Employment Change, Growth and Productivity in Canadian Manufacturing: an Extension and Application of Shift-Share Analysis

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Since the late 1950s manufacturing growth has slowed in many western economies as the rate of profit and investment have declined (Armstrong et al. 1991; Marglin and Schor 1990). The Canadian economy has been no exception, witnessing a reduction in the rate of growth of output and capital between the 1950s and the 1980s (Webber and Rigby 1986). Slow output growth, coupled with strong gains in labour productivity over much of the post-war period (see Baumol et al. 1988; Rao 1988), has had a dramatic influence on manufacturing employment in most industrial nations. In Canada, while the hours spent in direct production activities have increased since the 1950s, the pace of employment growth has become progressively slower.

The spatial and sectoral extent of these aggregate trends is unclear. The snowbelt-sunbelt and urban-rural shifts of manufacturing investment and employment in the U.S. are well-known (Norton and Rees 1979; Scott 1988). In the U.K. too, the growing disparities between north and south are increasingly evident (Martin 1982). Spatial differences in economic fortunes are

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just as prominent in Canada. Anderson (1990) and Rigby (1991) detail geographic variations in productivity and profitability, respectively, in the Canadian regional manufacturing system, while Gertler (1986; 1987) explores the patterns and determinants of Canadian regional investment.

There are relatively few studies of the spatial and sectoral extent of Canadian employment dynamics. Johnson (1989) and Altonji and Ham (1990) examine recent changes in industry and provincial employment. Norcliffe (1987) reports divergent patterns of unemployment in Canadian industries and regions during the 1981-84 recession. In more limited surveys, Andrikopoulos (1977) describes manufacturing employment growth in Ontario while Andrikopoulos et al. (1990) detail employment change in Quebec in their examination of the competitive component of the shift-share model. At the sectoral level Grass and Hayter (1989) examine recession-induced employment change in the forest products industry of British Columbia. While these studies provide important insights into the history of employment change in Canada, they remain limited, for the most part, in sectoral, spatial or temporal extent. A comprehensive overview of manufacturing employment over a relatively long period would represent a useful addition to the study of the Canadian economy. Such a survey is the focus of this work.

The method employed is shift-share. After defining the traditional shift-share model, we argue that regardless of its frequently debated methodological flaws the basic univariate shift-share model is of questionable use. The problem is the inability of the standard shift-share model to separate the effects of output growth and productivity change on regional employment. An extended shift-share model is outlined that overcomes this problem. This extended model is used to examine the regional employment performance of Canadian manufacturing industries between 1961 and 1986.

The Traditional Shift-Share Model

Shift-share analysis is a descriptive technique that allows net changes in regional output or employment to be decomposed into three elements: that due to the national rate of change of manufacturing output or employment; that due to the industrial structure of a region; and a residual element that may be interpreted as indicating the locational advantages or disadvantages of a regional economy. The traditional shift-share model is defined as follows. For notational convenience, time is not defined explicitly. It is to be understood that growth rates are measured over a given time interval and that all variables are measured at the start of the time period unless otherwise indicated. Let

E_i^r represent employment in industry i, region r;

g_i^r denote the rate of employment change in industry i, region r;

g_i^n denote the national rate of employment change in industry i;

g^n denote the overall rate of employment change in the nation; then,
$E_i^r g^n$ is the national growth effect for sector i in region r.

Adopting the standard terminology of shift-share, the total shift represents the difference between actual employment growth in a region and that expected on the basis of the national growth effect. Thus,

$$TS^r(g) = \sum_{i=1}^{I} E_i^r[(g_i^r - g_i^n) + (g_i^n - g^n)] = \sum_{i=1}^{I} E_i^r(g_i^r - g^n) \quad (1)$$

where $TS^r(g)$ denotes the total shift in region r and I is the number of industries. The total shift may itself be expressed as the sum of the proportional and differential shifts that are defined next.

The proportional shift captures the effect of the industry mix on regional employment change. The proportional shift expresses the difference between regional employment growth predicted on the basis of each industry in a region growing at its respective national rate and that predicted on the basis of each industry growing at the national average manufacturing growth rate. Thus, the proportional shift in region r is measured as

$$PS^r(g) = \sum_{i=1}^{I} E_i^r(g_i^n - g^n) \quad (2)$$

The differential shift captures the difference between actual employment growth in a region and that predicted on the basis of each industry in the region growing at its respective national rate. The differential shift thus expresses the employment generated by a region's industries compared to their performance at the national level. The differential shift in region r is

$$DS^r(g) = \sum_{i=1}^{I} E_i^r(g_i^r - g_i^n) \quad (3)$$

The shift-share model provides a useful and simple framework for examining regional output or employment changes by industry. It has been extensively used as a policy tool, providing a means of discriminating between the effects of the spatial distribution of industries and spatial variations in "economic competitiveness" on regional growth (see Buck 1970; Dunn 1960; Fothergill and Gudgin 1979). The traditional shift-share model outlined above has been extensively criticised by Richardson (1978) among others (see Knudsen and Barff 1991) and defended by Fothergill and Gudgin (1979).

