

Sources of Employment Growth by Occupation and Industry in Canada

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This paper uses Canadian input-output and census data from 1961, 1971 and 1981 to decompose employment changes during each decade into nine sources. The goals are to identify: the main sources of growth in aggregate employment; factors which facilitated the more rapid rate of growth of employment in the 1970s; and some reasons for intersectoral shifts of employment and changes in the occupational composition of employment. We pay particular attention to the changing importance of the 'information economy'.

This paper presents an analysis of various sources of employment change in the Canadian private sector between 1961 and 1981. It combines input-output data and census information so that workers are viewed not as identical members of a common labour pool, but as participants in a labour market which is specialized both by industry and occupation. The paper attributes changes in employment in each industry-occupational group to specific sources. To those familiar with shift-share analysis, the methodology is best described as a decomposition of employment changes into *shifts* in the level of employment by industry and changes in the *share* of each occupation in employment in each industry.

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Historical analysis of structural change is useful for analyses of many kinds. In particular, many economic studies try to predict the impact of some structural change on the future path of employment. For example, Harris and Cox (1983) develop a general equilibrium model to project the effects of free trade and other trade policies on several variables, including the distribution of Canadian employment between sectors, while McCurdy (1989) develops a model to predict the impact of computer-based technological change on the sectoral and occupational distribution of employment. The predictions made by such research can be put into context by comparing them to historical changes in the structure of employment. This paper seeks to contribute to such a 'baseline' analysis for Canada.

The shift-share decomposition analyses conducted in this paper extend the existing literature in several ways. Since Canadian input-output coefficients are available for each of our years of analysis, like Fujimagari (1989) we do not need to estimate these data using the rowscaler method of Feldman, McClain and Palmer (1987). Unlike both of these papers our focus is on employment changes by industry and occupation rather than on output changes by industry.

Figures 1 and 2 illustrate, for the 1960s and the 1970s respectively, that the correspondence between output change and employment change varies considerably by industry. Circle sizes indicate the magnitude of employment growth for each of the 39 industries.¹ The vertical axes depict the effect of labour market factors (changes in labour productivity and changes in working hours) on employment growth whereas the horizontal axes depict that due to gross output factors (changes in final demand and changes in intermediate inputs). If both gross output and labour market factors worked in the same direction, in terms of their effect on employment, then the circles would all be in either the first or the third quadrant, that is, the sign of their contributions would be the same. It is clear from the figures that almost all of the gross output effects have been positive whereas, for most industries, the effect of changes in labour productivity and working hours has been to decrease the number of workers required, *ceteris paribus*. The net effect is positive in most cases. However, the relative impact of these factors on employment growth varies considerably by industry.

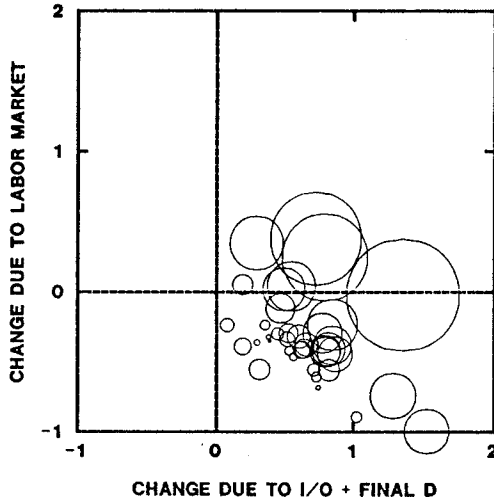
Of course, there have been many studies of changes in the shares of employment by industry.² However, most of those studies have a different focus and thus do not attempt to decompose historical employment changes

¹ For circles below a negatively sloped 45-degree line through the origin, employment growth will be negative.

² Examples for Canada include Baldwin and Gorecki (1990), Charette, Henry and Kaufmann (1986), and Picot (1986).

FIGURE 1

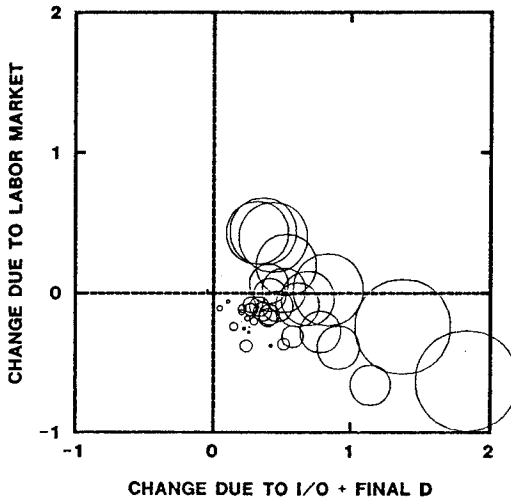
Employment Change by Source, 1961-1971



Note: The scale for the axes is such that 1 indicates that employment has doubled due to the given cause. Circle sizes indicate magnitude of employment growth for each of 39 industries. Circles below a negatively sloped 45-degree line through the origin refer to negative growth rates.

FIGURE 2

Employment Change by Source, 1971-1981



Note: See note to Figure 1.

into components associated with various factors — nor do they have an occupational dimension. Those studies which have used decomposition techniques, for example, Magun (1985), Picot and Lavallée (1987), and Postner and Wesa (1987), have been for shorter time periods³ and have not used an ‘information economy’ disaggregation for occupations. Like Wolff and Baumol (1987) for the U.S. case,⁴ we assess the extent to which Canadian employment growth has been associated with the ‘information economy’ occupations. We also study the impact of declining working hours on sectoral employment levels and the *individual* impact of consumption, investment, government spending, imports and exports on employment, unlike earlier authors who have not differentiated between these components of final demand. Finally, our paper uses a decomposition method, developed by Betts (1989), which is exact in that the sum of the employment changes attributed to the various factors equals the actual employment change.

The next section briefly outlines the method used in the paper. The third section summarizes sources of overall employment change as well as more detailed analyses of employment growth by industries and occupations. Finally, the last section reviews the main findings.

