A COMPUTABLE GENERAL EQUILIBRIUM ANALYSIS OF A STUMPAGE PRICE INCREASE POLICY IN BRITISH COLUMBIA

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ABSTRACT

The impact of a British Columbia policy which increased stumpage fees on the overall economy of the province and on the income distribution of two income classes and regions in British Columbia is investigated. Results indicate that the policy causes a significant decline in employment and income of the province. The results suggest that the decline in real gross domestic product is more than the fall in real income. Income for average households falls by more than that of poor households in response to the policy shock. Results also show that negative economic effects of the policy are higher in the Interior of British Columbia than those on the Coast.

Key words: Income classes, income distribution, real income, regions.

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INTRODUCTION

The forest industry of British Columbia (B.C.) makes significant contributions to the provincial economy. The forest sector share of gross domestic product (GDP) and direct employment in 1992 was, respectively, approximately 11 percent and 6 percent of provincial total (Ministry of Finance and Corporate Relations, 1993). Forest sector shipments accounted for 46 percent of total manufacturing shipments for the province and accounted for 59 percent of all provincial exports with the top two being softwood lumber at 28.3 percent and market pulp at 14.7 percent. These figures indicate that any changes in policies that affect the forest sector, either directly or indirectly, may have a significant impact on the overall economy of the province. In the recent past, concerns for the environment have prompted public agencies to impose a series of regulations

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on the use of public forests (Nelson & Hackett, 1993).[1] Several provinces are reducing their annual allowable cut (AAC) to reflect the growing demands on Canada's forests for non-timber values (Forestry Canada, 1992). Binkley *et al.* (1993) noted that there could be a reduction of 10-25 percent of AAC in B.C.

On April 14, 1994, the B.C. government released its Forest Renewal Plan. Under the plan the increase in stumpage and royalty revenues are estimated to total $600 million annually.[2] Since the Forest Renewal Plan is forestry industry financed, the provincial average stumpage rate is forecasted to increase from $15.17 per cubic metre to $27.43 per cubic metre, an increase of 80.8 percent (Financial Post, 1994).[3] Furthermore, the increase in stumpage rates is expected to differ between the Coast and Interior regions. The target stumpage rate in the Interior is forecasted to increase from $15.17 per cubic metre to $27.47 per cubic metre (81.8 percent) while the stumpage rate is to rise from $17.20 per cubic metre to $28.03 per cubic metre (63.8 percent) on the Coast (Ministry of Forests, 1994).

Currently stumpage fees in B.C. are levied following the Comparative Value Pricing System[4] as a charge per cubic metre of timber harvested from Crown lands. This manner of levying stumpage fees introduces distortions that would be absent were it levied as a lump-sum charge based on the value of stand as determined by the timber cruise (Percy, 1986). Under a lump-sum charge system, the value of stumpage payable for the stand is independent of the volume of timber harvested. However, if stumpage is payable as a per unit levy, it affects the volume of timber har-

[1] For example, the European Economic Community brought increasing pressure on the government of B.C. to reduce harvest levels (Duchesne, 1991).

[2] Out of this $400 million a year or $2 billion over five years will go into a new fund which will be used to replant B.C. forests and clean up past abuses (Vancouver Sun, 1994).

[3] Some believe that this is a strategy which the B.C. government has chosen to reduce harvest levels in response to the growing concerns for the environment. Others argue that the increase is a response to the long standing argument from U.S. lumber producers, that B.C. subsidizes its lumber producers with low stumpage prices.

[4] The Comparative Value Pricing System is a means of assessing the relative value of each stand of timber being sold. In this system the total stumpage revenue collected approximates an overall forest revenue objective set by government (Ministry of Forest, 1987).

vested (see Nautiyal & Love, 1971 for details). An increase in the per unit stumpage charge causes an increase in variable cost and thereby a reduction in the volumes of timber harvested. This result suggests that there would be a corresponding reduction in timber harvest levels in response to the increase in stumpage prices which were announced under the Forest Renewal Plan.

The aims of the Forest Renewal Plan may be viewed as being laudable — improve forest sector productivity, ensure a sustainable timber supply while employing best forestry practices, undertake job skills re-training programs, address environmental concerns, assist value added manufacturers, and increase research and development. Yet the means of financing this plan clearly have significant implications for the B.C. economy since the forest industry remains an economic mainstay of the province. Moreover, the significant differences in stumpage price increases between the Coast and Interior regions will lead to different effects on the regional economies.

The overwhelming economic importance of the forest sector to B.C. means that changes in stumpage prices will have pervasive effects on various facets of income distribution. This paper assesses the impact of the stumpage price increases on three key sets of distributional variables for the province. It does so through use of a computable general equilibrium (CGE) model of the B.C. economy. First, we examine how these stumpage price increases affect aggregate economic variables for the province such as real gross domestic product (GDP) and real income and industrial structure. Second, we assess what happens to the incomes of two income classes in the province, the "poor" consisting of those with incomes of less than $20,000 and "average" British Columbians whose income is above $20,000. Finally, we look at what happens to incomes on a spatial basis — changes of average incomes on the Coast and Interior regions. Not surprisingly, the study shows that stumpage price increases of the magnitude set out in the Forest Renewal Plan have significant distributional consequences in terms of each of the above three measures.

The remainder of paper is organized as follows. Structural characteristics of the B.C. economy are discussed in the next section. A brief literature review is presented in

TABLE 1. EMPLOYMENT OF B.C.
Employment of B.C. by sector and by region (values are in shares)

CATEGORY	COAST	INTERIOR
Forest Sector	0.069	0.144
Other pri. sector	0.028	0.087
Manufacturing	0.092	0.047
Service	0.736	0.670
Government	0.075	0.052

Note: Shares of Coast and Interior employment respectively, 0.745 and 0.255.
Source: British Columbia Regional Index 1986.

the third section. The fourth section is devoted to model specification. Policy simulation results are presented and discussed in the fifth section and summary and conclusions are given the final section.

STRUCTURAL CHARACTERISTICS OF THE BRITISH COLUMBIA ECONOMY

There are distinct differences apparent between the Coast and Interior regions of B.C. Population, employment and income are heavily concentrated in the Coastal region of B.C. It accounts for more than two thirds of provincial total of each variable. However, there is a large share of forestry activity in the Interior of the province. Table 1 provides a disaggregated view of employment by sector and region. The shares of forest sector and other primary sector activity in the Interior are more than twice their Coastal counterparts in terms of employment. The reverse trend holds for manufacturing on the Coast. Both government and services account for a greater share of employment on the Coast than in the Interior.

