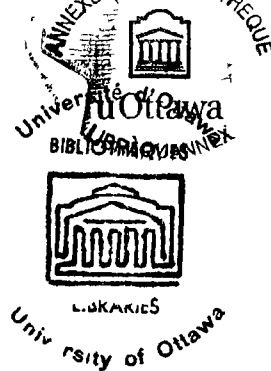


Labour Contributions to Regional Economic Growth

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Preface

Studies of regional income disparities and income growth rate differences have generally consisted of descriptive analyses, covering a large number of variables or a few strategic factors that might conceivably affect income parameters. In sharp contrast, macro studies of the national economy have generally been analytical and quantitative in nature.

This dichotomous anomaly is analogous to the situation that formerly prevailed, with regard to international trade theory, where the erroneous assumption was often made that an analysis of exchange between countries, on the one hand, and exchange within countries, on the other hand, required different analytical tools.

In this study, the macro analytical framework developed by Edward F. Denison is applied to the regions of Canada, in order to explain income level and growth rate differences. Although the estimates and analyses concentrate on labour and labour productivity contributions, some consideration is also given to other sources.

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Chapter One

Introduction

Although the use of production functions as a framework for analysing economic growth dates back to Adam Smith,^{1/} their use in the quantification of growth sources is of recent origin. "An historical play about growth models might consist of three acts: in the first, labour supported by an invisible chorus of capital, land and technological progress, holds the stage; in the second, capital and labour exchange roles. Finally, in the third act now being performed, labour capital (and sometimes land) and technological progress appear on the stage together, with the first two (or three) reading from the script while technological progress holds forth the rest of the time'^{2/}

This state of affairs, as of 1961, was largely due to the inappropriate specification of factor inputs and to the measurement of an insufficient number of other variables contributing to the growth process. As Griliches has pointed out, "conventionally derived residual measures of productivity growth are viewed not as measures of technological change but rather as the result of errors in the measurement procedure. These 'errors' are due to several sources:

1. the list of variables affecting output may be misspecified, excluding some relevant factors from the calculations;

^{1/} Smith of course only used production functions implicitly.

^{2/} Evsey D. Domar, "On the Measurement of Technological Change," Economic Journal, December, 1961.

2. changes in included variables may be mismeasured, particularly if changes in their quality are disregarded;
3. wrong weights may be used in estimating the contribution of changes in individual inputs to the growth in output."^{1/}

Since the time of Domar's article, a number of economists have been writing a fourth act, in an attempt to improve the measurement of factor inputs and to quantify the remaining sources of economic growth. The most ambitious attempts to quantify all the important source of economic growth have been made by Edward F. Denison in two important studies.^{2/}

Although Denison's work has been severely criticized by some, especially Abramovitz,^{3/} in his review of the American study, others, such as Harrod ^{4/} and Mathews,^{5/} in their reviews of the European study, have pronounced it "excellent" and "monumental" respectively. The Denison method of quantifying the sources of economic growth and income levels has been most favourably received in Canada.

^{1/} Zvi Griliches, "The Sources of Measured Productivity Growth: United States Agriculture, 1940-60", Journal of Political Economy, August 1963, p. 332.

^{2/} Edward F. Denison, The Sources of Economic Growth in the United States and the Alternatives Before Us, New York, Committee for Economic Development, 1962, and Why Growth Rates Differ: Postwar Experience in Nine Western Countries, Washington, Brookings, 1967.

^{3/} Moses Abramovitz, "Economic Growth in the United States," American Economic Review, September 1962, pp. 762-82.

^{4/} R. F. Harrod, "Review of Denison's Study," Economica, August 1969, pp. 323-25.

^{5/} R. C. O. Matthews, "Why Growth Rates Differ", Economic Journal, June 1969, pp. 261-68.

The first Canadian study to (partially) use the Denison methodology was Lithwick's analysis^{1/} of Canadian economic growth. The Economic Council of Canada has produced a study^{2/} of Canadian income levels and growth that parallels Denison's European study. The present work extends the analyses to the five regional economies^{3/} of Canada, covering the contribution of four labour measures and labour productivity to the level and growth of regional income. The unavailability of reliable regional capital stock estimates and other data necessitate concentrating on these five sources of economic growth, although limited analysis of some components of labour productivity is attempted.

The spacial analysis relates to the year 1961. The analysis over time concentrates on the 1951-66 period, although estimates are also provided for two sub-periods, 1951-61 and 1961-66. The contributions to both total and per employee income growth are measured.

Chapter Two covers quantitative estimates of regional income and employment. The three subsequent chapters present qualitative estimates of the volume of annual hours worked, the composition of annual hours worked and the stock of education.

^{1/} N. H. Lithwick, Economic Growth in Canada: A Quantitative Analysis, Toronto, University of Toronto Press, 1967.

^{2/} D. Walters, Canadian Income Levels and Growth: An International Perspective, Ottawa, Economic Council of Canada, 1968.

^{3/} The geographic areas covered by the regions correspond to popular usage; they were, however, selected for statistical reasons.

Chapters Six and Seven bring together the estimates of previous chapters to measure the contributions of labour and labour productivity to the level and growth of regional income and the regional contributions of labour and labour productivity to Canadian economic growth, respectively.

Chapter Eight compares the results of this study with Denison's estimates for nine foreign countries and the Economic Council's estimates for Canada. The concluding Chapter provides a brief summary and draws some conclusions.

Chapter Two

Income and Employment

The purpose of this study is to account for the labour and labour productivity contributions to the level and growth of regional income and, in turn, the regional labour and labour productivity contributions to Canadian economic growth. Although national income data are readily available from published sources, there are large gaps in regional income coverage. In addition, some of the available national and regional income data are not in a form suitable for growth analysis. Consequently a number of income estimates must be made.

This chapter provides estimates of regional income, in terms of per employee regional income, expressed as a percentage of the Canada level in 1951, 1961 and 1966; the growth in regional income over the 1951-66 period and two sub-periods, both in aggregate and per employee; and regional distributions of Canadian labour income in 1961 and over the above years. Estimates of employment change during the same periods are also provided.

In analyzing aggregate economic activity, a number of comprehensive measures are available, such as net national product or gross national product, national or domestic product, valued either in terms of factor costs or market prices. Denison has argued strongly for the use of net national income at factor cost. ^{1/} The essential point is that the goal of economic policy relates to the maximization

^{1/} Edward F. Denison, op. cit., pp. 14-16.

of national factor returns. On this assumption, capital consumption and government taxes, both positive and negative, and the income of foreigners are not maximization objectives. Estimates of real net regional income at factor cost, therefore, form the basis of the income measures used in this study.

The official measure of net national income at factor cost is in current dollars and pertains to the country, as a whole. Most of the components of this income measure are also available regionally. Estimates of regional corporate income were however required; these measures were derived by simply making them a function of labour income. The mixed incomes, such as farm income, were estimated on a functional basis, by using the ratio of labour income to total corporate income. The Implicit Price Index was used to convert each regional estimate from current dollars to constant 1957 dollars. The use of a national deflator to remove price effects from regional income assumes that aggregate price movements are the same in all regions. Although this is probably not true, as indicated by regional (city) consumer price indices, serious biasness should not be introduced, as a result of its use.

In addition, adjustments for unemployment were made, to make the comparisons on a potential income basis, and for the erratic fluctuations in farm income, in the Prairies, to "normalize" this source of income. The estimates of real net regional income at factor cost for the year 1951, 1961 and 1966 are contained in Appendix A (Table A-1), along with a more detailed explanation of their derivation.

Income Levels

Table 2-1 presents estimates of potential real net regional income per employee in 1951, 1961 and 1966, based on Canada 100. While the estimates are subject to certain limitations, especially with regard to the 1961 estimates, as elaborated on in Appendix A, they are considered to reflect general orders of magnitude. Prior to the recent revision of the National Accounts, the initial estimates prepared for this study were broadly confirmed by data compiled by Denton. ^{1/}

Although income relatives are shown for three specific years, only 1961 estimates are subsequently used in the spacial analysis of Chapter Six. The additional data are provided, as an alternative to the income growth rates shown below, to highlight the changes taking place in the regions of Canada.

Between 1951 and 1966, the years which provide the most reliable comparison, per employee income relatives in Ontario have been quite stable, while significant improvements have taken place in the Atlantic and Quebec regions, with a consequent sharp decline in the Prairies and British Columbia.

^{1/} Denton made estimates of relative actual average earned income per person employee for the 1961-64 period. The recent revisions to the National Accounts change his estimates substantially, especially with regard to the improved position of Quebec. See Frank T. Denton, An Analysis of Interregional Differences in Manpower Utilization and Earnings, Staff Study No. 15, Ottawa, Economic Council of Canada, 1966, p.9.

Table 2-1
Regional Income Levels Per Employee, 1951-66^(a)
 (Canada = 100)

Region	1951	1961	1966
Atlantic	74.7	83.9	79.2
Quebec	88.7	97.8	94.4
Ontario	109.5	106.8	110.6
Prairie ^(b)	103.2	89.2	91.5
British Columbia	119.4	116.3	108.8
Canada ^(b)	100.0	100.0	100.0

(a) Net regional income at factor cost, adjusted to represent potential income

(b) Each estimate is predicated on a five year average of farm income in the Prairies

Source: Derived from Table A-1 in Appendix A

Over this period, the per employee income level in British Columbia dropped from a level of over 19 per cent above the Canada average to slightly under nine per cent while the Prairies fell to a level well below the Canada average from a position of somewhat above it. The latter's level, as of 1966, was below the Quebec level. These declines are reflected in the higher relatives shown for the Atlantic and Quebec regions. In 1966, Quebec was only about five per cent below the national average, while the Atlantic region, notwithstanding some improvement, was still about 20 per cent below.

The above comparisons are on a production basis, while the usual comparisons are made on a welfare basis. However, as indicated by the Economic Council of Canada,^{1/} per capita regional income levels are also converging, in a manner similar to the trends shown in Table 2-1.

In subsequent chapters, the quantity and quality of labour input will be measured and used to explain the 1961 income differences, in terms of differential labour contributions and variations in labour productivity.

Income Growth, 1951-66

Growth rates of income, both in total and per employee for each region, are shown, for 1951-1961, 1961-1966 and the period as a whole, in Table 2-2. In the 1951-1961 period, only Quebec and British Columbia had higher growth rates in total income than the whole country while the Prairies had a lower growth rate; over the 1951-1966 period, Ontario replaced Quebec and together with British Columbia were the only two regions with growth rates above the Canada average. Over the whole period, Quebec, Ontario and British Columbia maintained the highest growth rates.

^{1/} Economic Council of Canada, Sixth Annual Review: Perspective 1975, Ottawa, Queen's Printer, 1969, p. 152

Table 2-2
Average Annual Compound Growth Rates of Real Net
Regional Income, 1951-66
(per cent)

<u>Region</u>	<u>Total</u>			<u>Per Employee</u>		
	51-61	61-66	51-66	51-61	61-66	51-66
Atlantic	4.9	3.5	4.4	4.2	0.9	3.1
Quebec	5.7	5.4	5.6	4.0	1.3	3.1
Ontario	5.0	6.0	5.3	2.8	2.8	2.8
Prairie	3.3	4.6	3.7	1.5	2.6	1.9
British Columbia	5.3	5.7	5.4	2.7	0.7	2.1
Canada	4.9	5.4	5.0	3.0	2.0	2.7

Source: Derived from Tables A-1 and C-1 in Appendix A and C.

A somewhat different picture emerges, when the comparisons are made in terms of net regional income per employee. Apart from Ontario and the Prairies recording the highest growth rates during the 1961-66 period, the Atlantic and Quebec regions attained the highest growth rates in the 1951-1961 and over the period as a whole.

These growth rates compared favourable with the U.S. but lagged significantly behind European per employee growth rates.^{1/}

^{1/} Some idea of how the regions of Canada fared in an international perspective may be obtained by comparing the above 1951-66 growth rates with the following American and European rates, covering the 1950-62 period:

<u>Area</u>	<u>Total</u>	<u>Per Employee</u>
U.S.	3.4	2.2
Europe	4.7	3.7

An attempt will be made to explain these differential growth rates, in terms of labour input and labour productivity, in subsequent chapters. This will require estimates of labour income shares and the growth rates of labour inputs. A regional distribution of Canadian income follows. This chapter concludes with estimates of the changes in regional employment during the 1951-66 period, while subsequent chapters measure other components of labour input.

Labour Income Shares

The marginal productivity theory of income distribution suggests that factors of production are remunerated in proportion to their contribution to total income. Thus, if labour income represents 77 per cent of national income, under constant returns to scale, a 1 per cent increase in income could be ascribed to capital and labour in the proportions of 23:77. The assumption that factors of production are rewarded according to the value of their marginal product implies the further assumption of pure competition in all markets, clearly a rather far reaching, if not unacceptable, assumption, though its use has been well established in the literature.

However, "the reasons for believing that in periods of full utilization of available resources, relative marginal value products fairly closely approximate proportionality to relative earnings are compelling. The incentive (and in most situations the pressure) for enterprises or other producing units to combine factors in a way that will minimize costs is pervasive and strong, and in the long run the opportunity to do so is generally present. One chief task of any entrepreneur or manager in a private, free enterprise sector of an economy is to maximize profit by finding the combination that yields

the desired result at the lowest cost. His enterprise will be at a competitive disadvantage if he is less successful than his competitors in doing so. Although ignorance, poor foresight, and time lags cause departures from proportionality in particular situations, these may in general be expected to be random, rather than biased in such a way as to raise or lower the relative returns to labour, capital and land, and to particular types of these factors, in the economies as a whole." 1/

Table 2-3

Labour Shares of National Income, Selected Years

(per cent)

Region	1961	1951 - 1961	1961 - 1966	1951 - 1966
Atlantic	5.9	5.8	5.5	5.6
Quebec	21.3	20.5	20.4	21.2
Ontario	32.2	31.9	32.2	32.4
Prairie	12.6	13.2	13.0	12.3
British Columbia	8.1	8.0	8.0	8.2
Canada	80.1	79.4	79.1	79.7

Source: Derived from Table A-1 in Appendix A

1/ Ibid., p. 35 .

The fact that the economy does not operate under conditions of "pure" competition implies that there are monopoly profits, part of which should be classified as a labour component. As a result of monopoly returns, the labour share of national income may be understated, somewhat. There may be, however, offsetting factors, such as the labour share containing some entrepreneurial capital income.^{1/} The net result is not important, as a small change in the income weights has only a marginal effect on the measured contribution of a particular factor, when income shares are used.

The above considerations have led a number of economists to employ factor shares in conjunction with factor growth rates to determine factor contributions to economic growth. The same approach is used in this study to measure contributions to regional economic growth, to measure contributions to regional income differentials and to measure regional contributions to Canadian income levels and growth.

Table 2-3 provides estimates of the labour share of national income in Canada by region over the period 1951-66 and two sub-periods, as well as for 1961. Over the 1951-61 period, the shares have been fairly stable, with only a small deterioration in the share obtained by the Atlantic and Prairie regions and an equivalent gain in the shares obtained by the remaining regions, as indicated by a comparison of the

^{1/} P. Studenski in The Behaviour of Income Shares, New York, National Bureau of Economic Research, 1964, pp. 98-9

two sub-periods. In terms of the proportion of national income going to labour and capital income, a somewhat higher share has been going to the former during the latter part of the 1951-66 period.^{1/}

Employment, 1951-66

With labour obtaining approximately 80 per cent of national income, manpower is easily the most important input, in accounting for both its level and growth. In his studies of growth, Denison employed a sequential approach in measuring labour input. Along with the quantitative aspect of employment, three qualitative components of labour input are specified: annual hours, age-sex compositions of annual hours and education.^{2/} This chapter also measures employment growth, with the remaining three aspects of labour input contained in the next three chapters. The qualitative measures employ 1961 weights but have 1951 as the base year.

Table 2-4 contains employments data, in percentages terms, for each region in Canada, covering the years 1951, 1961 and 1966. The Atlantic and British Columbia regions had the lowest and highest employment changes respectively. Quebec employment grew at a lower

^{1/} The estimated Canada labour share of 79.4 per cent for 1951-61 can be compared with Denison's and Walter's estimate over the period 1950-62 of 78.6 and 75.3 for the U.S. and Canada respectively. The latter's estimate was made prior to the recent revision of the national accounts. The initial estimate made for this study indicated a labour share of 76.4 per cent.
See Dorthy Walters, op.cit., p. 29

^{2/} Although the latter three measures are expressed in quantitative terms, they are described as qualitative, because standardization adjustments have been made to them.

rate initially, but had a high rate during 1951-66. Ontario's employment grew at a slightly faster rate than the Canada average while the Prairies employment growth, especially during the 1951-66 period, was much slower. Subsequently, these employment indices will be converted to growth rate form, to measure their contributions to regional and Canada income growth.

Table 2-4
Employment Growth, 1951-66^(a)
(1951 = 100)

Region	1951	1961	1966
Atlantic	100.0	106.1	120.8
Quebec	100.0	116.7	142.0
Ontario	100.0	123.5	143.9
Prairie	100.0	118.7	131.2
British Columbia	100.0	127.4	162.0
Canada	100.0	119.4	140.3

(a) Includes military and civilian employment.

Source: Derived from Table C-1 in Appendix C.

When compared to American and European employment growth, most of these regional rates are seen to be exceptionally high.^{1/} The higher regional employment growths result from a combination of four elements: natural population growth, net immigration, labour force participation growth and trends in the employment ratio.

This Chapter has provided regional estimates of the level, growth and distribution of income in Canada, as well as changes in employment. In subsequent chapters, the growth of other labour inputs will be quantified, in order to measure labour and labour productivity contributions to income levels and growth.

^{1/} See Edward F. Denison, op. cit., p. 52 for similar data covering the United States and eight European countries; see also Chapter Eight below, for a comparison of employment contributions to regional, American and European income growth rates.

Chapter Three

Annual Hours

This chapter presents estimates of inter-regional differences in annual hours worked in 1961 and the changes that have taken place in annual hours worked over the 1951-66 period. Estimates initially pertain to the total number of actual hours, in the form of indicies. Adjustments are then made to convert them to "effective" annual hours, on the assumption that hours worked are not necessarily composed of homogeneous elements.

The concept of effective annual hours is based on the assumption that the "Law of Diminishing Marginal Physical Productivity" comes into play, when the volume of hours worked per week exceeds a certain level. Thus, at a high level, say 80 hours per week, a reduction in hours worked by 10 per cent would, according to the above Law, reduce output by a smaller proportion. The converse can be true, as well, depending on the pattern of the relationship assumed.

