	.51
Boatbuilding and repair	.02	- .03	- .01	.01	.01	.01
Other transportation equipment	- .56	-1.85	- 2.41	.50	2.27	2.77
Electrical products industries	.02	.14	.16	- .14	.09	- .05
Manufacturers of lighting fixtures	- 02	.01	- .01	.01	.02	.02
Communication equipment	- .08	- .02	- .10	- .05	.09	.04
Manufacturers electrical industrial equipment	.14	- .10	.04	- .15	.14	- .01
Battery manufacturers	.00	.00	.00	.00	.00	.01
Other electrical products	- .02	.24	.22	.05	- .17	- .12
Nonmetallic mineral products industries	.03	- .30	- .27	- .15	.16	.01
Clay from domestic clays	.01	.00	.01	.00	.00	.00
Clay from imported clays	.00	- .01	- .01	.00	.00	.00
Cement	.06	- .21	- .15	- .13	.09	- .04
Concrete pipe manufacturers	.01	- .04	- .03	- .01	.01	.01
Manufacturers of structural concrete	.00	.03	.04	.00	- .01	- .01
Concrete products manufacturers	- .01	- .02	- .03	.00	.00	.00
Ready mix concrete	- .04	.05	.02	- .03	- .02	- .05
Glass and glass products	- .01	- .09	- .10	.01	.08	.09
Abrasives manufacturers	.01	- .01	.00	- .01	.01	- .01
Lime manufacturers	.00	.00	.00	.00	.00	.00
Miscellaneous nonmetallic mineral industries	- .01	.01	- .01	.01	- .01	.00
Other nonmetallic mineral industries	.01	- .01	- .01	.00	.02	.02
Petroleum and coal products industries	- .31	.55	.24	.10	- .86	- .76
Petroleum refining	- .31	.59	.28	.11	- .91	- .80
Other petroleum and coal	.00	- .04	- .04	.00	.04	.04
Chemical and chemical products industries	.03	- .94	- .91	.35	.58	.93
Mixed fertilizers	.00	.01	.01	.00	- .01	.00
Plastic and synthetic resins	.06	.03	.09	- .02	- .04	- .05

Pharmaceuticals and medicines	.22	− .09	.13	.03	.07	.10
Paint and varnish manufacturers	.00	− .06	− .06	.00	.05	.05
Manufacturers of soap and cleaning compounds	− .18	− .08	− .26	.20	.07	.27
Toilet preparations	.09	.11	.19	.02	− .07	− .05
Industrial chemicals	− .19	− .50	− .69	.11	.30	.41
Printing ink	− .01	.00	.00	.01	.00	.00
Miscellaneous chemical industries	.05	− .36	− .31	− .01	.21	.20
Miscellaneous manufacturing industries	− .10	− .35	− .45	− .00	.26	.26
Instrument and related products manufacturer	− .07	− .08	− .15	.08	.08	.16
Clock and watch manufacturers	.00	− .01	− .01	.01	.00	− .01
Orthopedic and surgical appliance manufacturers	.00	.00	.00	.00	.00	.00
Ophthalmic goods manufacturers	.03	.00	.03	− .01	.00	− .01
Dental laboratories	.02	.00	.02	.00	.00	.01
Jewellery and silverware industries	.01	− .04	− .03	− .04	.03	− .01
Sporting goods manufacturers	− .02	− .03	− .05	− .03	.02	− .01
Toys and games manufacturers	.00	− .03	− .03	− .01	.02	.01
Signs and display industries	.02	− .04	− .02	.00	.01	.00
Broom, brush and mop manufacturers	.01	− .02	− .01	.00	.02	.02
Button, buckle and fastener manufacturers	− .04	− .01	− .05	.01	.01	.02
Floor tile, linoleum and coated fabrics	− .01	− .04	− .05	.00	.03	.03
Sound recordings and musical instruments	.00	− .02	− .02	.00	.01	.01
Stamp and stencil manufacturers	.00	.00	.00	.00	.00	.00
Other miscellaneous industries	− .04	− .03	− .07	− .01	.03	.02
Total of 123 manufacturing industries*	−6.09	−6.36	−12.45	3.62	5.52	9.14

*Totals may not add due to rounding.
Source: Based in data from Statistics Canada.

Table B-8

Contribution of Various Factors to Provincial Variations in Labour Productivity, Based on Two Different Methods of Estimation, Six Goods-Producing Industries, Canada, by Province, 1970-73

	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
					(Per cent)					
Based on regression estimates[1]										
Industrial structure	- 2.1	-35.2	- 1.0	- 1.5	2.4	3.1	- 6.7	-26.9	- 6.9	2.7
Output per worker	-16.6	-18.9	-28.5	-26.0	-16.0	4.2	-11.4	18.5	37.4	11.8
Labour quality	- 1.4	- 2.0	- .4	- 1.0	- 2.2	.7	- .3	.3	2.4	3.3
Education	- 2.1	- 2.1	- 1.5	- 2.0	- 1.6	.6	- .1	.6	2.8	2.2
Age	.8	- 1.0	.3	.0	- .3	.1	- .1	- .5	- .5	.4
Sex	- .1	1.1	.8	1.0	- .3	.0	- .1	.2	- .1	.8
Capital stock	- 1.9	-13.8	- 9.2	- 4.3	- 7.2	- 1.1	- 6.2	18.4	23.0	8.5
Stock/worker	- 1.6	-22.9	- 7.3	- 4.1	- 6.2	- 3.0	- 4.8	14.1	24.1	7.7
Machine use	- .3	9.1	- 1.9	- .2	- 1.0	1.9	- 1.4	4.3	- 1.1	.8
Other factors	-13.3	- 3.0	-19.0	-20.6	- 6.5	4.6	- 5.0	- .2	12.1	- .1
Percentage difference between provincial and national productivity	-18.7	-54.1	-29.5	-27.5	-13.6	7.3	-18.1	- 8.4	30.5	14.5
Based on factor share estimates[2]										
Industrial structure	- 2	- 35	- 1	- 1	2	3	- 7	- 27	- 7	3
Output per worker	- 17	- 19	- 29	- 26	- 16	4	- 11	18	37	12
Labour quality	- 3	- 3	- 1	- 3	- 4	1	- 2	- 2	4	7
Capital stock	- 2	- 14	- 6	- 3	- 12	- 5	- 6	15	31	18
Other factors	- 12	- 2	- 22	- 20	0	8	- 3	5	2	- 13
Percentage difference between provincial and national productivity	- 19	- 54	- 30	- 27	- 14	7	- 18	- 9	30	15

1 Estimates are based on regression parameters of labour productivity and labour quality in Tables B-3 and B-4 above.
2 Estimates correspond to those of Tables 3-3 and 3-7 of the text.

(17) $MVP_Q = (1 - a) \cdot Q \cdot LQ/L$

where

α = production elasticity of capital;
Q = 1970-73 average current dollar output in a province;
LQ = provincial labour quality variable of manufacturing based on regression parameters α, β, ϵ, σ, in Table B-4, adjusted by the average annual factor share of labour for 1961-73; and
L = 1970-73 average provincial employment.

These marginal value productivities were then divided by the corresponding wage rates. The results are listed in column 1 of Table B-9. Correspondingly, the marginal value productivities of capital were derived on the basis of (18)

(18) $MVP = \alpha \cdot Q \cdot LQ/L$

where the symbols are the same as in (17) above, and

K = 1970-73 gross capital stock per worker

Table B-9

Marginal Value Productivities of Labour and Capital in Manufacturing, Canada, by Province, 1970-73[1]

	Ratio of Marginal Value Product of Labour to Wage Rate		Marginal Value Product of Capital	
	Actual	Relative	Actual	Relative
	(Dollars)	(Per cent)	(Dollars)	(Per cent)
Newfoundland	1.39	93	.08	47
Prince Edward Island	1.67	112	.25	147
Nova Scotia	1.02	68	.09	53
New Brunswick	1.44	97	.09	53
Quebec	1.45	97	.19	112
Ontario	1.53	103	.19	112
Manitoba	1.03	69	.15	88
Saskatchewan	1.67	112	.12	71
Alberta	1.49	100	.13	76
British Columbia	1.40	94	.12	70
Canada	1.49	100	.17	100

1 Estimates are based on the 1961-73 interprovincial production function of manufacturing specified in Tables B-3 and B-4 above.

and are listed in column 3 of Table B-9. On the basis of these estimates, it was concluded that, compared with its marginal value product and the Canadian average productivity, labour in manufacturing was overpriced in some of the Atlantic provinces, in Manitoba, and to some extent also in British Columbia, or in those provinces where unemployment rates tended to be higher.[10] They were more favourable in Prince Edward Island, Ontario, Saskatchewan and Alberta, where unemployment rates were generally low. It was also concluded that, because of variations in marginal value product of capital, the incentives to invest more capital were relatively strong in Prince Edward Island, Quebec, and Ontario, medium in the West, and weak in three of the four Atlantic provinces. These conclusions were discussed in more detail in Chapter 3 of the text.

B.7 Features of CANDIDE-R

A regional version of CANDIDE, CANDIDE-R, was developed by the Department of Regional Economic Expansion. It is an extension of the national CANDIDE model into Canada's five major regions: the Atlantic region, Quebec, Ontario, the Prairie region, and British Columbia. The national CANDIDE model describes the economy in terms of eight sectors or 46 blocks of equations (Table B-10). CANDIDE-R regionalizes CANDIDE in a number of areas: residential construction, labour demand and supply, wages and salaries, demography, industrial output, income, and investment. Among these, only the demographic block has received extensive treatment and reflects interregional migration flows. The other six blocks are less developed and are more dependent on the outcome of the estimates at the national level.

A simplified version of the model structure of CANDIDE-R is given in Table B-10. It shows that part of the demographic variables, labour force, and potential output enter CANDIDE-R as exogenous variables. The demographic variables play a key role in estimating the regional labour supply and demand, interregional migration, and regional demand for housing. Estimates of regional labour demand, wages and salaries, and incomes rely more heavily on industry output. Regional industry output, in turn, is estimated on the basis of regional shares of national industry output, regional shares of capital investment, and the ratio of the regional unemployment rate to the national unemployment rate. This means that a good part of the regional analysis in CANDIDE-R is tied to historical trends in regional shares and not based on the many diverse regional economic characteristics.[11] Although CANDIDE-R reflects only part of the regional economies it can be used in some areas of regional analysis. It was used in this study, for example, in regional population projections of Chapter 4.

10 Although the unemployment of Manitoba was lower than the Canadian average, it was higher than in Saskatchewan and Alberta, the neighbouring provinces in the Prairie region.

11 An alternative version of CANDIDE-R — incorporating an interregional I/O table — has also been developed. The I/O coefficients of this table are the same as those of the national I/O table but this table incorporates estimates of interregional shipments.