A crude measure of income distribution can be observed based on household taxable income. In the Interior, households whose income is below $20,000 account for 54.3 percent of the population while the corresponding figure for the Coast is 49.5 percent. This suggests that, in the Interior, households whose income is above $20,000 account for 45.7 percent of the population while the corresponding figure for the Coast is 50.5 percent. Table 2 provides a more detailed breakdown for specific communities within the

TABLE 2. HOUSEHOLD INCOME FOR SELECTED LOCALITIES IN B.C.
Sources of household income for selected localities in B.C. for the period 1991 (values are in shares).

DIVISION	WAGES AND SALARIES	OTHER SOURCES
Coast		
Victoria	0.587	0.412
Vancouver	0.600	0.399
Interior		
Prince George	0.785	0.214
East Kooteney	0.735	0.264

Source: Revenue Canada, Taxation Statistics 1993.

two regions for "wage and salary income" and "other sources". The latter category contains income derived from both government transfers and capital income of interest and dividends. The evidence suggests a greater share of income in the Interior is derived from wages and salaries than on the Coast.

In aggregate, these descriptive data show that the Interior of the province to be more dependent on the forest sector than the Coast and employment income is relatively more important in the Interior than on the Coast. Hence households in the Interior are more dependent on the income derived from the forest sector employment than on the Coast.

LITERATURE REVIEW

A number of studies have been conducted to determine the effects of forest policies, including a reduction in harvest levels, on the economy of B.C. Percy (1986) used a CGE framework to examine the consequences of various shocks, such as an increase in duty on softwood lumber exports and an increase in transportation costs of forest products exports, to the forest industry and the economy of B.C. Duchesne (1991) analyzed the effect of a 1% reduction in the forest land base by using an updated version of Percy's (1986) CGE model. Binkley *et al.* (1993) also used an updated version of Percy's model to examine the impact of decreases in the AAC. Horne *et al.* (1991) used the B.C. Input-Output model to assess the impacts of a 10% reduction in forest related supplies on employment and GDP. Lax &

Parker (1992) used an econometric policy simulation model to evaluate the time path of impacts of reductions in the AAC. Despite the differences in the techniques used, all these studies indicated a significant negative impacts on the overall economy of B.C. of harvest reduction.

Among the models used in the studies described above, CGE models have attractive features.[5] The strength of CGE models lies in their ability to account for inter-industry linkages while satisfying the constraints imposed by economic theory (Binkley *et al.,* 1993). The essence of a CGE model is as follows. Consumers maximize their utility and producers maximize their profits. The zero homogeneity of demand functions (i.e. no money illusion) and the linear homogeneity of profits in prices (i.e. a doubling of all prices doubles profits) imply that only relative prices are important and absolute price levels have no impact on the equilibrium (Shoven & Whalley, 1992). Equilibrium in the model is achieved by a set of prices and levels of production in each industry such that total supply of commodities equals to the total demand for commodities.[6]

This study departs from previous CGE studies (Percy, 1986; Duchesne, 1991; Binkley *et al.,* 1993) in three areas. First, production functions are specified in constant elasticity of substitution (CES) form. Previous studies used a Cobb-Douglas (C-D) functional form which restricts the elasticity of substitution between inputs to unity. CES functions allow substitution between primary inputs and variation across sectors.

The second issue addressed by this study is the effect of policy changes on real income (Dervis *et al.,* 1982). As a welfare indicator, real income is the amount of money required, at a given price level, to purchase alternative bun-

[5] Constantino & Percy (1988) reviewed various models and highlighted the merits of CGE models. Shoven & Whalley (1992) noted that CGE models provide an ideal framework for appraising the effects of policy changes on resource allocation and assessing the welfare effects. Conrad & Schroder (1993) argued that the CGE approach is a useful technique to get an understanding of the welfare effect and the qualitative results of a change in a given environmental policy.

[6] In spite of its attractive features, the CGE approach is not without its problems. Shoven & Whalley (1992) have discussed the problems associated with CGE models. See Hazledine & MacDonald (1992) for a detailed critique on general equilibrium models.

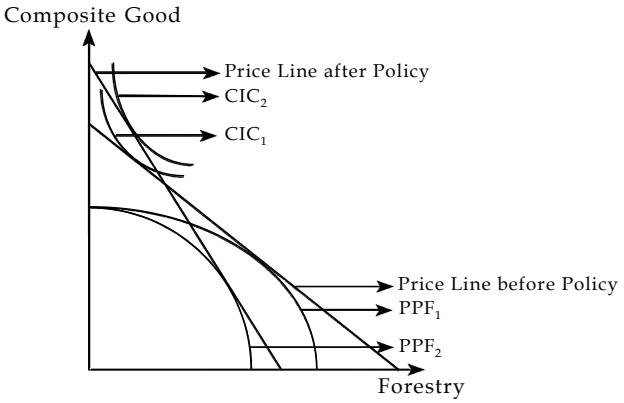

FIGURE 1. PRODUCTIVITY AND WELFARE CHANGES AFTER A POLICY SHOCK

dles of goods along the indifference curve which indicates an attainable welfare level (see Hicks, 1940). This interpretation is better suited to the measurement of real consumption than real income because indifference curves are defined over consumption goods alone. As a measure of productivity, an increase in real income is an outward shift in the production possibility frontier for the economy as a whole. In other words, given a level of prices, real income is the maximum value of any bundle of good on the production possibility frontier (PPF) in a given year.

The distinction between real income in terms of a PPF and a community indifference curve (CIC) is illustrated in Figure 1. For simplicity, only two goods are considered. With an initial production possibility frontier (PPF_1) and an initial price line, society's welfare level is at CIC_1. The position of CIC_1 off of PPF_1 implies that forest products will be exported while the composite good is being imported. The policy change, in this case a reduction in timber harvest level, causes a PPF shift inward along the forestry axis to PPF_2. If British Columbia is large enough to influence the price of forest products in the international market, the world terms of trade will change as the PPF contracts. This implies that the price of forest product increases and the price of composite good decreases causing a steeper slope for the price line after the policy.

With the new production possibility frontier and new price line, society's welfare is CIC_2. By construction, it is shown in the figure that welfare is increased after the policy

change. The reason is that the change in the terms of trade favours British Columbia with a large increase in imports of the composite good and a small decrease in forest products exports. Therefore, in the short-run, it is possible that society's welfare may increase when the reduction in forestry output occurs.

The third issue investigated in this study is the income distributional effects of a harvest reduction policy on the Coast and the Interior. The structural characteristics of these regions presented above indicate that the impacts of policy may not be identical across the two regions. In the Interior, the impacts of the policy may be higher than in the Coast since the forest sector is relatively more dominant in that region. Regional distribution analysis helps evaluate policies on both efficiency and equity grounds, and may have implications for using Forest Renewal Plan funds.