An Extended Shift-Share Model

In univariate analyses of employment, the sign of a shift-share component is an unreliable indicator of the relative performance of a region or an industrial

sector. With no way of interpreting its results, the shift-share model is clearly of limited use as a descriptive tool or as an aid in the formulation of policy. In this section, after the source of this problem is identified, the equations of the basic shift-share model are modified as a possible solution.

According to the shift-share model, a region with above average employment growth either has a favourable industry mix or enjoys a competitive advantage over other regions. Let us assume, for the moment, that all regions have a similar industry mix. In this case, variations in regional employment growth are generally held to reflect spatial variations in regional competitiveness. However, it is quite possible that above average employment performance may be found in relatively uncompetitive regions. These contradictory possibilities result from variations in labour productivity that are ignored in univariate accounts of employment change (Kuehn and Braschler 1986). In economically efficient regions, for example, productivity increases must be outweighed by output growth, if the region is to enjoy greater employment. Conversely, in economically inefficient regions, productivity reductions may increase employment even in conditions of output decline. Expressed differently, if output in all regions is constant, the region with the slowest productivity growth will have the highest differential shift. Thus, to understand regional employment change using the shift-share model, account must be taken of productivity variations. The problem is acute over short time periods, especially during business cycle swings, as economies adjust to relatively rapid changes in market conditions. This same issue plagues the evaluation of the mix of industries at the regional level. Irrespective of the technical criticisms of shift-share, without a consideration of the relationship between output and employment change, the technique is capable of producing extremely misleading results.

The basic shift-share model of equations (1)-(3) is extended here to separate the effects of output and productivity changes on employment. Let Q_{it}^r represent output in industry i region r at time t, and let

$q_{it}^r = \frac{Q_{it}^r}{E_{it}^r}$ represent average labour productivity in industry i region r at time t.

Then, the change in employment anticipated in industry i region r over the given time period, if productivity remains constant and output changes as observed, is

$$A_i^r = \frac{Q_{it+1}^r - Q_{it}^r}{q_{it}^r}.$$

The potential change in employment in industry i region r resulting from variations in productivity with output constant is

$$B_i^r = \frac{Q_{it+1}^r}{q_{it+1}^r} - \frac{Q_{it+1}^r}{q_{it}^r}.$$

In relative terms

$a_i^r = \frac{A_i^r}{E_i^r}$ represents the rate of employment change in industry i region r resulting from variations in output over the given time period with productivity constant;

$b_i^r = \frac{B_i^r}{E_i^r}$ represents the rate of employment change in industry i region r resulting from variations in productivity over the given time period with output constant.

It should be clear that $g_i^r = a_i^r + b_i^r$ and that these rates of change may be defined at the level of the industry, the region or the nation.

Equations (1)-(3), representing the basic shift-share model, may now be rewritten to incorporate the separate effects of productivity and output changes as

$$TS^r(g) = TS^r(a) + TS^r(b) = \sum_{i=1}^{I} E_i^r[(a_i^r - a^n) - (b_i^r - b^n)] \quad (1a)$$

$$PS^r(g) = PS^r(a) + PS^r(b) = \sum_{i=1}^{I} E_i^r[(a_i^n - a^n) - (b_i^n - b^n)] \quad (2a)$$

$$DS^r(g) = DS^r(a) + DS^r(b) = \sum_{i=1}^{I} E_i^r[(a_i^r - a_i^n) - (b_i^r - b_i^n)] \quad (3a)$$

Based on this extension, a more meaningful classification of regions can be made than is possible with the standard shift-share model. For example, Figure 1 defines a space in the values of $TS^r(a)$ and $TS^r(b)$. If a region is in quadrant 1, its output is expanding more rapidly than the national average ($TS^r(a) > 0$) while its rate of growth in productivity is also above the national average ($TS^r(b) < 0$). Thus the region has a positive profile in terms of both efficiency and growth. If the region falls in quadrant 2, it has above average output growth, but below average productivity growth. This may occur where expansion of output is driven by "capital broadening" rather than "capital deepening". If the region falls in quadrant 4, its output is contracting in relative terms, while its rate of productivity growth is above average. This situation is consistent with large-scale rationalisation whereby the segments of the manufacturing economy with the lowest productivity are being shut down and capital for labour substitution is employed as a cost-cutting strategy. A region in quadrant 3 has the worst possible profile, with below average growth in both productivity and output.