Table B-10

Sectors and Blocks of CANDIDE

Block Number in National CANDIDE[1]	Description	Block Number in Regional CANDIDE-R
	I *Final demand in constant dollars*	
1,2	Personal saving and consumption	
(3)	Residential construction	3
(4), 32	Business fixed investment	52
44, 45	Capital stocks	
43	Rental cost of capital	
5	Physical change in inventories	
6	Government expenditures	
7,39	Exports	
8	Imports	
	II *Industry outputs*	
10	Commodity requirements of final demand	
23	Approximations of industry outputs	
(23)	Industry outputs (RDP)	50
	III *Labour*	
(11), (12)	Labour demand and supply	12, 48
	IV *Industry wages and prices*	
(13)	Industry wages	13
14	Industry prices	
	V *Final demand deflators*	
25, 26	Commodity prices	
28, 29, 30, 31	Approximations of final demand prices	
15, 33, 34, 35	Deflators of domestic final demand	
	VI *Aggregates and other identities, incomes*	
24, 36	Aggregates	
19	Incomes	51
18, 37, 38, 41, 42	Final demand in current dollars	
	VII *Finance*	
20	Money and interest rates	
21	Capital flows and the balance of payments	
	VIII *Near-exogenous blocks*	
16	Export prices	
17, 40	Import prices	
(22)	Demography	
46	Forecast rules government variables	47, 49

1 The bracketed block numbers correspond to regional blocks in CANDIDE-R. For details on the national model, see CANDIDE Project Paper 18, Model 1.1, Volumes 1 and 2, Economic Council of Canada, Ottawa, 1975.

Table B-11

Simplified Model Structure of CANDIDE-R

Number of Block[1]	Description of Variables[2]
X	*Demography*$_i$ = no. of divorces, family households/nonfamily households, emigration, . . .
	Labour force$_i$ = labour force adjustments, participation rates
	Potential output$_i$ = agriculture, forestry, fishing, services
3	*Housing starts*$_i$ = f_i (CMHC approvals$_i$, costs$_i$, stock$_i$, family households$_i$, income$_i$, consumer price index$_n$, mortgage rates$_n$ . . .)
12	*Employment by industries*$_i$ = f_i (industry output$_i$, employment by industry$_n$)
13	*Wages and salaries* = f_i (ind. prices$_i$, employment$_i$, output$_i$, urate$_i$, CPI_n)
22	*National and regional demography* = f_i (nat. aggregate population, regional marr. shares)
47	*Population by age groups*$_i$ = f_i (fertility$_i$, cohort analysis$_i$, net migration$_i$)
48	*Labour force*$_i$ = f_i (population by age groups$_i$ – exog. adjustm$_i$)
49	*Interregional migration*$_i$ = f_i (urate$_{i/j}$, $pop_{i,\ n}$, disp. income$_{i/j}$)
50	*GDP by industries*$_i$ = f_i ($Y_{i/n}$, investment$_{i/n}$, urate$_{i,n}$)
51	*Incomes*$_i$ = f_i (ind. wages & salaries$_i$, ind. prices$_n$, ind. output$_i$, employ$_i$)
52	*Investment by industries* = f_i (investment shares$_i$ of constr.$_n$ and $M\&E_n$)

1 *X* stands for exogenous.
2 *i* denotes regional variables *n* denotes national variables.

C Background Statistics

C.1 Labour Quality Indexes

Tables C-1 to C-7 summarize estimates of labour quality by province and industry. Tables C-1 to C-4 relate to 11 major industries, Tables C-5 to C-7 to 20 manufacturing industries. The statistics of these tables were derived by estimation procedures described in Appendix B.1. Supplementary information is provided in footnotes of each table.

Table C-1

Labour Quality Index of Men Employed Full Time in 11 Major Industries, Canada, by Province, 1970[1]

	Agriculture	Forestry	Fishing and Trapping	Mining	Manufacturing	Construction	Transport and Utilities	Trade	Finance, Insurance and Real Estate	Community, Business, and Personal Services	Public Administration	All Sectors
						(Canada $8,096 = 100)						
Newfoundland	84	85	83	92	88	90	92	90	97	106	97	93
Prince Edward Island	78	81	77	85	90	90	94	91	105	112	104	97
Nova Scotia	88	86	83	92	94	90	97	94	105	114	100	98
New Brunswick	83	87	84	90	91	89	95	93	103	110	100	96
Quebec	82	85	93	90	94	90	97	93	105	109	104	97
Ontario	88	90	88	94	98	93	99	97	110	116	110	102
Manitoba	83	87	84	92	95	92	98	97	107	115	105	100
Saskatchewan	83	89	90	93	94	93	97	95	103	118	105	100
Alberta	90	95	114	113	99	95	99	98	107	117	104	103
British Columbia	95	95	108	101	99	98	101	101	111	119	107	103
Canada	87	91	89	97	97	93	98	96	108	114	106	100

1 This labour quality index is based on education-age characteristics of employment in industry and province. It was estimated as follows: Data were obtained from the 1971 Census which grouped *men*, who worked full-time, by industry and province into 30 education-age categories. The data showed how many employees were in each of five age groups (i.e., 15-24, 25-34, 35-44, 45-54, and 55-64 years old) and six education groups (i.e., less than grade 9, grade 9-11, grade 12-13, some university, university degree, and other postsecondary). A labour quality index was then computed by assigning to each of the 30 employment categories the corresponding national wage rate and computing an industry wage based on this "national pay scale". The labour quality index of 107 for public administration in British Columbia, for example, indicates that the wage rate would have been 7 per cent higher than the national average had civil servants in British Columbia been paid according to this national pay scale.

Source: Estimates based on 1971 Census data (special tabulation).

Table C-2

Labour Quality Index of Women Employed Full-Time in 11 Major Industries, Canada, by Province, 1970[1]

	Agriculture	Forestry	Fishing and Trapping	Mining	Manufacturing	Construction	Transport and Utilities	Trade	Finance	Community, Business, and Personal Services	Public Administration	All Sectors
						(Canada $4,786 = 100)						
Newfoundland	80	97	96	93	84	93	90	87	91	100	97	94
Prince Edward Island	85	–	78	–	89	101	93	95	101	107	105	102
Nova Scotia	90	83	94	100	90	104	98	94	98	109	107	102
New Brunswick	96	84	–	93	89	103	98	93	98	105	107	100
Quebec	86	91	85	98	85	96	96	90	93	105	101	96
Ontario	89	94	103	101	91	100	99	95	99	109	108	101
Manitoba	90	85	85	105	88	98	96	94	94	106	106	99
Saskatchewan	92	112	87	98	94	100	98	95	97	108	110	103
Alberta	95	89	–	106	95	101	97	97	98	112	105	105
British Columbia	96	101	121	105	97	103	101	99	100	113	109	105
Canada	91	96	100	103	89	99	98	94	97	108	106	100

1 This labour quality index is based on education-age characteristics of employment in industry and province. It was estimated as follows: Data were obtained from the 1971 Census which grouped *women*, who worked full time, by industry and province into 30 education-age categories. The data showed how many employees were in each of five age groups (i.e., 15-24, 25-34, 35-44, 45-54, and 55-64 years old) and six education groups (i.e., less than grade 9, grade 9-11, grade 12-13, some university, university degree, and other postsecondary). A labour quality index was then computed by assigning to each of the 30 employment categories the corresponding national wage rate and computing an industry wage based on this "national pay scale". The labour quality index of 109 for public administration in British Columbia, for example, indicates that the wage rate would have been 9 per cent higher than the national average had civil servants in British Columbia been paid according to this national pay scale.

Source: Estimates based on 1971 Census data (special tabulation).

Table C-3

Labour Quality Index of Men and Women Employed Full-Time in 11 Major Industries, Canada, by Province, 1970[1]

	Agriculture	Forestry	Fishing and Trapping	Mining	Manufacturing	Construction	Transportation and Utilities	Trade	Finance	Community, Business, and Personal Services	Public Administration	All Sectors
						(Canada $7,132 = 100)						
Newfoundland	92	96	94	103	96	101	100	90	88	91	103	95
Prince Edward Island	87	92	86	97	93	100	101	93	94	93	109	97
Nova Scotia	96	97	94	104	100	101	103	94	93	97	108	100
New Brunswick	91	98	96	101	97	99	103	93	91	93	107	97
Quebec	88	95	105	101	96	101	104	94	93	96	108	97
Ontario	92	100	95	105	101	104	106	96	95	100	112	101
Manitoba	86	96	87	103	97	103	104	95	92	97	109	99
Saskatchewan	86	101	94	104	101	104	104	97	92	99	110	100
Alberta	94	104	(129)[2]	120	104	106	105	99	95	102	108	103
British Columbia	100	106	117	112	106	109	107	101	98	104	112	105
Canada	91	101	98	107	100	104	105	96	95	99	110	100

1 This labour quality index is based on education-age-sex characteristics of employment in industry and province. It was estimated as follows: Data were obtained from the 1971 Census which grouped *all persons*, who worked full-time in 1970, by industry and province into 60 education-age-sex categories. The data showed how many employees were in each of five age groups (i.e., 15-24, 25-34, 35-44, 45-54 and 55-64 years old) and six education groups (i.e., less than grade 9, grade 9-11, grade 12-13, some university, university degree, and other postsecondary). A labour quality index was then computed by assigning to each of the 60 employment categories the corresponding national wage rate and computing an industry wage based on this "national pay scale". The labour quality index 112 for public administration in British Columbia, for example, indicates that the wage rate would have been 12 per cent higher than the national average had civil servants in British Columbia been paid according to this national pay scale.

2 Based on a small number and subject to large error.

Source: Estimates based on 1971 Census data (special tabulation).

Table C-4

Labour Quality Index of Men and Women Employed Full-Time in 11 Major Industries, Based on a Hypothetical Wage Scale,[1] Canada, by Province, 1970

	Agriculture	Forestry	Fishing and Trapping	Mining	Manufacturing	Construction	Transport and Utilities	Trade	Finance, Insurance, and Real Estate	Community, Business, and Personal Services	Government Administration	All Sectors
						(Canada $7,132 = 100)						
Newfoundland	85	87	85	93	89	91	93	89	90	99	97	93
Prince Edward Island	80	81	78	88	90	92	94	92	99	107	104	98
Nova Scotia	90	88	85	93	94	91	97	95	98	109	101	99
New Brunswick	86	89	86	92	92	90	96	93	97	105	102	97
Atlantic Region	87	88	85	93	92	91	95	93	96	106	101	97
Quebec	84	87	95	92	93	92	98	93	97	105	104	97
Ontario	90	92	91	96	98	95	100	98	102	110	110	101
Manitoba	87	88	84	93	95	94	97	97	97	109	105	99
Saskatchewan	87	92	91	94	95	94	97	96	96	111	106	101
Alberta	92	95	(118)[2]	113	99	96	98	98	99	112	103	103
Prairie Region	90	94	89	106	96	95	98	97	98	111	105	101
British Columbia	96	97	111	103	99	99	101	101	103	114	107	104
Canada	89	92	91	98	96	94	98	96	100	109	106	100

1 This table was computed in the same manner as Table C-3 but instead of using a different national pay scale for men and women, their pay scales were averaged for each of the 30 education-age groups. The underlying assumptions are that education and age are the only criteria of labour quality, that aside from education and age, labour quality of men and women is identical, and that the national average wage rate of $7,132 remained the same (as in Table C-3).