MODEL SPECIFICATION

The model underlying the analysis is based on the specification of Percy (1986), subsequently updated by Duchesne (1991). Like most models of the ORANI type (Dixon *et al.*, 1982), the input technology is specified in two levels. At the first level, it is assumed that intermediate inputs and primary factor inputs (labour, capital, and land) are demanded in fixed proportions to produce each unit of output. At the second level, substitution is made possible among primary factors using constant elasticity of substitution technology. One exception is that in the Coast and Interior logging sectors, substitution is only allowed between labour and capital.[7] This specification assumes constant ratio of elasticity substitution, homothetic (CRESH) technology for both logging sectors.[8]

The model divides the B.C. economy into nine sectors: (x_1) Coast logging, (x_2) Interior logging, (x_3) Coast wood products, (x_4) Interior wood products, (x_5) Pulp and paper products, (x_6) other primary products, (x_7) Manufacturing, (x_8) Services, and (x_9) Government. The first two sectors produce logs for the wood products, and pulp and paper

[7] In the short-run, labour and capital cannot be substituted for land to maintain the same level of log production.

[8] See Hanoch (1971) for details on CRESH functions.

industries, and a small proportion of the harvest is exported. B.C. has been disaggregated into Coastal and Interior regions because the resource base, the derived demands for timber, the production technology, and the stumpage values differ significantly between these two regions. The third and fourth sectors produce mainly saw-mill products such as construction grade lumber. It is assumed that the Interior and Coastal wood products industries use only logs from within their regions. The pulp and paper sector produces mainly for the export market and is not regionally differentiated in either output or input. The sixth sector consists of all renewable and non-renewable resource industries other than forests and is heavily export oriented. Sector 7, consists of all manufacturing industries other than wood and paper products. The eighth and ninth sectors are non-traded in the sense that their production is consumed completely within the province. The government sector produces publicly provided private goods and has been modelled separately from services because of differences in factor intensity.

The primary factors of production consist of labour, used in all sectors and assumed fixed within the province but mobile among sectors; capital, which is specific to each sector; and land, used in sectors x_1, x_2, x_6 and x_8. Interprovincial migration and adjustments to the capital stock in response to stumpage price increases are not permitted. These longer run adjustments of population and investment obscure the immediate impact of the policy shock on the economic well-being and income distribution of current residents of B.C. Furthermore, we model the labour market assuming that wages are rigid. This assumption may be appropriate since labour in B.C. is heavily unionized. Also, in the unionized economy, there is a possibility that skilled forest workers are less market responsive than those workers in other sectors (Daniels *et al.*, 1991).[9] It should be noted here that in a Keynesian world depicted by this model, where wages are assumed rigid, there is no mechanism for large scale adjustments of labour across sectors.

Capital is sector specific, so its rental rates, which are endogenous to the model, would adjust to clear the market. A similar assumption is made for land in sector 6 and

[9] Alternatively, full employment can be assumed because unemployed workers may find employment elsewhere in the local economy.

8. However, land in sector 1 and 2 is assumed to be responsive to the stumpage prices which are set exogenously. According to this assumption, there would be a reduction in the use of forest land base and a corresponding reduction in timber harvest levels in response to the increase in stumpage prices.[10] However, it is possible that the forest land base allotted to timber production may be fixed due to annual allowable cut constraints, thereby stumpage price changes may not alter the amount of land used. Furthermore, according to tenure regulations firms may be required to produce the same quantity under increased stumpage prices. In such a case the results from this model underestimate the negative effects on the provincial economy. In this study, it is expected that firms, in the short-run, will have some flexibility to adjust the use of forest land base and timber harvest levels in response to the increase in stumpage prices.

In this model, prices in both the logging sectors, the two wood products sectors, the pulp and paper sector, and the two non-traded sectors are endogenous. The prices facing the logging sectors are determined by the derived demands from the regional wood products sectors and pulp and paper. Production of the Coast and Interior wood products sectors and of pulp and paper do influence producer prices. Also, it is assumed that the production of forest products from B.C. is large enough to influence world prices. That is, B.C. faces a downward sloping excess demand curve for its forest products, by the rest of the world purchasers. This suggests that B.C. has the potential to exercise market power, thereby capturing monopoly gains from trade. Because of this market power, simulation results may be sensitive to the magnitudes of the elasticity of excess demand. The sixth sector is assumed to be small in world export markets, and thus is treated as a price-taker. Sector 7, represents import-competing manufacturing and the province will be treated as a small importer relative to world supply.

[10] We assume that the land released from forestry production is not available for the use in other sectors. The released land is assumed to be preserved to provide environmental benefits. On the other hand, if the released land is assumed to be used in other sectors, those sectors will expand thereby causing a decline in the negative impacts of the policy.

The model is short-run in nature.[11] In this scenario, the markets for mobile factors respond to policy shocks through price changes while in the long-run the adjustment is mainly through quantity changes. That is, in the short-run, factor price changes create quasi-rents or losses which in the long-run induce interregional factor flows until all incentives for entry and exit are exhausted. The model is not closed in the sense that neither the change in exports equals the change in imports nor the change in savings equals the change in imports. Since the model is short-run in nature and the capital stock is fixed, there is no change in investment. Consequently, we have assumed no savings. The exchange rate is assumed fixed and the balance of payments passively accommodates any change in the trade balance.[12] The modelling exercise also ignores any adjustments of macroeconomic variables such as interest rates in response to changes in the forest sector trade balance. Furthermore, the Forest Renewal Plan envisages that the revenue realized from the increased stumpage price would be invested in silviculture, job skills training, environmental protection, assistance to value added manufacturers, and research and development. In this model, it is not assumed that increased stumpage revenues are used in this way. Instead, the increased revenue is modelled as transfer payments to the households in the region.

Following Johansen (1960), the model is specified in the form of proportional rates of change in which variables are specified in a system of linear equations.[13] This format is used since it requires relatively little data, produces results easily interpreted in terms of elasticity relationships, uses a simple solution algorithm (i.e. matrix manipulation), and suits the economic analysis of a wide range of policy shocks. Although the Johansen approach allows for flexibility in terms of model size, modification, application, and implementation, it also introduces approximation errors (Prins,

[11] The short-run is a period which is sufficiently short such that both producers and consumers cannot adjust their input and output decisions to new relative prices (Dixon *et al.*, 1982). In forestry, we assume that such a time period my be about 5 to 10 years.

[12] Under this assumption, we note that a trade deficit associated with a policy change will overstate the welfare gain and understate the loss of welfare.

[13] See Dixon *et al.* (1980) for details on linearization.