METHODOLOGY

Using data on labour markets and on the input-output structure of the economy for 1961, 1971 and 1981, employment by industry and occupation in each of these years can be expressed as the product of a series of matrices:

$$\text{OCCIND} = \text{OC} \cdot \text{diag}\{\text{diag}(\text{HW}^{-1}) \cdot \text{diag}(\text{Q}) \cdot [\text{I} - \text{D}'\text{B}]^{-1} \text{D}' [\text{F}_1 + \dots + \text{F}_5]\} \quad (1)$$

where: OCCIND_{ij} is employment in occupation *i*, industry *j*; OC_{ij} gives the share of occupation *i* in total employment in industry *j*; HW⁻¹_j is the reciprocal of the average hours per worker per year in industry *j*; Q_j is the number of labour hours per dollar of output in industry *j*; I is the identity matrix; D_{kj} is the fraction of good *k* produced by industry *j*; B_{kj} is the value of good *k* used by industry *j* divided by the value of that industry's output (i.e. B is the rectangular input-output matrix); F1 through F5 are column vectors giving the final demand for 91 goods produced according to the five sources of final demand which are C, consumer expenditure, I, private sector investment in fixed capital, inventories and construction, G, all categories of government

³ Two exceptions are Meltz (1965) and Foot and Meltz (1985). We thank the referee for bringing these references to our attention. Our sample allows us to compare sources of employment growth and changes in the importance of the ‘information economy’ across two decades.

⁴ Osberg, Wolff and Baumol (1989) also provide a Canadian application.

spending except transfers, X, exports and re-exports, and M, imports. All values are in constant dollars.⁵

In other words, employment in each industry and occupation can be expressed as a function of (i) the occupational mix of employment by industry, (ii) the number of hours worked by employees in each industry, (iii) the labour productivity by industry in terms of output per person-hour, (iv) each industry's input-output vector, and the components of final demand for each industry's commodities, (v) the level of consumption, (vi) the level of private investment, (vii) the level of government spending on goods and services, (viii) the level of exports, and (ix) the level of imports.

For different disaggregations of the economy and for both of the periods 1961-71 and 1971-81, employment changes were decomposed into nine sources — corresponding to the factors listed above — using the second method in Betts (1989). The effect on employment of changes in each factor, *ceteris paribus*, was calculated by holding all the other matrices in (1) constant and changing the data for that factor from the initial to the final period's values. Our method ensures that the sum of the employment changes attributed to the nine factors equals the actual employment change. As indicated above, this methodology can be described as a decomposition of employment changes into changes in the *share* of employment in each industry by occupation, and *shifts* in the level of employment by industry, with the latter being further decomposed into various sources.

Economic analysis usually attempts to explain economic change in terms of changes in preferences, endowments and technology. Input-output analysis allows decomposition of an overall change in output (or, in our case, employment) into various components, for example, those associated with changes in labour productivity, working hours, final demand, and intermediate inputs. While each of these shifts is in turn an endogenous function of the 'deep parameters', input-output analysis remains useful as a way of assessing the relative importance of various factors which have contributed to changes in an economic aggregate such as employment.

⁵ For all decompositions, total employment levels for each industry were obtained from the Input-Output Division of Statistics Canada. We would like to thank the Input-Output Division of Statistics Canada for this information. We would also like to thank COPS (the Canadian Occupational Projection System), Employment and Immigration Canada, for providing the 1961/71/81 four-digit occupation by three-digit industry data file, which has been appropriately matched across census years. All input-output data were obtained from Statistics Canada at the medium level of aggregation. After adjustments, these data yielded information on 91 goods and 39 industries. A detailed appendix which lists adjustments made to the input-output data, and which explains the method used to aggregate the raw data, is available from the authors.

SOURCES OF EMPLOYMENT CHANGE

Tables 1 and 2 present, for the 1960s and 1970s respectively, sources of change in employment cross-tabulated by industry and occupation. These tables utilize a fairly highly aggregated industry-occupation breakdown. In particular, industries are grouped into primary, manufacturing/construction, and services; while, following Wolff and Baumol's 1987 study of U.S. employment, occupations are divided into five groups — knowledge, data, goods, services, and n.e.c. (occupations not elsewhere classified).⁶ This choice of occupational groupings is intended to reveal the importance of the 'information economy' to changes in employment by industry and occupation in Canada.

Table 1 shows the change in employment during 1961-71 for each industry-occupation combination, as a percentage of the base year employment for that combination. The first column of numbers lists the employment level in the base year, in this case 1961. The percentage changes in employment due to each of the nine causes are given, with the total percentage employment change appearing in the column on the right. The corresponding information for the 1971-81 period appears in Table 2. A more disaggregated 13-industry decomposition appears in Table 3, while Table 4 presents sources of employment change for a 21-occupation disaggregation.

Sources of Change in Aggregate Employment

Using data from the last row of Tables 1 and 2, Figure 3 shows the contributions which each factor made to changes in aggregate employment during the 1960s and the 1970s. The rectangular bars indicate the aggregate change attributed to each factor while the 'error bars' indicate the inter-sectoral dispersion associated with each factor.

By far the most important factor contributing to growth in aggregate employment was growth in final demand. However, during both decades a *ceteris paribus* decline in the average number of hours worked contributed

⁶ Knowledge workers, such as scientists and engineers, create knowledge and information. Data workers, also a part of the information economy, use and transmit data and other information. Examples include typists and bookkeepers. Some occupations will involve both of these functions so that their assignment into the data versus knowledge categories will be somewhat arbitrary. However, to the extent that we are interested in the total 'information economy' that assignment will not matter. Goods-producing occupations correspond to 'blue collar' jobs. Service occupations are self-explanatory, and the n.e.c. occupation group comprises those that the standard occupational classification (SOC) fails to allot to any specific occupational grouping. An appendix which summarizes our allocation of the 3-digit SOC occupations into these five groups is available from the authors.