2 Based on a small number and subject to large error.

Source: Estimates based on 1971 Census data (special tabulation).

Table C-5

Labour Quality Index of Men Employed Full-Time in 20 Manufacturing Industries, Canada, by Province, 1970[1]

	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Canada
						(Canada $8,068 = 100)					
1 Food and beverages	86	88	92	92	93	99	96	95	99	103	96
2 Tobacco products	0	0	96	82	101	100	103	106	94	91	100
3 Rubber	91	0	101	109	93	100	98	97	101	101	98
4 Leather	0	0	99	87	88	94	92	89	98	95	91
5 Textiles	83	101	92	87	93	99	114	84	107	117	95
6 Knitting mills	0	0	95	0	93	100	100	0	89	108	95
7 Clothing	78	0	104	92	93	100	97	103	100	103	95
8 Wood	92	93	89	88	87	91	92	90	94	95	92
9 Furniture and fixtures	81	0	93	85	90	94	97	93	101	99	93
10 Paper and allied products	99	89	99	97	99	99	96	97	102	105	100
11 Printing and publishing	90	101	102	106	101	105	103	102	105	107	104
12 Primary metals	86	108	100	93	100	99	95	95	103	104	99
13 Metal fabricating	93	97	96	94	96	100	98	98	100	104	99
14 Machinery, excluding electrical	98	109	104	97	103	105	100	98	106	110	104
15 Transportation equipment	92	99	97	95	100	101	98	96	99	103	100
16 Electrical products	101	108	107	94	107	107	101	104	105	113	107
17 Nonmetallic products	97	108	95	94	96	99	97	99	100	102	98
18 Petroleum and coal products	99	0	111	99	109	120	112	108	115	115	114
19 Chemicals	95	128	110	104	110	111	109	111	112	112	111
20 Miscellaneous	92	101	104	95	98	105	99	93	101	106	102
21 Total manufacturing	91	93	97	94	98	102	98	97	102	102	100

1 Estimates of this table correspond to those of Table C-1 for 11 major industries but relate to 20 manufacturing industries.
Source: Estimates based on 1971 Census data (special tabulation).

Table C-6

Labour Quality Index of Women Employed Full-Time in 20 Manufacturing Industries, Canada, by Province, 1970[1]

	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Canada
						(Canada $4,340 = 100)					
1 Food and beverages	87	96	96	99	95	102	99	103	104	104	100
2 Tobacco products	0	115	95	96	96	102	89	0	109	109	98
3 Rubber	82	0	98	87	94	100	96	92	106	103	99
4 Leather	94	100	0	96	90	95	96	0	111	94	93
5 Textiles	73	102	98	94	95	98	0	96	108	102	96
6 Knitting mills	0	0	99	109	91	96	102	0	97	102	94
7 Clothing	90	0	97	85	91	96	95	96	98	99	93
8 Wood	93	135	107	99	95	101	95	100	106	108	102
9 Furniture and fixtures	0	0	104	98	97	99	102	103	105	100	99
10 Paper and allied products	105	0	102	109	100	102	98	95	103	111	103
11 Printing and publishing	100	108	109	108	101	108	107	112	111	111	107
12 Primary metals	109	0	113	105	107	107	112	112	112	112	107
13 Metal fabricating	106	0	112	108	99	103	105	106	106	110	103
14 Machinery, excluding electrical	115	115	103	110	103	107	101	109	112	108	107
15 Transportation equipment	95	0	112	103	104	105	106	104	104	112	105
16 Electrical products	102	0	96	95	98	102	100	95	107	107	101
17 Nonmetallic products	100	0	113	97	100	104	105	103	104	106	103
18 Petroleum and coal products	98	0	113	116	110	112	105	115	111	108	111
19 Chemicals	109	109	104	112	103	108	106	106	108	109	106
20 Miscellaneous	92	106	100	99	95	101	99	91	103	108	100
21 Total manufacturing	93	100	101	100	95	102	99	104	105	107	100

1 Estimates of this table correspond to those of Table C-2 for 11 major industries but relate to 20 manufacturing industries.
Source: Estimates based on 1971 Census data (special tabulation).

Table C-7

Labour Quality Index of Men and Women Employed Full-Time in 20 Manufacturing Industries, Canada, by Province, 1970[1]

	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Canada
						(Canada $7,310 = 100)					
1 Food and beverages	89	88	93	92	95	98	97	97	101	103	97
2 Tobacco products	0	68	96	84	86	96	105	117	98	97	90
3 Rubber	74	0	103	114	93	98	93	104	106	102	97
4 Leather	56	59	110	76	78	80	80	98	95	85	79
5 Textiles	79	99	87	75	92	93	125	86	105	91	92
6 Knitting mills	0	0	73	65	76	74	87	0	74	77	75
7 Clothing	68	0	60	63	69	73	68	70	71	73	70
8 Wood	99	100	97	95	93	96	99	97	99	103	99
9 Furniture and fixtures	90	0	94	88	94	95	98	95	100	99	95
10 Paper and allied products	107	98	105	104	104	102	96	101	104	111	104
11 Printing and publishing	90	103	100	102	99	102	100	101	103	106	101
12 Primary metals	95	119	109	99	107	107	103	104	110	112	107
13 Metal fabricating	100	107	104	101	102	103	105	104	107	110	104
14 Machinery, excluding electrical	106	112	110	102	107	108	105	105	113	114	108
15 Transportation equipment	100	110	105	101	106	106	105	102	104	110	106
16 Electrical products	98	119	92	93	103	100	100	109	103	109	101
17 Nonmetallic products	105	119	103	99	101	103	104	108	106	107	103
18 Petroleum and coal products	104	0	119	107	114	122	120	116	118	121	119
19 Chemicals	102	133	116	112	108	110	112	115	117	115	110
20 Miscellaneous	97	92	106	95	94	96	99	97	100	106	96
21 Total manufacturing	100	93	100	98	96	102	98	101	104	106	100

1 Estimates of this table correspond to those of Table C-3 for 11 major industries but relate to 20 manufacturing industries.
Source: Estimates based on 1971 Census data (special tabulation).

C.2 Wage Rate Indexes

Tables C-8 to C-12 provide wage rate indexes by province and industry. Tables C-8 and C-9 refer to 11 major industries, Tables C-10 to C-12 to 20 manufacturing industries. The statistics of the tables were obtained from the 1971 Census. Estimation procedures are described in footnotes to the tables.

Table C-8

Wage Rate Index of Men Employed Full-Time in 11 Major Industries, Canada, by Province, 1970[1]

	Agri-cul-ture	For-est-ry	Fishing and Trapping	Mining	Manu-fac-turing	Con-struc-tion	Transport and Utilities	Trade	Finance, Insurance, and Real Estate	Community, Business, and Personal Services	Public Adminis-tration	All Sectors
						(Canada $8,096 = 100)						
Newfoundland	49	68	56	111	81	81	87	73	106	82	92	84
Prince Edward Island	36	34	40	83	73	65	78	65	103	74	96	75
Nova Scotia	50	53	56	79	80	82	86	77	107	88	97	85
New Brunswick	42	61	64	82	80	78	88	75	104	80	93	82
Atlantic Region	46	61	57	91	80	80	87	75	106	83	95	83
Quebec	49	76	65	97	93	94	100	85	115	94	103	94
Ontario	65	93	67	112	105	110	107	101	127	111	116	107
Manitoba	49	54	60	112	91	97	96	89	117	98	102	95
Saskatchewan	46	73	47	102	91	88	91	78	96	93	100	88
Alberta	55	83	97	134	99	105	101	93	119	104	100	101
Prairie Region	51	76	53	124	95	100	97	88	113	100	101	97
British Columbia	70	112	117	116	105	111	111	104	119	108	106	107
Canada	57	92	68	110	100	102	102	93	120	102	107	100

1 Wage rates were obtained from the 1971 Census for each industry in each province and expressed as a percentage of the Canadian average wage rate of *men*. Provincial indexes and Canadian industry indexes are employment weighted averages of the individual indexes.

Source: Estimates based on 1971 Census data (special tabulation).

Table C-9

Wage Rate Index of Women Employed Full-Time in 11 Major Industries, Canada, by Province, 1970[1]

	Agri-culture	For-est-ry	Fishing and Trapping	Mining	Manu-fac-turing	Con-struc-tion	Transport and Utilities	Trade	Finance, Insurance, and Real Estate	Community, Business, and Personal Services	Public Adminis-tration	All Sectors
						(Canada $4,786 = 100)						
Newfoundland	47	93	75	119	66	90	86	58	80	77	94	74
Prince Edward Island	48	–	17	–	67	98	74	61	78	82	94	78
Nova Scotia	61	56	110	90	68	91	91	68	87	93	110	86
New Brunswick	61	55	–	78	71	85	97	70	81	82	101	80
Atlantic Region	56	67	97	98	69	90	91	66	84	86	104	82
Quebec	65	90	–	117	85	98	115	82	94	108	113	98
Ontario	73	109	110	118	96	112	118	90	100	114	127	105
Manitoba	67	–	68	113	80	94	101	80	86	97	112	91
Saskatchewan	65	104	36	96	90	86	98	76	82	98	111	92
Alberta	72	81	–	110	92	102	104	85	89	106	107	99
Prairie Region	68	83	77	110	86	98	102	82	87	102	109	95
British Columbia	79	107	118	109	101	113	116	93	94	112	116	105
Canada	70	99	100	112	91	106	112	85	95	108	118	100

1 Wage rates were obtained from the 1971 Census for each industry in each province and expressed as a percentage of the Canadian average wage rate of *women*. Provincial indexes and Canadian industry indexes are employment weighted averages of the individual indexes.
Source: Estimates based on 1971 Census data (special tabulation).