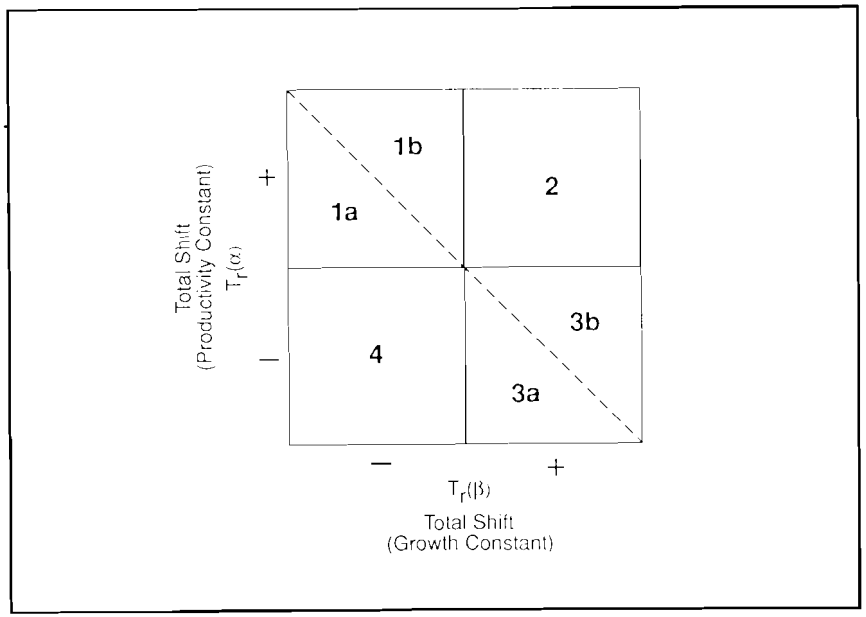

FIGURE 1 Matrix of Regional Performance based on Output and Productivity Differences

To highlight the difference between the basic and extended shift-share models, we divide both quadrant 1 and quadrant 3 into two segments. For segments 1b and 3b, the output effect dominates the productivity effect. For segments 1a and 3a, the reverse is true. A positive total shift is, therefore, measured if a region is in 1b, 2, or 3a. This despite the fact that segment 1b is indicative of growth and efficiency while segment 3a is indicative of decline and inefficiency.

The utility of this modified shift-share framework is demonstrated through an investigation of regional employment change in Canada between 1961 and 1986. The traditional shift-share model is used to outline the major changes in regional employment and relate them to industry-mix and the competitive standing of regional economies. The second stage of analysis investigates the impact of output and productivity changes on regional employment. Thirdly, the employment, output and productivity performance of regions during periods of recession and growth, identified from time series of the national manufacturing profit rate, is examined.

Data

The period of investigation is from 1961 to 1986. A major reclassification of industry groups in 1961 precludes incorporation of earlier data, while 1986

marks the most recent year for which regional manufacturing data were available at the time of analysis. Investigation is limited to the twenty (two digit SIC) manufacturing industries. While the homogeneity of these industry groups between regions is suspect, analysis at finer levels of spatial or industrial resolution is hampered by data availability. Industry reclassification in 1983 demanded the aggregation of the textile, knitting and clothing industries, and further data problems required that the rubber and plastic and tobacco industries be combined with the miscellaneous sector. Thus, sixteen industrial groups are used in the final analysis. Six regions of Canada are examined: Quebec, Ontario, Alberta, British Columbia (including the Yukon and Northwest Territories), an Atlantic region, comprising Newfoundland, Prince Edward Island, Nova Scotia and New Brunswick, and a Prairie region, comprising Manitoba and Saskatchewan.

For the sixteen industry groups in these six regions, annual employment and value added data are almost complete. On average, data withheld for disclosure reasons represented less than 1% of the national total in any year. For each industry, missing data were allocated between regions using information on the number of firms in each region for which data were suppressed. Most of the missing data originated in smaller industries within Atlantic Canada. Some care must, therefore, be exercised when drawing conclusions from these sources.

All data refer to direct production in manufacturing industries. Employment was measured using hours worked rather than the number of employees to account for variation in the length of the working day between industries and regions and over time. Value added data for each industry were used to measure output. These data were deflated using national industry price indexes.[1] Productivity was calculated as the ratio of deflated value added to hours worked.

Results

The results section of the paper confronts a series of issues. First, we provide an overview of employment changes in Canadian manufacturing industries from 1961 to 1986. Second, aggregate regional employment performance and the contribution of each sector to regional employment change is revealed. Third, the effects of changes in output and productivity on regional shift-share components are demonstrated. Fourth, the fortunes of the six regions through periods of economic expansion and decline are separated.

1. Regional industry price deflators do not exist.

TABLE 1 Employment Change in Canadian Industries Over the Business Cycle (%)

Industry[c]	61-64[a]	64-70[b]	70-73[a]	73-76[b]	76-78[a]	78-82[b]	82-86[a]	61-86
FNB	1.9	7.4	0.3	1.5	4.8	-2.0	-0.3	14.0
LTH	1.8	-13.8	-3.4	-2.3	-7.8	-6.5	0.4	-28.3
APL	13.3	-1.2	7.2	-6.7	-3.9	-12.6	9.5	3.0
WOD	18.2	-3.6	25.6	-5.1	11.6	-25.9	25.7	41.4
FNT	16.6	9.0	18.8	-0.9	-3.8	-2.0	31.3	85.1
PPR	9.2	9.0	1.2	2.9	-0.5	-6.5	-1.2	14.0
PUB	2.7	13.8	1.6	5.7	3.9	7.8	26.0	77.3
PMT	15.4	10.8	2.8	-4.5	4.7	-11.5	-1.6	14.4
MFB	27.6	18.4	2.8	5.1	2.9	-12.7	15.1	69.0
MCH	39.3	21.2	14.3	9.0	4.2	-4.4	1.2	112.0
TNS	31.8	13.1	28.6	-8.7	12.9	-15.5	53.3	155.9
ELC	26.3	14.6	8.0	-3.0	-5.8	0.2	20.0	71.7
NMM	14.5	-2.0	14.2	-2.4	1.1	-20.4	26.3	27.0
PET	-6.1	-4.9	2.9	-0.3	26.0	-5.9	-21.9	-15.1
CHM	6.4	18.4	-2.2	8.2	6.1	-0.9	6.1	48.7
MIS	17.1	14.3	13.9	4.6	1.4	-6.6	23.0	85.7
TOTAL	15.0	8.0	8.8	-0.8	3.0	-9.1	15.4	45.0