TABLE 1
 Percentage employment changes by cause, 1961-71, for the 3-industry by 5-occupation cross-tabulation

	Initial Level	Occ'l Mix	Hours Per Worker	Labour Prod'y	Input-Output Matrix	Components of Final Demand					Total Demand	Total Change
						C	I	G	X	M		
Primary Industries												
Knowledge	15.6	185.4	-11.4	-97.4	-16.1	33.9	22.1	9.1	62.6	-39.0	88.7	149.2
Data	13.8	108.3	-8.9	-79.8	-13.9	28.4	18.5	7.6	52.1	-32.5	74.0	79.7
Services	27.0	13.7	-5.9	-58.2	-11.2	21.6	14.0	5.7	39.2	-24.6	56.0	-5.6
Goods	797.5	-5.9	-5.3	-53.8	-10.6	20.2	13.1	5.4	36.6	-23.0	52.3	-23.3
Occupations n.e.c.	2.9	-7.1	-5.2	-53.5	-10.6	20.1	13.1	5.3	36.4	-22.9	52.1	-24.4
TOTALS	856.9	0.0	-5.5	-55.1	-10.6	20.6	13.4	5.5	37.4	-23.5	53.4	-17.9
Manufacturing/Construction Industries												
Knowledge	64.5	73.7	4.1	-54.2	4.9	35.3	26.0	8.2	39.1	-36.5	72.1	100.6
Data	221.4	20.4	3.4	-46.3	4.3	29.7	21.8	6.9	32.9	-30.7	60.6	42.4
Services	184.3	2.1	3.1	-43.6	4.1	27.8	20.4	6.4	30.7	-28.7	56.7	22.5
Goods	1307.7	-5.4	3.0	-42.5	4.0	27.0	19.8	6.3	29.9	-27.9	55.1	14.2
Occupations n.e.c.	49.1	-52.5	2.4	-35.5	3.5	22.0	16.2	5.1	24.3	-22.7	44.9	-37.2
TOTALS	1827.1	0.0	3.1	-43.3	4.1	27.6	20.3	6.4	30.5	-28.5	56.2	20.2
Service Industries												
Knowledge	62.8	85.7	8.9	-31.5	4.0	54.1	10.3	12.1	17.8	-14.6	79.8	146.8
Data	647.3	22.4	7.4	-26.5	3.4	44.3	8.4	9.9	14.5	-11.9	65.2	71.9
Services	982.2	-11.9	6.6	-23.9	3.1	38.9	7.4	8.7	12.7	-10.4	57.3	31.2
Goods	370.3	-18.2	6.4	-23.4	3.0	37.9	7.2	8.5	12.4	-10.1	55.9	23.8
Occupations n.e.c.	30.6	-48.2	5.7	-21.0	2.8	33.2	6.3	7.4	10.8	-8.9	48.9	-11.8
TOTALS	2093.2	-0.0	6.9	-24.8	3.2	40.8	7.7	9.1	13.3	-10.9	60.0	45.3
All Industries												
Knowledge	142.9	91.2	4.5	-48.9	2.2	43.4	18.7	10.0	32.3	-27.1	77.3	126.2
Data	882.5	23.3	6.1	-32.3	3.4	40.4	11.9	9.1	19.7	-16.9	64.2	64.6
Services	1193.6	-9.2	5.8	-27.7	2.9	36.8	9.5	8.3	16.1	-13.6	57.2	29.0
Goods	2475.6	-7.5	0.9	-43.2	-0.8	26.4	15.8	6.3	29.4	-23.6	54.3	3.6
Occupations n.e.c.	82.6	-49.3	3.4	-30.8	2.7	26.1	12.4	6.0	19.8	-17.6	46.7	-27.3
TOTALS	4777.2	0.0	3.2	-37.3	1.0	32.1	13.5	7.4	24.2	-19.9	57.4	24.4

Initial levels in column 1 refer to base year employment in thousands. The remaining columns are percentage change. "n.e.c." stands for not elsewhere classified.

TABLE 2
 Percentage employment changes by cause, 1971-81, for the 3-industry by 5-occupation cross-tabulation

	Initial Level	Occ'l Mix	Hours Per Worker	Labour Prod'y	Input-Output Matrix	Components of Final Demand					Total Final Demand	Total Change
						C	I	G	X	M		
Primary Industries												
Knowledge	38.9	82.9	13.4	-35.4	-8.6	23.0	22.9	2.2	20.8	-28.1	40.9	93.2
Data	24.8	88.0	13.7	-35.9	-8.7	23.4	23.3	2.3	21.1	-28.6	41.6	98.5
Services	25.5	20.6	10.5	-28.1	-7.2	18.6	18.4	1.8	16.7	-22.5	32.9	28.8
Goods	611.8	-9.8	9.1	-24.6	-6.5	16.4	16.2	1.6	14.7	-19.8	29.0	-2.8
Occupations n.e.c.	2.2	30.4	11.0	-29.3	-7.4	19.3	19.1	1.9	17.3	-23.4	34.2	38.9
TOTALS	703.3	0.0	9.6	-25.8	-6.7	17.1	16.9	1.7	15.3	-20.7	30.3	7.4
Manufacturing/Construction Industries												
Knowledge	129.5	57.9	3.1	-24.2	-6.7	24.3	30.0	2.1	23.0	-31.8	47.6	77.6
Data	315.3	-6.4	2.4	-19.2	-5.5	19.1	23.5	1.7	18.0	-24.9	37.4	8.7
Services	225.8	-25.6	2.2	-17.7	-5.1	17.6	21.5	1.5	16.5	-22.8	34.3	-11.9
Goods	1493.9	1.4	2.5	-19.8	-5.6	19.7	24.3	1.7	18.6	-25.7	38.6	17.0
Occupations n.e.c.	30.8	-56.6	1.8	-15.2	-4.6	15.1	18.4	1.3	14.1	-19.5	29.4	-45.2
TOTALS	2195.3	0.0	2.5	-19.7	-5.6	19.6	24.1	1.7	18.5	-25.6	38.4	15.5
Service Industries												
Knowledge	154.9	83.5	10.1	-18.9	9.6	54.9	14.3	7.8	12.3	-15.8	73.5	157.8
Data	1112.8	-0.1	8.0	-15.1	7.7	41.5	10.7	5.9	9.2	-11.9	55.4	55.9
Services	1288.7	-4.6	7.9	-14.9	7.6	40.7	10.5	5.8	9.0	-11.6	54.5	50.5
Goods	458.5	-14.6	7.6	-14.4	7.3	39.1	10.1	5.6	8.7	-11.2	52.3	38.3
Occupations n.e.c.	27.0	-7.2	7.8	-14.7	7.5	40.3	10.4	5.8	9.0	-11.5	53.9	47.3
TOTALS	3041.9	0.0	8.0	-15.1	7.7	41.5	10.7	5.9	9.2	-11.9	55.5	56.1
All Industries												
Knowledge	323.3	73.2	7.7	-23.0	0.9	38.8	21.6	4.9	17.6	-23.7	59.2	117.9
Data	1452.9	0.0	6.9	-16.3	4.5	36.3	13.7	4.9	11.3	-15.0	51.3	46.4
Services	1540.0	-7.2	7.1	-15.5	5.5	37.0	12.3	5.1	10.3	-13.5	51.2	41.0
Goods	2564.3	-4.2	5.0	-20.0	-3.5	22.4	19.8	2.4	15.9	-21.7	38.8	166.1
Occupations n.e.c.	60.0	-31.2	4.9	-15.5	0.8	25.6	14.8	3.3	11.9	-16.1	40.6	-0.6
TOTALS	5940.5	0.0	6.1	-18.0	1.1	30.5	16.4	3.9	13.4	-18.0	46.2	35.3