Table C-10

Wage Rate Index of Men Employed Full-Time in Manufacturing, Canada, by Province, 1970[1]

	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Canada
						(Canada $8,068 = 100)					
1 Food and beverages	64	69	68	70	86	100	91	89	93	105	91
2 Tobacco products	–	–	116	86	106	107	83	104	83	91	106
3 Rubber	72	–	83	80	83	104	85	84	99	101	97
4 Leather	–	–	50	63	75	85	78	–	88	78	80
5 Textiles	70	60	62	55	80	90	91	96	119	108	83
6 Knitting mills	–	–	61	–	86	97	79	–	87	129	88
7 Clothing	69	–	118	78	92	107	91	92	132	107	96
8 Wood	59	64	55	62	69	84	77	73	80	97	85
9 Furniture and fixtures	85	–	54	58	74	87	80	75	89	98	81
10 Paper and allied products	111	–	94	97	103	106	99	105	106	117	106
11 Printing and publishing	69	63	92	90	104	118	99	85	101	113	110
12 Primary metals	67	–	85	85	101	108	97	98	108	105	105
13 Metal fabricating	83	65	85	76	91	103	89	86	102	109	99
14 Machinery, excluding electrical	115	63	87	96	101	109	89	100	109	117	107
15 Transportation equipment	74	85	79	83	96	109	87	86	88	104	103
16 Electrical products	101	93	101	74	105	105	90	101	103	113	105
17 Nonmetallic products	79	33	83	78	91	102	89	86	102	110	98
18 Petroleum and coal products	102	–	120	107	122	138	117	119	125	126	128
19 Chemicals	88	94	110	91	108	117	100	109	113	111	113
20 Miscellaneous	78	72	84	73	89	106	86	85	96	110	99
21 Total manufacturing	81	71	80	80	94	106	91	91	100	106	100

1 This table corresponds to Table C-8 for 11 major industries but relates to 20 manufacturing industries.
Source: Estimates based on 1971 Census data (special tabulation).

Table C-11

Wage Rate Index of Women Employed Full-Time in Manufacturing, Canada, by Province, 1970[1]

	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Canada
						(Canada $4,340 = 100)					
1 Food and beverages	60	69	70	72	96	105	95	102	101	106	98
2 Tobacco products	–	122	92	73	132	130	–	–	128	–	131
3 Rubber	65	–	87	109	86	99	72	78	148	95	96
4 Leather	–	47	–	67	76	84	84	–	96	81	80
5 Textiles	54	72	73	62	94	92	–	82	152	101	93
6 Knitting mills	–	–	66	53	81	81	86	–	80	88	80
7 Clothing	63	–	47	51	79	85	77	80	82	91	81
8 Wood	84	106	64	80	88	98	86	68	100	130	105
9 Furniture and fixtures	–	–	72	67	92	98	86	85	91	101	95
10 Paper and allied products	119	–	100	106	106	108	98	108	100	128	109
11 Printing and publishing	79	65	84	80	102	114	95	97	107	112	108
12 Primary metals	83	–	109	95	123	126	103	–	114	120	124
13 Metal fabricating	89	–	88	82	102	106	101	99	108	116	106
14 Machinery, excluding electrical	139	73	97	110	110	119	98	109	108	118	117
15 Transportation equipment	–	–	94	97	118	124	101	123	106	110	121
16 Electrical products	99	–	63	79	113	106	86	79	92	112	107
17 Nonmetallic products	77	–	89	75	110	113	98	96	117	116	112
18 Petroleum and coal products	115	–	136	85	129	136	115	123	126	124	132
19 Chemicals	94	–	90	112	114	113	97	95	116	109	113
20 Miscellaneous	46	–	70	81	89	99	87	66	88	95	96
21 Total manufacturing	73	76	75	78	94	106	88	98	102	112	100

1 This Table corresponds to Table C-9 for 11 major industries but relates to 20 manufacturing industries.
Source: Estimates based on 1971 Census data (special tabulation).

Table C-12

Wage Rate Index of Men and Women Employed Full-Time in Manufacturing, Canada, by Province, 1970[1]

	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Canada
						(Canada $7,310 = 100)					
1 Food and beverages	66	68	69	70	88	99	93	92	96	105	92
2 Tobacco products	–	73	113	85	99	106	78	115	89	92	101
3 Rubber	59	–	85	86	84	101	79	91	107	102	96
4 Leather	–	28	55	54	66	71	68	–	85	71	69
5 Textiles	66	60	60	48	80	85	101	94	122	86	82
6 Knitting mills	–	–	48	32	69	67	70	–	67	78	67
7 Clothing	54	–	74	45	64	71	59	60	72	71	66
8 Wood	65	70	60	67	74	89	82	78	85	106	91
9 Furniture and fixtures	93	–	56	60	79	88	81	77	88	98	84
10 Paper and allied products	120	–	100	104	109	109	99	111	108	124	110
11 Printing and publishing	69	64	88	85	102	112	95	85	100	110	107
12 Primary metals	73	–	93	91	109	116	105	107	115	113	113
13 Metal fabricating	90	72	92	82	97	107	95	92	109	115	104
14 Machinery, excluding electrical	125	65	93	101	107	113	94	106	116	123	111
15 Transportation equipment	80	94	86	89	103	115	93	93	93	111	109
16 Electrical products	97	103	81	74	104	99	88	106	99	110	100
17 Nonmetallic products	85	37	90	83	96	106	96	93	108	115	103
18 Petroleum and coal products	108	–	129	114	128	141	126	127	129	134	134
19 Chemicals	93	92	116	98	107	116	103	113	118	114	112
20 Miscellaneous	80	106	85	74	86	96	86	88	94	108	93
21 Total manufacturing	89	72	82	83	92	105	90	95	102	110	100

1 This table is based on the same data as Tables C-10 and C-11 but provides an average wage rate index for *men and women*. Wage rates of each industry and province were expressed as a percentage of the Canadian average wage rate of men and women. Provincial indexes and Canadian industry indexes are employment weighted average of the individual industries.

Source: Estimates based on 1971 Census data (special tabulation).

C.3 Sources of Provincial Disparities, by Industry

Tables C-13 to C-18 provide industry details for all three industry aggregates. Estimates for the 11 major industries are summarized in Tables C-13 and C-14, for the six goods-producing industries in Tables C-15 and C-16, and for four groups of manufacturing industries in Tables C-17 and C-18. Estimates of the contribution of industrial structure and output per worker to labour productivity for the three industry aggregates are presented in Tables C-13, C-15 and C-17. Estimates of the contribution of capital stock per worker, labour quality and factor productivity for the same three industry aggregates, are given in Tables C-14, C-16 and C-18.

Estimates for the three industry aggregates, i.e., the total economy, the goods-producing industries, and manufacturing, were given in Chapter 3. Tables C-13 to C-18 provide the industry breakdown for Tables 3-3 and 3-7 of the text. The estimates of the last column in Table C-13, for example, correspond to those of the upper panel in Table 3-3 of Chapter 3. According to Table 3-3, the difference in labour productivity between Ontario and Canada, for example, was 4 per cent, of which 1 per cent was attributed to better industry structure and 3 per cent to greater output per worker. In Table C-13 these estimates are broken down further into their 11 major industry components. They show, for example, that Ontario's 1.4 per cent advantage in industry structure and its 3.1 per cent advantage in output per worker come largely from manufacturing.

Tables C-13 to C-18 are followed by Tables C-19 to C-23, which provide industry detail on employment, output per worker, and size of firm. Table C-24 summarizes the sources of growth of production in the six goods-producing industries.

Table C-13

Contribution of Industrial Structure and Output per Worker to Provincial Variations in Labour Productivity, Canada, by Province and Industry, 1970-73[1]

(Percentage Difference Between Province and Canada)

	Contribution of Major Industries											
	Agriculture	Forestry	Fishing and Trapping	Mining	Manufacturing	Construction	Transport and Utilities	Trade	Finance, Insurance, and Real Estate	Community, Business, and Personal Services	Public Administration	Total Provincial Economy
Industrial structure												
Newfoundland	2.2	.6	- 8.8	9.7	-3.4	1.8	3.1	-1.4	.7	n.a.	1.0	5.5
Prince Edward Island	- 5.8	- .3	- 6.1	- 3.8	-4.5	.7	2.3	- .3	.7	n.a.	1.3	-15.8
Nova Scotia	1.1	.0	- 2.4	1.9	-2.7	.1	.2	- .1	.2	- .4	.8	- 1.3
New Brunswick	1.0	.6	- 1.2	- .4	-2.4	.3	1.1	- .3	.3	.8	.8	.7
Quebec	.5	.0	.3	- .7	1.6	- .2	.2	.2	.0	- .2	- .2	1.4
Ontario	.8	- .2	.4	- .9	1.9	- .1	- .8	- .1	-.1	.2	0	1.2
Manitoba	- 1.8	- .2	.2	.8	-2.8	0	1.7	- .5	.1	- .1	- .1	- 2.7
Saskatchewan	- 7.8	- .2	.1	.4	-5.8	0	- .3	.6	.2	.6	0	-12.3
Alberta	- 3.0	- .2	.3	3.4	-4.6	.5	0	0	.1	- .7	0	- 4.1
British Columbia	1.2	.8	- .4	- .2	-1.6	.3	1.2	- .2	0	- .4	0	.6
Output per worker												
Newfoundland	0	- .9	- 2.2	- 4.8	-3.5	.5	-1.3	-1.6	0	n.a.	-1.1	-14.8
Prince Edward Island	- 5.1	0	- .5	0	-3.9	-3.3	-9.2	-2.3	0	n.a.	.3	-23.9
Nova Scotia	- .4	- .4	.7	- 5.5	-4.9	-1.2	-3.4	-1.2	-.3	-3.1	-2.1	-21.8
New Brunswick	- .1	- .9	- .1	- 2.6	-4.2	-3.0	-2.2	-1.3	-.2	-2.8	-1.6	-19.1
Quebec	- 1.1	- .2	- .1	- 2.1	-4.3	- .2	- .7	- .1	0	.2	- .3	- 8.8
Ontario	- .1	0	0	- 1.3	3.4	.1	.4	.1	.1	.5	0	3.1

Manitoba	1.1	- .1	- .1	- 1.3	-3.4	-1.2	-1.3	- .4	-.2	-1.7	.7	- 8.1
Saskatchewan	6.5	- .1	- .1	4.8	.5	-1.5	2.7	- .2	-.2	-2.4	1.0	11.1
Alberta	.4	0	0	15.5	.7	1.2	.3	.2	0	- .3	.7	18.4
British Columbia	- .2	1.3	.4	.1	2.0	1.5	1.8	1.1	-.2	.2	1.0	9.1
Labour productivity												
Newfoundland	2.2	- .3	-11.0	4.9	-6.9	2.3	1.8	-3.0	.7	n.a.	-0.1	- 9.3
Prince Edward Island	-10.9	- .3	- 6.6	- 3.8	-8.4	-2.6	-6.9	-2.6	.7	n.a.	1.6	-39.7
Nova Scotia	.7	- .4	- 1.7	- 3.6	-7.6	-1.1	-3.2	-1.3	-.1	-3.5	-1.3	-23.1
New Brunswick	.9	- .3	- 1.3	- 3.0	-6.6	-2.7	-1.1	-1.6	.1	-2.0	- .8	-18.4
Quebec	- .6	- .2	.2	- 2.8	-2.7	- .4	- .5	.1	0	.0	- .5	- 7.4
Ontario	.7	- .2	.4	- 2.2	5.3	0	- .4	0	0	.7	0	4.3
Manitoba	- .7	- .3	.1	- .5	-6.2	-1.2	.4	- .9	-.1	-1.8	.6	-10.8
Saskatchewan	- 1.3	- .3	0	5.2	-5.3	-1.5	2.4	.4	0	-1.8	1.0	- 1.2
Alberta	- 2.6	- .2	.3	18.9	-3.9	1.7	.3	.2	.1	-1.0	.7	14.3
British Columbia	1.0	2.1	0	- .1	.4	1.8	3.0	.9	-.2	- .2	1.0	9.7

n.a.—Not available.
1 This table provides industry detail for estimates of the "Total Economy" in Table 3-3 of the text. May not add because of rounding.
Source: Estimates based on data from Statistics Canada.

