**ALTIM 1.0:**
**The Economic Context of a General Equilibrium Model of the Alberta Forest Sector**

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Rural Economy Staff Paper No. 89-3 , [Rev.]

FEPA Working Paper 122

<u>Please note</u>: All figures and tables are located in the appendix.

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The authors wish to acknowledge the funding support provided by the Forest Development Research Trust Fund, Alberta Forestry, Lands and Wildlife Forest Service.

## Foreword

The project entitled "General Equilibrium Model of the Alberta Economy with Reference to the Forest Sector" and funded by the Alberta Forest Development Research Trust comprises three main tasks. These are: (1) to provide an economic context in which the Alberta forestry sector operates; (2) to develop the general equilibrium model; and (3) to conduct economic and policy simulations with the model.

This paper contains the results of the first of these three tasks in providing the economic context. In particular, it provides the international and national context for modelling the Alberta economy in general and the forestry sector in particular. Which sectors are important, what level of sectoral disaggregation should be used, and which assumptions concerning the economic responses of economic agents are appropriate are some of the questions answered in this paper.

# 1.0 THE ECONOMIC CONTEXT OF A GENERAL EQUILIBRIUM MODEL OF THE ALBERTA FOREST SECTOR

## 1.1 INTRODUCTION

The objective of the overall project is to develop a model of the Alberta economy with a detailed treatment of the Alberta forest sector. Policy analysts are constantly in need of evaluating the impacts of policy options being considered. On one hand they need to assess how the sector might respond to sectoral policies or to economic shocks elsewhere in the economy. On the other hand they sometimes need to investigate the repercussions of sectoral policies in other sectors or in the economy at large. Extant models of the forest sector or the regional economy are not appropriate for that type of analysis, because they fail to capture the important relationships between the various economic agents and between the various sectoral activities. Input output or activity analysis, on the other hand, is very restrictive in terms of the economic responses it can simulate, this giving rise to mutlipliers that do not inspire confidence.

General equilibrium models are becoming the preferred tool among economists for researching the economy-wide and multisectoral consequences of policies and economic change. General equilibrium models include all the important sectors of an economy and simulate the behaviour of particular groups of economic agents such as consumers, producers and Government. The general equilibrium model developed by this project can be used to examine the interactions between the forestry sector and other sectors of the economy, such as agriculture, energy, transportation, and others. One can measure how a given change in a sector, for example an expansion in pulp and paper capacity, will affect the Provincial economy or a specific sector such as agriculture or energy. One can also quantify the sectoral responses to changes in other sectors or in the economy, say, how an increase in transportation costs will affect sectoral performance.

The list of possible economic shocks or policy changes is limitless and it includes pulp capacity expansions, increases or declines in timber supplies, changes in agricultural or oil prices, changes in transportation costs due to deregulation or other factors, changes in taxation, to name just a few. Our intention was to develop a model that is flexible and easy to operate so that it will be readily available to policy analysts for a wide range of policy and economic analyses.

## 1.2 ECONOMIC STRUCTURE OF THE PROVINCIAL ECONOMY

The purpose of this paper is to highlight the features of the Alberta economy which are important from the perspective of model construction. From an economist's perspective three basic features stand out - (1) specialization, (2)"openness" to flows of goods and services, and (3) "openness" to flows in the markets for capital and labour. Each of these features is important and will be reviewed in terms of the constraints it imposes on model specification.

Specialization

The Alberta economy remains highly specialized despite significant efforts over the past two decades to diversify industrial structure. In 1987 agriculture and energy accounted for 3.9% and 19.0% respectively of gross domestic provincial product at factor cost (Alberta, 1989, 56). Manufacturing accounted for another 7.8% of gross domestic product; with the remaining 69.3% derived from the various service sectors (and .2% from forestry). Although services account for more than two thirds of provincial economic activity, much of the activity in these sectors derives from the demands of the agricultural and energy sectors.