1990).[14] Approximation errors result from the inability of the model to cope with large changes in the exogenous variables. Therefore, results of this analysis might well either understate or overstate the effect of price change.[15]

The model simulation is a comparative static exercise which solves for the changes in various variables required to achieve a new equilibrium in response to the shock introduced into the model. Thus the results indicate the particular impact of the policy in question as all other exogenous variables such as productivity growth and rest of the world price changes are assumed unchanged. The model does not consider shocks other than the increase in stumpage prices and does not forecast any variable. Models of this structure have been used extensively, for example, to asses policy scenarios in Australia (Dixon *et al.*, 1982). The model, consisting of 56 linear equations, is presented in Appendix 1. Appendix 2 gives tables defining the endogenous variables, exogenous variables, elasticities, and parameters used in the model. Appendix 3 provides data sources used in the computation of the parameters. The model is set up on a LOTUS 1-2-3 (4.0) spreadsheet and is solved by matrix manipulations.

POLICY SIMULATION: RESULTS AND DISCUSSION

Structural Responsiveness of the Coast and Interior Economy to 1% Increase in Stumpage Price

The results contained in Table 3 indicate the structural responsiveness of the provincial economy and each of the regional economies to a 1 percent increase in stumpage rates. They also provide a more analytical flavour to the assertion that the forest sector is more important to the Interior than the Coast. The figures can be interpreted as elasticities of the variables in question with respect to increases in stumpage rates. Structural responses are estimated under different excess demand (ED) elasticity scenarios.[16] Results show that employment, real gross domes-

[14] See Hertel *et al.* (1992) for critical comparison between the levels and linearized representations of CGE models.

[15] Assuming that the effect of exogenous variables on endogenous variables is increasing at decreasing rate, we believe that the impacts of policy are overstated in this linear model.

[16] Percy & Constantino (1989) provide a range of estimates of ED elasticities.

TABLE 3. EFFECTS OF 1% INCREASE IN STUMPAGE PRICE IN BRITISH COLUMBIA

Responsiveness of selected variables to a 1 % increase in stumpage prices, respectively, in the Coast and the Interior regions of B.C. (Values are expressed in percentage changes).

VARIABLE	ED ELASTICITY FOR B.C. WOOD PRODUCTS		
	Low (–.75)	Medium (–1.25)	High (–2.00)
Employed labour force Coast	–0.0146	–0.0256	–0.0404
Employed labour force Interior	–0.0181	–0.0310	–0.0481
Return on capital in Coastal logging	–0.0932	–0.1440	–0.2117
Return on capital in Interior logging	–0.1004	–0.1559	–0.2300
Return on capital in Coastal wood products	–0.0597	–0.0936	–0.1385
Return on capital in Coastal wood products	–0.0691	–0.1087	–0.1617
Logging area in coastal B.C.	–0.0465	–0.0719	–0.1057
Logging area in interior B.C.	–0.0502	–0.0779	–0.1149
Real GDP of Coastal B.C.	–0.0160	–0.0229	–0.0321
Real GDP of Interior B.C.	–0.0184	–0.0264	–0.0372
Real gross domestic product	–0.0166	–0.0238	–0.0334
GDP deflator	0.0041	–0.0003	–0.0062
CPI for average household	–0.0022	–0.0053	–0.0095
CPI for poor household	–0.0027	–0.0061	–0.0106
Nominal income for average household	–0.0122	–0.0232	–0.0379
Nominal income for poor household	–0.0066	–0.0116	–0.0183
Exports of coastal lumber	–0.0637	–0.1010	–0.1506
Exports of interior lumber	–0.0690	–0.1097	–0.1643
Real income for average household	–0.0101	–0.0179	–0.0284
Real income for poor household	–0.0039	–0.0055	–0.0077

tic product, and real income in B.C. fall in response to a one percent increase in stumpage price. Results also indicate that in all scenarios, the B.C. Interior region is more sensitive to the increase in stumpage prices. For example, with the medium ED elasticity (–1.25), the employed labour force in the Interior is expected to fall by 0.031 percent while the fall in Coastal employment is expected to be 0.025 percent. In the same ED elasticity scenario, the real GDP in the Interior is expected to fall by 0.026 percent and the fall on the Coast is expected to be 0.023. This result follows because the share of forest sector in employment and income of the Interior region is higher than in the Coast region. The rental rates on capital in logging and wood products, the use of forest land base, and exports of wood products in the Interior region fall more than those in the

Coast. It should be noted that in both regions, the fall in employment is higher if the excess demand is more elastic. On the other hand, the fall in real GDP is smaller when the excess demand is more inelastic. This is the result of B.C. market power in the international wood products market. The evidence of Table 3 demonstrates the Interior is more structurally responsive to changes in stumpage rates, than is the Coast, for a variety of variables.

Table 3 also contains the effect of a 1 percent increase in stumpage prices on real incomes, as measured by welfare, of average and poor households. The income of poor household falls less than that of average households. This may largely be due to the difference in the shares of wage income, capital income, and government transfers in the income of average and poor households. The fall in real income is shown to be smaller than the fall in real GDP since the fall in the CPI is higher than the fall in the GDP deflator.

Effect of May 1, 1994 Stumpage Changes

When B.C. stumpage fees were increased on May 1, 1994 they were raised significantly more in the Interior than on the Coast. Recall results in Table 3 indicate that for comparable stumpage price increases, impacts will be greater in the Interior than on the Coast. Now, in light of the large increase in stumpage prices for the Interior, we expect the impact on the Interior to be even greater. Table 4 provides the results of simulating the actual stumpage increases of 63.8 percent and 81.8 percent, respectively in the Coast and Interior regions. As log producers face a downward sloping demand for the use of crown land, an increase in stumpage price will cause a reduction in the use of the forest base.[17]

Again, the results are provided for a range of values of excess demand (ED) elasticities for B.C. solid wood products. Results indicate that in all scenarios the real GDP both in terms of productivity and consumers purchasing power falls, with greater impacts associated with higher ED elasticities.[18] This suggests that the province bears a greater

[17] A similar assumption is used by Wear & Lee (1993).

[18] We use the overall price index of the economy as a deflator for the real GDP in terms of productivity while consumer price index is used as the deflator to derive the real GDP in terms of purchasing power. Furthermore, the share of foreign ownership in each sector is netted out in calculating GDP.

TABLE 4. EFFECTS OF 63.8 % AND 81.8 % INCREASE IN STUMPAGE PRICES
Effect of 63.8 % and 81.8 % increase in stumpage prices respectively, in the Coast and the Interior regions of B.C. on selected variables (Values are in percentage changes).

