INCOME AND EMPLOYMENT MULTIPLIERS FOR SEVEN BRITISH COLUMBIA REGIONS

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Introduction

The purpose of this paper is to formulate, and to estimate empirically, income and employment multipliers that will assist both public and private sector employers in British Columbia to gauge the regional economic impacts of their expenditures on wages and salaries. Towards this end, the province has been divided into seven regions as shown in Figure 1. The boundaries of the seven regions are coincident with regional district boundaries, and the composition of each of the regions in terms of the twenty-nine regional districts of B.C., along with total employment in each region, is shown in Appendix 1.

For the purpose of constructing multipliers, the commonly adopted economic base model was rejected in light of the well-established tendencies of techniques of base identification (location quotients, minimum requirements, categorization) to result in an overstatement of the economic base multiplier because of problems of cross hauling and product mix [11;6;10]. The input-output (I-O) model represents a substantial improvement over the economic base model in that it incorporates the indirect impact as well as the induced impact and yields a multiplier for each producing sector, as opposed to the single aggregate multiplier of the economic base model. I-O models, however, are very expensive to construct in terms of both money and time. At the present time, an I-O model exists for only one of the seven B.C. regions.

Primarily because of the practical shortcomings of the base model and the prohibitive construction costs of the I-O model, an income-

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expenditure approach to the program was adopted. The income-expenditure methodology is sufficiently flexible to generate both income and employment multipliers, to utilize estimates of marginal rather than average propensities, to make use of disaggregated consumption data, and, most important for the purposes of this paper, to incorporate an exogenous estimate of the indirect effects.

Figure 1

BRITISH COLUMBIA REGIONS*

Theoretical Formulation of the Multipliers

Income Multipliers

The income multipliers, 1/(1-r), for the seven regions are based on the following well-known converging series:

$$1 + r + r^2 + r^3 + \ldots + r^n = 1/(1-r) \qquad (1)$$

in which r = the average amount of income retained locally after each round of spending. In its simplest form, r is equal to the marginal propensity to consume locally times the amount of local income generated per dollar of local sales.

The formulation of the multipliers in this study differs from the customary income-expenditure analysis [17;3;15;5;13] in that information produced by an I-O model of one of the regions (the Lower Mainland) is directly incorporated into the development of each regional income multiplier. More specifically, the I-O model is used to disaggregate each region's consumption expenditures, and to incorporate into each region's consumer spending process an estimate of the indirect income effects produced by this spending.

The manner in which these I-O based estimates were introduced into the income multipliers of equation (2) below can be seen more clearly in Figure 2. The purpose of this figure is to illustrate the determination of the value, r, of the proportion of a dollar of wages and salaries that is retained in the community in the form of local value added (LVA) at the end of each round of spending. As can be seen from Figure 2, an *additional* dollar of wages and salaries injected into the region results in immediate leakages of income taxes, t, and of personal savings, s. It is assumed that there are negligible feedback effects through increased government spending in the region because of expanded tax revenues and through increased investment spending attributable to an augmented flow of loanable funds.

Consumption spending in each region is divided between imported and locally-produced commodities. Local consumption spending in each region is allocated among the eighteen producing sectors of the Lower Mainland regional I-O model; c[i] is the proportion of consumption spending on the locally produced output of sector i. The values for these proportions are taken from the I-O household consumption column of the Lower Mainland I-O transactions matrix, see Table 1. No attempt was made to estimate differences in consumption patterns between regions, as no relevant data were available.

Having established the pattern of local sales of consumer goods, the next step is to translate these sales into the local value added generated directly and indirectly. The *direct* LVA produced is estimated by multiplying the sales, c[i], in each sector i by the ratio v[i] of LVA to sales.