Level of Annual Hours

Table 3-1 contains estimates of differences in regional civilian annual hours worked by sex and three employment classes (all part-time employees, full-time non-farm paid workers and full-time, other than non-farm paid workers). These indices are predicated on the hours input of people at work during survey weeks and adjustments, to represent actual hours worked by persons employed throughout the year. The derivation of these estimates is explained in Appendix B.

Table 3-1
Indices of Average Annual Civilian Hours of Work, 1961
(Canada = 100)

<u>Region</u>	<u>Part-time</u>			<u>Full-time</u>						<u>Total</u>		
				<u>Non-farm paid workers</u>			<u>Other than Non-farm paid workers</u>					
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Atlantic	100.0	105.0	103.2	104.8	104.4	104.6	100.2	101.2	100.4	103.4	104.3	103.6
Quebec	110.1	116.1	113.4	102.9	102.5	102.7	100.9	100.7	100.9	102.7	103.4	102.8
Ontario	96.8	97.1	96.8	98.3	98.5	98.3	99.7	100.7	99.7	98.5	98.4	98.5
Prairies	97.4	93.4	94.7	99.0	98.5	98.8	101.2	98.2	101.1	99.9	97.7	99.5
British Columbia	93.0	95.4	94.2	95.3	97.3	95.7	92.8	97.8	93.4	94.7	97.1	95.3
Canada	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: See Appendix B for derivation.

In general, annual hours worked per employee in the Atlantic and Quebec region are somewhat higher than the Canada level, while the British Columbia level is almost 5 per cent lower. The level in the Prairies may be unrepresentative of "normal years", due to the relatively low volume of farm output in 1961.^{1/}

Qualitative Level

Although the volume of hours worked has usually been treated as homogeneous in most growth and productivity studies, Denison, in particular, has made a strong case for not accepting this assumption.^{2/} Following Denison, as described in Appendix B, it is assumed that at the Canada levels in 1961, small differences in hours worked by male and female full-time non-farm paid workers in each region are partially offset in output per man-hour. Thus, relative hours worked in the Atlantic and Quebec regions are qualitatively below the Canada average while the converse is true in other regions. In the case of hours worked by full-time other than non-farm paid workers, complete productivity offsets were assumed for the level of hours above the Canada average and vice versa for those below this level. This

^{1/} Estimates of relative annual hours by Denton, based on two weeks in 1964, indicate that hours worked were highest in the Prairies. His estimates for each region are as follows: Atlantic 102.6, Quebec 101.9, Ontario 98.1, Prairies 104.3 and B.C. 91.7. See Frank F. Denton, op. cit., p. 8

^{2/} See Edward F. Denison, op. cit., pp. 59-66.

Table 3-2
Indices of Effect of Differences in the Length of
Hours Worked on the Quality of Labour per Hour and Year, 1961
(Canada = 100)

<u>Region</u>	<u>Actual annual hours worked</u>			<u>Quality index of an hour's work</u>			<u>Quality index of a year's work</u>		
	Full-time non-farm paid Workers	Civilian	Total	Full-time non-farm paid Workers	Civilian	Total	Full-time non-farm paid Workers	Civilian	Total
Atlantic	104.6	103.6	103.4	98.2	98.5	98.6	102.7	102.0	101.9
Quebec	102.7	102.8	102.8	99.0	99.0	99.0	101.7	101.8	101.8
Ontario	98.3	98.5	98.5	100.6	100.5	100.5	98.9	99.0	99.0
Prairies	98.8	99.5	99.6	100.4	99.9	99.9	99.2	99.4	99.5
British Columbia	95.7	95.3	95.9	102.0	101.7	101.7	97.6	96.9	97.5
Canada	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: See Appendix B for derivation .

assumption, in effect, means that the quality of a year's work of full-time agricultural workers, non-farm proprietors and family workers is not affected by differences in annual hours.^{1/} No adjustments were required for hours worked by part-time workers.

Table 3-2 contains estimates of the differences in actual hours worked by region and the quality adjustments required to arrive at the relative quality of a year's work per employee for full-time non-farm paid workers, all civilian workers and the total labour force (including military personnel).

The overall effect of the productivity offset assumptions is to reduce the differentials between regions. The convergence of effective relative annual hours towards the Canada average was obtained by reducing actual relative annual hours in the Atlantic and Quebec regions and raising them in the remaining regions.

In terms of effective annual hours per employee, in 1961, the Atlantic and Quebec regions were almost 2 per cent above the Canada average; Ontario and the Prairie regions were slightly below while British Columbia was 2.5 per cent below. These percentages suggest the regional differences in the qualitative volume of annual labour input, ascribable to hours of work.^{2/}

^{1/} For justifications of this assumption, see ibid., p. 62

^{2/} The estimates made by Walters indicate that effective annual hours were 4.5 per cent higher in Canada than the U.S. level in 1960. This implies that longer effective hours are worked in all regions of Canada, in comparison with the U.S. See Dorothy Walters, op. cit., p. 41.

Table 3-3
Indices of Average Annual Hours Worked
by Non-farm Paid Workers, 1951-66

(1951 = 100)

<u>Region</u>	<u>Male</u>				<u>Female</u>			
	<u>Full-time</u>		<u>Part-time</u>		<u>Full-time</u>		<u>Part-time</u>	
	1961	1966	1961	1966	1961	1966	1961	1966
Atlantic	94.1	96.2	86.9	86.9	91.9	92.6	86.5	82.5
Quebec	94.6	93.5	87.0	86.6	96.1	93.7	86.9	83.7
Ontario	95.6	96.5	86.9	88.8	96.0	95.0	87.0	88.9
Prairies	96.0	98.2	87.5	83.7	95.7	95.3	87.8	84.3
British Columbia	97.3	99.4	87.4	85.4	97.8	97.2	87.9	87.4
Canada	95.2	95.6	87.1	86.4	95.7	94.4	87.2	86.4

Source: See Appendix B for derivation.

Changes in Actual Annual Hours Worked

Changes in actual annual hours worked by non-farm paid workers, covering both part-time and full-time workers by sex, comparable to the cross-sectional indices, are contained in Table 3-3; totals are shown in Table 3-4, for all non-farm paid workers. In terms of the totals, the Atlantic regions showed the greatest decline in hours worked between 1951 and 1961 while British Columbia recorded the lowest decline. These declines may be due to structural shifts in the economy as a result of the labour force, in effect, "purchasing" more leisure, at the expense of income, or to cyclical factors, or a combination of both.

Between 1961 and 1966 only Quebec continued the downward movement in average hours worked, which offset the increase in other regions, such that the Canada average remained the same. The hours worked by full-time females in Quebec declined sharply (Table 3-3).

Changes in Effective Hours

Table 3-4 also contains estimates of the quality of an hour's work for all non-farm paid workers, needed to adjust the actual annual hours indices to arrive at time series estimates of the quality of a year's work for this type of worker. The same productivity offset assumptions are employed here, as in the case of the spacial indices. Changes in the hours worked by other employee classes were not required, on the assumption that alterations in hours worked by these groups had no effect on output, and were therefore set at 100 in all years, as were done for the spacial estimates. The indices for both groups were combined to determine the quality of a year's work for total employment.

Table 3-4
Quality Indices of a Man-Year's Work as
Affected by Changes in Annual Hours of Work, 1951-66
(1951 = 100)

<u>Region</u>	<u>Non-farm Paid Workers</u>						<u>Total Employment</u>	
	<u>Average hours per person employed</u>		<u>Quality of an hour's work</u>		<u>Quality of a year's work</u>		<u>Quality of a year's work</u>	
	1961	1966	1961	1966	1961	1966	1961	1966
Atlantic	92.8	94.5	104.0	103.1	96.3	97.4	97.2	98.0
Quebec	94.4	93.0	102.8	103.4	97.0	96.2	97.6	96.9
Ontario	94.9	95.3	103.6	103.3	98.3	98.4	98.6	98.7
Prairies	95.0	96.0	103.2	102.7	98.0	98.6	98.8	99.0
British Columbia	96.7	97.5	100.1	99.8	96.8	97.3	97.4	97.8
Canada	94.8	94.8	102.8	102.9	97.5	97.5	98.1	98.1

Source : See Appendix B for derivation .

As the final estimates in Table 3-4 indicate, the quality of a year's work of the total labour force, in terms of the volume of effective annual hours worked, declined, in all regions, by less than 3 per cent between 1951 and 1961.^{1/} Between 1961 and 1966 there was a marginal rise in these hours for all regions, except Quebec, which had a marginal decline; the Canada total did not change.

Had the usual practice been followed of assuming that the total number of actual annual hours worked is homogeneous, the estimates in this study would indicate an approximate decline of 5 per cent between 1951 and 1966. However, on the basis of Denison's assumption, with respect to productivity offsets, the above decline does not reduce output by a corresponding amount. As a result of using Denison's quality adjustment methodology, the actual decline of 5 per cent is reduced to an effective decline of only about 2 per cent.

^{1/} The Canada decline of 1.9 per cent in effective annual hours for all employees between 1951 and 1961 may be compared with Denison's and Walter's comparable figures of 2.8 and 2.9 for the U.S. and Canada respectively, over the period 1950-1960, as indicated in ibid., p. 43.

Chapter Four

The Composition of Annual Hours

The composition of annual hours, in terms of the shares worked by different age-sex groups and the military, is one of the factors determining the quality of labour input. On the basis of marginal productivity theory, civilians of both sexes and different age groups and the military are remunerated according to their contribution to marginal product. As a result, the greater is the proportion of annual hours worked by the higher paid groups, the greater is output. This chapter measures the relative importance of the composition of annual hours worked for each region, in terms of Canada as the standard in 1961 and the changes that have taken place in each region over the 1951-66 period. The measurements are made by weighing distributions of annual hours by hourly earning relatives.

Distributions of Hours

Percentage distributions of annual hours worked by males and females in three age groups (under twenty, twenty to sixty-four and over sixty-four) and the military are shown in Table 4-1 for the years 1951, 1961 and 1966. These distributions are based on the average weekly hours estimates and employment distributions contained in Appendix C.

The general trend of the civilian component of annual hours indicates a shift away from the male categories to the female categories. Apart from the relative importance of hours worked by the military, in

Table 4-1
Percentage Distribution of Annual Hours
Worked by Civilian Age-Sex and Military Groups, 1951-66

<u>Region</u>	<u>Civilian</u>						<u>Military</u>
	<u>Males</u>			<u>Females</u>			
	-20	20-64	65+	-20	20-64	65+	
<u>1951</u>							
Atlantic	4.5	71.5	3.6	2.8	14.1	.3	3.2
Quebec	5.1	72.0	2.3	3.3	16.5	.2	.6
Ontario	3.5	70.5	3.5	2.6	17.6	.5	1.8
Prairie	4.5	74.7	3.8	2.1	13.1	.2	1.6
British Columbia	2.8	71.9	3.3	1.9	17.7	.4	2.0
Canada	4.1	71.9	3.3	2.6	16.2	.3	1.6
<u>1961</u>							
Atlantic	3.9	64.6	3.0	3.4	18.4	.7	6.0
Quebec	3.7	69.7	1.8	3.6	19.8	.4	1.0
Ontario	2.7	67.8	2.5	2.3	22.3	.6	1.8
Prairie	3.7	69.6	3.1	2.2	18.8	.4	2.2
British Columbia	2.3	69.4	2.4	2.0	20.8	.5	2.6
Canada	3.2	68.5	2.5	2.7	20.5	.5	2.1
<u>1966</u>							
Atlantic	3.9	65.6	2.0	3.4	20.3	.7	4.1
Quebec	3.6	67.6	1.7	3.4	22.5	.4	.8
Ontario	3.4	66.1	2.2	2.5	23.6	.6	1.6
Prairie	4.5	68.1	2.3	2.6	20.2	.4	1.9
British Columbia	3.8	67.7	1.8	2.7	22.1	.5	1.4
Canada	3.7	67.0	1.8	2.8	22.3	.5	1.7

Source: See Appendix C for derivation.

the Atlantic Region and the converse in Quebec, the general pattern of annual hours worked by the different age-sex groups has been quite similar in each region. The Canada distribution for 1961 contained in Table 4-1 is quite similar to the estimates prepared by Walters for 1960.^{1/}

Hourly Earning Weights

In order to combine each distribution of annual hours worked into a composite measure, hourly earning differentials are required that reflect the relative value of an hour's work of each category. Table 4-2 provides the necessary weights, with the earnings of males 20-64 years of age as a base, for Canada and her five regions. The Canada weights are appropriate for spacial comparisons while the weights of each region are used to derive intertemporal comparisons.

The differentials are somewhat greater in the Atlantic and Quebec Regions while Ontario has an exceptionally high military differential, due to the concentration of senior military officials in Ottawa. Except for the military relative, which is much higher, due to the longer service period and higher proportion of officers in Canada, the Canada relatives are almost identical with similar estimates prepared by Denison, for the United States, covering the year 1960.^{2/}

^{1/} These shares are as follows: males under 20, 3.3 percent; males 20-64, 69.0 per cent; males over 64, 2.6 per cent; females under 20, 2.7 per cent; females 20-64, 19.9 per cent; females over 64, 0.5 per cent and the military, 2.1 per cent. See Dorothy Walters, op. cit., p. 49.

^{2/} The U.S. relatives are as follows: males under 20, 31; males 20-64, 100; males over 64, 82; females under 20, 40; females 20-64, 59; females over 64, 47; and the military, 69. See Edward F. Denison, op. cit., p. 72.

Table 4-2
Hourly Earning Differentials, 1961
(males 20-64 = 100)

<u>Region</u>	<u>Civilian</u>						<u>Military</u>
	<u>Male</u>			<u>Female</u>			
	-20	20-64	65+	-20	20-64	65+	
Atlantic	28	100	75	36	54	43	95
Quebec	29	100	78	37	56	45	97
Ontario	32	100	83	40	60	48	156
Prairie	32	100	84	42	63	50	98
British Columbia	32	100	84	39	59	47	67
Canada	31	100	81	39	59	47	112

Source: See Appendix C for derivation.

Spacial Relatives

Table 4-3 provides estimates of the quality of an hour's work for each region, in relation to the Canada quality level, by combining the 1961 hours distributions in Table 4-1 with the Canada weights, in Table 4-2, and the U.S. relatives, contained in the preceding footnote, to obtain the first two and last column respectively. The essential difference between the two sets of quality indices covering total employment, largely derive from the higher military differential in Canada as compared with the U.S.

Table 4-3
Spacial Quality Indices of an Hour's Work,
as Affected by Age-Sex and Military Groups, 1961
 (Canada = 100)

Region	Civilian Employment (a)	Total Employment (a)	Total Employment (b)
Atlantic	99.1	100.2	96.9
Quebec	99.7	99.4	99.9
Ontario	99.8	99.7	99.9
Prairie	100.7	100.7	100.7
British Columbia	101.0	101.2	100.9
Canada	100.0	100.0	100.0

(a) Canada weights

(b) U.S. weights

Source: Derived from Tables 4-1, 4-2 and previous footnote.

The quality indices, covering total employment, based on Canada weights, are used in the remainder of this study. Only Quebec and Ontario are below the Canada average, with British Columbia having the most favourable level.

Intertemporal Relatives

The data in Tables 4-1 and 4-2 also provide the necessary information for the derivation of temporal quality indices of an hour's work, as affected by the distribution of annual hours. The quality adjusted indices, with each region based on its own weights, are contained in Table 4-4.

Table 4-4
Temporal Quality Indices of an Hour's Work,
as Affected by Age-Sex and Military Groups, 1951-66 (a)
 (1951 = 100)

Region	1961	1966
Atlantic	97.5	96.9
Quebec	99.3	98.1
Ontario	98.8	97.5
Prairies	98.2	96.9
British Columbia	98.8	97.1
Canada	98.8	97.5

(a) Each region's estimate based on its own weights.

Source: Derived from Tables 4-1 and 4-2.

The decline in the quality of an hour's work, in all regions, largely reflects the increased participation of women in the labour force. The most pronounced decline occurred in the Atlantic Region while Quebec experienced the lowest deterioration.

The decline in the quality of an hour's work in Canada over the 1951-61 period of 1.2 per cent compares with Walters' estimate of a decline of 1.3 per cent over the 1950-60 period.^{1/} The Walters' estimate is predicated on U.S. weights whereas the estimate in Table 4-4 uses Canada weights.

^{1/} Dorothy Walters, op. cit., p. 51.

Chapter Five
The Stock of Education

Educational attainment has a dual effect on the quality of labour in that "It conditions both the types of work an individual is able to do and his efficiency in doing it".^{1/} In terms of the three quality measures of labour input, it is the only positive source of income growth measured, in this study. This chapter measures the regional differences in education stock in 1961 and its growth over the 1951-66 period, for Canada and her regions.

Meaning of Education

Although economists from Adam Smith to Alfred Marshal have considered education as a form of capital formation,^{2/} investment in human beings has only recently become the subject of empirical investigations. The realization that "...the laborer is himself a produced means of production, an item of capital equipment",^{3/} suggests that education stock might be treated, in a manner similar to capital stock.

Because of statistical and methodological difficulties, the measurement of education is restricted to formal schooling. Although

^{1/} Edward F. Denison, op. cit., p. 78.

^{2/} See John Vaizey, The Economics of Education, London, Faber and Faber, 1962, pp. 15-25, for a discussion of how economists view education.

^{3/} Harry G. Johnson, The Canadian Quandary, Toronto, McGraw-Hill 1963, p. 249.

technical, commercial and vocational education are significant in their own right, their importance relative to formal education is probably small and their exclusion should not greatly affect the educational measures developed in this study.^{1/}

The basic notion of education is that it increases the productive ability of the labour force. In Denison's use and the one used here, it must be clearly differentiated from closely related concepts and measures:^{2/}

1. Society's stock of knowledge is distinguished from the educational quality of the labour force. The former affects the quantity of output obtained with a given input while the latter affects the quantity of input.
2. The ability of the labour force to apply the most efficient techniques of production, as a result of better education, is distinguished from "changes in the lag in the application of knowledge", resulting from "improvements in channels of information, opportunities to observe the practices of other firms or countries and changes in the age of the capital stock". The effect of the former only is considered under education, as reflected in income differentials. Improvements in the course content of formal education, on the other hand, are considered under the latter category.

^{1/} See Edward F. Denison, ibid., pp. 96-98, for a discussion of the importance of these forms of education.

^{2/} Ibid., pp. 78-82.