VARIABLES	ED ELASTICITY FOR B.C. WOOD PRODUCTS		
	Low (–.75)	Medium (–1.25)	High (–2.00)
Employed labour force Coast	–1.098	–1.922	–3.023
Employed labour force Interior	–1.433	–2.434	–3.773
Wages	–0.012	–0.021	–0.032
Return on capital in sector 1	–5.975	–9.189	–13.430
Return on capital in sector 2	–8.188	–12.735	–18.841
Return on capital in sector 3	–3.827	–5.964	–8.784
Return on capital in sector 4	–5.636	–8.885	–13.248
Return on capital in sector 5	–0.941	–0.800	–0.612
Return on capital in sector 6	0.321	0.573	0.909
Return on capital in sector 7	1.752	3.132	4.976
Return on capital in sector 8	–1.606	–2.876	–4.573
Return on capital in sector 9	–1.539	–2.973	–4.889
Logging area in coastal B.C.	–2.984	–4.588	–6.705
Logging area in interior B.C.	–4.091	–6.362	–9.412
Land rent in sector 6	0.321	0.573	0.909
Land rent in sector 8	–1.606	–2.876	–4.573
Output in sector 1	–2.652	–4.078	–5.959
Output in sector 2	–3.769	–5.861	–8.670
Output in sector 3	–2.958	–4.608	–6.784
Output in sector 4	–4.159	–6.555	–9.773
Output in sector 5	–0.509	–0.427	–0.318
Output in sector 6	0.079	0.141	0.224
Output in sector 7	0.976	1.744	2.771
Output in sector 8	–0.731	–1.309	–2.081
Output in sector 9	–0.678	–1.311	–2.156
GDP in the Coastal B.C.	–0.936	–1.780	–2.906
GDP in the Interior B.C.	–1.117	–2.083	–3.375
Gross domestic product	–0.969	–1.848	–3.022
Gross domestic product deflator	0.267	–0.066	–0.511
Real gross domestic product	–1.236	–1.782	–2.510
Disposable income	–0.969	–1.848	–3.022
CPI for average household	–0.177	–0.416	–0.735
CPI for poor household	–0.220	–0.476	–0.820
Nominal income average household	–0.958	–1.795	–2.914
Nominal income for poor household	–0.510	–0.890	–1.398
Market price of x_1 good	10.778	10.432	9.975
Market price of x_2 good	17.605	17.264	16.806
Market price of x_3 good	5.391	5.113	4.744
Market price of x_4 good	7.535	7.198	6.745
Market price of x_5 good	1.271	1.130	0.942
Exports of x_6	0.125	0.267	0.456
Imports of x_7	–3.100	–5.512	–8.734
Market price of x_8 good	–0.563	–1.008	–1.602
Exports of coastal lumber	–4.043	–6.391	–9.487
Exports of interior lumber	–5.651	–8.997	–13.491
Exports of pulp & paper goods	–0.636	–0.565	–0.471
Real income average household	–0.781	–1.379	–2.178
Real income for poor household	–0.291	–0.414	–0.578

portion of the incidence of the policy shock in the high ED elasticity scenario. In other words, with high ED elasticities, B.C. has less market power in passing the burden of the policy shock to the consumers in the rest of the world. In all scenarios, both logging and lumber sectors absorb much of the burden. A large fall in the use of the forest base, in rental rates of return for capital (profits), and in output is noticed in these sectors. A corresponding fall in exports is also noticed in both wood products sectors. The fall in these variables is smaller when the ED is relatively inelastic. For example, in the highly elastic scenario, the reduction in land use is more in each logging sector than in the low elasticity case.

The results also indicate that the policy change, which affects the forest sectors, causes a greater diversification in the economy of the province. The large contraction of the forest sectors, and large fall in prices for service sectors, promotes the expansion of the domestic manufacturing sector and other primary products sector. This result supports Constantino & Percy (1988) argument that "a contracting sector especially one which forms the economic base of a region, induces expansion of peripheral sectors, particularly those facing highly elastic demand in output markets". In the high elasticity scenario, the model predicts a 8.73 percent decline in imports of manufacturing goods with a 2.77 percent increase in import competing manufacturing output.

One interesting result is that the decline in real income for both average and poor households is smaller than the fall in real GDP. For both income groups, nominal income falls, and falls more if the ED elasticity value is higher. However, the fall in both nominal and real income of poor households is smaller than those of average households. This may largely be because: 1) the wage income which declines as a result of the policy shock is small in poor households' income; and 2) the CPI for poor households falls more than that of average households because the proportion of forest product prices is small relative to other products and whose prices are increased as a result of the policy. In other words, a large proportion of poor households' consumption is from the service sector which makes up a large component of their CPI. Since their CPI drops significantly, there is a small decrease in their real income.

Regional Effects of the Policy Change

The effects of the May 1, 1994 policy on the regional economy of B.C. reported in Table 4 confirms structural responses reported in Table 3. For all ED elasticity values, employment in the Interior falls more than in the Coast region. Again, employment in both regions falls more when the value of ED elasticity is larger. For example, employment in the Interior falls by 1.43 percent in the low ED elasticity scenario while the fall is 3.77 percent in the high elasticity scenario. However, the real wage rises as a result of the stumpage price change policy and rises more as the ED elasticity value is higher. In spite of a small fall in nominal wages, because of wage rigidity assumption, a large fall in the CPI results in a significant rise in real wages. It must be noted, however, that the rise in real wages refers to the employed workers only. For all the elasticity values, the real GDP in both regions falls more with higher ED elasticity values. Furthermore, the real GDP of the Interior region falls more than in the Coast. Results also indicate that there is a substantial difference in rental rates of capital of logging and wood products sectors between Coast and Interior regions. For example, in the medium elasticity scenario, the return on capital in Interior wood products falls by 8.88 percent while the fall in return of capital in Coast wood products is only 5.96 percent. Similar differences are shown with respect to the reduction in logging area and wood products exports between the Interior and Coast.

SUMMARY AND CONCLUSIONS

In this paper, an attempt is made to study the impact of the May 1, 1994 stumpage price increases on the economy of British Columbia. In particular, the impact of this policy on various sectors, income distribution of two income classes, and two regions of B.C. is assessed. In order to capture the intersectoral linkages and to account for indirect effects of the policy change on all sectors in the economy, a CGE approach is used. Results indicate that the increase in stumpage prices causes a decline both in employment and real GDP. The results also show that for a comparable increase in stumpage rates both employment and real GDP fall more in the Interior than in the Coast. The results demonstrate that the negative impacts of the May 1, 1994 stumpage policy are greater in the Interior of B.C. than on the Coast.

The decline in real income for British Columbians as measured by consumption is smaller than the fall in real GDP. For consumers, when nominal wages are rigid (due to contracts or strong union activity) the change in prices of goods that have major shares in their consumption bundle matter the most. As forest products make up a small share in the consumption bundle, compared to the shares of other sector goods, large increase in prices of forest products do not greatly affect the CPI. In the long-run, however, when the assumption of rigid nominal wages is relaxed, the fall in nominal wages may be equal or even higher than the fall in the CPI.