For each local sale, the producing sector is assumed to purchase inputs from other sectors, which in turn buy supporting production from still other sectors, and so on. These supporting sales result in the *indirect* generation of LVA. The open variant of the Lower Mainland I-O model (that is, the I-O model with households as a final demand rather than a producing sector) was used to estimate the indirect LVA,

y[i], generated by a dollar of sales of sector i in the Lower Mainland. For each of the other six regions, individual sectoral indirect effects are scaled downward by P, the ratio of the region's total employment to that of the Lower Mainland. The underlying assumption for this scaling operation is that the complexity of the regional economy (and thus the size of the indirect income effect generated) is roughly proportional to the region's total employment. The LVA indirectly generated by a dollar of local consumption sales is thus expressed as P y[i].

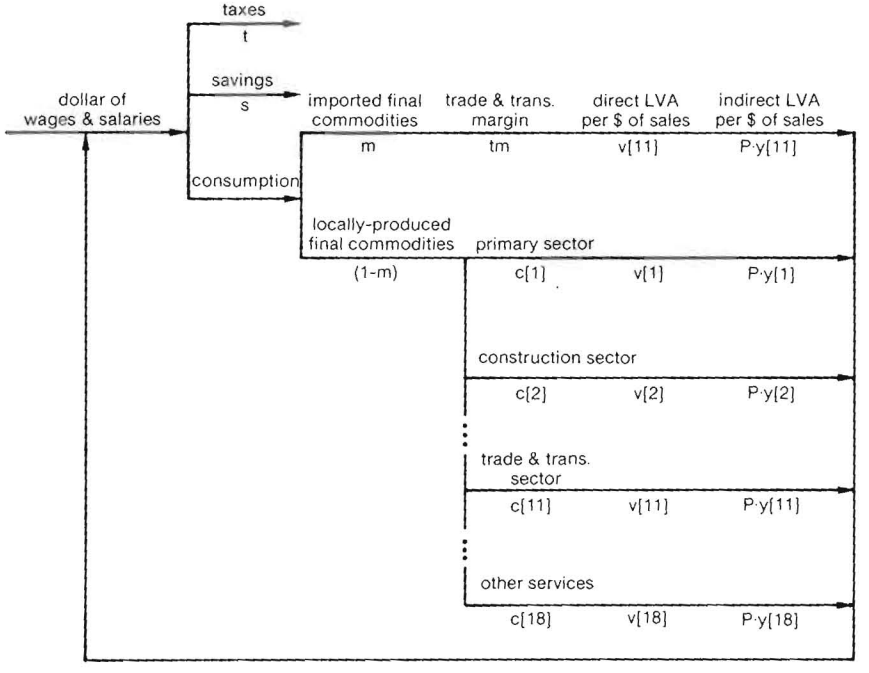

Figure 2

THE INCOME MULTIPLIER

The combined trade and transportation margin, tm, is responsible in the model for the generation of regional income through local transport and sale of externally produced commodities. The direct LVA generated is estimated by v[11], the LVA per dollar of sales of sector 11, Trade and Transport, and, as just discussed, the indirect LVA is generated by the scaled estimate, P y[11], of the I-O multiplier. The amount of local income (value added), r, retained within the community in the first round of spending from a dollar of wages and salaries injected into the region can now be expressed as:

Table 1

ECONOMIC CHARACTERISTICS OF THE
LOWER MAINLAND REGIONAL ECONOMY

Sector	SIC Codes	Proportion of Total Household Consumption	Direct LVA per Dollar of Sales	Indirect LVA per Dollar of Sales
1. Primary	1-9	.006	.542	.119
2. Construction	40,42	.005	.678	.120
3. Food & Beverage	10	.117	.371	.163
4. Wood Industries	25	.001	.491	.081
5. Paper Industries	27	.006	.457	.153
6. Chemicals & Petroleum	36-37	.028	.104	.048
7. Non-metallic Industries	35	.001	.552	.270
8. Metal Fabrication	30	.004	.452	.147
9. Printing & Publishing	28	.010	.403	.174
10. Other Manufacturing	15-18, 23-24, 26, 29, 31-33, 39	.007	.523	.081
11. Trade & Transport	50-52, 60-69	.285	.807	.094
12. Communications	54	.035	.759	.078
13. Utilities	57	.050	.634	.070
14. Finance, Insurance & Real Estate	70-73	.212	.848	.089
15. Health & Welfare	82	.045	.855	.052
16. Education	80	.015	.827	.081
17. Business Services	85-86	.017	.846	.073
18. Other Services	83-84, 87-89 90, 93, 95	.157	.803	.058