a. Growth Period
b. Recession Period
c. Industry abbreviations: FNB = Food and Beverage; LTH = Leather; APL = Apparel; WOD = Wood; FNT = Furniture and Fixtures; PPR = Paper and Allied; PUB = Printing and Publishing; PMT = Primary Metals; MFB = Metal Fabricating; MCH = Machinery; TNS = Transport; ELC = Electrical; NMM = Non-Metallic Minerals; PET = Petroleum and Coal; CHM = Chemical; MIS = Miscellaneous also including Tobacco, Rubber and Plastics.

Employment Change in Canadian Manufacturing Industries, 1961-1986

Between 1961 and 1986, hours worked (hereafter, employment) in Canadian manufacturing increased by 45%, though, as Table 1 reveals, this increase was by no means constant. After steady growth through the early 1960s, employment has become pro-cyclical and increasingly unstable. The most pronounced swings occurred during the deep recession of 1979-1983 when employment fell over 9%, and during the subsequent upswing when employment increased over 15%. Overall, the rate of growth of manufacturing employment has slowed markedly.

The contribution of individual industries to aggregate manufacturing performance was quite dissimilar. Table 1 outlines the rate of change in manufacturing hours worked for the sixteen industry groups. The key growth sectors between 1961 and 1986 were the transport, machinery, furniture, printing and publishing, electrical and miscellaneous industries, the latter dominated by the

rubber and plastics sector. The leather and petroleum industries performed the worst in terms of employment change, suffering absolute declines in hours worked from 1961 to 1986. The apparel, pulp and paper and primary metals industries did not lose jobs, although they all performed relatively poorly over the last two to three decades.

Table 1 also illustrates how employment in different sectors varied during business cycles. The resource-based sectors, in particular the wood and non-metallic minerals industries, exhibited the most pronounced pro-cyclical behaviour. The apparel industries and the transport sector followed this same pattern, though it was dampened. In contrast, the food and beverage, printing and publishing, machinery and chemical industries demonstrated a less variable growth history.

Regional Employment Change

The spatial distribution of Canadian manufacturing employment has changed significantly since 1961. Between 1961 and 1986, Ontario's share of manufacturing hours worked increased from 46% to almost 53%. In contrast, Quebec's share of the nation's manufacturing employment declined from just over one third in 1961 to a little more than one quarter by 1986. Employment growth in Quebec was the slowest of any region, registering only 35% of the national rate. In relative terms, the best employment performance was turned in by Alberta, with hours worked increasing 103% between 1961 and 1986. In the Atlantic region, manufacturing employment growth was marginally slower than the Canadian average, while in the Prairies and British Columbia it was 6% and 9.5% slower than in the nation, respectively.

Table 2 shows the impact of industry performance on regional employment. The table presents shift-share components for all regions over the period 1961 to 1986. The absolute shift components are estimated annually and then summed to yield the results in Table 2. The relative values express the absolute shifts in a region as a percentage of the annual average number of hours worked in the region over the period considered.

The total shift data reinforce the earlier discussion of regional differentials in employment performance. In absolute, terms Ontario and Quebec dominate changes in Canadian manufacturing employment. In Quebec, the reduction in hours worked relative to the nation was dramatic. In fact, had Quebec enjoyed employment growth at the national rate, an additional 174 million hours of labour would have been found in the region in 1986. This translates into about 90,000 full-time jobs. Employment in Ontario increased faster than the national average so that almost 162 million hours of manufacturing work, beyond that expected on the basis of Ontario's share of national growth, were located in the region in 1986. In Alberta, manufacturing hours worked were 30 million more than expected on the basis of the region's share of national employment. The

TABLE 2 Shift-Share Components, 1961-1986

	Atlantic	Quebec	Ontario	Prairies	Alberta	British Columbia
Total Shift[a]	-2.65	-173.83	161.81	0.03	30.15	-15.50
Relative TS[b]	-2.07	-22.52	13.21	0.03	34.90	-7.78
Proportional Shift	-9.81	-56.70	82.49	-4.49	-3.92	-7.57
Relative PS	-7.66	-7.35	6.74	-4.47	-4.53	-3.80
Differential Shift	7.16	-117.14	79.32	4.52	34.06	-7.93
Relative DS	5.59	-15.18	6.48	4.50	39.44	-3.98

a. The shift components, expressed in millions of hours worked, are calculated from annual data using the 'dynamic' method of Barff and Knight (1988).

b. Relative shifts, in percentage terms, are obtained by summing the annual absolute shifts and then dividing by the average annual number of hours worked between 1961 and 1986.