See note to Table 1.

modestly to the growth in employment. Changes in the input-output matrix had a very small effect on *aggregate* employment during both decades. Of course, as is clear from Tables 1 to 4 and discussed further below, aggregate effects can mask changes at a more disaggregated level. These positive contributions to employment were partially counterbalanced by increases in labour productivity, which *ceteris paribus* would have led to large employment losses in both decades.

Figure 4 further decomposes the overall change in employment associated with growth in final demand into the components of final demand. During both decades, growth in consumption provided by far the biggest boost to overall employment of any of the components of final demand. Although export growth was also strong, this was counterbalanced by import growth of approximately equal size. Government expenditure contributed little to employment growth associated with the *private* sector (recall that Canada's input-output data relate to the commercial sector only). Aggregate private-sector employment grew by 35.3% in the 1970s, compared to just 24.4% in the 1960s. Figure 3 shows that the much higher rate of growth of employment in the 1970s occurred despite a sharp decline in the growth of final demand (due almost solely to a decline in the growth rate of exports, as shown in Figure 4). Although the faster employment growth in the 1970s was accompanied by a decline in the rate of growth of labour productivity,⁷ it was also associated with increased female participation rates (see, for example, Beach and Kaliski (1986)).

Sources of Changes in Employment by Industry

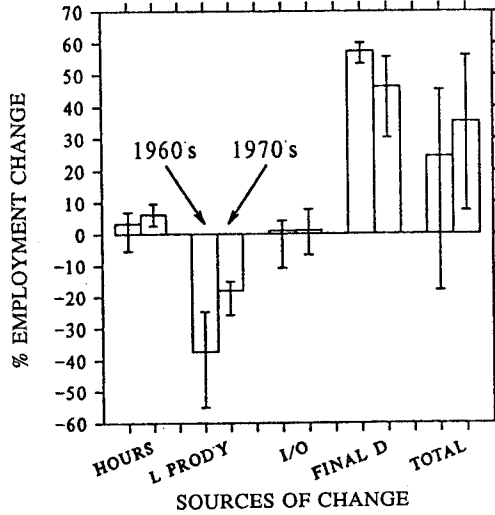
In this section we determine which factors have contributed the most to *variations* in employment growth by industry and whether these factors have changed over time. For example, which factors have contributed most to the consistently faster rate of growth of employment in the service sector?

In Figures 3 and 4 the 'error bars' superimposed on each rectangular bar indicate the range of employment growth between the primary, manufacturing and service sectors. As Figure 3 shows, most *intersectoral* variation in employment growth in the 1960s was related to variations in the growth of labour productivity. As can be seen from Tables 1 and 2, during both decades labour

⁷ The illustrated decline in labour productivity growth reflects the fact that 1961, 1971 and 1981 occurred at different points of the business cycle. Statistics Canada (1986) reports that the average capacity utilization rates of capital for all manufacturing industries during these three years was 73.9%, 83.4% and 79.4% respectively. For a review of the literature concerning the cyclical nature of labor productivity see Fay and Medoff (1985).

FIGURE 3

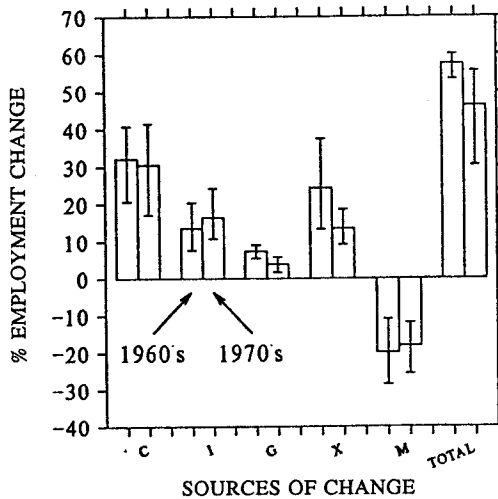
Decomposition of Aggregate Employment Change by Four Factors



Note: 'error bars' indicate the range of employment changes across sectors (primary, manufacturing/construction and services).

FIGURE 4

Changes in Aggregate Employment Associated with Changes in Individual Components of Final Demand



Note: See note to Figure 3.

productivity grew most quickly in the primary sector and most slowly in the service sector.

In contrast, the most important factor contributing to the intersectoral variation in employment growth in the 1970s was final demand which grew in a highly skewed fashion, favouring the service sector. As shown by the 'error bars' in Figure 4, variations in consumption growth were responsible for much of the intersectoral variation in employment changes related to growth in final demand. Indeed, as Table 2 indicates, the main reason why growth of aggregate final demand so favoured employment in the service sector in the 1970s was a shift in consumption toward the service sector. Table 3 indicates that the three industries in the service sector in which employment grew the most strongly due to growth in consumption, other things being equal, were electricity, gas and water; communication; and finance, insurance and real estate. Table 3 also shows that the industries in the primary and manufacturing/construction sectors which gained the least employment from the rise in consumption were agriculture and construction.