Table 5-1
Percentage Distribution of the Civilian Labour Force
by Sex and Years of School Completed, 1961

Region & Sex	No Schooling	Kindergarten & Elementary	Secondary		University	
			1-3	4-5	Some	Degree
<u>Males</u>						
Atlantic	3.1	48.8	34.2	7.0	3.7	3.2
Quebec	1.0	51.6	25.2	13.2	4.0	5.0
Ontario	1.1	41.4	30.7	17.4	3.9	5.5
Prairies	2.3	40.2	34.7	14.0	4.6	4.2
British Columbia	1.3	29.8	35.0	22.2	6.5	5.2
Canada	1.5	43.6	30.6	15.1	4.3	4.9
<u>Females</u>						
Atlantic	1.0	25.2	46.9	18.5	6.1	2.3
Quebec	0.5	37.5	31.0	23.7	4.3	3.0
Ontario	0.4	28.7	36.0	28.6	3.6	2.7
Prairies	1.0	26.0	39.3	24.2	7.0	2.5
British Columbia	0.3	17.7	35.4	34.7	8.7	3.2
Canada	0.6	29.4	36.0	26.3	5.0	2.7

Source: Based on 1961 Census of Canada data; see Appendix D for derivation.

3. An extension of schooling also affects employment, hours worked and age-sex compositions. These effects are not traced back to education. However, if increased education raises hours worked, this is counted as an effect of education.
4. In obtaining more education, the labour force forgoes experience. Therefore, the net effect of more education over the associated loss of experience is measured.
5. The increased versatility and mobility of the labour force, as a result of more education, are reflected in the educational measures.

The measurement of education input, as defined above, requires estimates of the volume of formal schooling for males, females and the military, education income weight to combine the levels of formal education and income share to combine these three labour force classes. The required estimates follow.

Educational Distribution

Table 5-1 contains regional percentage distributions of civilian labour force educational attainment for 1961. Similar estimates have been prepared for 1951 and 1966; these are contained in Appendix Tables D-1 and D-2. The pattern of the regional distribution is generally similar in each region, although the Atlantic and Quebec regions have a greater concentration of their labour force in the lower educational levels, but these same regions have also been improving at a faster rate, than the other regions of Canada, as shown below. British Columbia has consistently maintained the most

educated labour force.

Income Weights

Because members of the labour force with different levels of schooling constitute different amounts of input, weights are required to reduce each element to a comparable basis. Marginal productivity theory suggests that a college graduate earning twice the income of a high school graduate is equivalent to two units of the latter. In more general terms, the theory indicates that income is a measure of the relative importance of different units of education.

The 1961 DBS Census Population Sample provided mean incomes of males cross-classified by educational attainment and age groups, from which appropriate weights can be constructed. Mean income by educational category of labour force members, as a per cent of those with 1-3 years of secondary schooling, for four ten-year age groups, between 25 and 64, were averaged, to obtain the actual or unadjusted indices in Table 5-2. These indices can be used directly as weights, if education is considered the only factor determining income differentials. As this assumption represents a very distorted picture of reality, the initial indices require adjustments, to remove the effects of economic rent.

Allowance has already been made for differences in male incomes, as a result of age. There remains the requirement to take account of such influences as intelligence and family background, and to take account of female income differences. In his studies of

Table 5-2
Average Income Indices of 4 Male Age Groups, 1961
(Income of 1-3 years secondary school=100)

Region	No Schooling	Kindergarten & Elementary	Secondary 1-3	Secondary 4-5	University Some	University Degree
<u>Unadjusted</u>						
Atlantic	44	67	100	126	140	211
Quebec	45	77	100	132	155	222
Ontario	50	79	100	124	139	209
Prairies	36	77	100	119	131	208
British Columbia	47	84	100	114	127	207
Canada	44	77	100	125	140	214
<u>Rent Adjusted</u>						
Atlantic	66	80	100	116	124	167
Quebec	67	86	100	119	133	173
Ontario	70	87	100	114	123	165
Prairies	62	86	100	111	119	165
British Columbia	68	90	100	108	116	164
Canada	66	86	100	115	124	168

Source: Derived from Table D-3, Appendix D and reduction factor contained in text.

economic growth, Denison assumed that two-fifths of the earning differential between his male education groups was due to these factors.^{1/} The same reduction factor was applied to the actual indices of Table 5-2 to arrive at the rent adjusted series in the same table.

Although the reduction factor is predicated on a different base than that employed by Denison, who used those with grade eight as the control group, implying a somewhat greater reduction factor for this study, the overall effect is a small convergence of the final differentials.^{2/}

The same education weights are used for females, because of less reliable female income data. "Use of the same percentage differentials implies that absolute differentials are much smaller for females, since their average earnings are much lower."^{3/} 1961 Census

^{1/} See Edward F. Denison, op. cit., p. 84 for a discussion of empirical data supporting this assumption.

^{2/} The 1961 weights derived for Canada are similar to the 1949 weights used by Denison, ibid., p. 374. The U.S. weights shown below have been rebased and adjusted to reflect comparability with the Canada weights used in this study.

<u>School Completed</u>	<u>Canada</u>	<u>U.S.</u>
None	66	66
High School, 1-3	100	100
Some University	124	126
University Degree	168	163

^{3/} Ibid., p. 85.

data indicates that this is the case for Canada.^{1/} The small proportion of female income relative to male income as indicated below, suggests that any overstatement, resulting from the use of male weights, would only moderately affect the final results.

Labour Earnings

To obtain education quality indices (both spacial and temporal) for the entire labour force of each region, weighted averages of separately constructed indices for civilians of each sex and the military (held constant at 100) are required. Distributions of the labour share of net national income at factor cost, according to these three categories for each region, are used as weights. The regional distributions are shown in Table 5-3. The relatively small share, in each region, of national income distributed to the female labour force, reflects lower participation rates, coupled with lower average income levels, in relation to males.^{2/}

^{1/} J. R. Podoluk, Earnings and Education, Ottawa, Dominion Bureau of Statistics, 1965, p. 31.

^{2/} The 1961 estimates for Canada are similar to the 1960 Denison estimates for the U.S. (Denison, op. cit., p. 87), as indicated below:

	<u>Male</u>	<u>Female</u>	<u>Military</u>
Canada	80.8	16.7	2.5
U.S.	77.9	18.9	3.2

Table 5-3
Percentage Distribution of Labour Income by Sex
and Military Status, 1961

<u>Region</u>	<u>Civilian</u>		<u>Military</u>
	<u>Male</u>	<u>Female</u>	
Atlantic	79.2	14.5	6.3
Quebec	82.6	16.4	1.0
Ontario	79.6	17.3	3.1
Prairies	80.8	16.9	2.3
British Columbia	82.3	15.8	1.9
Canada	80.8	16.7	2.5

Source: Derived from Table D-4, Appendix D.

Spacial Education Stock

1961 education quality relatives, predicated on years of school completed and adjusted indices, to allow for days of school attended by the labour force, covering both civilian and total (including military) employment, are shown in Table 5-4. The former set of indices were derived from the educational distributions contained in Table 5-1, the rent adjusted Canada income weights of Table 5-2, and the earning distribution of Table 5-3. These indices were then adjusted to allow for the number of school days attended by the labour

force. The derivation of the educational measures is more fully explained in Appendix D.

The initial indices, based on years of school completed by the civilian labour force, change little, after incorporating adjustments to include the effects of school days attended and the military. The final indices, covering total employment and both years and days of school attended, indicate that the educational quality of the labour force in Quebec, Ontario and the Prairie regions is not greatly different from Canada as a whole. The most significant differences pertain to the Atlantic and British Columbia regions, with the former almost as low as the latter is high, relative to Canada.

As noted in Appendix D, the labour force, with grade eight education, is classified as having secondary education in Quebec and as having elementary education in the remaining regions, in the 1961 Census of Canada and in subsequent Dominion Bureau of Statistics publications.^{1/} This classification is also followed in this study, primarily because of statistical necessity. Greater consistency would only marginally effect the time-series comparisons, shown below, but the inconsistency does have some effect on the spacial comparisons. With a consistent classification, a rough calculation indicates that the Quebec level, in 1961, would be about 98.5, instead of the 99.2 shown

^{1/} Such as the Spacial Labour Force Studies series.

in Table 5-4. However, as the official educational attainment data are not entirely comparable, due to different educational systems in the regions, and for statistical considerations, the official classification has been followed.

Table 5-4
Education Quality Indices, 1961
(Canada = 100)

<u>Region</u>	<u>Based on years of school completed</u>		<u>Based on years of school completed and days of school attended per year</u>	
	Civilian	Total labor force	Civilian	Total labor force
Atlantic	96.7	96.9	96.0	96.3
Quebec	98.7	98.7	99.2	99.2
Ontario	100.9	100.9	101.1	101.0
Prairies	99.8	99.8	99.3	99.3
British Columbia	103.9	103.8	104.0	104.0
Canada	100.0	100.0	100.0	100.0

Source: See text for derivation.

As a check on the reliability of the spacial estimates, alternative estimates were prepared using:

1. U.S. weights (computed from Denison, Why Growth Rates Differ, Tables F-2 and F-3),

2. Expanded educational detail to include a breakdown of the primary education class into 1-4 and 5-8 years of education and a reallocation of those with 13 years of secondary education to those with some university education,
3. Incomes of those with 5-8 years of primary education as 100, with the same two-fifths reduction factor.

The civilian results, based on years of school completed, were very similar: Atlantic 95.8, Quebec 98.5, Ontario 101.4, Prairie 99.5, and British Columbia 104.1.

Intertemporal Education Stock

Table 5-5 presents similar estimates, covering the changes in education stock, over the 1951-66 period. Each region's estimate is based on its own income weights, as contained in Tables 5-2 and 5-3, and the educational distributions shown in Tables 5-1, D-1 and D-2. The same adjustments were made to the time-series as was made to the spacial comparisons, to account for the length of the school-year.

The growth in the education stock of the labour force suggests a narrowing of the education gap, shown in Table 5-4. Quebec and the Atlantic regions, followed closely by the Prairies, have shown the greatest improvement, while the remaining regions have lagged behind Canada. The average annual growth in the education quality of the total labour force over the 1951-66 period is as follows: Atlantic Region .76 per cent, Quebec .71 per cent, Prairie Region .69 per cent, Canada .64 per cent, British Columbia .55 per cent and Ontario .54 per cent.

Table 5-5
Education Quality Indices, 1951-66
(1951 and 1961 = 100)

<u>Region</u>	<u>Preliminary indices predicated only on years of school completed</u>			<u>Final indices allowing for changes in days of schooling per year of school completed</u>					
	1951	Civilian 1961	1966	1951	Civilian 1961	1966	Total labor force 1951	1961	1966
Atlantic	95.7	100.0	103.7	93.3	100.0	104.7	100.0	106.7	111.4
Quebec	97.1	100.0	104.0	94.8	100.0	104.9	100.0	105.4	110.6
Ontario	97.6	100.0	102.1	95.2	100.0	103.2	100.0	104.8	108.1
Prairies	96.4	100.0	102.8	94.0	100.0	103.8	100.0	106.3	110.3
British Columbia	97.2	100.0	101.9	95.0	100.0	102.9	100.0	105.2	108.2
Canada	97.0	100.0	102.9	94.6	100.0	103.9	100.0	105.6	109.6

Source: See text for derivation.

Chapter Six

Labour and Labour Productivity Contributions to the Level and Growth of Regional Income

In preceeding chapters, four aspects of the quantity and quality of labour were presented. These included employment, annual hours worked, the age-sex composition of annual hours and education. A number of other factors affecting the quality of labour, such as experience, effort and health have not been measured. Probably the most important of these is experience. This element has been reflected to some extent in the age-sex measure by the use of three age groups and in the educational estimates by allowing for the loss of experience in continuing education.^{1/} Denison's illustrative quality indexes for differences in experience within the 20-64 years labour force indicate relatively small differences between the United States and Western European countries.^{2/} If there is little difference between countries, one would not expect great variation between the regions of Canada.

Apart from the adjustments to annual hours for productivity offsets, resulting from changes in the volume of annual hours, no attempt has been made to measure work effort. As noted by Denison,

^{1/} The net benefits of education is obtained "...by basing the weights for individuals with different amounts of education on earnings differentials based on age groups rather than length-of-experience groups."
Edward F. Denison, op. cit., p. 80.

^{2/} Ibid., p. 111.

"...the quantitative importance of differences in the intensity of work I find impossible to judge, much less to measure by any direct approach."^{1/}

Nor has it been possible to measure the effects of health on the quality of labour input. Sickness and injury are reflected to some extent in time lost from work but debility due to disease, malnutrition or other causes are ignored. Denison suggests that this is not an important factor in advanced countries.^{2/}

The objective of this chapter is to bring together the separate estimates of labour input, contained in previous chapters, in order to quantify their contribution to the level and growth of regional income. The contributions of labour productivity will also be determined, residually. The measurements will provide some idea of the relative importance of these sources in determining the level and growth of regional income in Canada. The contributions are the product of the growth rates of labour input and Canada income share weights.

Summary of Labour Input

The final labour input estimates, representing level comparisons, in Tables 6-1 and temporal comparisons in Table 6-2, differ in one essential way, from those presented in previous chapters. An adjustment has been made to allow for that portion of income measured

^{1/} Ibid., p. 114 .

^{2/} Ibid., pp. 114-115 .

in terms of labour input. As noted by Denison, "The three quality indexes for labor...must be adjusted before they can be used to measure contributions to growth of national income as measured. Deflated national product estimates...imply that output per person employed does not change in industry segments falling within the general government, nonprofit organizations, and private household sectors, and certain other industry components. No matter what happens to the quality of labor in such industry segments, or how much output per person employed may in fact change within them, this does not affect the real national income or product as measured. Hence, changes in the quality of a year's work in such activities do not affect the growth rates under investigation and, for analysis of the sources of measured growth, labor quality indexes should not be affected by changes in the quality of labor in these activities".^{1/}

The same reasoning applies to the level estimates.

Denison uses a 15 per cent reduction factor for the 1950-62 period,^{2/} yielding an approximation. The estimate was based on the Gilbert and Associates' study,^{3/} covering the year 1950. This study did not include Canada. To obtain a similar estimate for Canada, and especially for each region, would be difficult and probably of

^{1/} Ibid., pp. 187-88 .

^{2/} Ibid., p. 188.

^{3/} Milton Gilbert and Associates, Comparative National Products and Price Levels: A Study of Western Europe and the United States, Paris, Organization for Economic Cooperation and Development, 1958.

marginal usefulness. Walters has argued that it is unlikely that the difference between Canada and the United States could be more than one percentage point.^{1/} Denison's estimate was assumed to be equally applicable to each of the five regions in Canada.

In addition to the adjusted labour level comparisons, shown in Table 6-1, the 1961 relative levels of regional income, contained in Table 2-4 are also included, to obtain an indication of relative labour productivity. This measure represents the quotient of regional income to total labour input.

The data in Table 6-1 are used subsequently to explain the differences in regional income. However, it is readily apparent on the basis of the data shown, that labour productivity accounts for most of the deviation from the Canada level. With the three spacial indices of labour input combined, only the Atlantic and British Columbia regions differ significantly from the Canada level. Quebec and Ontario are identical to the Canada level, while the Prairie region is only marginally lower.

^{1/} D. Walters, op. cit., p. 104.

Table 6-1
Labour Input and Labour Productivity Per Employee, 1961
 (Canada = 100)

Growth Sources	Atlantic	Quebec	Ontario	Prairies	British Columbia	Canada
Hours ^(a)	101.4	101.3	99.3	99.7	98.2	100.0
Age-sex ^(a)	100.2	99.5	99.8	100.6	101.0	100.0
Education ^(a)	96.8	99.3	100.9	99.4	103.4	100.0
Total Labour ^(a)	98.3	100.0	100.0	99.7	102.5	100.0
Labour Productivity	85.4	97.8	106.7	89.5	113.5	100.0
Regional Income	83.9	97.8	106.7	89.2	116.3	100.0

(a) Reduced to exclude quality changes in sectors where output is measured by employment.

Source: Derived from Tables 2-1, 3-2, 4-3 and 5-6.

Although there is some variation in annual hours and the age-sex composition of the employed labour force, the major factor accounting for the differences in the level of labour input per employee is the level of education in the Atlantic and British Columbia regions. The average quality of labour in Quebec, Ontario and the Prairies is approximately the same. The basic difference pertains to the Atlantic and British Columbia regions, where the educational level is low and high respectively, in relation to the Canada average. Labour input per person employed in all regions would be approximately the same, due to

offsetting factors, if these two regions had educational levels closer to the Canada average. Thus, the prime explanation of differences in regional incomes, in terms of labour input, is education. The above analysis pertains only to the employed labour force and to potential per employee income, within the framework used.^{1/}

Table 6-2 brings together the temporal estimates of labour input derived in previous chapter. As with the spacial comparisons, adjustments have been made to allow for sectors, where output is measured by employment. The data are shown in terms of compound percentage increases, as opposed to the original indices, to permit measurement of their contributions to income growth.

The period from 1951-66 reflects the performance of labour input in the two sub-periods; 1961 was a low yield year, due largely to farm and cyclical factors, both in terms of performance and for comparison purposes. The high unemployment rates in 1961 account for much of the slow growth in employment between 1951-61 and the high growth of employment between 1961 and 1966. Cyclical influences also affect the quality measures, other than education, but to a much lesser extent. The most useful comparisons, therefore, relate to the whole period.

^{1/} See Chapter Eight below for some comments on the limitations of the framework used.

Table 6-2
Average Annual Compound Growth Rates of
Labour Input
 (percentages)

Growth Sources	Atlantic	Quebec	Ontario	Prairies	British Columbia	Canada
<u>1951-61</u>						
Employment	.60	1.55	2.14	1.73	2.45	1.79
Hours (a)	-.24	-.21	-.12	-.11	-.23	-.16
Age-sex (a)	-.21	-.06	-.09	-.15	-.11	-.11
Education (a)	.56	.45	.40	.52	.43	.46
Total labour (a)	.71	1.73	2.33	1.99	2.54	1.98
<u>1961-66</u>						
Employment	2.62	4.01	3.10	2.02	4.93	3.28
Hours (a)	-	-	-	-	-	-
Age-sex (a)	-.11	-.19	-.22	-.22	-.29	-.21
Education (a)	.73	.81	.52	.63	.48	.63
Total labour (a)	3.24	4.63	3.38	2.43	5.12	3.70
<u>1951-66</u>						
Employment	1.27	2.37	2.46	1.82	3.27	2.28
Hours (a)	-.11	-.18	-.11	-.06	-.13	-.13
Age-sex (a)	-.18	-.11	-.14	-.18	-.17	-.14
Education (a)	.62	.57	.44	.56	.45	.52
Total labour (a)	1.60	2.65	2.65	2.14	3.42	2.53

(a) Reduced to exclude quality changes in sectors where output is measured by employment.

Source: Derived from Tables 2-4, 3-4, 4-11 and 5-7.