Table C-14

Contribution of Labour Quality, Capital per Worker, and Factor Productivity to Provincial Variations in Labour Productivity, Canada, by Province and Major Industry, 1970-73[1]

(Percentage Difference Between Province and Canada)

	Contribution of Major Industries											
	Agriculture	Forestry	Fishing and Trapping	Mining	Manufacturing	Construction	Transport and Utilities	Trade	Finance, Insurance, and Real Estate	Community Business, and Personal Services	Public Administration	Total Provincial Economy
Labour quality												
Newfoundland	0	−.1	− .2	− .3	− .3	− .8	−1.0	−1.3	0	n.a.	−1.4	− 5.4
Prince Edward Island	− .5	0	− .6	0	− .8	− .5	− .5	− .6	0	n.a.	− .2	− 3.7
Nova Scotia	.1	0	− .1	− .1	0	− .4	− .2	− .3	−.1	− .5	− .3	− 2.0
New Brunswick	0	−.1	.0	− .1	− .4	− .6	− .2	− .6	−.1	−1.1	− .5	− 3.8
Quebec	− .1	−.1	.0	− .1	−1.5	− .3	− .2	− .4	−.1	− .8	− .2	− 3.6
Ontario	0	0	0	0	.6	0	.1	.1	.1	.3	.2	1.4
Manitoba	− .3	0	0	− .1	− .4	− .1	− .1	− .1	−.1	− .3	− .1	− 1.7
Saskatchewan	− .9	0	0	− .1	.1	0	− .1	.1	−.1	0	0	− 1.1
Alberta	.2	0	0	.8	.6	.5	0	.5	0	.7	− .3	3.1
British Columbia	.1	.2	.1	.1	1.6	.9	.4	.8	.2	1.3	.3	6.1
Gross capital stock per worker												
Newfoundland	0	−.4	− .3	− 1.2	.4	.2	.6	0	0	n.a.	.7	− .1
Prince Edward Island	−4.7	0	− .5	0	−3.6	− .6	−7.6	0	0	n.a.	3.0	−14.0
Nova Scotia	− .1	−.1	.2	− 3.9	2.6	− .8	−2.5	0	0	0	− .5	− 5.3
New Brunswick	.1	−.7	− .1	− 1.9	2.5	−1.1	−1.2	0	0	0	− .3	− 2.7
Quebec	− .4	−.1	0	− 1.6	−3.6	− .3	− .5	− .1	0	.1	.1	− 6.5

Ontario	.1	0	0	- 1.6	- .6	- .1	0	0	0	- .1	- .6	- 3.0
Manitoba	.6	0	0	- 2.5	- .3	- .3	- .5	.1	-.1	- .2	.9	- 2.3
Saskatchewan	.9	0	0	5.6	1.4	.6	3.2	.3	-.1	.4	1.3	13.6
Alberta	.6	0	0	11.2	1.9	1.0	.5	.0	.2	.5	.9	16.7
British Columbia	- .2	.6	.1	1.8	4.7	.7	1.0	0	-.1	- .3	.9	9.3
Factor productivity												
Newfoundland	0	-.3	-1.6	- 3.3	-3.6	1.2	-0.9	- .3	0	n.a.	- .4	- 9.2
Prince Edward Island	0	0	.6	0	.5	-2.2	-1.0	-1.8	0	n.a.	-2.4	- 6.2
Nova Scotia	- .4	-.2	.6	- 1.4	-7.4	0	- .8	- .8	-.1	-2.6	-1.3	-14.5
New Brunswick	- .3	-.0	0	- .6	-6.4	-1.3	- .8	- .7	-.1	-1.6	- .7	-12.6
Quebec	- .6	-.1	0	- .4	.8	.4	0	.4	.1	.9	- .2	1.3
Ontario	- .1	0	0	.3	3.4	.2	.3	0	0	.3	.4	4.8
Manitoba	.7	0	0	1.4	-2.7	- .9	- .7	- .4	0	-1.3	- .1	- 4.1
Saskatchewan	6.6	0	- .1	- .7	- .9	-2.1	- .4	- .6	-.1	-2.9	- .2	- 1.4
Alberta	- .4	0	0	3.5	-1.8	- .3	- .2	- .4	-.2	-1.6	.1	- 1.4
British Columbia	0	.4	.1	- 1.8	-4.3	- .1	.3	.3	-.2	- .8	- .2	- 6.3

n.a.–Not available.

1 This table gives details on the contribution of "Outputer per Worker" in the preceding Table and corresponds to Table 3-7 of the text. Totals may not add because of rounding.

Source: Estimates based on data from Statistics Canada.

Table C-15

Contribution of Industrial Structure and Output Per Worker to Provincial Variations in Labour Productivity of Goods-Producing Industries, Canada, by Province, 1970-73[1]

(Percentage Difference Between Province and Canada)

	Agri-culture	Forestry	Fishing and Trapping	Mining	Manufac-turing	Construc-tion	Total of 6 Goods-Producing Industries
Industrial structure							
Newfoundland	8.1	.3	-19.3	11.9	- 2.1	-1.0	- 2.1
Prince Edward Island	-12.8	- .2	-12.4	- 7.0	- 2.5	- .1	-35.2
Nova Scotia	3.5	.0	- 8.5	5.3	- .9	- .4	- 1.0
New Brunswick	3.2	.6	- 4.2	.3	- .7	- .6	- 1.5
Quebec	2.1	.0	.9	- 1.4	.6	.2	2.4
Ontario	2.9	- .1	1.3	- 1.9	.8	.2	3.1
Manitoba	- 8.0	- .2	.5	2.3	- 1.1	- .1	- 6.7
Saskatchewan	-24.3	- .2	.5	- .2	- 2.9	.2	-26.9
Alberta	-11.7	- .2	1.0	6.7	- 2.1	- .6	- 6.9
British Columbia	4.0	.8	- 1.5	.4	- .4	- .5	2.7
Output per worker							
Newfoundland	.0	-1.4	- 3.2	- 7.5	- 5.4	.9	-16.6
Prince Edward Island	- 7.6	.0	- .7	.0	- 5.8	-4.8	-18.9
Nova Scotia	- 1.1	- .9	1.6	-13.2	-11.9	-3.0	-28.5
New Brunswick	- .4	-2.0	- .2	- 6.2	-10.2	-7.0	-26.0
Quebec	- 2.2	- .4	- .1	- 4.3	- 8.5	- .4	-16.0
Ontario	.0	- .2	.0	- 2.6	6.7	.2	4.2
Manitoba	2.4	- .1	- .2	- 2.9	- 7.8	-2.9	-11.4
Saskatchewan	11.9	- .1	- .3	8.7	1.0	-2.6	18.5
Alberta	.8	.0	- .1	32.9	1.4	2.5	37.4
British Columbia	- .4	2.9	+ .9	.2	4.5	3.5	11.8

Labour productivity

Newfoundland	8.1	−1.1	−22.5	4.4	− 7.5	−0.1	−18.7
Prince Edward Island	−20.4	− .2	−13.1	− 7.0	− 8.3	−4.9	−54.1
Nova Scotia	2.4	− .9	− 6.9	− 7.9	−12.8	−3.4	−29.5
New Brunswick	2.8	−1.4	− 4.4	− 5.9	−10.9	−7.6	−27.5
Quebec	− .1	− .4	.8	− 5.7	− 7.9	− .2	−13.6
Ontario	2.9	− .3	1.3	− 4.5	7.5	.4	7.3
Manitoba	− 5.6	− .3	.3	− .6	− 8.9	−3.0	−18.1
Saskatchewan	−12.4	− .3	.2	8.5	− 1.9	−2.4	− 8.4
Alberta	−10.9	− .2	.9	39.6	− .7	1.9	30.5
British Columbia	3.6	3.7	− .6	.6	4.1	3.0	14.5

1 This table provides industry detail for estimates of the "Goods-Producing Industries" in Table 3-3 of the text. Totals may not add because of rounding.

Source: Estimates based on data from Statistics Canada.

Table C-16

Contributions of Labour Quality, Capital Per Worker, and Factor Productivity to Provincial Variations in Labour Quality of Goods-Producing Industries, Canada, by Province, 1970-73[1]

(Percentage Difference Between Province and Canada)

	Agriculture	Forestry	Fishing and Trapping	Mining	Manufacturing	Construction	Total of 6 Goods-Producing Industries
Labour quality							
Newfoundland	.0	- .2	- .3	- .4	- .4	-1.3	- 2.7
Prince Edward Island	- .7	.0	- .9	.0	- 1.2	- .8	- 3.5
Nova Scotia	.1	- .1	- .3	- .2	.0	-1.0	- 1.4
New Brunswick	.0	- .2	- .1	- .2	- .9	-1.4	- 2.9
Quebec	- .1	- .1	.0	- .2	- 2.9	- .6	- 4.0
Ontario	.0	.0	.0	- .1	1.2	.1	1.2
Manitoba	- .7	.0	.0	- .3	- 1.0	- .2	- 2.2
Saskatchewan	- 1.7	.0	.0	- .2	.2	.0	- 1.7
Alberta	.4	.0	.0	1.7	1.2	1.1	4.5
British Columbia	.2	.5	.3	.2	3.7	2.1	7.0
Gross capital stock per worker							
Newfoundland	.0	- .7	- .4	- 1.9	.6	.4	- 2.0
Prince Edward Island	- 6.9	.0	- .8	.0	- 5.3	- .8	-13.8
Nova Scotia	- .3	- .3	.4	- 9.6	6.2	-2.0	- 5.5
New Brunswick	.2	-1.6	- .2	- 4.6	5.9	-2.5	- 2.7
Quebec	- .7	- .2	.0	- 3.2	- 7.3	- .7	-12.1
Ontario	.1	- .1	.0	- 3.2	- 1.2	- .3	- 4.7
Manitoba	1.4	- .0	- .1	- 5.7	- .8	- .7	- 5.9
Saskatchewan	1.7	.0	- .1	10.2	2.5	1.0	15.3
Alberta	1.3	.0	- .1	23.7	4.1	2.1	31.2
British Columbia	- .5	1.4	.3	4.2	10.8	1.5	17.8

Factor productivity

Newfoundland	.0	- .5	-2.5	- 5.2	- 5.6	1.8	-11.9
Prince Edward Island	.0	.0	.9	.0	.7	-3.2	- 1.6
Nova Scotia	- 1.0	- .6	1.5	- 3.5	-18.1	.0	-21.6
New Brunswick	- .7	- .1	.0	- 1.4	-15.2	-3.1	-20.4
Quebec	- 1.3	- .1	- .1	- .9	1.7	.9	.2
Ontario	- .2	.0	.0	.7	6.7	.4	7.6
Manitoba	1.7	- .1	- .1	3.1	- 6.0	-2.0	- 3.4
Saskatchewan	11.9	- .1	- .2	- 1.2	- 1.7	-3.7	5.0
Alberta	- .9	.0	- .1	7.4	- 3.9	- .7	1.8
British Columbia	.0	1.0	.3	- 4.2	-10.0	- .1	-13.1

1 This table gives details on the contribution of "Output per Worker" in the preceding appendix table and corresponds to Table 3-7 of the text. Totals may not add because of rounding.
Source: Estimates based on data from Statistics Canada.