Change in the input-output matrix is associated with a very small change in aggregate employment, in either decade, but it did lead to substantial shifts in employment from one sector to another. Over the two-decade period, employment in the service sector gained the most from this change in the input-output coefficients, while employment in the primary industries fell the most, *ceteris paribus*. Table 3 reveals that the mining and oil industry has experienced far fewer job losses than the other primary industries due to this factor. It also indicates that the service industries which have benefited most from changes in intermediate inputs are communications and the social/business/personal service groups.⁸

Although changes in hours worked contributed relatively little to the observed variation in employment growth between sectors, the decline in hours worked contributed more to the percentage change in employment in the service sector than the other two sectors. This trend probably reflects the growing share of part-time employment in service-sector jobs. Table 3 indicates that it was the social/business/personal services industry which displayed the strongest employment gains associated with this factor.

To summarize, the main sources of intersectoral variations in employment growth during the 1960s were different rates of growth in labour productivity across sectors; in the 1970s the main source was different rates of growth

⁸ A 39-industry decomposition (available from the authors) shows that the growth in employment in the social/business/personal services industry due to changes in the input-output matrix arises almost solely from an increase in the use of 'services to business management' as an input. During the 1971-81 period, this industry saw an increase in employment of 63.6% due to *ceteris paribus* changes in the input-output matrix.

TABLE 3
Percentage employment changes by cause, 1961-71 and 1971-81, for the 13-industry aggregation

	Initial Level	Hours Per Worker	Labour Prod'y	Input-Output Matrix	C	I	G	X	M	Total Final Demand	Total Change
Results for 1961-71											
PRIMARY INDUSTRIES											
Agriculture	665.6	-7.8	-47.5	-19.6	23.3	15.4	4.1	29.3	-21.7	50.4	-24.6
Forestry	75.0	-8.8	-29.4	-18.9	23.5	7.7	5.2	28.1	-27.6	36.9	-20.2
Fishing, Hunting & Trapping	16.3	7.6	-1.8	-22.3	29.6	11.8	5.4	30.4	-36.6	40.6	24.0
Mines, Quarries & Oil Wells	100.0	4.1	-58.1	3.5	27.2	7.3	6.8	69.1	-38.7	71.7	21.2
MANUFACTURING/CONSTRUCTION INDUSTRIES											
Manufacturing	1352.9	2.6	-44.8	6.4	33.9	15.3	5.5	39.2	-37.0	56.9	21.0
Construction	474.2	4.6	-38.3	-3.1	7.6	35.6	9.9	4.4	-3.1	54.4	17.6
SERVICE INDUSTRIES											
Transportation & Storage	327.7	-0.5	-55.3	11.3	31.2	11.9	8.7	27.3	-19.9	59.3	14.8
Communication	105.1	2.9	-45.0	3.5	54.8	9.1	11.4	14.2	-13.8	75.7	37.1
Electricity, Gas & Water	44.1	-15.8	-22.2	7.6	57.6	6.7	7.7	19.4	-14.7	76.7	46.2
Wholesale Trade	232.9	6.7	-36.1	2.9	39.2	18.8	6.7	25.3	-15.8	74.1	47.7
Retail Trade	690.8	6.4	-17.9	-4.4	42.1	4.3	3.1	5.8	-4.8	50.5	34.6
Finance/Insurance/Real Estate	212.5	1.6	2.4	-0.5	47.2	4.2	3.1	7.8	-7.6	54.6	58.2
Social/Busin./Pers'l Services	480.1	15.9	-13.9	7.8	33.8	6.9	25.8	13.2	-13.0	66.7	76.4
TOTALS	4777.2	2.9	-35.4	-0.3	32.0	13.8	7.8	23.7	-20.1	57.2	24.4
Results for 1971-81											
PRIMARY INDUSTRIES											
Agriculture	502.0	12.6	-33.0	-10.4	17.5	13.4	2.0	21.2	-23.6	30.5	-0.3
Forestry	59.8	-6.0	-18.9	-14.4	22.8	23.6	2.4	20.3	-28.7	40.4	1.2
Fishing, Hunting & Trapping	20.2	-8.4	52.3	-13.2	23.9	23.9	3.0	38.4	-40.5	48.6	79.3
Mines, Quarries & Oil Wells	121.3	0.3	2.7	-2.0	20.5	17.0	2.2	14.2	-24.4	29.4	30.4
MANUFACTURING/CONSTRUCTION INDUSTRIES											
Manufacturing	1637.5	3.0	-22.7	-6.1	23.6	21.7	2.7	23.7	-32.9	38.8	12.9
Construction	557.8	0.9	-10.4	-3.5	5.6	32.0	-0.9	2.3	-2.6	36.3	23.2
SERVICE INDUSTRIES											
Transportation & Storage	376.3	2.4	-18.0	-1.0	25.3	15.8	4.9	14.3	-19.2	41.1	24.5
Communication	144.0	1.6	-67.8	38.1	57.5	10.9	11.9	10.6	-14.6	76.3	48.2
Electricity, Gas & Water	64.5	1.6	-29.5	11.0	57.6	8.7	-5.0	17.5	-12.1	66.6	49.7
Wholesale Trade	343.9	6.9	-8.3	-8.0	24.0	21.5	3.2	14.6	-14.8	48.5	39.1
Retail Trade	929.9	7.1	-0.5	-4.2	38.9	4.9	1.5	3.4	-4.6	44.0	46.4
Finance/Insurance/Real Estate	336.2	1.5	-5.3	9.8	50.0	8.2	3.1	5.3	-8.1	58.5	64.4
Social/Busin./Pers'l Services	847.1	13.2	-10.9	20.3	43.1	9.5	16.3	10.6	-16.1	63.5	86.1
TOTALS	5940.5	5.6	-15.5	0.2	29.3	16.0	4.4	13.7	-18.3	45.1	35.3

Initial levels in column 1 refer to base year employment in thousands. The remaining columns are percentage change.

of final demand, particularly consumption. During both decades, these sources of variation favoured the growth of employment in the service sector.

Sources of Changes in Employment by Occupation

Figure 5 demonstrates that between 1961 and 1981 the composition of employment shifted sharply towards the 'information economy': together, the share of workers in the 'knowledge' and 'data' occupations rose from 21.5% in 1961 to 35.2% in 1981. However, the idea that this trend originated in the 1970s is false: as the figure shows, well over half of the observed increase in employment in the 'information economy' occurred during the 1960s.