$$r = (1-t-s)\{m\ tm(v[11] + P\ y[11]) + (1-m)\Sigma i\ c[i](v[i] + P\ y[i])\}$$

$$(i=1, \ldots, n) \qquad (2)$$

In the derivation of the income multiplier of equation (1) it is assumed that each round of spending is subject to the same marginal propensities (that is, that r does not change from one round of spending to the next). Likewise in equation (2) it is assumed that the local value added generated at the end of the first round is subject to the tax rate t, the savings rate s, and so forth in the subsequent rounds. That is, it is assumed that the LVA generated flows through the regional economy as do wages and salaries. No attempt is made to distinguish the pattern of flow for a dollar of LVA from that associated with a dollar of wages and salaries.[1]

Employment Multipliers

As can be seen from equation (3) below, the employment multiplier, Me, for each region is constructed in a manner to be consistent with the income multiplier, My.

$$Me = (1 + k(My - 1))/W \qquad (3)$$

where W is the prevailing wage rate in the region determined by weighting the average wage in each sector by the sector's proportion of total regional employment. The factor k is the average ratio of wages and salaries to total value added. The equation may be conceptualized in two components: $1/W + k(My - 1)/W$. The first term represents a dollar of wages and salaries divided by the average wage in the region and is the direct employment impact of the dollar of wages and salaries.

The indirect and induced employment impacts are estimated by the second term. (My - 1) yields the local value added generated by the initial flow of income into the region, and this value added is translated into wages and salaries by the ratio k. The division by the weighted average wage converts this dollar figure into employment. The resulting employment multiplier reveals the employment generated in the region per dollar of wages and salaries paid by employers in the region.

[1]Even if local value added were to "filter" through the regional economy in a different manner, the fact that it is only the second and subsequent rounds that would be affected substantially limits the error introduced into the multiplier determination. For example, if it is assumed that the portion of local value added retained in the community in the second and subsequent rounds is not r but r′, then the re-spending process takes the form:

$$1 + r + rr' + rr'^2 + rr'^3 + \ldots + rr'^n = (1 + r - r')/(1 - r').$$

Thus if r = 0.5 and r′ = 0.4, the multiplier would be 1.83 instead of 2.00 (which would result if r′ = r = 0.5). If r = 0.3 and r′ = r, the multiplier is 1.43; however, if r′ were, say, equal to 0.2, the multiplier falls to 1.38 and an error of 3.5 percent is introduced.

Empirical Results

I-O Values

An I-O model [7] exists for the Greater Vancouver Regional District (GVRD). Since the GVRD's 1981 population was 81 percent of that of the Lower Mainland region, the I-O model was assumed to be representative of the economic structure of the region. Economic activity in the region outside the GVRD is primarily agriculture.

From the model, three particular sets of data were developed in order to estimate empirically the regional income multipliers of equation (2). The data are shown in Table 1. The proportion of consumer expenditures on each sector, c[i], and the sector value added per dollar of sales, v[i], were calculated directly from the I-O model's transactions table. The indirect local value added per dollar to sales of sector j, y[j], was calculated as:

$$y[j] = \Sigma i\ r[i,j]v[i] - v[j] \qquad (i, j=1, \ldots, n) \qquad (4)$$

where r[i,j] is the element in the ith row and jth column of the Leontief inverse formed from the open variant of the I-O model.