Source of Income Differences

Labour income shares could be applied directly to the labour input relatives, contained in Table 6-1, to explain the contributions to regional income differences, except that the interaction among the variables needs to be taken into account. "Initially the contribution of factor inputs and...productivity to differences in income levels, measured using the relatives...would over account for income difference because of interaction among the factors".^{1/} Denison's method of avoiding this problem, is to convert the relatives to pseudo growth rates.^{2/} Following this approach, it is assumed that each component of labour input, output per labour input and regional income, in all regions, will converge to the Canada level, ten years hence.

This approach to the elimination of the interaction effect is not predicated on the realism of the assumption. It is not expected, for example, that relative income in Ontario and the Atlantic regions will actually decline and rise respectively, to the Canada level, ten years hence. In his European study, Denison used a 20-year period. As noted by Denison, "the use of a 20-year period is arbitrary but the results are not sensitive to the length of the period, provided it is long enough to reduce interaction terms to negligible size".^{3/} As income differentials are much greater, between

^{1/} D. Walters, op. cit., p. 110.

^{2/} Edward F. Denison, op. cit., p. 197.

^{3/} Ibid., p. 198.

the United States and Europe than between Canada and its regions, a ten-year period is arbitrarily employed, in this study.

Thus, the relatives in Table 6-1 were converted to growth rates, using a ten-year time span. The growth rates of the four labour components were again reduced, by the application of the Canada labour share weights contained in Table 2-3. Percentage distributions of the contributions, as indicated by the growth rates of the labour components, in relation to the growth rates of regional income, were then applied to the regional income differentials in Table 6-1, to obtain the final measures shown in Table 6-3.

The results obtained in Table 6-3 are predicated on the state of economic activity in 1961. Somewhat different results would be obtained, if the comparisons had been made for another year. As previously mentioned, 1961 is not a representative year, for comparison purposes. Although adjustments have been made to regional income estimates, to remove the effects of irregular fluctuations in farm income and cyclical adjustments in nonfarm income, the adjusted 1961 income estimates still reflect these influences more so than other years and are therefore less representative of relative regional income, than either 1951 or 1966. In 1966, for example, per employee regional income differences, with Canada representing 100, were as follows: Atlantic region, 20.8 per cent lower; Quebec, 5.6 per cent lower; Ontario, 10.6 per cent higher; Prairie region, 8.5 per cent lower; British Columbia, 8.8 per cent higher. If the comparisons were made on the basis of 1966, the most notable change would have been in

British Columbia with a per employee income level 16 per cent higher than Canada in 1961 and only about 9 per cent higher in 1966.

Although different regional income differentials per employee are obtained, depending on the year used, the labour contributions to these differences, in percentage points, would not change greatly because of their small weight; most of the variation would still be reflected in the contribution of labour productivity.

As Table 6-3 indicates, only a small portion of regional income differences are explained by total labour input. The contributions of the three components of labour input in Quebec and Ontario cancel out; in the remaining regions, total labour input in the Atlantic and Prairie regions account for only 7 per cent and 2 per cent respectively of their lower income, while the higher level of total labour input accounts for 12 per cent of British Columbia's greater income per employee.

The Atlantic and British Columbia regions deviate the most from the Canada level of income; the former in a negative sense, the latter in a positive sense. The most significant labour component, in terms of explaining these differences, is education. This factor accounts for 14 per cent and 17 per cent of the deviation in these two regions respectively. Conversely, labour productivity accounts for about 93 per cent of the lower per employee income level in the Atlantic region while the same factor accounts for about 88 per cent of the higher income level in British Columbia. Table 6-4 provides a percentage distribution of all measured factors contributing to

Table 6-3Contributions to Regional Income Differences Per Employee, 1961

(percentage difference from Canada)

Sources of Difference	Atlantic	Quebec	Ontario	Prairies	British Columbia	Canada
Hours	-1.0	-1.0	.7	.2	1.5	-
Age-sex	-.1	.4	-	-.3	-.8	-
Education	2.3	.6	-.7	.3	-2.7	-
Total labour	1.2	-	-	.2	-2.0	-
Labour productivity	14.9	2.2	-6.7	10.6	-14.3	-
Regional income	16.1	2.2	-6.7	10.8	-16.3	-

Source: Derived from Tables 2-3 and 6-1.

Table 6-4Percentage Distribution of the Contributions to PerEmployee Income Differences, 1961

(distribution of differences from Canada)

Sources of Difference	Atlantic	Quebec	Ontario	Prairies	British Columbia	Canada
Hours	- 6.2	- 45.4	10.4	1.9	9.8	-
Age-sex	- .6	18.2	-	- 2.8	- 4.9	-
Education	14.3	27.2	- 10.4	2.8	- 17.2	-
Total labour	7.5	-	-	1.9	- 12.3	-
Labour productivity	92.5	100.0	100.0	98.1	- 87.7	-
Regional income	100.0	100.0	100.0	100.0	100.0	-

Source: Derived from Table 6-3.

differences in the regional levels of income in Canada, in 1961.

In her comparison of the United States and Canadian income levels, Walters found that labour input per employee was the same in both countries and consequently labour accounted for none of the higher United States income level.^{1/} Similarly, Denison found that labour input explained only 3 per cent of the lower per employee income level in Northwest Europe, as compared with the United States, ^{2/} even though the income differential, in contrast to the regional differences were quite substantial, 43 per cent, in the case of the U.S. and Europe.

Contributions of Growth Sources

In addition to measuring the contribution of labour input and labour productivity to regional income differences, another purpose of this study is to quantify the contribution of these sources to the growth of regional income. The growth rates contained in Table 6-2 and the Canada income share weights contained in Table 2-3 are combined in Tables 6-5 and 6-7 to provide contributions, measured in percentage points, both to total regional income and per employee regional income respectively. The income growth rates are obtained from Table 2-2. The contribution of labour productivity is obtained residually. Tables 6-6 and 6-8 provide percentage distributions of the

^{1/} D. Walters, op. cit., p. 170.

^{2/} Edward P. Denison, op. cit., p. 336.

contributions to total regional income and per employee regional income, respectively.

As with level comparisons, growth rates of income represent potential measures. Adjustments have been made to remove irregular fluctuations in farm income and cyclical fluctuations in nonfarm income, with limited success. In addition, the effects of these influences still remain, with regard to the labour contributions and therefore the labour productivity contributions. This is especially true with respect to the employment data. The cyclical influence on employment, coupled with the overall high employment growth, is such that the measurements, for 1951-61 and 1961-66, are not representative of long-run growth. This can readily be seen, for example, with regard to the Atlantic region, where employment accounted for only 10 per cent of the growth of total regional income in the earlier period, while it accounted for 59 per cent during the later period (Table 6-6). Some of the variations are of an offsetting nature, making comparison over the longer period more meaningful. Thus, summaries are presented, in what follows, for the 1951-66 period, as a whole.

Contributions to Total Income Growth

Atlantic Region. The growth of regional income averaged 4.40 per cent over the 1951-66 period. Only the Prairie region experienced a slower growth rate. The contributions of employment and education were the smallest and highest respectively of all the regions. The negative contributions of annual hours and age-sex composition were

Table 6-5
Contributions of Labour Input and Labour Productivity
to Growth Rates of Total Regional Income
 (percentage points)

Growth Sources	Atlantic	Quebec	Ontario	Prairies	British Columbia	Canada
<u>1951-61</u>						
Employment	.48	1.23	1.70	1.38	1.95	1.43
Hours	-.19	-.17	-.10	-.09	-.18	-.13
Age-sex	-.17	-.05	-.07	-.12	-.09	-.08
Education	.44	.36	.32	.41	.34	.36
Total labour	.56	1.37	1.85	1.58	2.02	1.58
Output per labour input	4.29	4.28	3.11	1.71	3.24	3.28
Regional income	4.85	5.65	4.96	3.29	5.26	4.86
<u>1961-66</u>						
Employment	2.09	3.20	2.47	1.61	3.93	2.63
Hours	-	-	-	-	-	-
Age-sex	-.09	-.15	-.18	-.17	-.23	-.17
Education	.58	.64	.41	.50	.38	.50
Total labour	2.58	3.69	2.70	1.94	4.08	2.96
Output per labour input	.94	1.71	3.25	2.69	1.58	2.44
Regional income	3.52	5.40	5.95	4.63	5.66	5.40
<u>1951-66</u>						
Employment	1.00	1.87	1.94	1.44	2.58	1.81
Hours	-.09	-.14	-.08	-.05	-.10	-.10
Age-sex	-.14	-.09	-.11	-.14	-.13	-.10
Education	.49	.45	.35	.44	.35	.41
Total labour	1.26	2.09	2.10	1.69	2.70	2.02
Output per labour input	3.14	3.48	3.19	2.04	2.69	3.02
Regional income	4.40	5.57	5.29	3.73	5.39	5.04

Source: Derived from Tables 2-2, 2-3 and 6-2.

about the same as the Canada average. Total labour contributions to income growth were also the lowest in the country, primarily because of the slow growth in employment, while the labour productivity contribution was similar to the Canada average. The slow growth rate in regional income is therefore, largely due to the relatively small contribution made by employment growth. More ultimately, the lack of employment opportunity must be predicated on structural problems, in the Atlantic region.

Quebec Region. At an average rate of 5.57 per cent, Quebec attained the highest growth rate of income in Canada. The contribution of the four labour sources were similar to the Canada average. As a result, the contribution of labour productivity was also the highest among the regions and largely accounts for Quebec having the growth of income in Canada. The sources of labour productivity are not separately measured, it consists of the following major elements: capital stock, resource shifts, scale economies, advances in knowledge and residual sources.^{1/} As the contribution of advances in knowledge is probably the same in all regions,^{2/} the higher income growth in Quebec can be ascribed largely to the remaining four sources.

Ontario Region. The total labour contribution to income growth, like that of Quebec, was about the same as the Canada average, with a

^{1/} Ibid., Chapter Twenty-One.

^{2/} See Chapter Eight below.

slightly higher employment contribution than the former, being offset by a lower education contribution.^{1/} With a somewhat higher growth in income than the Canada rate, the contribution of labour productivity also largely accounted for Ontario's relatively better performance in the growth of income; again the above four factors would account for the difference.

Prairie Region. In comparison with all regions, the growth of regional income in the Prairies was most unsatisfactory. Only the contribution of education was favourable, having exceeded the Canada average. The low contribution of employment and especially labour productivity account for the relatively small growth of 3.73 per cent in regional income. The lack of employment opportunity is behind much of the labour force movement out of the region, a large portion of which goes to British Columbia.

British Columbia. Like Quebec, British Columbia had an exceptionally high rate of income growth, at an average annual rate of 5.39 per cent. Labour productivity and education contributed less than in most regions to this growth. Hours and age-sex contributions were similar. However, the high contribution of employment growth, by far the highest in the country, permitted the region to rank second to

^{1/} See Economic Council of Canada, Sixth Annual Review: Perspective 1975, Ottawa, Queen's Printer, 1969 for an analysis of regional educational patterns, which accounts for some of the factors behind regional educational attainment growth.

Quebec in income growth. As previously noted, the Prairie region has been important to the high employment growth rate.

A percentage distribution of the contributions to total regional income growth is provided in Table 6-6. The share of employment in expanding income over the 1951-66 period ranges from a low of 23 per cent in the Atlantic region to a high of 48 per cent in British Columbia; employment in the remaining regions was similar to the Canada proportion of 36 per cent.

The percentage contribution of annual hours and age-sex composition was similar in all regions, with a combined negative contribution of about 4 per cent. As both of these sources change slowly and at about the same rate in each region, they are relatively unimportant in explaining growth differentials.

The importance of education to regional growth was highest in the Prairies and Atlantic regions at 12 per cent and 11 per cent respectively, compared to an 8 per cent share for Canada. In the remaining regions, the importance of education was similar to the Canada share.

With the negative contributions of annual hours and age-sex largely offsetting the positive contribution of education, the share of employment in income growth largely determines the share attributable to total labour growth. The importance of total labour ranges from a low of 29 per cent in the Atlantic region to a high of 50 per cent in British Columbia; with the contribution of labour productivity derived residually, the converse represents the importance of this factor, with

Table 6-6
Percentage Distribution of the Contributions
to the Growth of Total Regional Income

Growth Sources	Atlantic	Quebec	Ontario	Prairies	British Columbia	Canada
<u>1951-61</u>						
Employment	10	22	34	42	37	29
Hours	-4	-3	-2	-3	-3	-2
Age-sex	-3	-1	-1	-3	-2	-1
Education	9	6	6	12	6	7
Total labour	12	24	37	48	38	33
Output per labour input	88	76	63	52	62	67
Regional income	100	100	100	100	100	100
<u>1961-66</u>						
Employment	59	59	41	35	69	49
Hours	-	-	-	-	-	-
Age-sex	-2	-3	-3	-4	-4	-3
Education	16	12	7	11	7	9
Total labour	73	68	45	42	72	55
Output per labour input	27	32	55	58	28	45
Regional income	100	100	100	100	100	100
<u>1951-66</u>						
Employment	23	34	37	38	48	36
Hours	-2	-2	-2	-1	-2	-2
Age-sex	-3	-2	-2	-4	-2	-2
Education	11	8	7	12	6	8
Total labour	29	38	40	45	50	40
Output per labour input	71	62	60	55	50	60
Regional income	100	100	100	100	100	100

Source: Table 6-5.

a range of 71 per cent and 50 per cent respectively. Quebec and Ontario were similar to Canada, which had a 40 to 60 proportion, while the Prairies, like British Columbia, relied more on labour growth than labour productivity.

Contributions to Per Employee Income Growth

Table 6-7 provides the percentage point contributions to regional income growth per employee. The exclusion of the contribution of employment growth leaves the three quality factors unchanged, but alters the growth rates of income and consequently the contributions of labour productivity.

On a per employee basis Quebec and the Atlantic regions had the highest growth rates of income; the Ontario income growth rate was similar to the Canada rate; while the Prairies and British Columbia, especially the former, had relatively slow growth rates. The rates ranged from a high of 3.13 per cent in Quebec to a low of 1.88 per cent in the Prairie region.

The same relative regional positions pertained with regard to the significance of labour productivity contributions, with this factor contributing the highest in Quebec at 2.91 percentage points and the lowest in the Prairies at 1.63 percentage points.

With the relatively small contributions of total labour to regional per employee growth, the variation in regional income growth rates is almost entirely due to labour productivity performance.

Table 6-7
Contributions of Labour Input and Labour Productivity
to Growth Rates of Regional Income Per Employee
 (percentage points)

Growth Sources	Atlantic	Quebec	Ontario	Prairies	British Columbia	Canada
<u>1951-61</u>						
Hours	-.19	-.17	-.10	-.09	-.18	-.13
Age-sex	-.17	-.05	-.07	-.12	-.09	-.09
Education	.44	.36	.32	.41	.34	.37
Total labour	.08	.14	.15	.20	.07	.15
Output per labour input	4.15	3.90	2.61	1.33	2.67	2.87
Regional income	4.23	4.04	2.76	1.53	2.74	3.02
<u>1961-66</u>						
Hours	-	-	-	-	-	-
Age-sex	-.09	-.15	-.18	-.17	-.23	-.17
Education	.58	.64	.41	.50	.38	.50
Total labour	.49	.49	.23	.33	.15	.33
Output per labour input	.39	.84	2.54	2.24	.54	1.65
Regional income	.88	1.33	2.77	2.57	.69	1.98
<u>1951-66</u>						
Hours	-.09	-.14	-.08	-.05	-.10	-.10
Age-sex	-.14	-.09	-.11	-.14	-.13	-.10
Education	.49	.45	.35	.44	.35	.41
Total labour	.26	.22	.16	.25	.12	.21
Output per labour input	2.84	2.91	2.60	1.63	1.94	2.49
Regional income	3.10	3.13	2.76	1.88	2.06	2.70

Source: Derived from Tables 2-2, 2-3 and 6-2.

Table 6-8
Percentage Distribution of the Contributions to
the Growth of Regional Income Per Employee

Growth Sources	Atlantic	Quebec	Ontario	Prairies	British Columbia	Canada
<u>1951-61</u>						
Hours	-4	-4	-4	-6	-7	-4
Age-sex	-4	-1	-2	-8	-3	-3
Education	10	9	11	27	12	12
Total labour	2	4	5	13	3	5
Output per labour input	98	96	95	87	97	95
Regional income	100	100	100	100	100	100
<u>1961-66</u>						
Hours	-	-	-	-	-	-
Age-sex	-10	-11	-7	-6	-33	-13
Education	66	48	15	19	55	39
Total labour	56	37	8	13	22	17
Output per labour input	44	63	92	87	78	83
Regional income	100	100	100	100	100	100
<u>1951-66</u>						
Hours	-3	-4	-3	-3	-5	-4
Age-sex	-5	-3	-4	-7	-6	-4
Education	16	14	13	23	17	15
Total labour	8	7	6	13	6	7
Output per labour input	92	93	94	87	94	93
Regional income	100	100	100	100	100	100

Source: Derived from Table 6-7.

Table 6-8 contains a percentage distribution of these contributions to the per employee income growth of each region. The importance of each of the four factors in each region is basically similar, with only the Prairies showing any significant deviation, largely due to the greater importance of education. Labour productivity accounts for the lion's share of per employee regional income growth at an average of 93 per cent, with the other three factors netting out to the remainder.

Conclusion

The level and growth of income is a function of factor inputs and the efficiency in which they are combined. According to Denison's classification, there are two basic factor inputs (capital and labour) and four basic efficiency sources (advances in knowledge, resource shifts, scale economies and residual sources). In this Chapter, four components of labour input have been quantified and their contributions to regional income levels and growth measured, all other contributions have been subsumed under the heading of labour productivity.

In the international comparisons that follow Denison's assumption that advances in knowledge contributed the same amount to the growth or level of income in different countries is assumed to be equally applicable to the regions of Canada. On this assumption, differential labour productivity contributions would be due to the above four remaining non-labour sources.

The 1961 spacial comparisons were made on the basis of potential per employee income relatives and, as a result, employment is not a factor in accounting for income differentials. Labour contributed to regional income differences, as measured by the net quality of labour input, basically only in the Atlantic and British Columbia regions, in a negative and positive way respectively. The remaining regions had levels of labour quality similar to the national average. The basic difference between the two former regions pertained to education.

The quality of labour, basically education, accounted for approximately 10 per cent of the lower and higher level of income in the Atlantic and British Columbia regions respectively. Labour input accounted for only 2 per cent of the lower than Canada income level in the Prairies and none at all in Quebec and Ontario.

Apart from labour quality having accounted for 10 per cent of regional income differences in the Atlantic and British Columbia regions, such factors as misallocation of resources, scale economies, capital and residual sources are behind regional differentials. The relative importance of these factors is unknown.