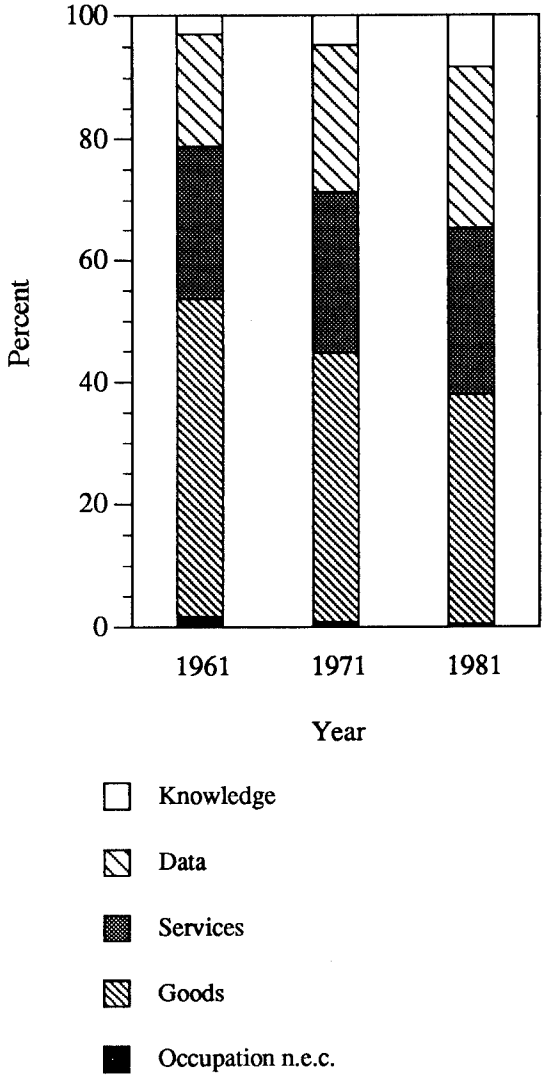
The figure also shows a slight increase in the share of workers in service occupations. The share of employment in goods occupations fell in both decades, while the miscellaneous category of workers, which consists largely of unskilled labour, experienced both relative and absolute declines in employment during both periods. The strong performance of the two groups of occupations comprising the 'information economy', along with service occupations, confirms that the Canadian economy has indeed undergone a shift away from occupations directly related to goods production.

Broadly speaking, differences in the growth rates of employment among occupations stem from two sources. First, the occupational mix — the distribution of employment in a given industry by occupation — has changed over time. Second, differences in growth rates of total employment between industries has tended to shift the distribution of employment by occupation, since the occupational mix differs between industries.

Figure 6 shows a decomposition of employment growth for information workers and non-information workers during each of the two decades. Not surprisingly, an important factor leading to the faster growth of employment in the 'information economy' was changes in the occupational mix. However, shifts in final demand also contributed significantly to the faster growth of information jobs relative to non-information jobs. The bottom sets of numbers in Tables 1 and 2 give more insight into which components of final demand growth contributed most to the shift toward information jobs. Consumption tended to shift towards information-intensive industries during both decades. Growth in investment and exports also tended to favour knowledge workers.

Because Tables 1 and 2 provide a cross-tabulation of employment changes by occupation and industrial sector, we can identify those sectors in which information employment grew most quickly. Knowledge and data jobs tended to grow much more quickly in the primary and service sectors than in

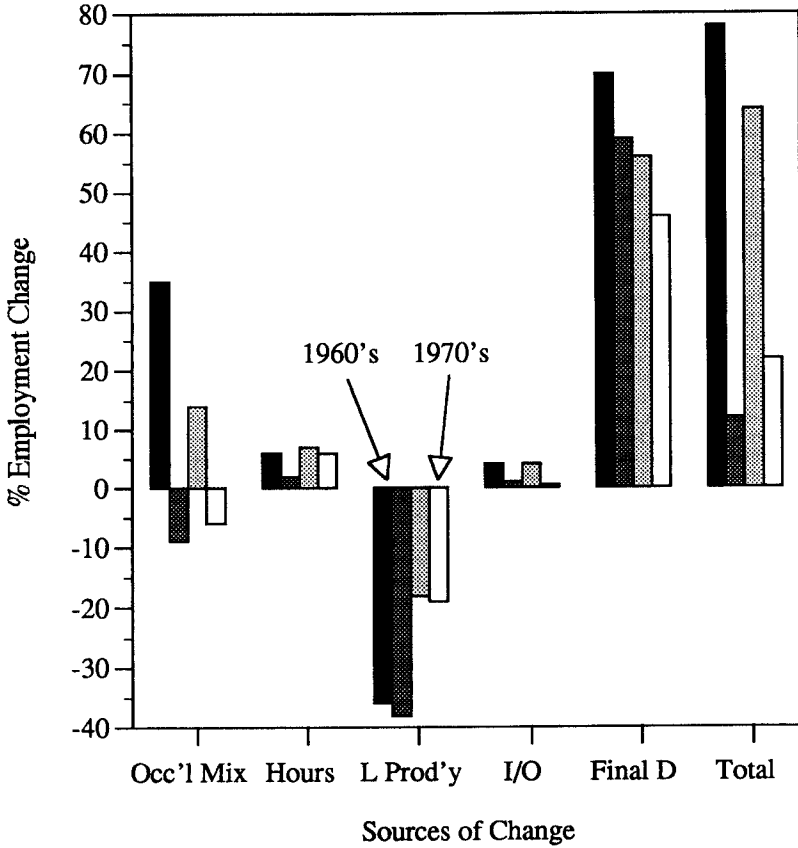
FIGURE 5
Share of Employment by Occupational Group, 1961-1981



Note: Calculations based on Tables 1 and 2.