Table C-17

Contribution of Industrial Structure and Output per Worker to Provincial Variations in Labour Productivity of Manufacturing,[1] Canada, by Province and Manufacturing Sector, 1970-73

(Percentage Difference Between Province and Canada)

	Contribution of Manufacturing Sectors				
	Food and Fibre	Forest Products	Metal Products	All Others	Total Manufacturing
Industrial structure					
Newfoundland	8.1	.7	- 2.4	- 4.4	2.0
Prince Edward Island	9.7	.8	- 2.3	- 6.2	2.0
Nova Scotia	3.9	.8	.4	- 4.4	.7
New Brunswick	6.5	- .9	- 1.0	- 5.8	- 1.2
Quebec	- 4.8	.1	- .9	- .1	- 5.7
Ontario	1.7	.3	.7	.2	2.9
Manitoba	- 2.5	- .5	.6	- 5.1	- 7.5
Saskatchewan	6.9	- .5	- 2.3	- 2.3	1.8
Alberta	5.5	- .9	0	- 2.2	2.4
British Columbia	3.9	-2.3	- .8	- .9	- .1
Output per worker					
Newfoundland	-23.3	- 1.4	- .5	1.4	-23.8
Prince Edward Island	-30.3	-1.0	0	- 3.8	-35.1
Nova Scotia	-13.5	-1.8	-10.3	-1.4	-27.0
New Brunswick	- 9.6	-4.2	- 5.5	- 0.9	-20.2
Quebec	- 1.0	-1.3	- 3.0	- 1.3	- 6.6
Ontario	2.4	- .4	4.1	.2	6.3
Manitoba	- 4.2	-1.9	- 6.7	1.4	-11.4
Saskatchewan	- 3.8	0	- .5	10.3	6.0
Alberta	- .7	.9	- 4.8	8.1	3.6
British Columbia	.5	9.9	- 1.9	.2	8.7
Labour productivity					
Newfoundland	-15.2	- .7	- 2.9	- 3.0	-21.8
Prince Edward Island	-20.6	- .2	- 2.3	-10.0	-33.1
Nova Scotia	- 9.6	-1.0	- 9.9	- 5.8	-26.3
New Brunswick	- 3.1	-5.1	- 6.5	- 6.7	-21.4
Quebec	- 5.8	-1.2	- 3.9	- 1.4	-12.3
Ontario	4.1	- .1	4.8	.4	9.2
Manitoba	- 6.7	-2.4	- 6.1	3.7	-18.9
Saskatchewan	3.1	.5	- 2.8	8.0	7.8
Alberta	4.8	0	4.8	5.9	6.0
British Columbia	4.4	7.6	- 2.7	- .7	8.6

1 This table provides industry detail for estimates of "Manufacturing" in Table 3-3 of the text. The analysis is based on 20 manufacturing industries (composed of the two-digit industries of the Standard Industrial Classification), and the results are grouped into "Manufacturing Sectors" of this table. The totals may not add because of rounding.

Source: Estimates based on data from Statistics Canada.

Table C-18

Contributions of Labour Quality, Capital Per Worker, and Factor Productivity to Provincial Variations in Labour Productivity of Manufacturing,[1] Canada, by Province and Manufacturing Sector, 1970-73

(Percentage Difference Between Province and Canada)

	Contribution of Manufacturing Sectors				
	Food and Fibre	Forest Products	Metal Products	All Others	Total Manufacturing
Labour quality					
Newfoundland	- 3.5	0	- .1	.2	- 3.4
Prince Edward Island	- 5.7	0	0	- .8	- 6.5
Nova Scotia	- 1.1	- .1	- .4	5.3	3.7
New Brunswick	- 1.3	- .5	- .6	- 1.5	- 3.9
Quebec	- .6	- .4	0	- .3	- 1.3
Ontario	.3	- .2	- .2	.1	0
Manitoba	- .2	- .4	- .6	.7	- .5
Saskatchewan	.2	-2.9	- .1	.5	- 2.3
Alberta	1.5	.2	.4	1.6	3.7
British Columbia	.9	3.0	1.3	.3	5.5
Gross capital stock per worker					
Newfoundland	-11.8	.4	.3	80.8	69.7
Prince Edward Island	-22.5	- .5	0	- .6	-23.6
Nova Scotia	- 4.1	1.6	-2.7	33.5	28.3
New Brunswick	- 5.4	4.1	-2.9	73.8	69.6
Quebec	- 2.1	-1.9	-1.2	- 2.1	- 7.3
Ontario	1.3	-1.4	2.0	- .6	1.3
Manitoba	- 1.2	- .3	.5	8.7	7.7
Saskatchewan	3.7	1.1	-1.7	25.1	28.2
Alberta	- .1	- .7	-6.0	13.9	7.1
British Columbia	.3	8.2	-2.7	.7	6.5
Factor productivity					
Newfoundland	- 8.0	-1.8	- .8	-79.6	-90.2
Prince Edward Island	- 2.1	- .6	0	- 2.3	- 5.0
Nova Scotia	- 8.4	-3.4	-7.2	-40.2	-59.2
New Brunswick	- 3.0	-7.9	-1.8	-73.2	-85.9
Quebec	1.8	1.0	-1.7	1.1	2.2
Ontario	.7	1.1	2.3	.7	4.8
Manitoba	- 2.8	-1.3	-6.5	- 8.1	-18.7
Saskatchewan	- 7.8	1.8	1.4	-15.4	-20.0
Alberta	-2.1	1.4	.9	- 7.3	- 7.1
British Columbia	- .1	-1.3	- .6	- .7	- 2.7

1 This table gives details on the contribution of "Output per Worker" in the preceding appendix table and corresponds to Table 3-7 of the text. Totals may not add because of rounding.

Source: Estimates based on data from Statistics Canada.

Table C-19

Employment Estimates of 11 Major Industries, Canada, by Province,[1] 1970-73

	New-foundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatch-ewan	Alberta	British Columbia	Canada
						(in thousands)					
Employment numbers											
Agriculture	–	6	7	6	97	126	43	89	94	23	492
Forestry	2	–	1	4	14	9	1	1	1	20	51
Fishing	16	3	11	5	6	2	2	2	1	11	59
Mining	5	–	5	3	23	32	6	5	17	11	110
Manufacturing	13	2	34	29	518	822	50	15	53	134	1,673
Construction	19	3	21	18	132	212	28	23	65	74	596
Goods-producing industries	55	14	79	65	790	1,203	130	135	231	273	2,981
Transport and utilities	16	4	23	22	184	227	45	26	56	89	692
Trade	20	4	37	31	285	454	59	40	91	121	1,143
Finance, insurance and real estate	2	1	8	5	87	142	13	8	22	34	323
Community, business and personal services	32	8	63	45	507	743	93	72	166	205	1,937
Public administration	18	5	37	30	161	293	33	29	60	74	752
Total provincial economy	143	36	247	198	2,014	3,062	373	310	626	796	7,828
						(Per cent)					
Employment shares											
Agriculture	–	17	3	3	5	4	11	29	15	3	6
Forestry	1	–	0	2	1	0	0	0	0	3	1
Fishing	11	8	4	2	0	0	1	1	0	1	1
Mining	4	–	2	2	1	1	2	2	3	1	1
Manufacturing	9	6	14	15	26	27	13	5	9	17	21

Construction	13	8	9	9	6	7	8	7	10	9	8
Goods-producing industries	38	39	32	33	39	39	35	44	37	34	38
Transport and utilities	11	11	9	11	9	7	12	8	9	11	9
Trade	14	11	15	16	14	15	16	13	14	15	14
Finance, insurance and real estate	1	3	3	2	5	5	3	3	3	5	4
Community, business and personal services	23	22	26	23	25	24	25	23	27	26	25
Public administration	13	14	15	15	8	10	9	9	10	9	10
Total provincial economy	100	100	100	100	100	100	100	100	100	100	100

1 Estimates are based on establishment data and do not match labour force data. For more details, see Appendix D.
Source: Estimates based on data from Statistics Canada.

Table C-20

Employment Estimates of 20 Manufacturing Industries, Canada, by Province,[1] 1970-73

	New-foundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatch-ewan	Alberta	British Columbia	Canada
Employment numbers											
Food and beverages	6,822	1,796	10,293	9,508	59,426	84,306	11,039	5,867	13,870	17,782	220,770
Tobacco products					5,987	3,428					9,650
Rubber and plastics					12,812	31,698	428		1,091	994	48,084
Leather					13,518	12,706	694		242	288	27,686
Textiles			1,062		38,169	30,226	714	128	648	1,176	72,542
Knitting mills			1,309		15,014	7,400	329				24,566
Clothing					65,216	23,042	7,021			2,307	100,554
Wood	457	66	2,030	3,757	22,062	18,190	1,535	1,108	5,409	43,837	98,494
Furniture and fixtures			290	274	18,343	21,290	1,891	76	1,189	1,937	45,313
Paper and allied industries			3,056	5,570	42,321	44,683	2,028		1,652	18,500	121,171
Printing, publishing and allied industries			1,377	990	23,300	44,138	4,099	1,560	3,725	6,336	86,205
Primary metal					25,931	70,125	2,678		3,010	7,917	115,320
Metal fabricating	435		1,310	1,578	35,850	81,154	4,373			9,167	140,236
Machinery					14,417	52,254	2,947	817	2,220	4,244	77,668
Transportation equipment			4,556	2,154	31,650	103,036	4,962		3,676	6,289	157,149
Electrical products			1,558	994	33,885	80,870	1,683		1,180	2,830	123,324
Nonmetallic mineral products	392		754	974	14,186	26,601		686		3,966	52,438
Petroleum and coal products					3,094	8,627		551	1,124	984	15,665
Chemical and chemical products	712		438		26,823	41,862	864	207	2,432	3,312	77,126
Miscellaneous manufacturing industries	72		287	422	16,589	36,880	2,803				59,186
Remaining industries	3,999	551	5,502	3,003				4,401	12,114	21,529	
All manufacturing	12,889	2,413	33,822	29,224	518,594	822,516	50,088	15,401	53,582	134,395	1,673,150

Employment shares											
Food and beverages	53	74	30	33	11	10	22	38	26	13	13
Tobacco products					1	0					1
Rubber and plastics					2	4	1		2	1	3
Leather					3	2	1		0	0	2
Textiles			3		7	4	1	1	1	1	4
Knitting mills			4		3	1	1				1
Clothing					13	3	14			2	6
Wood	4	3	6	13	4	2	3	7	10	32	6
Furniture and fixtures			1	1	4	3	4	0	2	1	3
Paper and allied industries			9	19	8	5	4		3	14	7
Printing, publishing and allied industries			4	3	4	5	8	10	7	5	5
Primary metal					5	9	5		6	6	7
Metal fabricating	3		4	6	7	10	9			7	8
Machinery					3	6	6	5	4	3	5
Transportation equipment			14	8	6	13	10		7	5	9
Electrical products	3		5	3	7	10	3		2	2	7
Nonmetallic mineral products			2	3	3	3		5		3	3
Petroleum and coal products	5				1	1		4	2	1	1
Chemical and chemical products			1		5	5	2	1	5	2	5
Miscellaneous manufacturing industries	1		1	1	3	4					4
Remaining industries	31	23	16	10	0	0	6	29	23	2	
All manufacturing	100	100	100	100	100	100	100	100	100	100	100

1 Estimates are based on Census of Manufacturing. They are establishment data and cover the two-digit industries of the Standard Industrial Classifications. Confidential data are included under Remaining industries.