Prairie region recorded a disproportionate employment gain of about 30,000 hours. In British Columbia and the Atlantic region, employment increased more slowly than in the nation as a whole, but significantly faster than in Quebec. In relative terms, Alberta registered the largest employment rise, some 35% faster than the Canadian average, and more than two and a half times faster than Ontario. Quebec performed worst of all regions, in a relative sense, with employment growth lagging behind the national rate by almost 23%. By this criterion, the Atlantic region performed significantly better than British Columbia, even though both regions lost ground to the rest of Canada, save for Quebec.

Table 2 also provides a first step in the explanation of the different employment fortunes of Canada's regions. The proportional shift indicates that Ontario contains a mix of industries that have, in general, experienced faster than average employment growth at the national level. In all other regions, an unfavourable distribution of industries, those that have added employment more slowly than the average, has tended to depress employment growth. Eastern Canada, comprising the Atlantic provinces and Quebec, has the weakest industry mix. In relative terms, the favourable distribution of industries is responsible for approximately half of the employment gains registered by Ontario between 1961 and 1986. This same factor accounts for about one third of the employment losses experienced by Quebec and about one half of the relative employment losses experienced by British Columbia. An unfavourable industry mix dominated the pattern of employment change in the Atlantic provinces. Albertan and Prairie producers are also found largely in slow-growth industries, though in these regions other factors have offset the deleterious industry mix on overall employment performance.

The proportional shift is the largest component of the total shift in the

Atlantic provinces and Ontario alone, casting clear doubt on the efficacy of industry mix arguments to explain regional economic performance. In Quebec, Alberta, and to a lesser extent, in the Prairies and British Columbia, regional manufacturing change has been more strongly influenced by the differential shift or by region-specific production considerations.

In Ontario, the positive differential shift added to the effect of the region's industry mix to account for the largest absolute gains in employment of any region after 1961. In Alberta, the differential shift was almost ten times larger than the proportionality shift, completely masking the effects of the weak industry mix. In contrast, the positive differential shift within the Atlantic region was not enough to overcome the employment loss resulting from this region's debilitating industrial structure. In the Prairie region, the negative differential and positive proportional shifts are more or less in balance. Employment loss resulting from an inability to compete in production is dominated by Quebec. The negative differential shift in Quebec is responsible for two-thirds of the region's employment losses. In British Columbia also, a negative differential shift contributes to the region's overall poor manufacturing employment record.

Table 3 illustrates the contribution of each industry to regional employment performance. This table reports absolute proportional and differential shifts. The contribution of each industry to the total shift in any region may be calculated by adding the values of the two shift components. Table 3 shows that regional performance in the Prairies and in Alberta is not dominated by a few industries as it is in the other four regions. In Ontario, the transport sector far outweighs the influence of any other industry, both in terms of the proportional and differential shifts. Most sectors in Quebec performed relatively poorly although the influence of the transport and apparel industries is prominent. In the Atlantic region, the food and beverage and transport industries are key sectors, and in British Columbia the poor performance of the region's wood-based industry explains much of the differential shift. Also in evidence from Table 3, is the remarkable performance of Albertan manufacturers who outperformed their national counterparts in all but the transport sector.

Output Growth and Productivity

The effects of output growth and labour productivity change on the shift-share components (equations (1a)-(3a)) are given in Table 4. With productivity constant, the results show the employment effects of variations in output, and with output constant the results show the employment effects of productivity changes. In the latter case, a negative (positive) shift implies rising (falling) productivity relative to the national average.

Gains in labour productivity are likely to be positively correlated with scale expansion through the process of capital deepening. It is, therefore, not surprising that the total shift figures in Table 4 indicate that four of the six

TABLE 3 Industry Contributions to Regional Shifts, 1961-1986

Industry[c]	Atlantic Provinces PS[a]	DS[b]	Quebec PS	DS	Ontario PS	DS	Prairies PS	DS	Alberta PS	DS	British Columbia PS	DS
FNB	-10.45	18.06	-18.99	-7.51	-28.13	-5.35	-5.48	-5.44	-4.14	-0.36	-5.18	0.59
LTH	-0.36	-0.15	-17.04	-7.30	-17.07	6.10	-0.84	0.49	-0.23	0.55	-0.32	0.32
APL	-1.98	-0.55	-67.59	-22.66	-35.68	14.06	-5.25	4.36	-1.52	1.61	-2.17	3.18
WOD	-0.33	-2.06	-1.93	10.18	-1.09	10.52	-0.57	1.19	-0.26	1.97	-3.26	-21.80
FNT	0.25	-0.19	8.50	-7.44	12.14	9.25	1.00	-1.80	0.70	1.13	0.77	-0.95
PPR	-4.20	-0.68	-15.96	-6.67	-16.15	-3.05	-0.92	0.93	-0.74	1.69	-6.01	7.77
PUB	0.89	-1.18	7.33	-3.42	13.53	1.32	2.01	-0.46	2.31	2.93	2.27	0.81
PMT	-1.31	-3.57	-8.93	3.73	-25.87	1.99	-1.29	-2.00	-1.42	2.94	-2.48	-3.10
MFB	0.86	-1.99	8.43	-13.33	19.14	9.92	1.08	-0.94	0.72	4.71	1.40	1.63
MCH	0.42	1.56	6.85	0.17	27.21	-13.26	1.25	2.57	0.06	7.72	1.96	1.24
TNS	5.89	-10.36	26.56	-28.90	98.07	46.37	3.98	0.70	1.99	-2.68	5.39	-5.13
ELC	0.38	-0.28	6.33	-5.51	16.42	-3.04	0.43	3.57	0.14	2.34	0.24	2.92
NMM	-0.50	0.77	-2.98	-7.22	5.42	3.29	-0.60	0.70	-1.18	0.43	-0.70	2.03
PET	-0.85	0.13	-1.85	-1.48	-2.88	2.02	-0.77	-1.17	-1.14	0.31	-0.74	0.20
CHM	0.12	0.40	0.81	-4.16	0.97	0.53	0.03	0.34	0.07	4.62	-0.15	-1.73
MIS	1.36	7.24	13.77	-15.62	27.33	-1.33	0.89	1.47	1.01	4.14	1.28	4.09