FIGURE 6

Decomposition of Employment Changes by Worker Activity and Decade



- Non-info workers, 1970's
- ▨ Info workers, 1970's
- ▩ Non-info workers, 1960's
- Info workers, 1960's

Note: Calculations based on Tables 1 and 2.

the manufacturing/construction sector due to much larger shifts in the occupational mix in the first two of these sectors.⁹

Table 4 summarizes employment changes during the 1960s and 1970s for 21 occupations. This table indicates that the strong growth of employment among knowledge workers has resulted almost solely from growth in the share of the management and administration occupation in the occupational mix. Changes in the occupational mix caused employment of this group to grow by 54.5% and then 59.0% during the two decades. Less important but nonetheless large contributions to the growth of employment in the 'information economy' came from shifts in the input-output matrix and in consumption which increased the employment of managers and administrators, scientists, engineers and mathematicians, and social scientists.

The third column of Table 3 highlights the fact that the effect of labour productivity changes on employment has varied considerably by industry. This is also the case when one disaggregates by occupation as in column 4 of Table 4. It is instructive to note¹⁰ that a slower than average growth rate of labour productivity will, *ceteris paribus*, contribute positively to the *share* of workers in that occupation or industry. For example, the effect of changes in labour productivity on 'clerical and related' occupations from 1961-71 (column 4, row 7 of Table 4) reduced the number of workers required to produce a given output by 30.8 percent. However, the *average* effect of these changes was to decrease employment required to produce that given output by 35.4 percent. Therefore, the 'clerical and related' occupations, which were .136 of total employment in 1961, would have increased to a .146 share if the only changes had been those in column 4, while their actual share — incorporating the effects of all factors — increased to .172 in 1971. This attribution of almost a third of the increase in the share of these workers to a relatively slower increase in labour productivity closely matches the results of Foot and Meltz (1985).

Table 4 also reveals that the trends in occupational mix in the 1960s for a few of the occupations were reversed in the 1970s. In certain cases this may well reflect the beginning of the new wave of automation during the 1970s. For instance, note that the machining and materials handling occupations, which experienced a gain in the occupational mix in the earlier decade, registered sharp losses during the later decade.

⁹ Factors other than 'occupational mix' have an effect on the variation between occupations within an industry due to the way that our decomposition method removes higher-order interactions. We calculate the change in employment due to one factor given values of the other factors which are intermediate between those of the base and final year. These changes as a percentage of the base year employment will in general differ between occupations.

¹⁰ We thank the referee for suggesting this example.

TABLE 4
Percentage employment changes by cause, 1961-71 and 1971-81, for the 21-occupation aggregation

	Initial Level	Occ'l Mix	Hours Per Worker	Labour Prody	Input-Output Matrix	Components of Final Demand							Total Final Demand	Total Change
						C	I	G	X	M				
Results for 1961-71														
Management & Administration	116.4	54.5	5.2	-33.4	8.8	45.6	17.9	12.0	30.3	-29.3	76.4	111.6		
Science/Engineering/Math	93.8	29.9	3.5	-42.6	13.6	41.0	21.5	12.6	43.5	-41.9	76.7	81.1		
Social Sciences & Related	15.5	-4.5	10.6	-20.2	27.0	42.1	14.9	24.6	30.9	-31.7	80.7	93.6		
Teaching & Health	28.5	-0.7	9.3	-32.6	2.6	-5.5	2.3	84.6	4.7	-4.3	81.9	60.4		
Medicine & Health	21.6	-5.0	5.2	-30.5	0.5	26.0	7.6	27.1	14.3	-14.4	60.6	30.8		
Artistic/Literary/Recreational	38.0	1.1	7.6	-21.3	4.5	46.8	10.7	10.9	20.4	-22.0	66.8	58.8		
Artistic & Related	649.1	14.7	4.4	-30.8	4.7	43.2	12.8	8.2	23.0	-22.2	65.0	57.9		
Sales	622.7	-6.2	5.5	-21.6	-1.4	40.2	7.6	3.9	12.1	-10.7	53.2	29.5		
Services	361.6	-0.8	14.9	-16.9	-1.7	38.8	6.5	5.7	13.3	-11.6	52.7	48.3		
Agricultural	667.7	-0.1	-7.4	-47.1	-11.4	23.5	9.2	21.1	15.8	-7.6	43.1	-23.0		
Fishing, Hunting & Trapping	17.9	2.7	6.9	-9.2	-8.9	32.0	2.3	1.8	10.2	-14.3	32.0	23.6		
Forestry & Logging	65.4	-8.9	-6.2	-31.5	-12.2	12.8	5.2	5.3	25.0	-11.0	37.4	-21.3		
Mining/Quarrying inc. Gas/Oil	54.9	-21.2	3.9	-47.2	4.9	18.1	8.7	7.1	52.6	-28.3	58.2	-1.5		
Processing	316.6	-11.9	3.0	-40.1	5.4	32.7	9.3	4.4	26.6	-26.2	46.9	3.2		
Machinery & Related	174.3	1.9	2.9	-49.1	7.5	33.5	28.9	7.1	54.8	-51.7	72.5	35.6		
Fabrication/Assembly/Repair	470.6	4.1	3.8	-40.6	5.8	40.6	14.4	4.5	32.6	-34.1	58.1	31.2		
Construction Trades	500.4	-11.9	3.4	-38.4	-0.2	15.4	28.1	8.8	12.5	-9.7	55.1	8.1		
Transport Equipment Operation	244.1	0.7	1.4	-46.7	7.1	30.2	13.0	7.6	25.2	-17.7	58.2	20.7		
Materials Handling, n.e.c.	150.0	7.6	2.8	-42.2	3.8	32.2	13.5	6.1	26.8	-21.2	57.3	29.3		
Other Crafts/Equip't Operation	85.4	-24.6	2.1	-30.2	-3.7	33.8	10.1	7.8	24.0	-23.6	52.1	-4.3		
Occupations n.e.c.	82.6	-53.5	2.7	-30.7	4.6	28.4	12.8	5.4	25.3	-24.3	47.6	-29.2		
TOTALS	4777.2	0.0	3.0	-35.4	0.9	33.0	13.3	6.6	22.1	-19.2	55.8	24.4		
Results for 1971-81														
Management & Administration	246.3	59.0	5.3	-20.7	10.5	40.5	22.8	8.5	18.5	-27.1	63.2	117.2		
Science/Engineering/Math	169.9	14.2	3.8	-24.8	16.1	31.6	25.3	10.4	22.6	-34.5	55.5	64.8		
Social Sciences & Related	30.0	15.5	8.4	-27.5	43.5	40.9	17.5	24.2	19.6	-30.4	71.8	111.7		
Teaching & Health	45.7	5.3	2.8	-12.5	1.8	30.7	3.5	29.5	4.5	-5.4	62.7	86.5		
Medicine & Health	28.3	39.2	7.1	-14.9	0.4	37.8	9.8	12.6	11.9	-17.4	54.6	96.6		
Artistic/Literary/Recreational	60.3	28.0	7.7	-25.8	17.7	56.5	13.8	6.4	14.4	-22.1	69.0	49.6		
Artistic & Related	1025.2	-2.7	4.9	-17.6	7.3	36.9	15.0	5.8	12.8	-18.3	52.2	49.6		
Sales	806.2	10.9	6.0	-18.8	11.8	34.9	9.2	2.2	7.2	-9.6	44.0	31.5		
Services	536.1	-9.6	16.0	-2.6	1.7	41.0	8.0	3.1	7.7	-10.5	49.3	54.9		
Agricultural	514.3	-5.0	11.8	-31.0	-2.3	16.0	3.8	1.0	13.0	-10.1	23.4	-3.1		
Fishing, Hunting & Trapping	22.1	3.8	3.8	-36.1	1.2	23.0	3.7	0.8	20.7	-15.3	32.9	68.4		
Forestry & Logging	51.5	-5.6	-3.1	-18.9	-15.4	14.3	18.6	1.1	22.3	-13.0	43.3	0.3		
Mining/Quarrying inc. Gas/Oil	54.0	-15.6	1.0	-8.2	6.6	13.2	16.9	1.6	16.1	-20.5	27.4	11.1		
Processing	326.8	7.2	4.1	-21.2	-6.9	24.0	14.9	1.9	19.0	-21.9	37.8	21.1		
Machinery & Related	236.4	-8.6	2.9	-15.1	8.8	21.7	33.8	2.6	25.8	-40.5	43.5	13.5		
Fabrication/Assembly/Repair	617.6	5.5	3.9	-16.4	-5.3	31.8	19.0	2.6	17.7	-29.3	41.8	29.6		
Construction Trades	540.8	-5.5	1.5	-14.2	-1.2	13.1	27.1	0.6	6.6	-8.1	39.3	19.8		
Transport Equipment Operation	294.7	-3.3	3.4	-15.5	-1.4	24.0	15.7	3.7	13.4	-15.8	41.0	24.2		
Materials Handling, n.e.c.	194.0	-17.3	3.7	-15.9	-3.5	23.1	14.3	2.4	15.3	-18.6	38.0	5.0		
Other Crafts/Equip't Operation	81.8	-3.6	5.4	-27.3	5.1	36.1	15.8	2.8	16.5	-21.3	48.5	28.1		
Occupations n.e.c.	58.5	-32.0	4.4	-12.7	-1.0	29.0	14.7	2.4	13.4	-19.1	40.3	-0.8		
TOTALS	5940.5	0.0	5.9	-15.5	0.7	29.7	15.4	3.7	13.2	-17.7	44.3	35.3		