Finally, some of the limitations of the study should be noted. The results are sensitive to the parameters used in the model, particularly to the ED elasticity values. Since the model is short-run in nature, the increased stumpage revenues are modelled as transfer payments to households in the region. The feedback effects of increased stumpage revenues through investments in silviculture, job skills training, and environmental protection on the overall economy are not considered. In the long-run, the returns from the investment of increased stumpage revenues may be higher such that they can completely offset the short-run costs of the policy causing an increase in welfare of the households. Furthermore, the model does not incorporate the non-market benefits associated with the decrease in harvest levels. Finally, the predicted impacts of our simulation are difficult to validate with actual occurrences. Although increased stumpage fees occurred April 1, 1994, data on actual impacts is not yet available. Furthermore, since April 1, 1996 a lumber quota system restricting access of Canadian exports to U.S. markets may obscure the results of the model.

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APPENDIX 1
Johansen Specification of the Complete Model

Unit Cost Equations

Equations 1 through 9 express that in competitive equilibrium the change in producer price of a given sector equals the weighted sum of input price changes.

$$-p_1^p + \theta_{81}p_8 + \theta_{w1}w + \theta_{r1}r_1 = -(\theta_{m1} + \theta_{71})p_m - \theta_{v1}cst \quad (1)$$

$$-p_2^p + \theta_{82}p_8 + \theta_{w2}w + \theta_{r2}r_2 = -(\theta_{m2} + \theta_{72})p_m - \theta_{v2}cst \quad (2)$$

$$-p_3^p + \theta_{13}p_1 + \theta_{83}p_8 + \theta_{w3}w + \theta_{r3}r_3 = (\theta_{m3} + \theta_{73})p_m \quad (3)$$

$$-p_4^p + \theta_{24}p_2 + \theta_{84}p_8 + \theta_{w4}w + \theta_{r4}r_4 = (\theta_{m4} + \theta_{74})p_m \quad (4)$$

$$-p_5^p + \theta_{13}p_1 + \theta_{25}p_2 + \theta_{35}p_3 + \theta_{45}p_4 + \theta_{85}p_8 + \theta_{w5}w + \theta_{r45}r_5 = -(\theta_{m5} + \theta_{75})p_m \quad (5)$$

$$-p_6^p + \theta_{86}p_8 + \theta_{w6}w + \theta_{r6}r_6 + \theta_{v6}v_6 = -(\theta_{m6} + \theta_{76})p_m - (\theta_{66}p_{ind}) \quad (6)$$

$$-p_7^p + \theta_{87}p_8 + \theta_{w7}w + \theta_{r7}r_7 = -(\theta_{m7} + \theta_{77})p_m \quad (7)$$

$$-p_8^p + \theta_{88}p_8 + \theta_{w8}w + \theta_{r8}r_8 + \theta_{v8}v_8 = -(\theta_{m8} + \theta_{78})p_m \quad (8)$$

$$-p_9^p + \theta_{89}p_9 + \theta_{w9}w + \theta_{r9}r_9 = -(\theta_{m9} + \theta_{79})p_m \quad (9)$$

Employment of Primary Factor Input

The model treats nominal wages as highly rigid in the short-run and the labour participation rates adjust through changes in employment. Capital is treated as specific to each sector. The supply of sector specific capital to the region is assumed to be a function of after-tax nominal returns. Land is also treated as sector specific like capital. But land is truly specific in the sense that it has no alternate use in the particular industry within the region. The supply of land to Coast and Interior logging is assumed responsive to changes in rental rates of land.

$$-elf_c + \sum_{i=1}^{9}\beta_{ic}x_i - \sum_{i=1}^{9}\beta_{ic}(1-\theta_{wi}^p)\sigma_i w + \sum_{i=1}^{9}\beta_{ic}\theta_{ri}^p\sigma_i r_i + \beta_{6c}\theta_{v6}^p\sigma_6 v_6 + \beta_{8c}\theta_{v8}^p\sigma_8 v_8 = -\beta_1\theta_{v1}^p\sigma_1 cst \quad (10)$$

$$-elf_I + \sum_{i=1}^{9}\beta_{il}x_i - \sum_{i=1}^{9}\beta_{il}\left(1-\theta^p_{wi}\right)\sigma_i w + \sum_{i=1}^{9}\beta_{il}\theta^p_{ri}\sigma_i r_{il} + \beta_{6l}\theta^p_{v6}\sigma_6 v_6 + \beta_{8l}\theta^p_{v8}\sigma_8 v_8 = -\beta_1\theta^p_{v1}\sigma_1 cst \quad (11)$$

$$elf_c + elf_I - \lambda w = 0 \quad (12)$$

$$x_1 - \left(1-\theta^p_{r1}\right)\sigma_1 r_1 + \theta^p_{w1}\sigma_1 w = k_1 - \theta^p_{v1}\sigma_1 cst \quad (13)$$

$$x_2 - \left(1-\theta^p_{r2}\right)\sigma_2 r_2 + \theta^p_{w2}\sigma_2 w = k_2 - \theta^p_{v2}\sigma_2 ist \quad (14)$$

$$x_3 - \left(1-\theta^p_{r3}\right)\sigma_3 r_3 + \theta^p_{w3}\sigma_3 w = k_3 \quad (15)$$

$$x_4 - \left(1-\theta^p_{r4}\right)\sigma_4 r_4 + \theta^p_{w4}\sigma_4 w = k_4 \quad (16)$$

$$x_5 - \left(1-\theta^p_{r5}\right)\sigma_5 r_5 + \theta^p_{w5}\sigma_5 w = k_5 \quad (17)$$

$$x_6 - \left(1-\theta^p_{r6}\right)\sigma_6 r_6 + \theta^p_{w6}\sigma_6 w + \theta^p_{v6}\sigma_6 v = k_6 \quad (18)$$

$$x_7 - \left(1-\theta^p_{r7}\right)\sigma_7 r_7 + \theta^p_{w7}\sigma_7 w = k_7 \quad (19)$$

$$x_8 - \left(1-\theta^p_{r8}\right)\sigma_8 r_8 + \theta^p_{w8}\sigma_8 w + \theta^p_{v8}\sigma_8 v = k_8 \quad (20)$$

$$x_9 - \left(1-\theta^p_{r9}\right)\sigma_9 r_9 + \theta^p_{w9}\sigma_9 w = k_9 \quad (21)$$

$$-land_1 + x_1 + \theta^p_{w1}\sigma_1 w + \theta^p_{r1}\sigma_1 r_1 = \left(1-\theta^p_{v1}\right)\sigma_1 cst \quad (22)$$

$$-land_2 + x_2 + \theta^p_{w2}\sigma_2 w + \theta^p_{r2}\sigma_2 r_2 = \left(1-\theta^p_{v2}\right)\sigma_2 ist \quad (23)$$

$$x_6 + \theta^p_{w6}\sigma_6 w + \theta^p_{r6}\sigma_6 r_6 - \left(1-\theta^p_{v6}\right)\sigma_6 v_6 = land_6 \quad (24)$$

$$x_8 + \theta^p_{w8}\sigma_8 w + \theta^p_{r8}\sigma_8 r_8 - \left(1-\theta^p_{v8}\right)\sigma_8 v_8 = land_8 \quad (25)$$