Table C-21

Output Per Worker in Manufacturing Industries, Canada, by Province, 1970-73

	New-foundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatch-ewan	Alberta	British Columbia	Canada
Food and beverages	9,640	10,141	9,931	11,817	16,130	18,692	14,110	14,781	15,892	17,101	16,308
Tobacco products					22,097	31,716					24,974
Rubber and plastics					13,726	15,967	8,682		14,678	11,456	15,010
Leather					7,853	8,320	8,315		8,775	9,153	8,083
Textiles			10,338		10,745	12,884	7,438	11,288	11,839	10,294	11,574
Knitting mills			6,692		9,057	7,925	10,530				8,605
Clothing					7,580	7,988	7,236			7,685	7,657
Wood	7,095	7,279	9,175	9,264	10,856	11,796	10,254	16,951	13,432	15,642	13,244
Furniture and fixtures			7,265	8,335	9,747	11,221	9,368	9,585	10,832	11,894	10,517
Paper and allied industries			17,504	14,841	15,720	15,364	16,688		19,853	21,640	16,626
Printing, publishing and allied industries			12,226	11,184	14,452	14,497	12,315	11,576	14,525	14,728	14,248
Primary metal					18,145	17,845	15,663		15,944	15,849	17,352
Metal fabrication	12,131		11,915	11,684	13,455	15,089	13,096			15,840	14,556
Machinery					12,725	16,455	10,511	13,742	13,308	13,758	15,178
Transportation equipment			10,303	10,563	12,902	22,064	10,479		11,160	14,064	18,719
Electrical products			6,878	11,963	14,145	14,154	11,068		11,714	12,268	13,937
Nonmetallic mineral products	16,577		16,445	13,933	17,039	18,069		18,731		18,462	18,117
Petroleum and coal products					43,510	16,890		40,278	44,809	43,247	29,399
Chemical and chemical products	23,401		9,434	21,433	18,426	24,963	20,318	18,029	28,825	19,940	21,808
Miscellaneous manufac-turing industries	9,869		10,017		10,681	14,384					13,051
All manufacturing	11,856	10,156	11,171	11,925	13,315	16,562	12,309	16,346	16,068	16,476	15,160

Source: Based on data of Statistics Canada (Census of Manufacturing).

Table C-22

Size of Firms in Manufacturing Industries, Number of Employees per Establishment, Canada, by Province, 1970-73

Manufacturing Industry	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Canada	
											Per cent	Number of Employees
						(Canadian average = 100)						
Food and beverages	137	46	81	93	71	89	68	52	59	65	76	40
Tobacco					756	521					665	352
Rubber					125	173	42		53	29	133	71
Leather					111	138	81		46	39	115	61
Textiles			173		187	151	34	27	50	42	149	79
Knitting				519	144	145	134				148	78
Clothing					82	95	120			90	88	47
Wood	12	46	22	55	42	47	34	29	50	130	59	31
Furniture			15	21	46	46	34	5	21	16	40	21
Paper			474		385	291	153		143	613	355	188
Printing			36	39	42	52	43	25	31	33	44	23
Primary metals					50	636	278		247	353	536	283
Metal fabricating	82		50	73	69	73	64			42	66	35
Machinery					174	184	114	51	86	90	158	84
Transport equipment			140	268	317	510	214		103	70	311	165
Electrical products			430	290	368	334	127		124	98	312	165
Nonmetallic minerals	60		38	51	82	96			29	52	78	41
Petroleum and coal					288	520		106	147	152	295	156
Chemicals	235		69	52	156	138	54	31	101	63	129	68
Miscellaneous	25		16		47	66					47	25
Total manufacturing	98	32	82	92	97	123	71	41	56	77	100	= 53

Source: Estimates based on *Census of Manufacturing*, 1970-73.

Table C-23

Size of Firms in Manufacturing Industries, Value Added per Establishment, Canada, by Province, 1970-73

Manufacturing Industry	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Canada	
											Per cent	Value Added in $1000
						(Canadian average = 100)						
Food and beverages	87	31	53	73	76	111	63	50	62	74	82	663
Tobacco					1108	1093					1100	8840
Rubber					113	181	24		51	21	131	1055
Leather					58	76	45		26	24	62	496
Textiles			118		133	128	17	20	39	28	114	916
Knitting				232	86	76	95				84	674
Clothing					41	50	58			45	45	358
Wood	6	2	14	34	30	36	23	34	45	135	52	417
Furniture			7	12	29	34	21	3	15	13	27	220
Paper			549		399	295	167		186	870	389	3121
Printing			29	29	40	50	35	19	29	32	41	332
Primary metal					598	748	285		261	367	612	4919
Metal fabricating	65		39	56	61	73	56			44	63	506
Machinery					144	199	79	46	75	80	158	1266
Transport equipment			95	172	269	739	147		75	65	382	3072
Electrical products			188	228	343	312	93		96	79	286	2300
Nonmetallic minerals	65		41	47	92	115		36		63	93	748
Petroleum and coal					810	572		285	434	441	568	4560
Chemicals	366		44	74	190	218	72	36	190	83	186	1495
Miscellaneous	16		11		33	63					41	325
Total manufacturing	77	21	61	72	85	134	58	44	59	84	100	803

Source: Estimates based on *Census of Manufacturing*, 1970-73.

Table C-24

Actual and Relative Contributions of Employment and Labour Productivity to Growth Rates of Provincial Production, Six Goods-Producing Industries, Canada, by Province, 1961-73

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
Actual Contribution											
Employment	.9	1.3	- 3.7	- .9	.4	.4	1.9	- 1.0	- 1.4	0.3	2.9
Labour productivity	5.6	4.8	9.4	6.6	6.9	4.9	4.8	7.0	8.3	7.0	5.9
Industrial structure	.6	1.3	3.1	1.2	1.4	.5	.3	1.3	1.2	1.7	.6
Output per worker	5.0	3.5	0.3	5.4	5.5	4.4	4.5	5.7	7.1	5.3	5.3
Labour quality	.3	.2	- .1	.0	.3	.2	.3	.2	.0	.3	.4
Education	.3	- .3	.1	.1	.3	.1	.2	.2	.2	.3	.4
Age	.0	.5	- .3	- .1	.0	.1	.1	.0	- .1	.0	.0
Sex	.0	.0	.1	.0	.0	.0	.0	.0	- .1	.0	.0
Capital	1.7	3.3	2.9	3.1	1.9	1.2	1.2	2.1	3.5	2.1	1.7
Stock	1.5	3.5	3.0	2.7	1.5	1.0	.9	1.9	3.1	2.1	1.3
Machine use	.2	- .2	- .1	.4	.4	.2	.3	.2	.4	.0	.4
Other factors	3.0	.0	3.5	2.2	3.3	3.0	3.0	3.4	3.6	2.9	3.3
Growth rate of provincial production	6.5	6.2	5.7	5.7	7.3	5.3	6.7	6.0	6.9	7.3	8.8
Relative Contribution											
Employment	15	22	- 65	- 16	5	7	28	- 17	-21	4	32
Labour productivity	85	78	165	116	95	93	72	117	121	96	68
Industry structure	9	22	54	21	20	10	4	22	17	24	7
Output per worker	76	56	111	95	75	83	68	95	104	72	61
Labour quality	4	3	- 2	1	4	4	5	3	0	5	4

Table C-24 (concl'd)

	Canada	New-foundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatch-ewan	Alberta	British Columbia
Education	4	− 5	2	2	3	2	4	3	4	4	4
Age	0	8	− 6	− 1	0	2	1	0	− 2	1	0
Sex	0	0	2	0	1	0	0	0	− 2	0	0
Capital	26	53	51	53	25	22	18	35	51	28	19
Stock	22	56	53	47	20	19	13	32	45	28	15
Machine use	4	− 3	− 2	6	5	3	5	3	6	0	4
Other factors	46	0	62	39	46	57	45	57	53	39	38
Growth rate of provincial production	100	100	100	100	100	100	100	100	100	100	100

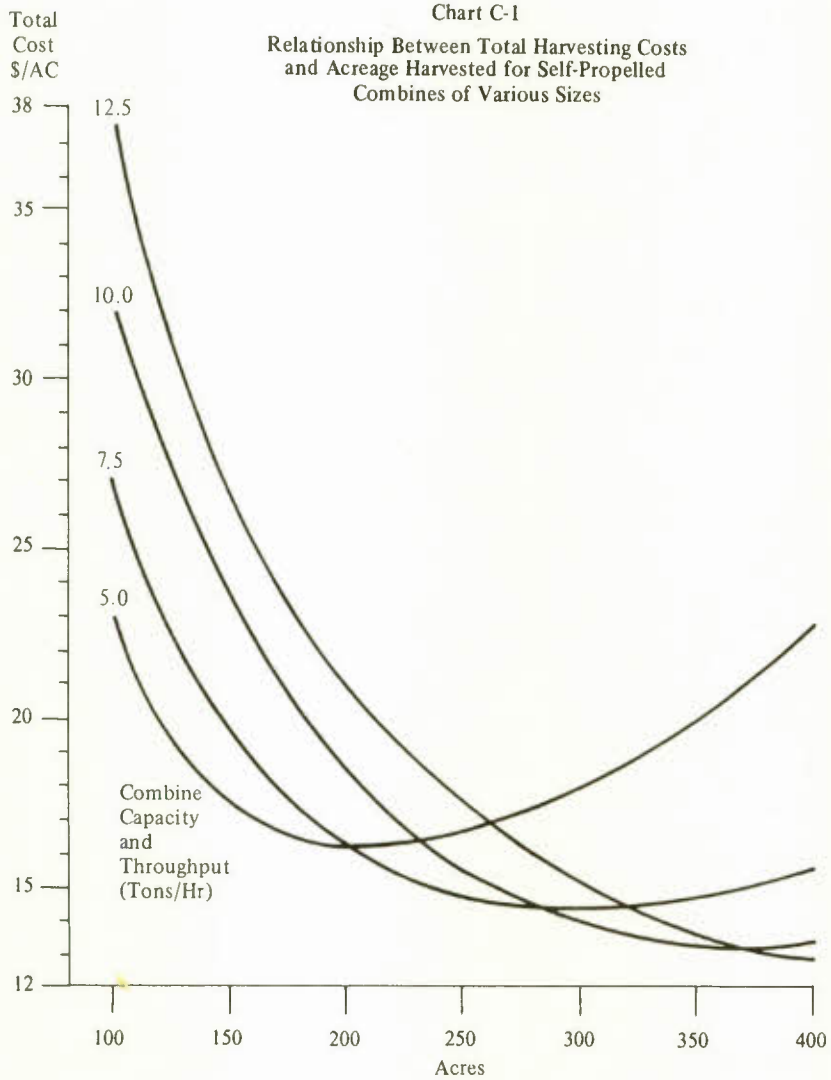
Source: Estimates based on data from Statistics Canada. For more details, see Appendix D.