In terms of the three regions with lower incomes, it would appear that there is great variation. For example, the Prairie region probably has one of the highest levels of capital stock per employee in Canada, such that this factor should reduce the differential. This would suggest that the major factor accounting for the lower Prairie income level, apart from residual sources, is resource

misallocation, followed by scale economies. The resource misallocation would be due to the disproportionate amount of the labour force engaged in agriculture.

The Atlantic and Quebec regions probably fall short of the national level because of each productivity source. Conversely, Ontario and British Columbia probably exceed the national level because of higher contributions from the four productivity sources.

In terms of income growth, employment is by far the most significant element of the four labour components. If employment growth had been similar in all regions, the contributions of total labour input to the growth of total regional income would have been approximately the same during the 1951-66 period. Employment and labour productivity therefore largely accounted for the variations in the growth rates of total regional income.

When measurements are made on a per employee basis, the labour contributions to regional income growth are quite similar, with the exception of the Prairies, largely because of the relatively small growth of labour productivity. On average, labour contributions account for 7 per cent of income growth. Labour productivity is therefore the key factor in determining variations in growth rates. This factor accounts for the high income growth rates in Quebec and the Atlantic regions as well as the low growth rates in the Prairies and British Columbia. Ontario corresponded to the Canada performance.

As with the income levels, resource shifts, scale economies, capital and residual factors are behind differential labour productivity

contributions. These factors have been providing high contributions in the Atlantic and Quebec regions and the converse in the two Western regions; Ontario has grown at the Canada average. As a result, there has been some convergence to the Canada income level, as indicated in Table 2-1.

A more detailed breakdown of growth sources is provided in Chapters Eight and Nine. The additional data presented in Chapter Nine are considered illustrative of possible orders of magnitude.

Chapter Seven

Regional Contributions to Canadian Growth

The approach used to measure labour and labour productivity contributions to regional income growth can also be applied, using data already developed, to determine the regional contributions of each factor to Canadian income growth. The purpose of this Chapter is to measure the contributions of each region to the Canada growth rates of total and per employee income.

Instead of using Canada labour share weights, in conjunction with the growth rates of regional labour input (Table 6-1), as was done to measure labour contributions to regional income growth, the individual regional labour share weights (Table 2-3) are applied to the data of each region, to estimate the contribution made by each region, to the contribution of each Canada labour measure and as a result, the Canada growth rates, as well. The labour contributions, so derived, are shown in Tables 7-1 and 7-2, covering total and per employee Canada income growth rates, respectively.

The contribution of regional income growth rates to the total Canada income growth rates were obtained by weighing the income growth rates of each region (Table 2-2) by regional shares of net national income (based on an average of initial and terminal years, as obtained from Table 2-3). The labour productivity contributions were again derived, residually.

To determine the regional per employee income growth contributions, regional income growth rates (Table 2-2) and employment share weights were used (based on an average of initial and terminal years, as obtained from Table C-1). The regional productivity contributions were derived residually.

The regional contributions shown in Tables 7-1 and 7-3 indicate the absolute economic importance of regional growth sources to Canadian income growth. The economic importance of each region to the growth process can be more readily observed, if the data are presented in terms of percentage distributions. This has been done in Tables 7-2 and 7-4, covering total and per employee income growth, respectively.

The importance of the individual growth sources in each region to each Canada growth source is generally similar. The relative importance of each region varies, depending on the income measure used. In the case of per employee income, as indicated in Table 7-4, the Atlantic region contributed 10 per cent, Quebec 33 per cent, Ontario 38 per cent, the Prairies 12 per cent and British Columbia 7 per cent, to the growth of income in Canada, over the 1951-66 period.

Table 7-1

Regional Contributions to Canadian Total Income Growth, 1951-66

(percentage points)

Growth Sources	Atlantic	Quebec	Ontario	Prairies	British Columbia	Canada
<u>1951-61</u>						
Employment	.03	.31	.68	.22	.19	1.43
Hours	-.01	-.04	-.04	-.02	-.02	-.13
Age-sex	-.01	-.01	-.03	-.02	-.01	-.08
Education	.03	.09	.13	.07	.04	.36
Total labour	.04	.35	.74	.25	.20	1.58
Labour productivity	.30	1.11	1.26	.28	.33	3.28
Regional income	.34	1.46	2.00	.53	.53	4.86
<u>1961-66</u>						
Employment	.14	.85	1.00	.24	.40	2.63
Hours	-	-	-	-	-	-
Age-sex	-.01	-.04	-.07	-.03	-.02	-.17
Education	.04	.17	.17	.08	.04	.50
Total labour	.17	.98	1.10	.29	.42	2.96
Labour productivity	.06	.46	1.35	.40	.17	2.44
Regional income	.23	1.44	2.45	.69	.59	5.40
<u>1951-66</u>						
Employment	.07	.47	.78	.23	.26	1.81
Hours	-.01	-.03	-.04	-.01	-.01	-.10
Age-sex	-.01	-.02	-.04	-.02	-.01	-.10
Education	.04	.12	.14	.07	.04	.41
Total labour	.09	.54	.84	.27	.28	2.02
Labour productivity	.22	.37	1.29	.38	.26	3.02
Regional income	.31	1.41	2.13	.65	.54	5.04

Source: Derived from Tables 2-2, 2-3 and 6-2.

Table 7-2
Percentage Distribution of Regional Contributions to
Total Canadian Income Growth, 1951-66

Growth Sources	Atlantic	Quebec	Ontario	Prairies	British Columbia	Canada
<u>1951-61</u>						
Employment	2	22	48	15	13	100
Hours	8	31	31	15	15	100
Age-sex	12	13	38	25	12	100
Education	8	25	36	20	11	100
Total labour	2	22	47	16	13	100
Labour productivity	9	34	38	9	10	100
Regional income	7	30	41	11	11	100
<u>1961-66</u>						
Employment	6	32	38	9	15	100
Hours	-	-	-	-	-	-
Age-sex	6	23	41	18	12	100
Education	8	34	34	16	8	100
Total labour	6	33	37	10	14	100
Labour productivity	3	19	55	16	7	100
Regional income	4	27	45	13	11	100
<u>1951-66</u>						
Employment	4	26	43	13	14	100
Hours	10	30	40	10	10	100
Age-sex	10	20	40	20	10	100
Education	10	29	34	17	10	100
Total labour	4	27	42	13	14	100
Labour productivity	7	29	43	12	9	100
Regional income	6	28	42	13	11	100

Source: Derived from Table 7-1.

Table 7-3

Regional Contributions to Canadian Per Employee IncomeGrowth, 1951-66

(percentage points)

Growth Sources	Atlantic	Quebec	Ontario	Prairies	British Columbia	Canada
<u>1951-61</u>						
Hours	-.01	-.04	-.04	-.02	-.02	-.13
Age-sex	-.01	-.01	-.03	-.02	-.01	-.08
Education	.03	.09	.13	.07	.04	.36
Total labour	.01	.04	.06	.03	.01	.15
Labour productivity	.37	1.07	.96	.25	.22	2.87
Regional income	.38	1.11	1.02	.28	.23	3.02
<u>1961-66</u>						
Hours	-	-	-	-	-	-
Age-sex	-.01	-.04	-.07	-.03	-.02	-.17
Education	.04	.17	.17	.08	.04	.50
Total labour	.03	.13	.10	.05	.02	.33
Labour productivity	.04	.24	.94	.39	.04	1.65
Regional income	.07	.37	1.04	.44	.06	1.98
<u>1951-66</u>						
Hours	-.01	-.03	-.04	-.01	-.01	-.10
Age-sex	-.01	-.02	-.04	-.02	-.01	-.10
Education	.04	.12	.14	.07	.04	.41
Total labour	.02	.07	.06	.04	.02	.21
Labour productivity	.26	.82	.96	.28	.17	2.49
Regional income	.28	.89	1.02	.32	.19	2.70

Source: Derived from Tables 2-2, 2-3, 6-2 and C-1.

Table 7-4
Percentage Distribution of Regional Contributions to
Canadian Per Employee Income Growth, 1951-66

Growth Sources	Atlantic	Quebec	Ontario	Prairies	British Columbia	Canada
<u>1951-61</u>						
Hours	8	31	31	15	15	100
Age-sex	13	37	13	25	12	100
Education	8	25	36	20	11	100
Total labour	7	26	40	20	7	100
Labour productivity	13	37	33	9	8	100
Regional income	12	37	34	9	8	100
<u>1961-66</u>						
Hours	-	-	-	-	-	-
Age-sex	6	23	41	18	12	100
Education	8	34	34	16	8	100
Total labour	9	40	30	15	6	100
Labour productivity	2	15	57	24	2	100
Regional income	4	19	52	22	3	100
<u>1951-66</u>						
Hours	10	30	40	10	10	100
Age-sex	10	20	40	20	10	100
Education	10	29	34	17	10	100
Total labour	10	33	29	19	9	100
Labour productivity	10	33	39	11	7	100
Regional income	10	33	38	12	7	100

Source: Derived from Table 7-3.

Chapter Eight

A Comparison with the Work of Denison and the Economic Council of Canada

As the methodology developed by Denison has been followed in this study, as well as by the Economic Council of Canada, the contributions to regional and national economic growth presented in Chapter Six yield estimates comparable to those prepared for the United States and eight European countries by Denison, as well as the Canada estimates prepared by the Economic Council of Canada. Although regional estimates were prepared for the 1951-61 time period, which closely approximates the 1950-62 period used by Denison, the 1951-66 regional estimates are used in the international comparisons below because they are more representative of long-term growth; the low level of economic activity, in 1961, especially affected some regions while the use of the Okun formula^{1/} to convert the actual levels to potential levels appears to be unsatisfactory. The Canada estimates of this study, however, are all used in comparisons with similar estimates by the Economic Council of Canada.^{2/}

^{1/} See Appendix One, and Edward F. Denison, op. cit., pp. 441-42 for comments on the weakness of the Okun formula.

^{2/} The study by Dorothy Walters, op. cit., prepared for the Economic Council of Canada, could not be used for the comparisons because her estimates were made before the Dominion Bureau of Statistics revised the Canadian national accounts. The Council's estimates shown below represent, in most cases, revisions to the original Walters' estimates.

In his European study, Denison quantified 23 growth sources. Some of the sources represented statistical adjustments to effect international and temporal comparability. Two of the adjustments were required to remove the effects of cyclical fluctuations and irregular swings in farm output; these adjustments have also been made to the regional estimates. In terms of broad categories, Denison's long-term sources cover, in addition to the labour contributions, capital, advances in knowledge, improved allocation of resources, scale economies and residual sources. The lack of data prevented the measurement of the contribution of these sources at the regional level. Instead, they were grouped under labour productivity, in previous chapters, which was derived residually.

Denison's estimate of the contribution of advances in knowledge for the United States has been constant at .76 percentage points per year over the 1929-62 period. He uses this figure for each of the European countries included in his study, "because knowledge is an international commodity, I should expect the contribution of advances in knowledge - as distinct from changes in the lag - to be of about the same size in all countries examined...."^{1/} This reasoning would be equally applicable to the regions of Canada and is followed in this chapter. The contribution of regional residual sources is obtained by deducting the contribution of advances in knowledge from the labour productivity contributions.

^{1/} Ibid., p. 282.

Limitations

As indicated above, different time periods are used in the following comparisons. Although this factor does limit the validity of the comparisons somewhat, the results still provide a reasonable basis for judging how the regions of Canada fared, in relation to some other countries and how the two sets of estimates for Canada, as a whole compare.

A more serious limitation relates to the inability to quantify the contributions of capital^{1/} resource shifts and economies of scale, as has been done by both Denison and the Economic Council of Canada; these sources accounted for approximately 18 per cent, 14 per cent and 20 per cent respectively to the growth of potential total income growth in Europe during the 1950-62 period.^{2/} For purposes of comparing the results of this study with the above, it has been necessary to combine these sources into an overall residual measure.

An additional limitation of the estimates should be noted. Even if the above three sources could have been properly quantified, at the regional level, the highly aggregate nature of the model used means that the results do not provide answers, as to why the quantified variables behaved, as they did. As noted by Denison, "there is no unambiguous answer to the question: What are the principal sources of growth? It has meaning first of all, only within the framework of

^{1/} Although firmly based estimates of capital contributions could not be made, as previously noted, Chapter Nine does contain measurements of capital contributions, as illustrative of possible orders of magnitude.

^{2/} Ibid., p. 309.

some particular classification. The type of classification adopted is one that I consider informative and useful, but it represents a certain degree of 'ultimateness'. I have tried to measure the contributions of employment, of capital, and of the reduction in the waste of resources in agriculture, to take a few examples; but it could be asked with regard to each of these sources measured: Why did it change as it did? There is no room in my classification for such more ultimate influences on growth as birth control, tax structures, the spirit of enterprise, or planning - to name only a few. These must operate to influence growth by affecting one or more of the sources considered...."^{1/}

International Comparisons

Table 8-1 shows the regions of Canada and ten countries, including Canada, ranked in order of total income growth rates along with the contributions made by several growth sources to the respective rates. In comparison to the nine foreign countries, only Germany and Italy had higher income growth rates than Quebec, British Columbia and Ontario. The Atlantic and Prairie regions, with much lower growth rates, still outranked five of the nine foreign countries. The major factor accounting for the relatively high performance of the regions is employment; all regions of Canada, as well as Canada itself, had higher contributions from employment growth than all countries, except Germany, which outranked the Atlantic and Prairie regions. On the average, the residual contributions in the regions were unfavourable. Quebec, with the highest residual contribution of the regions, ranked behind four of the nine

^{1/} Ibid., p. 301.

Table 8-1

International Comparisons of Contributions to TotalIncome Growth, 1950-62 and 1951-66

(percentage points)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Area	Employ- ment	Hours	Age-Sex	Educa- tion	Total Labour	Knowledge Advances	Residual Sources ^{a/}	Total Labour Productivity (6) + (7)	Area Income (5) + (8)
Germany ^{b/}	1.49	-.27	.04	.11	1.37	.76	5.13	5.89	7.26
Italy ^{b/}	.42	.05	.09	.40	.96	.76	4.23	4.99	5.95
Quebec ^{c/}	1.87	-.14	-.09	.45	2.09	.76	2.72	3.48	5.57
British Columbia ^{c/}	2.58	-.10	-.13	.35	2.70	.76	1.93	2.69	5.39
Ontario ^{c/}	1.94	-.08	-.11	.35	2.10	.76	2.43	3.19	5.29
Canada ^{c/}	1.81	-.10	-.10	.41	2.02	.76	2.26	3.02	5.04
France ^{b/}	.08	-.02	.10	.29	.45	.76	3.49	4.25	4.70
Netherlands ^{b/}	.78	-.16	.01	.24	.87	.76	2.89	3.65	4.52
Atlantic Region ^{c/}	1.00	-.09	-.14	.49	1.26	.76	2.38	3.14	4.40
Prairies ^{c/}	1.44	-.05	-.14	.44	1.69	.76	1.28	2.04	3.73
Norway ^{b/}	.13	-.15	-.07	.24	.15	.76	2.56	3.32	3.47
Denmark ^{b/}	.70	-.18	-.07	.14	.59	.76	2.01	2.77	3.36
United States ^{b/}	.90	-.17	-.10	.49	1.12	.76	1.48	2.24	3.36
Belgium ^{b/}	.40	-.15	.08	.43	.76	.76	1.51	2.27	3.03
United Kingdom ^{b/}	.50	-.15	-.04	.29	.60	.76	1.02	1.78	2.38

^{a/} Covers the contributions of capital, resource shifts, scale economics and other residual sources.^{b/} 1950-62.^{c/} 1951-66.

NOTE: Income refers to net "national" income at factor cost. The 1951-66 estimates are predicated on depreciation, valued at original cost, whereas the 1950-62 estimates use replacement cost. In addition, Canadian income estimates include the effects of the construction productivity adjustment, which overstates the growth rates slightly relative to the foreign country estimates. See Economic Council of Canada, Sixth Annual Review: Perspective 1975, Ottawa, Queen's Printer, 1969, p. 23 for an estimate of the size of this statistical adjustment, 1950-62.

Source: Canadian data, except for column (6), Table 6-5; remaining estimates, Edward F. Denison, Why Growth Rates Differ: Postwar Experience in Nine Western Countries, Washington, Brookings, 1967, pp. 298, 302, 304, 308, 310, 312, 314 and 316.

foreign countries, while the Prairies, with the lowest, exceeded only the United Kingdom.

The Canada growth rate represents a weighted average of the five regions; in terms of countries, only Germany and Italy had higher growth rates. Canada had the highest contribution from employment growth and ranked third in terms of the contribution from education growth, and as a result, had the highest contribution from total labour input.

The contributions of annual hours and the age-sex composition of annual hours are relatively small, and in most cases negative. The contribution of employment to income growth varied greatly. British Columbia far exceeded all areas; this source contributed 2.58 percentage points to its growth rate. In contrast, Norway derived a negligible amount from this source. The importance of education also varied greatly. The Atlantic Region and the United States both derived the highest contribution from this source, followed closely by Quebec.

The regions and the nine foreign countries are ranked in terms of per employee income growth rates, along with the contributions to these rates, in Table 8-2. As a result of the exclusion of employment, as a contributor to income growth, the ranking of the regions, in relation to the foreign countries, declines. The three Eastern regions of Canada ranked higher, in per employee income growth, than only four of the countries, while the two Western regions, surpassed only the United Kingdom. With residual sources accounting for most of the income growth of all regions and countries, this factor largely explains the generally

Table 8-2

International Comparisons of Contributions to PerEmployee Income Growth, 1950-62 and 1951-66

(percentage points)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Area	Hours	Age-Sex	Education	Total Labour	Knowledge Advances	Residual Sources ^{a/}	Total Labour Productivity (5) + (6)	Area Income (4)+ (7)
Italy ^{b/}	.05	.09	.40	.54	.76	4.05	4.81	5.35
Germany ^{b/}	-.27	.04	.11	-.12	.75	4.52	5.27	5.15
France ^{b/}	-.02	.10	.29	.37	.76	3.45	4.21	4.58
Netherlands ^{b/}	-.16	.01	.24	.09	.75	2.60	3.35	3.44
Norway ^{b/}	-.15	-.07	.24	.02	.76	2.15	3.27	3.29
Quebec ^{c/}	-.14	-.09	.45	.22	.76	2.14	2.91	3.13
Atlantic Region ^{c/}	-.19	-.14	.49	.26	.76	2.08	2.84	3.10
Ontario ^{c/}	-.08	-.11	.35	.16	.76	1.84	2.60	2.76
Canada ^{c/}	-.10	-.10	.41	.21	.76	1.73	2.49	2.70
Belgium ^{b/}	-.15	.08	.43	.36	.76	1.35	2.11	2.47
Denmark ^{b/}	-.18	-.07	.14	-.11	.75	1.77	2.52	2.41
United States ^{b/}	-.17	-.10	.49	.22	.75	1.22	1.97	2.19
British Columbia ^{c/}	-.10	-.13	.35	.12	.76	1.18	1.94	2.06
Prairies ^{c/}	-.05	-.14	.44	.25	.76	.87	1.63	1.88
United Kingdom ^{b/}	-.15	-.04	.29	.10	.76	.86	1.62	1.72

^{a/} Covers the contributions of capital, resource shifts, scale economies and other residual sources.