Income and Employment Multipliers

Given values of c[i], v[i] and y[i] from Table 1, there remain a number of variables which must be estimated before the income multipliers of equation (2) can be empirically established. The marginal rate of savings, s, and the trade and transportation margin are assumed invariant over the seven regions, and estimates of these factors are developed in Appendix 2. The marginal rate of taxation, t, was calculated from data pertaining to average taxes paid in each regional district. The marginal propensity to import consumer commodities, m, is assumed to vary with the size of the region. Estimates of t and m are also shown in Appendix 2. Employment in each region as a proportion, P, of total employment in the Lower Mainland is determined for the purpose of scaling regional indirect multiplier effects and is estimated from data shown in Appendix 1. The resulting income multipliers are shown in Table 2. Each multiplier reveals for its region the total (direct + indirect + induced) regional value added generated per additional dollar of local wages and salaries paid.[2]

[2]The magnitude of these multipliers are generally consistent with the work on regional income multipliers undertaken in the U.K., where the bulk of such work has been done. For example, Archibald [1] estimated the range of income multipliers of 1.2 to 1.7 for

Table 2

INCOME AND EMPLOYMENT MULTIPLIERS FOR SEVEN B.C. REGIONS

Region	Income Multiplier*	Average Weekly Wages	Employment Multiplier**
1. North	1.25	$470.48	46.6
2. Cariboo	1.19	474.62	44.8
3. Vancouver Island	1.37	455.40	50.9
4. Lower Mainland	1.49	449.14	54.5
5. Kamloops	1.22	464.83	46.6
6. Okanagan	1.27	460.61	48.0
7. Kootenay	1.23	470.43	46.0

* Total local value added/dollar of wages and salaries.
** Man-years of employment/$M of wages and salaries.

In constructing the associated employment multipliers, the average annual sector wage in equation (3) was weighted in each region by the number of employees in the sector. The weighted wage and the employment multiplier for each region are shown in Table 2. The multipliers reveal the total regional man-years of employment generated per additional million dollars of regional wages and salaries paid.

Summary and Conclusions

In common with the economic base multiplier, but in contrast to the input-output multiplier, the customary income-expenditure multiplier accounts for the induced impact component but ignores the indirect component. In an attempt to remedy this shortcoming, the input-output model was partially integrated into an income-expenditure analysis. I-O sector multipliers were estimated for each of the six regions outside the Lower Mainland by scaling the sector multipliers of the latter region on the basis of the region's employment relative to that of the Lower Mainland.

After constructing estimates of the marginal rate of taxation, the marginal propensity to save, and the marginal propensities to consume locally and non-locally in each region, empirical estimates of the income multipliers for the seven regions were constructed. Employment multipliers were then derived from the income multipliers and the weighted average wage in each region. The income and employment multipliers developed herein are distinctive in their formulation in that they are designed to incorporate substantial information produced by a survey-based I-O model of one of the seven study regions.

ten different "development" regions in the U.K. Brown [2] suggests a multiplier of 1.24 for a small region, which is relatively low compared with Steele's [16] estimates of 1.7-1.89 for Scotland. Grieg [9] puts the income multiplier of the Highlands of Scotland at 1.44-1.54. Brownrigg and Grieg [4] estimate that the income multiplier for the Isle of Skye lies between 1.13 and 1.23.

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Appendix 1

TOTAL EMPLOYMENT AND REGIONAL DISTRICT COMPOSITION OF EACH OF THE SEVEN B.C. REGIONS

Region	Employment (1981)	Regional District
1. North	124,180	Bulkley-Nechako Fraser-Ft. George Kitimat-Stikine Peace River-Liard Skeena-Queen Charlotte Stikine
2. Cariboo	28,995	Cariboo Central Coast (Ocean Falls)
3. Vancouver Island	239,385	Alberni-Clayoquot Capital Comox-Strathcona Cowichan Valley Mount Waddington Nanaimo
4. Lower Mainland	752,295	Central Fraser Valley Dewdney-Allouette Fraser-Cheam Greater Vancouver Powell River Sunshine Coast
5. Kamloops	58,455	Squamish-Lillooet Thompson-Nicola
6. Okanagan	104,770	Central Okanagan Kootenay-Boundary North Okanagan Okanagan-Similkameen
7. Kootenay	68,150	Central Kootenay Columbia-Shuswap East Kootenay