C.4 Grain Harvesting Costs in Relation to Harvested Acreage

J. A. McIsaac and J. Lovering, economists of the Canada Department of Agriculture, have estimated cost functions for various grain acreages, taking into account machine capacity, harvesting and crop conditions, labour costs, and other factors. Their results show that harvesting costs can be reduced by about one-third as the harvested grain acreage is

Chart C-1

Relationship Between Total Harvesting Costs and Acreage Harvested for Self-Propelled Combines of Various Sizes



Source: J. A. McIsaac and J. Lovering, "Combine Sizes for Least-Cost Cereal Harvesting," *Canadian Farm Economics*, vol. 9, no. 6 (December 1974), p. 28, fig. 4.

increased from 100 to 200 acres, and that it can be further reduced by use of high capacity combine harvesters on larger acreages.[1]

1 J. A. McIsaac and J. Lovering, "Combine Sizes for Least-Cost Cereal Harvesting", *Canadian Farm Economics*, vol. 9, no. 6 (December 1974), pp. 24-34.

D Data Review

Although it is unlikely that the principal conclusions of this study would have been altered, a different choice of data would have yielded somewhat different statistical results. Also, if certain data gaps could have been bridged more adequately, more reliable results might have been obtained. A general description of the data sources and some of the related problems are given below.

Value-Added Data

All provincial estimates of output per worker were based on nominal dollar values of industry output. Output was measured in value-added terms and neither industry outputs nor industry inputs — that is, materials and supplies, fuel and electricity — were adjusted for provincial variations in prices.[1] When it was necessary to measure industry output in real terms, it was done by deflating the provincial industry data by the national implicit price deflators of the same industries.

Interprovincial comparisons of nominal dollar values of industry output per worker would not have biassed the results if all markets had been perfectly competitive and if transport costs, market demand, and supply conditions had been the same in all provinces. Needless to say, they were not.

The potential bias of estimating provincial output in nominal dollars may not be quite as serious as it may seem at first glance. Assuming for the moment that there was only one central market for industries anywhere, transport costs would be higher for industries located further away, along the periphery, than for those close to the central market. After allowance for transport costs, industries at the periphery would have to pay more for their resource inputs and receive less for their outputs. This would lower the nominal value of output per worker in the peripheral region relative to the central market. But, in Canada, not all industry output is shipped to one central market. The West, for example,

1 For appropriate procedures of price deflation see, for example, E. C. West, *Canada-United States Price and Productivity Differences in Manufacturing Industries, 1963*, Economic Council of Canada Staff Study 32 (Ottawa: Information Canada, 1971).

has its own markets and industries located there may well have — aside from real productivity differences — a competitive advantage over industries trying to compete with them from central Canada. Indeed, if it were not for returns to scale, preferential freight rates and, perhaps, some oligopolistic powers, prices in the West might be so much higher that it would raise the nominal value of output per worker well above the level of the central provinces. This would run counter to the earlier hypothesis and partly, at least, cancel the bias that may come from valuing output in nominal dollars. Obviously, these hypotheses can only be tested when price data of industry inputs and outputs become available.[2]

The data sources for the "value-added" estimates of industry output are summarized by major industries below.

Industry	Source of Data
Agriculture	*Survey of Production*, Statistics Canada cat. no. 61-202.
Forestry	*Logging*, Statistics Canada cat. no. 25-201 for the years prior to 1972, and *Canadian Forestry Statistics*, Statistics Canada cat. no. 25-202 for the years 1972 and 1973.
Fishing	*Survey of Production*, Statistics Canada cat. no. 61-202.
Mining	*General Review of the Minerals Industry*, Statistics Canada cat. no. 26-201.
Manufacturing	*General Review of the Manufacturing Industries*, Statistics Canada cat. no. 31-203.
Construction	*Survey of Production*, Statistics Canada cat. no. 61-202.
Transportation, storage, communications and utilities	Estimated on the basis of wages and salaries, interest charges, and depreciation of capital stock.
Wholesale and retail trade	Estimated on the basis of wages and salaries, interest charges, and depreciation of capital stock.

2 It is likely that the results will differ significantly among industries since interprovincial competition can be expected to differ between producers of durables and nondurables.

Finance, insurance, and real estate	Estimated on the basis of wages and salaries, interest charges, and depreciation of capital stock
Government administration	Estimated on the basis of wages and salaries, interest charges, and depreciation of capital stock.

As indicated, estimates of output of the service industries were based on the dollar value of wages and salaries plus interest and depreciation allowances for capital stock. It was assumed that the value-added output of the service industries matched at least these major cost items, an assumption that may have led to under- or overestimation of the real output of the service industries. Given the more adequate data base of the other industries, it is likely that estimates of the goods-producing and manufacturing industries, presented separately in Chapters 3 and 4 of the text, were more realistic than those of the service industries.

Employment Data

Statistics Canada publishes three major series of employment data by province and industry:

- The Labour Force;
- Estimates of Employees by Province and Industry;
- Industry-Specific Annual Reviews.

Statistics of *The Labour Force* survey are based on a monthly sample of 30,000 households. The survey is designed to represent all persons in the population 14 years of age and over, and counts as being employed anyone who worked for pay or profit, or who contributed to the operation of a farm, or who had a job but was not at work because of illness, industrial dispute, bad weather, or was taking time off for other reasons.[3]

Estimates of Employees by Province and Industry are based on four sources: monthly employment and payrolls of establishments employing 20 or more persons, a rotating sample of establishments employing fewer than 15 workers, a complete survey of establishments with 15 to 19 employees, and a variety of data sources that cover the remaining industries, such as health, education, and public administration.[4]

3 Statistics Canada, *The Labour Force*, May 1974, p. 96.

4 Statistics Canada, *Estimates of Employees by Provinces and Industry, 1961-1968*, cat. no. 72-508, p. 5.

Industry-Specific Annual Reviews provide employment data together with other data, such as wages and salaries, dollar value of shipments, costs of fuel and electricity, purchases of material inputs, and dollar value added.

This third data set were selected over the other two. A comparison of the three data sets of employment shows that the labour force survey data, disaggregated by industry and province, are far more unstable than the other two series. The latter series run more closely in line and nearly coincide for some of the industries, such as manufacturing. Moreover, their sampling errors are generally smaller than those of the labour force survey, at the disaggregated levels of industries and provinces. Wherever possible, industry-specific annual reviews are given preference over the other two data sets, since they provide at the same time internally consistent dollar values of wages and salaries, inputs and outputs.

The relevant data sources, used for estimates of employment in this study, are:

Industry	Source of Data
Agriculture	*Labour Force Survey*, Statistics Canada, special tabulations.
Forestry	*Logging*, Statistics Canada cat. no. 25-201 for the years prior to 1972, and *Canadian Forestry Statistics*, Statistics Canada cat. no. 25-202 for the years 1972 and 1973.
Fishing	*Fisheries Statistics of Canada*, Statistics Canada cat. no. 24-201.
Mining	*General Review of the Minerals Industry*, Statistics Canada cat. no. 26-201.
Manufacturing	*General Review of the Manufacturing Industries*, Statistics Canada cat. no. 31-203.
Construction	*Construction in Canada*, Statistics Canada cat. no. 64-201.
Transportation, storage, communications and utilities	*Estimates of Employees by Province and Industry*, Statistics Canada cat. no. 72-514.
Wholesale and retail trade	*Estimates of Employees by Province and Industry*, Statistics Canada cat. no. 72-514.

Finance, insurance, and real estate	*Estimates of Employees by Province and Industry*, Statistics Canada cat. no. 72-514.
Public administration	*Federal Government Employment*, Statistics Canada cat. no. 72-004; *Provincial Government Employment*, Statistics Canada cat. no. 72-007; *Local Government Employment*, Statistics Canada cat. no. 72-009.

Some of the data series required intermediate computations for derivation of the necessary employment estimates. At the federal level, employment estimates for Public Administration, for example, were obtained by separating the employment of Crown Corporations (agency corporations, proprietory, and other agencies and corporations) from administrative employment (departments and departmental corporations). At the provincial level, they were obtained by separating employment of institutions of higher education, government enterprises, and workmen's compensation boards from that of administrative employment in public services. This was necessary to avoid double counting of employment included in other industries.

Other Data

Statistics of wages and salaries were obtained from the industry-specific annual reviews whenever possible. Estimates for agriculture were derived by multiplying the value added in production by its labour share.[5] Similarly, estimates of wages and salaries were based on the labour share of value added in the fishing industry.[6] Data for wages and salaries of the service industries were obtained from the CANSIM data bank of Statistics Canada except for Public Administration, which came from the same source as the employment estimates described in the previous section.

Data of capital stock, labour quality, as well as data for manufacturing industries were made available by Statistics Canada in special tabulations. These tabulations contained only nonconfidential data.

5 Labour and capital shares are given in "Market Commentary: Canadian Agricultural Outlook Conference Report", Agriculture Canada, Economics Branch, Communications Unit, December 1975, p. 58.

6 Labour share values are based on *Survey of the Canadian Sea Fishing Industry, 1965*, Statistics Canada cat. no. 24-501, which gives estimates of wages and owners' cash withdrawals, as well as estimates of value of production.

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Summary

From international experience it is known that industrial structure, quality of labour, capital per worker, management and technology are important factors in explaining variations in per capita incomes among nations. In this study, the same factors are used to explain variations in industrial productivity among the Canadian provinces. The study shows that management, technology, and quality of the work force are very important factors contributing to provincial variations in industrial labour productivity and that industrial structure is a less significant factor than often alleged. It also shows that more capital, if combined with other inputs, can raise the level of industrial productivity but that it is not likely to solve the productivity problem of Canada's low income provinces. To achieve that, other measures would be needed.