^{b/} 1950-62.

^{c/} 1951-66.

NOTE: Same income measures as contained in Table 8-1.

Source: Canadian data, except for column (5), Table 6-7; other estimates, Edward F. Denison, Why Growth Rates Differ: Postwar Experience in Nine Western Countries, Washington, Brookings, 1967, pp. 298, 302, 304, 306, 308, 310, 312, 314 and 316.

lower performance of the regions, in relation to the countries. For example, the Prairies, with the lowest growth rate of the regions, had a residual contribution of only .87 percentage points, while Germany, with the second highest income growth rate of both countries and regions, had a remarkable residual contribution of 5.13 percentage points, almost six times higher.

Summary of International Comparisons

The measurements contained in the two previous tables permit the comparison of individual regions with individual countries. The Canada estimates, for the years 1951-66, represent weighted averages of the five regions. A more general picture of the differences in growth sources can be obtained by averaging the results of the regions and countries. The unweighted averages are shown in Table 8-3.

In terms of total income growth, the regions of Canada experienced about a 16 per cent higher growth rate than the nine foreign countries combined. The composition of these growth rates, in respect to the contribution of labour input and labour productivity, was quite different. The regions of Canada derived 1.21 percentage points more from the former source and .55 percentage points less from the latter source than did the nine countries. As indicated in the per employee comparisons, almost all of the higher labour contribution was due to employment growth.

Table 8-3
Summary Contributions to Income Growth, Averages for
Regions and Countries, 1950-62 and 1951-66
 (percentage points)

Area	Total Labour	Labour Productivity	Area Income
<u>Total Income</u>			
Regions ^(a)	1.97	2.91	4.88
Countries ^(b)	.76	3.46	4.22
Difference	1.21	-.55 ^(c)	.66
<u>Per Employee Income</u>			
Regions ^(a)	.20	2.38	2.58
Countries ^(b)	.16	3.24	3.40
Difference	.04	-.86 ^(c)	-.82

(a) Covers the five regions of Canada, 1951-66.

(b) Covers the nine foreign countries contained in Tables 8-1 and 8-2, 1950-62.

(c) Covers the contributions of capital, resource shifts, economies of scale and residual sources; the contribution of advances in knowledge cancels out.

Source: Derived from Tables 8-1 and 8-2.

When the comparison is made on a per employee basis, the labour contribution in the regions and countries is similar. The sign-

ificantly higher per employee income growth rate performance of the foreign countries, in comparison to the regions, is almost entirely due to the labour productivity contribution, which was 36 per cent higher.

The regions of Canada have performed well, in terms of total income growth, only because of high employment growth rates. The labour productivity contribution of the regions has been unfavourable, both on a total and per employee basis, but especially with respect to the latter. As a result, per employee income growth in the regions was well below that of the nine countries examined by Denison.

Domestic Comparisons

Table 8-4 presents the estimates derived in this study along with similar estimates and projections by the Economic Council of Canada for a number of periods. The seven estimates cover a twenty-five year span. The two sets of estimates are generally similar, except for the 1960-67 and 1961-66 periods, where the importance of labour and labour productivity contributions are reversed.

The highly aggregative nature of the Council's estimates does not permit a reconciliation of the two. However, the contributions of employment over the 1960-67 period would approximate the Council's estimate of the total labour contribution, suggesting that no qualitative improvement in labour took place. In other words, improvements in education were offset by declines in annual hours and changes in the age-sex composition of the labour force. The estimates of this study indicate a significant contribution from education and only a small negative contribution from the age-sex composition of annual hours and

and no contribution from annual hours (Table 6-5). The somewhat different time periods might account, in part, for the difference.

Table 8-4
Contributions to Total Income Growth, Canada 1950-75
(percentage points)

Period	Labour	Labour Productivity	Income
1950-62 ^(a)	1.5	3.5	5.0
1951-61 ^(b)	1.6	3.3	4.9
1951-66 ^(b)	2.0	3.0	5.0
1955-67 ^(a)	2.0	2.9	4.9
1960-67 ^(a)	2.4	3.1	5.5
1961-66 ^(b)	3.0	2.4	5.4
1967-75 ^(a)	2.5	3.0	5.5
1951-75 ^(c)	2.2	3.0	5.2

(a) Economic Council of Canada.

(b) This study.

(c) Weighted Average of 1951-66 and 1967-75.

Source: Table 6-5 and Economic Council of Canada, Sixth Annual Review: Prospective 1975, Ottawa, Queen's Printer, 1969, pp. 12 and 23.

The estimates of this study, covering the 1951-66 period, and the Council's projections, for the years 1967-75, have been combined, using the number of years as weights, to derive estimates for the 24-years span 1951-75. The difference between the two sub-periods relates to labour contributions, with a 25 per cent increase and a consequent 10 per cent increase in the growth rate of income. Thus, over the period as a whole, labour productivity contributions are constant at 3 percentage points, while the relative small increase in the growth rate of income is a function of labour growth only. The share of the two in accounting for the growth rate of income is 42 per cent for labour input and 58 per cent for labour productivity.

Conclusion

In concluding his study of why growth rates differ, Denison observed that "although most of the European countries achieved higher growth rates than the United States, this was not because they were doing more to obtain growth. They were able to secure higher growth rates only because they were operating in a different environment. Conditions were very different with respect to factor proportions; to misallocation of resources; to the existing level of technology, management, and general efficiency in the use of resources; and to economies of scale."^{1/} These observations are equally applicable to the regions of Canada.

^{1/} Edward F. Denison, op. cit., p. 344.

In terms of total income growth, the outstanding difference between the regions, in general, relative to the foreign countries relates to employment. Notwithstanding lower labour productivity contributions, (basically economies of scale, resource shifts and other residual measures), the regions still attained, on the average, higher income growth rates than most foreign countries, because of this factor. Only Germany compared favourably with the regions. By way of contrast, employment contributed 2.58 and 0.08 percentage points to the income growth rates of British Columbia and France respectively.

Labour contribution to per employee income growth rates was relatively small in all regions and countries. With the contributions of advances in knowledge the same in all areas, such sources as economies of scale, capital, resource shifts and other residual sources largely explain income growth differentials. These factors are behind the generally lower growth rates of the regions. Residual sources, for example, contributed 4.52 and 0.87 percentage points respectively, to the income growth rates of Germany and the Prairies respectively.

Chapter Nine

Summary and Conclusions

Traditionally, the measurement of the source of economic growth was confined to quantifying the contributions of labour, without taking account of qualitative improvements in labour input, and capital. Denison extended the analysis by measuring the contributions of three qualitative aspects of labour, as well as largely quantifying the remaining growth sources. He also used his growth methodology to explain the factors accounting for differences in income levels. In this study, the same methodology has been used to explain regional income growth and level differences, to the extent that available data and reasonable estimates permitted.

Purpose

Since the development of the Denison growth analysis framework in 1962, the methodology has been used by a number of economists, especially in Canada, to quantify the sources of national income growth or the contributions of a particular source, such as education. This study extends the analysis to the subnational level, covering labour and labour productivity contributions to regional income differences and the growth of regional income, on a total and per employee basis, and, in turn, the regional contributions of these factors to national income growth.

A comparison of the regions of Canada with a number of foreign countries, covering a limited number of growth sources has also been made.

Findings on Income Levels

Comparisons of per employee regional income differences, based on the Canada average, have been made for 1951, 1961 and 1966 on a potential or full employment basis. As indicated in Table 2-1, regional income levels have been converging towards the Canada level. Over the whole period, sharp declines have taken place in the Prairie and British Columbia relatives. With the Ontario relative largely stable, these declines have been associated with substantial improvements in the Atlantic region and Quebec relatives.

As of 1966, Ontario and British Columbia had per employee income levels of 10.6 and 8.8 per cent respectively above the Canada average, while the Atlantic, Prairie and Quebec regions had lower relatives of 20.8, 8.5 and 5.6 per cent respectively. The Atlantic region, notwithstanding improvement, is still well below the national average while the Prairies is now (as of 1966) below the Quebec level.

In accounting for 1961 regional per employee income differences, three qualitative aspects of labour input and labour productivity were measured. Total labour input in Quebec and Ontario was the same as the Canada level; the Prairie level was marginally lower. Only in the Atlantic and British Columbia regions did labour input account for a significant portion of differential income; the quality of labour, especially education, explained 10 per cent of the lower and higher level of income respectively.

Regional income level differentials can largely be ascribed to non-labour sources, more specifically to capital intensity (capital stock

per employee), resource allocation (overallocation in agriculture and nonagricultural self-employment), economies of scale and what Denison calls "state of knowledge, lag in the application of knowledge, efficiency and errors and omissions". Apart from the capital source and errors and omissions, these sources all relate to efficiency.

The relative volume of capital stock, as indicated by the Economic Council of Canada, appears to be highest in the Prairies, followed by British Columbia and Ontario. In the Atlantic and Quebec regions, and especially in the former, the level appears to be well below the Canada average. The significance of capital, in explaining relative regional income differences would appear to be in the order of five to ten per cent. Thus, for example, the greater volume of capital per employee in Ontario, relative to the Canada average, might account for five per cent of that regions relatively higher income level. The converse would be true with respect to the Atlantic region; capital, in this instance, might account for as much as ten per cent of that region's lower income relative.

Judging from the work of Denison and Walters, resource misallocation might also have the same orders of magnitude as capital, in accounting for income differences. This factor would be a positive contributor, with respect to the remaining three regions. Resource misallocation would be relatively more significant in the Prairies than in the Atlantic and Quebec regions, due to the higher proportion of the labour force employed in agriculture.

Again, in the Denison and Walters studies, the unexplained

residual amounted to over 50 per cent. No doubt, if all factors measured by them could have been quantified in this study, a similar sized residual would have resulted, respecting regional income relatives. The remainder, representing economies of scale, might account for between 5 and 25 per cent of differences in regional income.

Findings on Income Growth

The quantification of growth sources in previous chapters pertained to four components of labour input and residual labour productivity, covering both total and per employee income growth. The lack of adequate and comprehensive capital stock data, as well as other information, limited the number of sources that were measured.

However, in the summary table that follows, estimates of capital stock contributions are provided. The contributions are predicated on gross domestic stock estimates, excluding consideration of inventories and international assets, and are considered as illustrative of possible orders of magnitude, rather than firmly based estimates. The Canada capital stock contributions shown are similar to estimates prepared by the Economic Council of Canada, covering all forms of capital; this is partly because of the small weight assigned to inventories and international assets.

The capital stock contributions, in conjunction with the labour contribution make it possible to provide measures of total factor contributions (land being fixed in supply, this source does not contribute to income growth). In addition, a further reduction of the residuals is

possible, leaving a final residual composed primarily of resources shifts and scale economies contributions. The final summaries cover income growth on both a total and per employees basis.

Quebec, British Columbia and Ontario, in that order, attained higher total income growth rates than the Canada average, while the remaining two regions lagged behind. The superior Quebec performance is largely due to factor productivity sources, essentially resource shifts and economies of scale. British Columbia's relatively poor productivity performance was more than offset by the highest regional factor contribution, more specifically, the contribution of labour sources. The favourable Ontario growth rates was due to labour sources, resources shifts and scale economies.

Although the Atlantic region attained the highest contribution from productivity sources, the low contribution from factor inputs placed the area behind the Canada income growth rate. Both factor inputs and factor productivity, but especially the latter, accounted for the relative slow Prairie income growth rate.

With income growth on a per employee basis, with the result that employment is not a contributor, the rankings of the regions changes somewhat. Quebec and the Atlantic region surpassed the Canada income growth rate, Ontario had a rate similar to Canada, while the two Western regions had slower rates.

Table 9-1

Source of Total and Per Employee Income Growth, 1951-66

(percentage points)

Sources	Atlantic	Quebec	Ontario	Prairies	British Columbia	Canada
Labour	1.26	2.09	2.10	1.69	2.70	2.02
Capital ^{a/}	.70	1.12	1.05	1.06	1.16	1.04
Factor inputs	1.96	3.21	3.15	2.75	3.86	3.06
Knowledge advances	.76	.76	.76	.76	.76	.76
Residual sources ^{b/}	1.68	1.60	1.38	.22	.77	1.22
Factor productivity	2.44	2.36	2.14	.98	1.53	1.98
Total income	4.40	5.57	5.29	3.73	5.39	5.04
Labour	.26	.22	.16	.25	.12	.21
Capital ^{a/}	.38	.86	.70	.88	.82	.75
Factor inputs	.64	1.08	.86	1.13	.94	.96
Knowledge advances	.76	.76	.76	.75	.76	.76
Residual sources ^{b/}	1.70	1.29	1.14	-	.36	.98
Factor productivity	2.46	2.05	1.90	.75	1.12	1.74
Per employee income	3.10	3.13	2.76	1.88	2.06	2.70

^{a/} 1949-63.^{b/} Primarily covers contributions from resource shifts and scale economies.

Source: Capital contributions based on Canada nonlabour weights, derived from Table 2-3, covering 1951-66, and gross capital stock estimates, contained in P. Camu et al, Economic Geography of Canada, Toronto, Macmillan of Canada, 1964, pp. 104-7; remaining data derived from Table 8-1 and 8-2. See Appendix E, for a note on the capital estimates.

Again, Quebec had the highest growth rate largely because of greater contributions from resource shifts and scale economies, although the capital contribution was also favourable, being exceeded only in the Prairies. The relative improvement of the capital contribution, on a per employee basis, as opposed to a total basis, in these two regions, reflects their relatively lower employment growth rates.

With employment not being a direct contributor, the Atlantic region equaled Quebec's income growth rate, due to a high contribution from resource shifts and scale economies. The low contribution from capital indicates the possibility that the capital stock estimates may not be reliable, as is suggested in Appendix E.

In Ontario, the somewhat lower contribution from factor inputs was offset by a larger productivity contribution, thereby allowing it to parallel the Canada income growth rate.

The relatively slow rates in the Prairies and British Columbia were due entirely to resource shifts and economies of scale. The estimates for the former indicate no contribution at all from these sources, which may be due to an overstatement of the capital contribution.

Quebec and Ontario Comparison

Table 9-2 provides a separate comparison of the sources of total income growth in Quebec and Ontario over the 1951-66 period. As indicated, the performance of the two regions was similar.

The higher Quebec income growth rate, about five per cent above the Ontario rate, was due to greater contributions from education,

capital and residual sources, which more than offset the lower contribution from employment and the larger negative contribution from other labour sources (annual hours and the age-sex composition of annual hours). The most important source, in accounting for the higher Quebec rate, is the residual, consisting primarily of resource shifts and economies of scale. These two factors were probably of about equal importance.

Table 9-2
Quebec and Ontario, Total Income Growth, 1951-66
(percentage points)

Source	Quebec	Ontario	Differ- ences	Quebec	Ontario	Differ- ences
Employment	1.87	1.94	-.07	33.6	36.7	-25.0
Education	.45	.35	.10	8.1	6.6	35.7
Other labour sources	-.23	-.19	-.04	-4.1	-3.6	-14.3
Capital	1.12	1.05	.07	20.1	19.8	25.0
Knowledge advances	.76	.76	-	13.6	14.4	-
Residual sources	1.60	1.38	.22	28.7	26.1	78.6
Income	5.57	5.29	.28	100.0	100.0	100.0

Source: Derived from Tables 8-1 and 9-1.

While the percentage distributions of the absolute contributions are similar, the percentage distribution of the differences highlight the relative importance of each growth source in explaining the income growth differential. As a result of netting, the residual sources accounted for close to 80 per cent.

The higher contributions of resources shifts and economies of scale probably reflect a greater potential for contributions from these sources, in Quebec, largely because of significant differences in industrial structure, between Quebec and Ontario, with respect to so called higher productivity industries, such as steel in Ontario, as contrasted with textiles in Quebec.

Regional Shares in National Growth

Estimates of the contributions made by the regions to Canadian economic growth, covering the labour components and labour productivity were made for the 1951-66 period and two sub-periods. The 1951-66 regional shares of Canadian income growth, both on a total and per employee basis, with the latter in brackets, were as follows: Atlantic region, 6 (10) per cent; Quebec region, 28 (33) per cent; Ontario region, 42 (38) per cent; Prairies 13 (12) per cent and British Columbia, 11 (7) per cent.

International Comparisons

On average, the regions of Canada had higher total income growth rates than the nine foreign countries studied by Denison. Although labour productivity was much higher in the foreign countries, the regions were able to obtain higher average income growth rates because of excep-

tionally high contributions from labour sources, especially employment.

With comparisons made on a per employee basis, the Denison countries, on average, had higher income growth rates, in the main due to labour productivity contributions. It appears that the contributions of capital were higher in the regions of Canada. With the contribution of advances in knowledge assumed to be the same in both the regions and countries, the greater productivity performance of the latter would appear to be largely due to the contributions from resource shifts and scale economies. This conclusion would apply equally to both total and per employee productivity comparisons.

Conclusion

The analytical model developed by Denison includes a number of growth sources that this study could not quantify. Although rough indications of capital contributions are suggested, there is a real need for reliable capital stock estimates, on a provincial or regional basis. The capital stock data could be put to numerous analytical uses.

It appears that the major explanation of growth rate differentials can be ascribed to two general sources - resource shifts and scale economies. Under these headings, Denison includes three types of resources shifts (contraction of agricultural inputs, contraction of non-agricultural self-employment and reduction of trade barriers) and two types of scale economies (growth of national markets and growth of local markets). If the orders of magnitude suggested above are reasonable, it would appear that these two general sources are the key to explaining regional income growth differentials.

In comparing the contributions of labour and capital, within the Denison framework, the former is found to be the more important factor accounting for economic growth. Further statistical and analytical inquiries may indicate that this is not necessarily the case. In the estimates presented in this study, allowances have been made for changes in the quality of labour, but no such corresponding allowances have been made for changes in the quality of capital. According to the Denison approach, quality improvements in capital are counted as a contribution of total factor productivity, or more particularly, advances in knowledge. Conceptually, quality improvements in capital stock could very well be classified as a capital contribution, as has been done by a number of economists, thereby significantly changing the relative importance of this source, in relation to labour and other sources of economic growth. An "imbodyed" capital approach would present the importance of capital in a more favourable light.