See note to Table 1.

SUMMARY

Aggregate private-sector employment grew by 35.3% in the 1970s, compared to just 24.4% in the 1960s. The higher rate of growth of employment in the 1970s, which occurred despite a decline in the growth of final demand, was accompanied by a decline in the rate of growth of labour productivity. The slowdown in growth of final demand was primarily due to a decrease in the growth of exports.

The main sources of intersectoral variations in employment growth during the 1960s were different rates of growth in labour productivity across sectors; in the 1970s the main sources of variation were different rates of growth of final demand, particularly consumption. During both decades, these sources of variation favoured the growth of employment in the service sector.

The share of information-related jobs in total employment grew more rapidly during the 1960s than the 1970s. Most of the growth in the share of information workers in total employment has derived from changes in the occupational mix. However, differences in growth rates of employment between industries, related to differences in the rates of change in hours worked, labour productivity, final demand and changes in the input-output matrix, have also contributed to this shift toward information-related occupations.

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Sources de la croissance de l'emploi par occupation et industrie au Canada

Dans cet article, nous utilisons des données canadiennes des modèles d'intrants et d'extrants et des recensements de 1961, 1971 et 1981 afin d'identifier les causes des changements dans l'emploi durant chaque décennie. Neuf causes de changement sont retenues. L'objectif de cet article est de déterminer les causes les plus importantes de la croissance de l'emploi agrégé de même que les facteurs expliquant la croissance plus rapide de l'emploi durant les années 1970. De plus, les déterminants des déplacements de l'emploi entre les secteurs de même que des changements dans la composition de

la main-d'œuvre sont identifiés. Une attention particulière est prêtée à l'importance des changements dans l'économie de l'information.

L'emploi agrégé du secteur privé a crû de 35,3 % durant les années 1970 alors que dans les années 1960, la croissance ne fut que de 24,4 %. Le taux de croissance supérieur des années 1970, qui survint malgré un déclin de celui de la demande finale, fut accompagné d'un déclin du taux de croissance de la productivité du travail. Le déclin du taux de croissance de la demande finale dans cette décennie était dû à un ralentissement de celui des exportations.

Les différences sectorielles du taux de croissance de l'emploi durant les années 1960 peuvent être expliquées par des taux de croissance dans la productivité du travail différents entre les secteurs alors que durant les années 1970, celles-ci furent plutôt attribuables à des variations sectorielles du taux de croissance de la demande finale, et en particulier de la consommation. Durant ces deux décennies, ces déterminants des différences sectorielles ont généré une croissance supérieure dans le secteur des services.

Par rapport à l'emploi total, la proportion des emplois reliés au domaine de l'information a crû plus rapidement durant les années 1960 que durant les années 1970. La croissance de cette proportion est due en grande partie aux changements dans la composition de la main-d'œuvre. Il y a cependant d'autres explications de ce déplacement vers des emplois reliés au domaine de l'information. Parmi celles-ci, citons les taux de croissance sectoriels de l'emploi différents dus à des différences dans le taux de changement des heures travaillées, de la productivité du travail, de la demande finale et de la matrice d'intrants-extrants.