Appendix 2

ESTIMATES OF REGIONAL ECONOMIC FACTORS

Estimation of the Marginal Rate of Taxation

From the Financial Post [8], an estimate of the average taxes paid in each regional district was obtained for 1980. These estimates were weighted by district populations to calculate the average taxes paid by inhabitants of each of the seven B.C. regions. The results range from $2,919 (Region 6: Okanagan) to $3,761 (Region 1: North). Letting F and T represent federal and total taxes, respectively,

$$T = F + 0.44\,(F + 200)$$

where the 1980 B.C. provincial tax was 44 percent of the "basic federal tax", and the latter was assumed to be federal taxes paid plus the standard individual deduction of $200. Once the above equation was solved for the federal tax payment, the marginal rate for federal taxation was then determined from the tax table [12]. The marginal federal rate was then multiplied by 1.44 to determine the marginal rate of total (federal plus provincial) taxation. The resulting rates, t, for the seven regions are as follows:

Region	t
1. North	0.33
2. Cariboo	0.30
3. Vancouver Island	0.30
4. Lower Mainland	0.33
5. Kamloops	0.33
6. Okanagan	0.30
7. Kootenay	0.33

Estimation of the Marginal Rate of Savings

The average propensity to save from personal disposable income for B.C. is currently around 12 to 14 percent and is very close to the marginal propensity.[3] For purposes of this study an estimate of the *marginal* propensity to save from *personal* income is required.

The relationship between the average propensity to save from personal income, S/Yp, and from personal disposable income, S/Yd, is as follows:

$$S/Yp = S/(Yd + T) = (S/Yd) / (1 + T/Yd) \qquad (5)$$

where S = savings, T = taxes, and Yp and Yd = personal income and personal disposable income, respectively. To estimate the average pro-

[3]Private communication from Mr. H. Singh of the Central Statistics Bureau, Victoria, B.C.

pensity S/Yp in the above equation (as a preliminary step to estimating the marginal propensity), it is necessary to estimate first T/Yd. Average taxes paid in B.C. for all family sizes was taken to be $4,917.90 [14]. Alternatively, T/Yd can be estimated by first establishing personal disposable income per capita in B.C. as $10,940 [8]. From this figure and the previously estimated average family income of $28,844, T/Yd = $4,917.90/(28,444-4,917.90) = .209. Taking the average family size to be 2.5, average personal disposable income per family is $27,350 and the taxes/disposable income = .180.

Given the range of S/Yd of 12 to 14 percent and a range of T/Yd of .180 to .209, a high estimate of S/Yp from equation (5) is 0.12 (.14/(1+.180)) and the low estimate is 0.10 (.12/(1+.209)). Since the marginal propensity to save is presumed to be slightly higher than the average, a marginal propensity to save from personal income is taken to be the higher estimate of the average propensity to save, 0.12.

Estimation of the Marginal Propensity to Import

For purposes of this study, imports were divided into final and intermediate commodities. For the Lower Mainland region, an estimate of the average propensity to import final consumer goods of 35 percent is yielded by the GVRD I-O table. As the economy expands, it can be expected that import substitution will occur and that the propensity to import will decline. At the same time, however, as income rises the marginal propensity to import generally increases. In this study the present Lower Mainland marginal propensity to import consumer commodities is assumed to be 35 percent. Given total employment for the Lower Mainland and an estimated m of 35 percent, the corresponding propensities to import for the other six regions were set roughly in accordance with their employment totals relative to that of the Lower Mainland.

Region	Propensity to Import Consumer Commodities
North	0.65
Cariboo	0.80
Vancouver Island	0.50
Lower Mainland	0.35
Kamloops	0.70
Okanagan	0.65
Kootenay	0.70

For the imported commodities a trade and transportation margin, tm, of 20 percent as determined from the GVRD I-O model was assumed.

Estimation of the Factor k

The factor k in equation (3) is the average ratio of wages and salaries to total value added. A value of 0.56 was obtained from the Lower Mainland I-O model and was assumed invariant over the seven regions.