While the Denison model is useful in explaining differential growth rates among regions of Canada, in terms of overall results, it does not adequately pinpoint the ingredients or provide appropriate economic policies to suggest optimal growth paths. There is a need to supplement the Denison approach, as it applies to regional economic analysis, by disaggregation of the key factors involved. A more detailed analysis of the determinants of the macro variables, in terms of their micro elements, would be useful.

Appendix A

Derivation of Income Estimates

The use of income share to measure the contribution of factor inputs to economic growth requires a functional distribution of national income. As the classification used in most systems of national income accounting, including the Canadian, contain both function and institutional types of income, an approximation to theoretical capital and labour shares is required.

In the Canadian National Accounts, labour income is included under four categories: wages, salaries and supplementary labour income; military pay and allowances; accrued net income of farm operators from farm production; and net income of non-farm unincorporated business.^{1/} The first two are considered to be composed of pure labour income while the last two contain heterogeneous elements. It is therefore necessary to decompose proprietor's income to obtain a breakdown of national income, into approximations of capital and labour shares.

In his study of European economic growth, as in his earlier study of American economic growth, Denison assumed, "...that the percentage of national income that is allocable to labour is the same for proprietorships and partnerships as for non-financial corporations."^{2/}

^{1/} DBS provided a regional breakdown of military pay and allowances not published in the National Accounts. The relative minor labour incomes earned abroad were regionally distributed according to the domestic distribution.

^{2/} Edward F. Denison, op. cit., p. 37.

As the Canadian National Accounts do not provide the same detail as the U.S. system, the more aggregate Business Sector Account was used. This sector account provides a breakdown of factor costs into labour, corporate and proprietorship income. As the labour portion includes labour income derived from both corporations and proprietorships, the wage bill was reduced to represent labour income originating in the non-crown corporate sub-sector by using the American ratio of employee compensation in the non-government corporate sub-sector to employee compensation in the business sector.^{1/} The ratios of estimated labour costs to total factor costs originating in the non-crown corporate sub-sector were then applied to proprietorship income to obtain separate estimates of labour and capital income. The inventory evaluation adjustment of proprietorships could not be excluded from the calculation. Since it is relatively unimportant, there would be no serious effect on the estimates.

The estimated proportion of proprietorship income allocable to labour varied by one or two percentage points during the period 1951 to 1966, for an average of about 68 per cent. In his European study, Denison found that in the U.S. "on the average, this technique allocated 63 per cent of proprietor's income in proprietorships and partnerships to the labour share during the fifties, and rather more in the early sixties."^{2/}

^{1/} The reduction ratios were computed from U.S. Department of Commerce, Survey of Current Business, Washington, U.S. Government Printing Office.

^{2/} Edward F. Denison, ibid., p. 37.

Table A-1
Net Regional Income at Factor Cost, 1951-66(a)
(millions of current dollars)

Region	Labour	1951 Capital	Total	Labour	1961 Capital	Total	Labour	1966 Capital	Total
Atlantic	932	241	1,173	1,800	437	2,237	2,439	615	3,054
Quebec	3,161	778	3,939	6,552	1,554	8,106	9,701	2,407	12,108
Ontario	5,088	1,276	6,364	9,875	2,381	12,256	15,004	3,792	18,796
Prairies	2,234	805	3,039	3,875	1,111	4,986	5,524	1,657	7,181
British Columbia	1,257	318	1,575	2,503	619	3,122	3,798	924	4,723
Canada	12,672	3,418	16,090	24,605	6,102	30,707	36,466	9,395	45,861

(a) After adjustments for fluctuations in farm income and adjustments to represent income at 4 per cent or less unemployment levels.

Source: Based on Dominion Bureau of Statistics, National Income and Expenditure Accounts: 1926-1968, Ottawa, Queen's Printer, 1970 and unpublished DBS data; see text of Appendix A, for derivation of estimates.

The same Canada ratios were used for each region. The relatively small portion of labour income that can be ascribed to proprietorships, in relation to net national income at factor cost, about six per cent in 1968, indicates that no serious biasness would be introduced by using Canada ratios for each region. This is especially true, in terms of the final use of labour shares as weights; small variations hardly affect the contributions of factor inputs to income growth rates or levels.

Corporate capital income is only available on a national basis. This income was distributed by making regional shares a function of labour income. Labour and capital income estimates are contained in Table A-1.

In order to derive income growth rates and income level relatives, a number of further adjustments are required, for comparability reasons. The erratic fluctuations in farm income were smoothed out, by computing five year averages. Adjustments were also made, to put the data on a full-employment basis.^{1/} The cyclical adjustment was accomplished by use of the Okun formula, as modified by Denison.^{2/} The use of the Okun formula seems adequate for the 1951-66 period. However, the results for the two sub-periods indicate that the formula does not work well when there is a large difference in unemployment rates.

^{1/} With unemployment levels at 4 per cent or less.

^{2/} Ibid., pp. 441-2.

Table A-2
Net Real Regional Income at Factor Cost, 1951-66
 (1961 dollars)

<u>Region</u>	<u>Total</u>			<u>Per Employee</u>		
	1951	1961	1966	1951	1961	1966
	(\$ millions)			(\$)		
Atlantic	1,393	2,237	2,659	2,758	4,173	4,359
Quebec	4,677	8,106	10,543	3,273	4,863	5,196
Ontario	7,556	12,256	16,366	4,043	5,308	6,084
Prairies	3,608	4,986	6,253	3,810	4,436	5,035
British Columbia	1,870	3,122	4,111	4,410	5,781	5,984
Canada	19,104	30,707	39,932	3,692	4,972	5,502

Source: Derived from Table A-1, C-1 and Dominion Bureau of Statistics, National Income and Expenditure Accounts, 1926-1968, Ottawa, Queen's Printer, 1970.

"I should perhaps add that Denison has recently expressed some concern about this particular component of his sources of growth. He now thinks that the approach based on Okum relationships may overstate the effect of the cycle on productivity performance."^{1/} Finally, the current dollar estimates were converted to constant dollar estimates by means of the implicit price index of gross national expenditure. The resulting estimates are shown in Table A-2.

^{1/} Communication by Dorothy Walters of the Economic Council of Canada, to the author, dated October 29, 1969.

Appendix B
Annual Hours Estimates

This appendix describes the derivation of qualitative annual hours worked in 1961 and over the period 1951-66, for Canada and its regions.

Average Weekly Paid Hours

As available annual hours estimates are either at the global or industry level, it has been necessary to prepare regional estimates for this study. The most comprehensive hours data are collected in conjunction with the monthly DBS Labour Force Survey. From this source, unpublished weekly hours distributions by sex, for agricultural and non-agricultural groups, as well as a subdivision of the latter into paid workers, were obtained.^{1/} The distributions implicitly provided a required further breakdown of the labour force into full-time and part-time employment; by definition, the former cover those who work 35 or more hours per week, while the latter pertains to those who usually work less hours per week.

The DBS distributions were converted into average weekly hours of persons at work for all survey weeks in each year, other than those in which a holiday or vacation occurred, covering the employment classes shown in Tables B-1 and B-2. Because of the assumptions made

^{1/} The distributions, in class interval groupings of 0, 1-14, 15-24, 25-34, 35-44, 45-54 and 55 and over, covered four weeks in 1951 and one week in each month of 1961 and 1966.

Table B-1

Average Annual Weekly Hours of Civilians at Work, 1961

<u>Region</u>	<u>Part-time</u>		<u>Full-time</u>			
	<u>All Workers</u>		<u>Non-farm Paid Workers</u>		<u>Other Than Non-farm Paid Workers</u>	
	Male	Female	Male	Female	Male	Female
Atlantic	19.5	18.9	44.7	43.0	51.1	47.7
Quebec	21.7	21.0	44.1	42.4	51.7	47.7
Ontario	18.9	17.7	42.4	41.0	51.4	48.0
Prairie	19.0	16.3	42.7	41.0	52.0	46.8
British Columbia	18.1	17.4	41.1	40.5	47.9	46.6
Canada	19.5	18.0	43.0	41.5	51.4	47.5

Source: See text of Appendix B for derivation.

Table B-2
Average Annual Weekly Hours of Civilian
Non-farm Paid Workers at Work, 1951-66

<u>Region</u>	1951				1961				1966			
	Part-time		Full-time		Part-time		Full-time		Part-time		Full-time	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Atlantic	22.9	22.9	46.7	46.0	19.9	19.8	44.7	43.0	19.9	18.9	44.2	41.9
Quebec	25.4	25.2	46.0	43.5	22.1	21.9	44.1	42.4	22.0	21.1	44.0	41.7
Ontario	21.4	20.8	43.7	42.1	18.6	18.1	42.4	41.0	19.0	18.5	43.1	40.9
Prairie	20.8	20.4	43.8	42.2	18.2	17.9	42.7	41.0	17.4	17.2	43.9	41.1
British Columbia	20.6	19.8	41.4	40.6	18.0	17.4	41.1	40.5	17.6	17.3	42.2	40.5
Canada	22.8	22.1	44.5	42.7	19.4	18.8	43.0	41.5	19.4	18.7	43.5	41.2

Source: See text of Appendix B for derivation.

with respect to effective annual hours of work, estimates of average hours worked by non-agricultural paid workers only were required for 1951 and 1966.

Annual Hours Worked Indices

A number of factors, such as vacations, holidays, strikes and lockouts,^{1/} sickness, bad weather and cyclical movements affect the volume of hours worked per year. The use of hours data, based on a limited number of weekly surveys throughout the year, would be significantly biased by holidays and vacations. Weeks with holidays or vacations were, therefore, excluded in making the initial estimates; the remaining weeks were then adjusted to reflect these factors. Ideally, an adjustment for cyclical factors should also be made; this was not possible.

Estimates of the number of vacation weeks per year in 1951 and 1961 were derived from the vacation distributions of office and non-office employees contained in the Department of Labour publication Vacations with Pay: 1951-1961^{2/} and from the distribution of employees contained in the DBS publication General Review of the Manufacturing Industries of Canada.^{3/} Data for 1966 were obtained by extrapolation. The vacation estimates for manufacturing were assumed to be representative of all industries.

^{1/} With regard to strikes and lockouts, data contained in the Department of Labour publication, Strikes and Lockouts in Canada, Ottawa, Queen's Printer, various issues, indicated that these factors have insignificant effects on the volume of annual hours, although they can be important in individual cases.

^{2/} Ottawa, Queen's Printer, 1963.

^{3/} Ottawa, Queen's Printer, various issues.

Table B-3Number of Civilian Holidays and Vacation Weeks Per Year1951, 1961 and 1966

Region	Holidays			Vacation Weeks		
	51	61	66	51	61	66
Atlantic	3.8	6.4	8.0	1.8	2.3	2.5
Quebec	5.5	6.9	7.8	2.0	2.5	2.8
Ontario	6.9	7.8	8.4	2.1	2.7	3.0
Prairie	7.7	8.3	8.8	1.9	2.6	2.8
British Columbia	6.9	8.3	8.8	1.8	2.6	2.8
Canada	6.2	7.5	8.3	2.0	2.6	2.8

Source: See Text of Appendix B for derivation.

As the original data pertained to vacation weeks, predicated on the length of service, they would not be representative of average vacation time; the estimates would overstate the actual by some unknown quantity. The initial estimates were arbitrarily reduced by 10 per cent in each year to arrive at the final estimates shown in Table B-3.

The Department of Labour's annual publication Working Conditions in Canada^{1/} contained distributions of the number of holidays by type of employee that were useful in deriving estimates of the number of holidays in 1951, 1961 and 1966. The same weights used to combine estimates of vacations by type of employee were employed to obtain the number of holidays per year. These are also shown in Table B-3.

The estimated annual holiday and vacation time was used to reduce and convert the annual average weekly hours estimates, in Tables B-1 and B-2 into the indices of actual annual hours worked, shown in Tables 3-1 and 3-3.

Relative Effective Annual Hours

As Denison points out, it is generally believed that the intensity of effort is negatively correlated with the volume of hours worked; however, "...the available studies do not seem to lead to firm

^{1/} Ottawa, Queen's Printer, various issues.

generalizations concerning either the amount of the productivity offset or the reasons for it under particular circumstances."^{1/}

In the case of Canada, there appears to be a complete lack of information on productivity offsets. As a result, it has been necessary to employ the assumptions made by Denison in his study of European economic growth. These are:^{2/}

1. The output per hour of part-time workers of either sex is assumed not to be affected by the number of hours worked.
2. The output per man-year of full-time agricultural workers and non-farm proprietors and family workers of either sex is assumed not to be affected by the number of hours worked.
3. Differences in hours worked by full-time non-farm wage and salary workers are assumed to be partially offset by differences in productivity.

The assumptions require no quality adjustment for part-time workers and the use of the reciprocals of male and female annual hours indices for full-time workers, other than non-farm paid.

The specific Denison assumption, regarding U.S. male and female full-time non-farm workers in 1960, to the effect that "...a small

^{1/} Edward F. Denison, op.cit., p. 60.

^{2/} Ibid., p. 62.

change in average hours worked has a 30 per cent offset in output per man-hour, and that the point at which a small change in average hours worked is fully offset in output per man-hour is higher by 520 hours a year (10 hours per week throughout the year)"^{1/} was used. The level of hours for Canada in 1961 was employed as a base for the spacial and temporal comparisons. Productivity offset curves for male and female full-time workers, relating the actual hours indices to indices, measuring the quality of an hour's work, were derived by interpolation.

The combined actual hours indices, quality adjustment indices of an hour's work and the quality indices for a year's work covering full-time non-farm paid workers, total civilian employment and total employment are shown in Table 3-2 for 1961. The same data are shown for non-farm paid workers and for total employment for the temporal comparisons in Table 3-4.

^{1/} Ibid., p. 63.

Appendix C

Derivation of Labour Force Composition Estimates

As the quality of labour input is affected by the age-sex and military composition of hours worked, distributions of total annual hours worked by these categories and earning weights are required to measure this factor. This appendix describes the spacial estimates made for 1961 and the temporal estimates obtained for 1951, 1961 and 1966, covering Canada and her regions.

Distribution of Total Hours

The unavailability of suitable Canadian hours worked data, cross-classified by age and sex, necessitated converting the annual weekly hours estimates by sex, derived in Appendix B, into the required distributions; this was accomplished, for 1961, by use of American percentage differentials. The Canadian differentials for each sex were derived from the relationship between the U.S. average hours for all ages and each particular age group.^{1/} The estimates for males 20-64 in 1961 were used for the military in all years. The trends of average annual non-farm weekly hours were applied to the 1961 estimates, to obtain comparable annual weekly hours, cross-classified by age and sex, for 1951 and 1966. The estimates are shown in Table C-2.

^{1/} The U.S. relatives were calculated from data in Edward F. Denison, op. cit., pp. 55 and 371.

Table C-1
Employment by Civilian Age-Sex and
Military Groups, 1951-66
(thousands)

Region	Civilian						Military
	Males			Females			
	-20	20-64	65+	-20	20-64	65+	
<u>1951</u>							
Atlantic	34	339	21	20	74	2	15
Quebec	107	952	39	69	249	4	9
Ontario	100	1225	77	72	353	11	31
Prairie	63	651	42	31	144	2	14
British Columbia	18	289	17	12	78	2	8
Canada	322	3456	196	204	898	21	77
<u>1961</u>							
Atlantic	31	320	19	27	105	4	30
Quebec	91	1082	37	89	345	8	15
Ontario	92	1448	68	80	563	18	40
Prairie	61	708	39	40	247	6	23
British Columbia	19	351	15	17	122	3	13
Canada	294	3909	178	253	1382	39	121
<u>1966</u>							
Atlantic	35	368	14	31	134	5	23
Quebec	108	1263	41	104	489	11	13
Ontario	133	1619	68	104	708	18	40
Prairie	79	748	33	53	302	6	21
British Columbia	38	422	14	29	171	4	9
Canada	393	4420	170	321	1804	44	106

Source: See text of Appendix C for derivation.

Table C-2
Average Annual Hours Worked Per Full Week by
Civilian Age-Sex Groups, 1951-66

<u>Region</u>	<u>Male</u>			<u>Female</u>		
	<u>-20</u>	<u>20-64</u>	<u>65+</u>	<u>-20</u>	<u>20-64</u>	<u>65+</u>
<u>1951</u>						
Atlantic	29.9	48.0	38.1	31.3	43.6	38.3
Quebec	30.0	41.8	38.2	30.2	42.1	37.0
Ontario	28.6	46.0	36.6	28.5	39.7	34.9
Prairie	30.0	48.2	38.3	27.5	38.3	33.7
British Columbia	26.8	43.0	34.2	28.1	39.2	34.5
Canada	29.1	46.8	37.2	29.1	40.5	35.6
<u>1961</u>						
Atlantic	28.2	45.3	36.0	28.2	39.3	34.6
Quebec	28.6	46.0	36.0	29.4	41.0	36.1
Ontario	27.3	43.8	34.8	26.6	37.0	32.5
Prairie	28.6	46.0	36.6	25.5	35.5	31.2
British Columbia	26.0	41.8	33.2	25.8	36.0	31.7
Canada	27.9	44.8	35.6	27.2	37.9	33.3
<u>1966</u>						
Atlantic	28.0	45.0	35.8	27.4	38.2	33.6
Quebec	28.8	45.8	36.4	28.3	39.4	34.7
Ontario	27.7	44.6	35.4	26.2	36.5	32.1
Prairie	29.2	46.9	37.3	24.8	34.5	30.3
British Columbia	26.5	42.5	33.8	24.6	34.3	30.2
Canada	28.1	45.1	35.8	26.4	36.8	32.4

Source: See text of Appendix C for derivation.

Civilian employment distributions were obtained from the Dominion Bureau of Statistics, while military employment distributions were obtained from the Department of National Defence for 1961 and 1966. The Canada military employment figure for 1951, as published in the National Accounts,^{1/} was distributed regionally, on the basis of 1951 Census of Canada distributions.^{2/} Military personnel stationed abroad were distributed regionally, according to domestic allocations. The employment distributions are shown in Table C-1.

The annual weekly hours estimates, by age and sex, were then combined with the employment distribution, by age and sex, to obtain the percentage distribution of total annual hours, by age and sex, shown in Table 4-1.

Relative Hourly Earnings

To combine the components of each annual hours distribution into a single measure, relative hourly earnings by age and sex of full-time year round workers are required.^{3/} The only available data are the unpublished 1961 Census average annual employment earnings by sex of full-time year round workers. These are shown in Table C-4. The remaining data had to be estimated.

^{1/} Dominion Bureau of Statistics, National Accounts Income and Expenditure, 1951, Ottawa, Queen's Printer, 1952.

^{2/} Dominion Bureau of Statistics, 1951 Census of Canada, Volume IV, Ottawa, Queen's Printer.

^{3/} Full-time year round workers are defined as those who were employed 35 or more hours per week and 49 or more weeks per year.