Note: Summing the shift values for each region yields the absolute shift values in Table 2.
a. Absolute Proportional Shift
b. Absolute Differential Shift
c. See Table 1 for an explanation of abbreviations

regions fall in quadrant 1 of Figure 1. Only in the case of Alberta do the relative employment gains from output growth outweigh losses from productivity growth. For the Atlantic region and British Columbia, the output induced relative employment gain is outweighed by strong productivity growth. For the Prairies, the two effects roughly cancel one another.

Proportional and differential shifts from the extended model indicate whether industry mix explains a large proportion of the rapid growth in output and productivity in these regions. Table 4 indicates that industry mix explains very little of the strong performance of the Atlantic region and Alberta. In other words, the production sectors in these two regions generally fared better in terms of both output and productivity growth than their national counterparts. In British Columbia, however, about one third of the productivity growth effect is due to sectoral mix. This means that a concentration in sectors with above average productivity growth has contributed significantly to this region's slower than average employment growth. The case of the Prairies is interesting because here the signs of the productivity growth and output growth effects are reversed in the proportional and differential shifts. This region performed rather well in light of its disadvantageous industry mix.

Employment prospects in Quebec's manufacturing sector look dismal. This region lost jobs relative to the nation as a whole as a result of sluggish output growth and rapid productivity improvements. Although above average productivity gains may appear to be a source of optimism, coupled with the relative decline in output, they are suggestive of a process of restructuring dominated by economic retrenchment and rationalisation.

The results for Quebec are especially instructive in defining the advantages of the extended over the conventional shift-share model. Examining Table 2, one might conclude that the situations in Quebec and British Columbia are similar. Both regions have slow employment growth that appears to be due to both mix effects and poor competitiveness. The situation just appears to be more severe in Quebec. Table 4 gives quite a different impression. Here it is clear that Quebec's weak employment record is due to the relatively poor output growth of the manufacturing sector. By contrast, slow employment growth in British Columbia is consistent with an economically healthy manufacturing sector, but one where growth in output is not enough to offset the labour savings due to productivity growth, at least in relative terms.

Ontario is the only region to experience below average productivity gains. This sluggish productivity record, coupled with rapidly expanding output, has resulted in significant manufacturing employment gains. While the low rate of productivity improvement in Ontario must be cause for some concern, Anderson (1990) notes that absolute productivity is significantly higher in Ontario than most other regions. The proportional shifts indicate that while Ontario's mix of industries is relatively growth oriented, it is neutral with respect to productivity growth. The differential shift reveals that producers in Ontario appear less innovative than their national counterparts on an industry-

TABLE 4 Regional Components of the Extended Shift-Share Model, 1961-1986

	Relative Proportional Shift		Relative Differential Shift		Relative Total Shift	
	Productivity Constant[a]	Output Constant[b]	Productivity Constant	Output Constant	Productivity Constant	Output Constant
Atlantic	-7.68	0.02	44.35	-38.76	36.66	-38.73
Quebec	-3.84	-3.51	-9.47	-5.71	-13.30	-9.22
Ontario	5.67	1.07	2.52	3.96	8.18	5.03
Prairies	-7.08	2.62	9.33	-4.84	2.25	-2.22
Alberta	-8.14	3.61	63.31	-23.87	55.17	-20.26
British Columbia	1.97	-5.77	7.56	-11.54	9.53	-17.31

a. This measures the effect of output on the shift term with the effects of productivity held constant.
b. This measures the effect of productivity on the shift term with output held constant.

by-industry basis.