Product Market Equilibrium

The equilibrium condition is that product markets clear. The demand for output of each sector within the region is the sum of final demand by consumers, intermediate uses of firms, and net exports.

$$-x_1 + \psi_{13}x_3 + \psi_{15}x_5 + \psi_{18}x_8 + \psi_{1q}\left(\varepsilon_1 q + \eta_{11}p_1\right) = -\psi_{1e}\,export_1 \quad (26)$$

$$-x_2 + \psi_{24}x_4 + \psi_{25}x_5 + \psi_{28}x_8 + \psi_{2q}\left(\varepsilon_2 q + \eta_{22}p_2\right) = -\psi_{2e}\,export_2 \quad (27)$$

$$-x_3 + \psi_{35}x_5 + \psi_{37}x_7 + \psi_{38}x_8 + \psi_{3q}\left(\varepsilon_3 q + \eta_{33}p_3\right) + \psi_{3e}\,export_3 = 0 \quad (28)$$

$$-x_4 + \psi_{45}x_5 + \psi_{47}x_7 + \psi_{48}x_8 + \psi_{4q}\left(\varepsilon_4 q + \eta_{44}p_4\right) + \psi_{4e}\,export_4 = 0 \quad (29)$$

$$-x_5 + \psi_{57}x_7 + \psi_{58}x_8 + \psi_{5q}\left(\varepsilon_5 q + \eta_{55}p_5\right) + \psi_{5e}\,export_5 = 0 \quad (30)$$

$$-(1-\psi_{66})x_6 + \psi_{67}x_7 + \psi_{68}x_8 + \psi_{69}x_9 + \psi_{6q}(\varepsilon_6 q) + \psi_{6e}\,export_6 = -\psi_{6q}(\eta_{66}p_{ind}) \tag{31}$$

$$-(\Gamma_d - \psi_{77})x_7 - (\Gamma_m)import_7 + \sum_{i=1}^{9}\psi_{7i}x_i + \psi_{7q}(\varepsilon_7 q) = -\psi_{7q}(\eta_{77}p_m) \tag{32}$$

$$-(1-\psi_{88})x_8 + \psi_{81}x_1 + \psi_{82}x_2 + \psi_{83}x_3 + \psi_{84}x_4 + \psi_{85}x_5 + \psi_{86}x_6 + \psi_{87}x_7 + \psi_{89}x_9 + \psi_{8q}(\varepsilon_8 q + \eta_{88}p_8) = 0 \tag{33}$$

$$-x_9 + \psi_{9q}(\varepsilon_9 q + \eta_{99}p_9) = 0 \tag{34}$$

Other Set of Equations

Provincial GDP is specified as the sum of payments to all factors of production. The share of foreign ownership of capital is netted out in calculating the GDP. The GDP deflator is defined as the cost of output weighted by base period sector output. The consumer price index is defined as the cost of a representative basket of consumer goods. The nominal income is defined as the sum of wage, capital rents, and land rents weighted by their shares.

$$-GDP_c + \delta_{wc}elf_c + \delta_{wc}w + \sum_{i=1}^{9}\delta_i r_{ic} + \delta_{v6c}v_6 + \delta_{v8c}v_8 = -\sum_{i=1}^{9}\delta_{ic}k_i - \delta_{v1c}cst - \delta_{v6c}land_6 - \delta_{v8c}land_8 \tag{35}$$

$$-GDP_l + \delta_{wl}elf_l + \delta_{wl}w + \sum_{i=1}^{9}\delta_{il}r_i + \delta_{v6l}v_6 + \delta_{v8l}v_8 = -\sum_{i=1}^{9}\delta_{il}k_i - \delta_{v2}ist - \delta_{v6l}land_6 - \delta_{v8l}land_8 \tag{36}$$

$$-gdp + \delta_w elf + \delta_w w + \sum_{i=1}^{9}\delta_i r_i + \delta_{v1}land_1 + \delta_{v2}land_2 + \delta_{v6}v_6 + \delta_{v8} - \sum_{i=1}^{9}\delta_i k_i - \delta_{v1}cst - \delta_{v2}ist - \delta_{v6}land_6 - \delta_{v8}land_8 \tag{37}$$

$$gdpd + \delta_1 p_1 + \delta_2 p_2 + \delta_3 p_3 + \delta_4 p_4 + \delta_5 p_5 + \delta_8 p_8 + \delta_9 p_9 = -\delta_6 p_{imd} - \delta_7 p_m \tag{38}$$

$$-\xi_q q + gdp = \xi_t tax + \xi_s psav \tag{39}$$

$$y_1 - \xi_{w1}(w + elf) - \sum_{j=1}^{9}\xi_{rj1}r_j - \xi_{v16}v_6 - \xi_{v18}v_8 = \xi_{tf}(cst + ist) \tag{40}$$

$$y_2 - \xi_{w2}(w + elf) - \sum_{j=1}^{9} \xi_{rj2} r_j = \xi_{tf}(cst + ist) \tag{41}$$

$$cpi_1 - \pi_{13} p_3 - \pi_{14} p_4 - \pi_{15} p_5 - \pi_{18} p_8 - \pi_{19} p_9 = \pi_{16} p_6 + (\pi_{17} + \pi_{1m}) p_m \tag{42}$$

$$cpi_2 - \pi_{23} p_3 - \pi_{24} p_4 - \pi_{25} p_5 - \pi_{28} p_8 - \pi_{29} p_9 = \pi_{26} p_6 + (\pi_{27} + \pi_{2m}) p_m \tag{43}$$

$$y_{1r} - y_1 + cpi_1 = 0 \tag{44}$$

$$y_{2r} - y_2 + cpi_2 = 0 \tag{45}$$

Linkage between Producer Prices and Parket Prices

Indirect taxes can create a wedge between producer and market prices and will play a major role in tax policy simulations.

$$-p_1 + \rho_1 p_1^p = -\iota_1 itt_1 \tag{46}$$

$$-p_2 + \rho_2 p_2^p = -\iota_2 itt_2 \tag{47}$$

$$-p_3 + \rho_3 p_3^p = -\iota_3 itt_3 \tag{48}$$

$$-p_4 + \rho_4 p_4^p = -\iota_4 itt_4 \tag{49}$$

$$-p_5 + \rho_5 p_5^p = -\iota_5 itt_5 \tag{50}$$

$$-export_6 + \phi_6 \zeta_{p6} p_6^p = -\phi_6 \zeta_{t6} tt_6 \tag{51}$$

$$import_7 - \gamma p_7^p = -\gamma p_m \tag{52}$$

$$-p_8 + \rho_8 p_8^p = -\iota_8 itt_8 \tag{53}$$

Forest Products Exports

The net export demand for forest products is a function of the sector's producers price and transportation charges in delivering one unit of product to market.