The annual earnings were converted into relatives, with each civilian group expressed as a percentage of the average earnings of males 20-64 years of age.^{1/} The groups are the same as those used in the hours estimates by age and sex. The ratios of total average female earnings to total average male earnings were first computed. The ratios were then reduced to represent the relationship between males and females in the 20-64 years group, by means of American income data. The reduction factors represent the rates of female earnings as a proportion of male earnings for the age group 20-64 to female earnings as a proportion of male earnings for all age groups.

For the remaining age groups of both sexes, indices with the earnings of American females 20-64 years of age as a base were applied to the Canadian regional female relatives to obtain the required relatives for males and females under 20 and 65 and over years of age.

A 1961 regional distribution of military pay and allowances was obtained from Dominion Bureau of Statistics. The military relatives were derived as the product of the ratio of military earnings to civilian earnings and weighted (by total hours) average indices of civilian earnings.

The annual employment earnings indices were next adjusted to put them on an hourly basis. As full-time female employees work shorter hours than full-time males, all female indices were increased by the ratio of average weekly hours of full-time males to average weekly hours of full-time females.

^{1/} American relatives were used to convert. See Edward F. Denison, op. cit., p. 371.

Table C-3
Employment Earnings of Full-Time,
Year Round Workers, 1961
(dollars)

Region	Male	Female
Atlantic	3,808	2,051
Quebec	4,212	2,371
Ontario	4,668	2,811
Prairie	4,368	2,649
British Columbia	4,824	2,934
Canada	4,444	2,620

Source: Calculated from unpublished DBS 1961 Census of Canada data.

The final adjustment concerns "full-time, year round workers who earn more per hour than other workers (full-time workers who do not work full year and part-time workers). I assume the earning differentials per hour within each age-sex group to be 10 per cent".^{1/} The same assumption was employed in this study. The final hourly earning relatives are contained in Table 4-2.

^{1/} Ibid., p. 372.

Appendix D

Education Estimates

This appendix describes the derivation of regional educational measures for 1961 and the period 1951 to 1966. The methodology developed by Edward Denison is used. In essence, the product of weighted educational attainment and labour income shares is employed, to measure the contribution of education to economic growth.

Educational Attainment

The educational attainment distributions contained in Tables D-1, D-2 and 5-1 are predicated on published and unpublished 1951 and 1961 Census of Canada statistics, unpublished data collected in the February, 1967, Dominion Bureau of Statistics Labour Force Survey, as well as Estimates.

The labour force educational attainment data available from the 1951 Census of Canada are restricted to five educational categories, according to the number of years spent in school: 0-4, 4-8, 9-12, 13-16 and 17 and over. Estimates of the number of males and females without education were obtained, by using 1951 Census ratios of the population 10 years of age and over not at school and without schooling to the corresponding population with up to eight years spent in school.^{1/} The remainder of the first group were then combined with the second group to obtain the estimate of the labour force with 1-8 years of education.

The 1951 Quebec labour force, with eight years of schooling, was included with those having secondary schooling, to be consistent with subsequent Dominion Bureau of Statistics practice.^{2/} The effects of this procedure on the cross-sectional comparisons is discussed in Chapter Five.

^{1/} Dominion Bureau of Statistics, 1951 Census of Canada, Volume IV, op. cit.

^{2/} An estimate of the Quebec Labour Force with eight years of schooling in 1951 was obtained from the Economic Council of Canada.

Table D-1
Percentage Distribution of the Civilian Labour Force
by Sex and Years of School Completed, 1951

Region & Sex	No Schooling	Kindergarten & Elementary	Secondary		University	
			1 - 3	4 - 5	Some	Degree
<u>Males</u>						
Atlantic	4.6	59.0	27.2	5.5	2.2	1.5
Quebec	1.6	52.3	30.4	10.7	1.9	3.1
Ontario	1.6	48.6	28.8	14.4	2.8	3.8
Prairies	3.2	51.4	29.3	11.2	3.0	1.9
British Columbia	2.0	39.6	33.0	18.3	3.9	3.2
Canada	2.2	50.5	29.5	12.2	2.6	3.0
<u>Females</u>						
Atlantic	2.0	31.3	43.6	16.8	5.1	1.2
Quebec	0.9	37.6	39.4	20.2	0.4	1.5
Ontario	0.9	29.0	36.7	27.6	3.3	2.5
Prairies	2.3	26.8	39.3	23.8	6.5	1.3
British Columbia	1.0	19.4	37.8	33.2	6.2	2.4
Canada	1.2	30.6	38.6	24.4	3.3	1.9

Source: See text of Appendix D for derivation.

Unpublished 1961 Census data contain separate coverage of the labour force with four and five years of secondary schooling. Ratios of the labour force with 4 years secondary schooling to those with 1-4 years secondary schooling in 1961 were applied to the 1951 group with 9-12 years spent at school to obtain estimates covering those in the labour force with 4 years of secondary education in 1951. Those with 5 years of secondary schooling in 1951 were estimated in the same way and combined with the previous estimate to obtain the numbers with 4-5 years of secondary education.^{1/}

The two remaining residual groups were assumed to represent those with 1-3 years secondary education and those with some university education, respectively. The labour force with 17 or more years of schooling was assumed to represent university graduates.

For 1961 and 1966, only estimates of the numbers in the labour force without education were required. Estimates of the number of males in the labour force without schooling in 1961 were obtained by applying to those with less than secondary school the ratio of males 15 years of age and over not attending and without education to the corresponding total with secondary education or less.^{2/} The same source could not be employed to derive similar estimates for females because of

^{1/} Because of the upward trend in the average level of education, the estimate of those with four and five years of secondary education should be biased in opposite directions, thereby largely netting out the biasness.

^{2/} Dominion Bureau of Statistics, Educational Levels and School Attendance, Ottawa, Queen's Printer, 1965.

Table D-2
Percentage Distribution of the Civilian Labour Force
by Sex and Years of School Completed, 1966

Region & Sex	No Schooling	Kindergarten & Elementary	Secondary 1 - 3	Secondary 4 - 5	University Some	University Degree
<u>Males</u>						
Atlantic	2.4	44.6	28.8	16.0	4.0	4.2
Quebec	0.8	43.1	26.7	18.4	4.1	6.9
Ontario	0.9	33.4	37.7	15.9	5.0	7.1
Prairies	1.9	34.5	34.3	18.4	5.2	5.7
British Columbia	1.0	24.6	36.0	23.2	8.3	6.9
Canada	1.2	36.5	33.0	17.7	5.0	6.6
<u>Females</u>						
Atlantic	0.6	23.2	30.8	32.6	8.7	4.1
Quebec	0.3	29.6	25.8	33.2	4.4	6.6
Ontario	0.1	22.4	40.9	27.3	5.3	4.0
Prairies	0.3	22.5	30.9	32.2	8.7	5.4
British Columbia	0.0	13.7	36.5	35.6	10.1	4.1
Canada	0.2	23.7	33.8	31.0	6.3	5.0

Source: See text of Appendix D for derivation.

relative low female participation rates. However, unpublished Census data, collected in the Population Sample mentioned below, contained the proportions of the female non-farm private household labour force without education that were required to complete the estimates.

The 1966 estimates of the labour force without education were obtained by extrapolating 1951 and 1961 data. After removing those with no education, the remaining categories were assumed to be comparable to previous years, although the labour force classification, unlike the Census classification, did not relate to specific years of schooling, but covered those that had some or had completed primary, secondary or university education.^{1/}

Income Differentials

During the 1961 Census, DBS conducted a Population Sample of non-farm private households, to obtain income and other data, supplemental to that collected in the complete enumeration. Unpublished data from this source permitted the derivation of male mean income, cross-classified by education and age, as shown in Table D-3.

The basic data were converted into the actual indices of Table 5-4 by first calculating separate indices for each age group, based on the income of males in each education group expressed as a percentage of the income of those with 1-3 years of secondary education

^{1/} See Dominion Bureau of Statistics, Educational Attainment in Canada: Some Regional and Social Aspects, Special Labour Force Studies No. 7, Ottawa, Queen's Printer, 1968.

Annual Male Mean Income by Age and Schooling, 1961

Region & Age	No Schooling	Kindergarten & Elementary	Secondary		University	
			1-3	4-5	Some	Degree
<u>Atlantic</u>						
25-34	1,691	2,551	3,652	4,440	4,585	5,845
35-44	2,016	3,022	4,354	5,246	6,283	9,377
45-54	1,819	2,879	4,292	5,393	6,292	9,908
55-64	1,703	2,530	4,032	5,519	5,819	9,507
<u>Quebec</u>						
25-34	1,891	3,250	4,000	4,771	5,396	6,823
35-44	2,006	3,744	4,727	6,220	7,241	10,255
45-54	2,275	3,650	4,803	6,470	7,704	11,527
55-64	2,014	3,256	4,508	6,375	7,731	11,625
<u>Ontario</u>						
25-34	1,934	3,713	4,464	5,056	5,366	7,324
35-44	2,456	4,096	5,028	6,130	7,099	10,516
45-54	2,566	4,030	5,131	6,712	7,402	11,675
55-64	2,892	3,729	5,060	6,543	7,578	11,930
<u>Prairies</u>						
25-34	1,371	3,549	4,349	4,807	4,992	7,029
35-44	1,564	3,909	4,856	5,822	6,447	10,481
45-54	1,907	3,690	4,925	6,024	6,925	11,090
55-64	1,817	3,274	4,517	5,505	6,078	10,360
<u>British Columbia</u>						
25-34	2,186	3,906	4,675	4,782	4,823	6,686
35-44	2,017	4,242	4,993	5,707	6,476	10,278
45-54	2,757	4,222	4,980	5,883	6,763	11,473
55-64	2,032	3,551	4,422	5,325	6,200	10,988
<u>Canada</u>						
25-34	1,772	3,412	4,269	4,886	5,178	6,993
35-44	2,042	3,833	4,856	6,018	6,889	10,357
45-54	2,174	3,742	4,912	6,398	7,227	11,431
55-64	2,145	3,396	4,637	6,134	7,014	11,427

Source: Calculated from unpublished 1961 Census data, pertaining to non-farm private households.

and then taking an unweighted average of the four indices. This averaging "...procedure largely removes the effect of correlation between age and amount of education".^{1/}

The actual indices reflect other factors, in addition to the amount of education and the experience lost in obtaining an education, such as intelligence and parental income. To exclude these factors, Denison assumed "...that three-fifths of the reported income differential between each of the other groups and the group with 8 years of education represented differences in earnings due to differences in education as distinguished from associated characteristics".^{2/} The same adjustment is employed to arrive at the rent adjusted indices of Table 5-4.^{3/}

Although the basic data cover annual income, as opposed to annual employment earnings, as would be more desirable, little distortion is expected as a result. Denison was able to compare indices based on both types of American data and found them to be almost identical. "They are almost the same...except that the earnings of high school graduates are a bit lower relative to other groups."^{4/}

^{1/} Edward F. Denison, op. cit., p. 373.

^{2/} Ibid., p. 83.

^{3/} The effect of using a different base than did Denison, while using the same reduction factor, results in slightly smaller differentials.

^{4/} Ibid., p. 374.

A more important consideration relates to the incomplete coverage of the data, as the labour force living on farms or in non-private households are excluded. The effect of this exclusion from Denison's data narrows earning differentials somewhat, especially at the degree level. Probably there would be a somewhat greater narrowing in Canada, due to a greater proportion of the labour force in agriculture than in the United States. However, the rent adjustment would reduce the affects of the biase and the relatively small number of degree holders would not give much weight to the remaining biase.

Distribution of Labour Input

To obtain total quality indices, the separate male and female indices and the military taken as 100 must be combined. A distribution of labour input, measured in terms of employment earnings, amongst the three categories, is required, as 1961 weights.

Although the most comprehensive coverage of labour income is contained in the National Accounts, the required breakdowns are not provided and therefore, a number of estimates must be made.

Wages, salaries and supplementary labour incomes were distributed among the sexes on the basis of the proportions of labour income reported in the 1961 Census of Canada.^{1/} The same source provided a distribution of military income by region that was applied to the Canada total of Military Pay and Allowances, as contained in the National Accounts.

^{1/} Dominion Bureau of Statistics, Earnings, Hours and Weeks of Employment of Wage-Earners, Ottawa, Queen's Printer.

Table D-4
Distribution of Labour Income by
Sex and the Military, 1961
(millions of dollars)

<u>Region</u>	<u>Civilian</u>		<u>Military</u>
	<u>Male</u>	<u>Female</u>	
Atlantic	1,218	223	96
Quebec	4,546	903	56
Ontario	7,123	1,546	275
Prairies	2,786	583	79
British Columbia	1,849	355	42
Canada	17,522	3,610	548

Source: See text of Appendix D for derivation.

1961 estimates of the labour share of proprietors income were derived as in Appendix A and allocated among the sexes, on the basis of relative distributions of self employment income, contained in the 1961 Census Population Sample.^{1/} The Canada ratios were applied to each region.

An estimated breakdown of labour income, according to the required categories, is provided in Table D-4, based on unrevised national income data.

^{1/} Dominion Bureau of Statistics, Incomes of Individuals, Ottawa, Queen's Printer, 1965.

School Days Adjustment

As the amount of education received is a function of the number of days spent in school, as well as the number of years spent in school, an adjustment to take account of this factor is required. Changes in the number of hours spent in school per year result from the lengthening of the school year, especially in rural areas, and the reduction of absenteeism.

Available data do not permit an independent calculation for Canada. The expedient followed is to assume that Denison's adjustments are equally applicable to Canada, although not necessarily to each region. This assumption is predicated on the view that the volume of days spent in school is a function of the degree of urbanization attained and that the rate of urbanization in Canada and the United States has been historically similar.

Denison assumes that the less time spent in school by older members of the labour force, relative to more recent entrants, reduces his educational index for the U.S. in 1960 by 5.5 per cent;^{1/} the same reduction factor is employed for Canada in 1961. Reduction factors for each region were computed by weighting indices, with Canada = 100, of the ratio of absenteeism to enrolment^{2/} by Denison's reduction factor. The reciprocals of these regional adjustment factors

^{1/} Edward F. Denison, op. cit., p. 91.

^{2/} M.C. Urquhart and K.A.H. Buckley (Editors), Historical Statistics of Canada, Cambridge, Cambridge University Press, 1965., pp. 587-8.

were then applied to the educational measures, based on years of schooling, to arrive at the adjusted series. Both series are shown in Table 5-4.

The adjustments required for the period 1951-66 are based on Denison's annual average estimate for the U.S. over the period 1950-62.^{1/} Again, the Canada adjustment was distributed regionally, as described in the spacial estimates. Both the unadjusted and adjusted estimates are shown in Table 5-5.

^{1/} Edward F. Denison, ibid., p. 89.

Appendix E
Capital Stock Estimates

The capital stock estimates used to derive the capital contributions in Table 9-1, are shown below. The authors of these estimates do not provide an account of the methodology employed in deriving the regional data, although the Canada estimate for 1949 was apparently obtained from Hood and Scott.^{1/} As such, the reliability of these estimates is unknown. It would appear, however, that the estimates are not firmly based; this is especially true with regard to the Atlantic Region.

A simple comparison of the estimates, on a per employee basis, indicates that the Atlantic region has the highest level of capital intensity of the five regions. This conclusion is not born out by present knowledge, regarding the state of industrial development in the Atlantic region. The only other data available, presented in the form of per capita capital stock indices, suggests the opposite.^{2/} As the 1949 estimates are predicated on a regional allocation of the Hood-Scott Canada figure, the overstatement of the level in the Atlantic region means that one or more other regions are understated.

^{1/} W. C. Hood and A. Scott, Output, Labour and Capital in the Canadian Economy, Ottawa, Queen's Printer, 1957.

^{2/} Economic Council of Canada, Second Annual Review: Towards Sustained and Balanced Economic Growth, Ottawa, Queen's Printer, 1965, p. 121.

Table E-1
Gross Capital Stock Estimates
 (billions of 1949 dollars)

Region	1949	1963
Atlantic	6.66	10.71
Quebec	13.13	29.03
Ontario	20.79	41.99
Prairies	12.27	24.97
British Columbia	6.06	13.22
Canada	59.51	119.92

Source: P. Camu et al, Economic Geography of Canada, Toronto, Macmillan of Canada, 1964, pp. 104-7.

With consistency over time, however, the regional estimates might be used in deriving capital stock growth rates, in order to derive capital contributions to income growth. In this regard, the capital contributions contained in Table 9-1 are considered illustrative of possible orders of magnitude. It appears that capital contribution measures are reasonable for Quebec, Ontario and British Columbia, while they appear on the low and high side for the Atlantic and Prairie regions respectively.

Appendix F

The Model

A number of production function models are available for quantifying economic growth. These range from the fixed proportions or Leontieff function, with a zero elasticity of substitution, to the so-called pathological^{1/} or one factor function, with an infinite elasticity of substitution. This elasticity measure". . . is defined as the percentage change in the relative amount of the factors employed resulting from a given percentage change in their relative marginal productivities or relative prices."^{2/}

In between these two extremes lie the Cobb-Douglas function, with unitary elasticity of factor substitution and the so-called constant elasticity of substitution function, with the coefficient taking any value, other than zero, infinity or one.

Although the Cobb-Douglas function has traditionally been the most commonly used framework for analyzing economic growth, recently, the more general constant elasticity of substitution model has come to dominate the literature. Unlike the former, the latter makes no assumption regarding the elasticity coefficient,

^{1/} A. A. Walters, An Introduction to Econometrics, London, Macmillan, 1968, p. 283.

^{2/} Mark Blaug, Economic Theory in Retrospect, London Heinemann, 1968.

but, on the contrary, attempts to determine it empirically. Theoretically, this is a more acceptable procedure. However, Denison and others have argued that "the bias resulting from errors in this assumption (unitary elasticity of substitution) is slight for any likely amount of departure from unity."^{1/} Denison's version of the unitary elasticity of substitution function has therefore been followed.

The model used assumes two factors of production, labour and capital. Because of the heterogeneity of productive factors, each input is treated as a multicomponent vector. Labour, for example, is assumed to consist of four components: employment, annual hours, the age-sex composition of annual hours and education.

The partial elasticities of production were estimated from national income data. "It follows that if the elasticities of production function are estimated from relative shares of the factors and these are assumed to sum up to total income, it implies ipso facto that the production function is linear and homogeneous."^{2/}

In addition to factor inputs and their elasticity coefficients, the model has a shift parameter covering all other elements affecting changes in the level of output. This parameter

^{1/} Edward F. Denison, ibid., p. 36.

^{2/} Mark Blaug, ibid., p. 559.

has been called "technical change", "total factor productivity" and "the residual". It includes such elements as economies of scale, advances in knowledge and improved resource allocation.

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