Employment Change in Periods of Growth and Recession

Tables 5 and 6 show the extended shift-share model results for different phases of the business cycle. Ontario dominates Table 5, with large values for relative shifts in this region tending to correlate with large values of the opposite sign for the shifts in most other regions. Since the early 1960s, Ontario's performance has generally been somewhat lacklustre, although this changed dramatically with the sharp economic upturn of the mid-1980s, causing a sudden halt to the relative employment gains made by regions such as British Columbia, Alberta and the Atlantic provinces. The relative proportional shift is positive over all periods in Ontario, revealing a relatively diversified and strong manufacturing base. In relative terms, the industries in Ontario appear to perform better, relative to their national counterparts, in upswing phases of the business cycle. This might indicate the core role of the Ontario economy, as firms here enjoy growth before the capacity of firms in "peripheral" regions is brought on-line.

In Table 5, Quebec shows all signs of a regional manufacturing economy in full-scale retreat, enjoying no relative gains compared to the nation in any stage of the business cycle. For every period, all three relative shift measures are negative, evidence that the industry mix and economic structure of the region are simply uncompetitive.

Of the remaining regions, British Columbia has the most pro-cyclical industry structure, its manufacturers performing very well in the upswing stages of the business cycle, although even this region failed to share in the gains of

TABLE 5 Shift-Share Results over the Business Cycle

Growth Years	61-64		70-73		76-78		82-86		Total
Recession Years		64-70		73-76		78-82		Total	
Atlantic									
RTS[a]	-3.71	4.80	-1.95	-0.15	4.54	0.04	-6.20	4.27	-6.77
RPS[b]	-3.38	-0.81	-1.74	0.54	1.40	1.31	-5.89	1.28	-9.36
RDS[c]	-0.32	5.61	-0.21	-0.69	3.14	-1.27	-0.30	2.99	2.60
Quebec									
RTS	-4.85	-2.49	-4.10	-1.71	-2.64	-2.62	-4.50	-6.85	-16.06
RPS	-0.90	-1.82	-0.96	-0.44	-1.51	-0.13	-1.68	-2.37	-5.09
RDS	-3.94	-0.67	-3.14	-1.28	-1.12	-2.49	-2.82	-4.48	-10.97
Ontario									
RTS	4.25	-0.05	0.99	-0.25	-0.02	0.70	7.97	0.44	13.17
RPS	1.47	1.87	0.37	0.32	0.10	0.79	1.97	2.93	3.84
RDS	2.78	-1.92	0.62	-0.56	-0.12	-0.09	5.99	-2.49	9.32
Prairies									
RTS	-4.27	3.88	1.94	5.67	-5.86	9.49	-12.79	20.10	-21.31
RPS	-3.10	-0.61	-1.56	0.47	0.26	0.92	-1.72	0.98	-5.65
RDS	-1.17	4.49	3.49	5.20	-5.52	8.58	-11.07	19.12	-15.66
Alberta									
RTS	-1.87	12.95	1.05	20.17	4.31	14.16	-16.13	49.19	-15.16
RPS	-3.23	-0.69	-0.51	0.68	1.58	0.20	-3.45	-0.41	-5.02
RDS	1.36	13.64	1.55	19.49	2.73	13.96	-12.69	48.78	-10.14
British Columbia									
RTS	0.66	1.04	10.15	-3.10	7.38	-6.48	-16.28	-9.80	2.53
RPS	-0.04	-3.20	3.62	-1.09	3.11	-5.34	-0.20	-10.13	7.06
RDS	0.70	4.24	6.53	-2.00	4.27	-1.14	-16.07	0.34	-4.53

a. Relative Total Shift
b. Relative Proportional Shift
c. Relative Differential Shift

the mid-1980s. The economy of British Columbia also appears a little more volatile than that of Ontario, with large swings in relative shift components between recession and growth years. The industry mix dominates the sign of the relative total shift in this region and the performance of individual producers is poor especially in growth periods. The Atlantic region, the Prairies and Alberta exhibit counter-cyclical employment shifts, gaining employment during national recessions and losing it during upswings. In part, this reflects the dominance of Ontario, but it may also point to the types of industries located in these regions, and the fact that they do not follow the same periodic fluctuations as those in "central" Canada. In all of these regions, the industry

TABLE 6 Extended Shift-Share Model Results over the Business Cycle

	Relative Proportional Shift		Relative Differential Shift		Relative Total Shift	
	Productivity Constant	Output Constant	Productivity Constant	Output Constant	Productivity Constant	Output Constant
Atlantic						
Growth	-6.20	-3.16	19.03	-16.43	12.82	-19.59
Recession	-1.66	2.95	25.15	-22.16	23.49	-19.22
Quebec						
Growth	-1.54	-3.55	-11.65	0.68	-13.19	-2.87
Recession	-2.28	-0.09	1.66	-6.14	-0.61	-6.23
Ontario						
Growth	2.38	1.46	4.78	4.55	7.16	6.01
Recession	3.26	-0.34	-2.05	-0.43	1.21	-0.77
Prairies						
Growth	-7.87	2.21	-14.26	-1.40	-22.13	0.81
Recession	0.52	0.46	22.51	-3.39	23.03	-2.92
Alberta						
Growth	-6.18	1.16	17.62	-27.76	11.44	-26.60
Recession	-2.03	2.44	45.34	3.44	43.32	5.87
British Columbia						
Growth	18.82	-11.76	11.16	-15.69	29.98	-27.45
Recession	-15.39	5.26	-2.99	3.32	-18.38	8.58

mix exerted a strong depressant effect on the relative total shift in national upswing periods. However, only in the Atlantic region, did the in-dustry mix effect dominate. In the Prairies and in Alberta, the difference in the total shift between recession and growth years is dominated by the differential shift, so their counter-cyclical trends cannot be explained by industry mix.