$$-export_3 + \phi_3 \zeta_{p3} p_3^p = -\phi_3 \zeta_{t3} tt_3 \tag{54}$$

$$-export_4 + \phi_4 \zeta_{p4} p_4^p = -\phi_4 \zeta_{t4} tt_4 \tag{55}$$

$$-export_5 + \phi_5 \zeta_{p5} p_5^p = -\phi_5 \zeta_{t5} tt_5 \tag{56}$$

APPENDIX 2
Variables, Elasticities, and Parameters

Endogenous Variables in the Model

p^p $i = 1,....9$	Producer price of sector *i*.
elf_c	Employed labour force in the Coast.
elf_i	Employed labour force in the Interior.
w	Nominal wage.
r_i $i = 1,....9$	Rate of return on capital in sector *i* .
$land_i$ $i = 1,2$	Land used in sector *i*.
v_i $i = 6,8$	Rental rate of land in sector *i*.
x_i $i = 1,....9$	Output in sector *i*.
gdp	Gross domestic product.
$gdpd$	GDP deflator.
q	Disposable income.
cpi_i $i = 1,2$	Consumer price index for income category *i*.
GDP_c	GDP for the Coast.
GDP_i	GDP for the Interior.
y_i $i = 1,2$	Nominal income for household category *i*.
y_{ir} $i = 1,2$	Real income for household category *i*.
p_i $i = 1,...5\&8$	Market price of sector *i*.
$export_3$	Export of lumber from coastal BC.
$export_4$	Export of lumber from interior BC.
$export_5$	Export of pulp and paper products.
$export_6$	Exports of primary industry.
$import_7$	Imports of manufacturing goods.

Exogenous Variables in the Model

p_{ind}	Price of private industries sector.
p_m	Price of imports or price of sector 7.
tt_i $i =3,....6$	Transportation cost in sector *i*.
itt_i $i =1,....8$	Indirect taxes in sector *i*.
k_i $i =1,.....9$	Capital in sector *i*.
$land_i$ $i =6,8$	Land in sector *i*.
cst	Coast stumpage rate.
ist	Interior stumpage rate.
tf	Personal transfers.
tax	Income tax rate.
$psav$	Personal savings.
$export_1$	Log exports from costal BC.
$export_2$	Log exports from interior BC.

Elasticities in the Model

σ_i	i = 1,.....9	Technical elasticity of substitution in sector i (values are used based on judjement and drawing on previous studies).
ϕ_i	i = 3,4,5,6	Export demand elasticity in sector i (adopted from Percy & Constantino (1989))
γ		Import demand elasticity for manufacturing goods (a value of –100 is used to reflect the small country assumption).
ε_i	i = 1,.....9	Expenditure elasticity = 1 in each sector.
η_{ii}	i =1,..9	Own price elasticity = 1.
λ		Supply elasticity of labour (a value of 100 is used to reflect the wage rigidity assumption).

Parameters in the Model

α_i	i = 1,.....9	Allocation of capital in sector i.
β_{ij}	i = 1,....9; j = C,I	Allocation of labour in sector i of the Coast and Interior.
θ_{wi}	i = 1,.....9	Distributive share of labour in sector i.
θ_{ri}	i = 1,.....9	Distributive share of capital in sector i.
θ_{vi}	i = 1,2,6,8	Distributive share of land in sector i.
θ^p_{wi}	i = 1,.....9	Distributive share of labour in total private inputs cost of sector i.
θ^p_{ri}	i = 1,.....9	Distributive share of capital in total private inputs cost of sector i.
θ^p_{vi}	i = 1,2,6,8	Distributive share of land in total private inputs cost of sector i.
θ_{ji}	j,i = 1,.....9	Distributive share of intermediate input j in sector i.
θ_{mi}	i = 1,.....9	Distributive share of imports in sector i.
ψ_{ij}	i,j = 1,.....9	Share of output from sector i to j.
ψ_{iq}	i = 1,.....9	Share of output from sector i to consumption.
ψ_{ie}	i = 1,.....6	Share of output from sector i to export.
Γ_d		Share of domestic production in x_7.
Γ_m		Share of imports in x_7.
ζ_{ti}	i = 3,4,5,6	Share of transport cost in sector i.
ζ_{pi}	i = 3,4,5,6	Share of producer price in sector i.
δ_w		Share of wages in income.
δ_{ri}	i = 1,.....9	Share of capital rents in income.
δ_{vi}	i = 1,2,6,8	Share of land rents in income.
δ_i	i =1,.....9	Share of price i in GDP deflator.
ξ_q		Share of disposable income in GDP.
ξ_t		Share of direct taxes in GDP.
ξ_s		Share of personal savings in GDP.
ξ_{wi}	i = 1,2	Share of wages in ith group's income.
ξ_{rji}	i = 1,2; j = 1,..9	Share of capital rents in ith group's income.
ξ_{vi}	i = 1,2	Share of land rent in ith group's income.
ξ_{tf}		Share of transfer payments in ith group's income.

π_{ij}	$i = 1,2;$	
	$j = 3,....9,m$	Share of price j in ith group's CPI.
ρ_i	$i = 1,....5,8$	Share of producer price in ith market price.
ι_i	$i = 1,....8$	Share of indirect taxes in ith market price.

APPENDIX 3
Data Sources Used in the Model

The source used to allocate labour across sectors is Statistics Canada Catalogue (SCC) 72-002 (December 1989). For disaggregation between Coast and Interior B.C. the source used is SCC 25-202 (1987). The source used to allocate labour between the regions and across sectors within the regions is B.C. Regional Index (1986).

Distributive shares of inputs and output, share of manufacturing consumption, share of transportation costs and producer prices of total delivered price, share of primary factors in provincial GDP, and weights for the GDP deflator are adopted from Duchesne (1991).

Shares of primary factors and transfers in total income of average and poor income group are calculated from SCC 13-208 1991. Households with income below $20,000 are considered as poor and the rest as average income group. Sources of income were grouped into three categories: 1) wages and salaries; 2) self employment, investment and other income and; 3) transfer payments. The share of capital and land are calculated from self employment, investment and other income by weighting with shares of capital and land used in different sectors. The share of stumpage in total income is calculated from Ministry of Forests and Lands, B.C. Annual Report (1988).

Weights for consumer price index are calculated for both average and poor income groups by using SCC 62-555.

Shares of producer price and indirect tax in market price are calculated from the B.C. Input-Output table 1984.