The extended shift-share model provides two new dimensions to our analysis of regional employment trends over the business cycle. First, by holding productivity constant, the output growth effect gives us a more accurate picture of how production is affected by recessions. If we assume away changes in inventories, the output growth effect reveals the relative business cycle sensitivity of the demand for the goods each region produces. Second, by comparing the effect of productivity growth on employment during growth periods and recessions, we can infer more about the kinds of forces that are at work. That is, if this effect is greatest during recessions, it is likely that productivity growth is largely the effect of rationalisation, while if it is greatest during growth periods, it is more likely to indicate the effect of technological innovations embodied in new productive capacity.

Table 6 presents the relative shifts of the extended shift-share model for national growth and recession periods. The results in this table confirm some of the generalizations that were made on the basis of Table 5. In particular, the growth components indicate that manufacturers in the Atlantic region, the Prairies and Alberta perform relatively well during recessions, and that this performance is not generally due to sectoral mix effects. However, a result that is not evident in Table 5 is that in the Atlantic region and Alberta, the total shift that is directly attributable to output growth is positive in growth periods as well as recessions. Thus, in terms of output, both regions perform better than average throughout the business cycle, despite unfavourable industry mixes. The poor performance in employment generation for these two regions during growth periods is due to extremely rapid productivity growth rather than slow output growth.

British Columbia has by far the worst output performance during recessions. The proportional shift indicates that this is largely due to sectoral mix, confirming that the British Columbia economy probably relies more than most regions on the export of resource based products the demand for which is extremely sensitive to business cycle swings. Table 6 also indicates that rapid employment growth in Ontario during upswings is due almost as much to relatively slow productivity growth as it is due to relatively fast output growth. The Prairies have relatively weak performance in terms of both output and productivity growth during periods of national economic growth.

The Atlantic region is the only region whose productivity growth effect appears to be insensitive to the business cycle. This region experiences very large employment losses due to productivity growth during both upswings and recessions. Quebec, Ontario, and the Prairies have their largest productivity growth effects during recessions. These results must be interpreted with some caution, as productivity growth is greater over all regions during periods of economic growth. It is only in relative terms that it is greater in these regions during recessions. Still, they at least suggest that rationalization and the scrapping of old facilities plays a greater role in these regions than in the others. In contrast, Alberta and British Columbia experience rapid productivity growth during upswings, indicating the more dynamic nature of these regional economies.

Conclusion

The extended shift-share model presented in this paper measures the impact of changes in output and labour productivity on regional employment. This model allows a more useful decomposition of regional employment trends than the basic shift-share model. We conclude with some general observations from the extended model about regional employment trends in the Canadian

manufacturing sector.

The results for the Atlantic region shed some light on ongoing debates concerning the effect of regional policy in Canada. Over the period of our study, the Canadian federal government has used various policy instruments such as investment incentives to promote manufacturing employment growth in Atlantic Canada. One of the major criticisms of these instruments has been that they cheapen capital relative to labour, and, therefore, tend to bias industrial growth toward increasing capital intensity rather than employment generation (Woodward 1974). Since increasing capital intensity generally gives rise to labour productivity growth, the results of our study lend empirical support to this position. Our model indicates that despite healthy output gains, rapid growth in labour productivity has kept the Atlantic region's manufacturing employment growth below the national rate.

Based on our results, Alberta appears to be the most dynamic of all Canadian regional economies. Despite some slowdown in the 1980s, Alberta is the only region in which above average rates of growth in both employment and productivity have been maintained. The popular conception among Canadians is that Alberta's rapid growth is highly concentrated in the industries associated with oil and gas exploitation. However, our results suggest that growth in Alberta is broadly distributed across sectors.

The basic shift-share model indicates that manufacturing employment growth in British Columbia has lagged behind that of the nation. We have shown that this is due to rapid productivity growth rather than slow output growth. Beyond this, the results in Tables 5 and 6 demonstrate that employment change in this region is largely the outcome of weak output growth through recessions. During economic expansion, output growth is sufficient to overcome the effects of rapid productivity growth, so in these years British Columbia is in a similar position to Alberta. In the Prairies, by contrast, growth lags national rates during business cycle upswings.

Since shift-share analysis compares regional growth rates to national growth rates which are essentially weighted averages over all regions, large regions tend to have a dominant effect on the results. It is, therefore, not that surprising that Ontario is the only region with below average productivity growth and Quebec is the only region with below average output growth. The slow growth of productivity in Ontario should be viewed in light of the fact that the current value of its productivity remains well above that of all regions except Alberta and British Columbia throughout the study period. Despite slow productivity gains, Ontario's employment trends indicate that its central role in Canadian manufacturing remains undiminished. Quebec's employment record since 1961 is dismal. Slow productivity gains coupled with weak output growth across much of the manufacturing sector is to blame.

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