The influence of the energy sector is pervasive. Diversification efforts, for example, have promoted the forward linkages of the petroleum sector through creation of a world scale petrochemical sector. Some of the diversification of the manufacturing sector draws upon the availability of plastics, and resins as a key reason for plant location in Alberta.

Perhaps the most significant linkage of the energy sector is to the government sector. During the period of high and rising energy prices in the period 1974-1982, energy revenues captured by the provincial economy, accounted for nearly 50% of government revenues. Since the sharp fall in energy prices in late 1986, energy revenues have accounted for a smaller share of provincial government revenues. In 1988, non-renewable resource revenues amounted to $2.6 billion or 27.4% of provincial expenditures. Income from the Heritage Savings Trust Fund, now transferred directly to general revenues, amounted to $1.4 billion or 14.7% of budgetary revenues. This link between energy prices and the fiscal stance of the provincial government is an essential element of any model of the Alberta economy.

On one hand, the narrow economic base of the province simplifies modelling structure as less sectoral disaggregation is required to capture industrial structure. Yet, on the other hand, a wide array of government policies at the provincial level are aimed at promoting industrial diversification. Thus, a sector may be relatively small (i.e the food and beverage sector) but a variety of government tax and expenditure policies may be aimed at promoting its growth. Hence a policy simulator, such as the one proposed here, must take this into account by including important sectors both in terms of the level of economic activity and policy relevance.

Another key feature which has characterized economic activity in the province is the tremendous volatility of the domestic economy. Much of this instability follows from the province's economic dependence on energy and agriculture - two sectors characterized by a high degree of instability both on the supply and demand sides of the market. Fluctuations in prices for the output of these key sectors is transmitted directly to the provincial economy through shifts in production and employment. Equally apparent from the data on price movements is that there are significant shifts in service, or non-traded, prices during export and import price shocks. Non-traded prices often rise sharply during export or construction booms and fall even more sharply during slumps in primary prices. These shifts in relative prices - the prices of exports and imports relative to non-traded or service prices - in response to trade shocks is a phenomenon that must be incorporated into the modelling exercise.

The government sector is particularly important in resource abundant regions such as Alberta. Crown ownership of natural resources provides provincial governments, such as Alberta's, with a significant independent fiscal capacity to vary tax and expenditure policies relative to other provinces. For example, since the early 1970's per capita expenditures by the provincial government in Alberta have exceeded the national average by 30 to 40%, while tax effort - the actual level of various taxes compared to the national level - is often between 20 and 30% below the national average. Provincial government tax and expenditure policies do not affect industrial structure in the short-run; but in the longer run can influence interprovincial capital and labour flows to the province. Thus, any modelling effort has to ensure that the full array of linkages between government and the rest of the economy is captured both in the short-run and the long-run.

## "Openness" in Flows of Goods and Services

The specialization of the Alberta economy on the production side is highlighted when the composition of exports is examined. In 1985 four commodities - crude petroleum, natural gas, sulphur and wheat - accounted for $9.4 billion of exports and 69% of

Alberta's total exports (Alberta, 1986, 5). The top twenty exports, composed primarily of natural resources (crude and processed), accounted for 89.5% of total exports. Not only was the commodity composition of Alberta's exports highly specialized, but a remarkably high degree of geographic concentration of exports was evident. In 1985, 77% of the province's total exports were directed to the United States (ibid, 6).

Exports remain the fundamental determinant of the level of, and change in, living standards of Albertans. Although exports only accounted for 21.1% of gross domestic product in 1984, this number belies their true importance. Investment activity in the province is driven by expected returns in the key export sectors. Moreover, the level of provincial government expenditures is also linked directly to export prices; more precisely, energy prices.

Despite the importance of exports to the provincial economy, Alberta itself is a relatively small player in international export markets. In 1985 Alberta's share of world exports was 0.59%, a significant increase from 0.39% in 1980 (Alberta, 1986, 2). In a variety of export markets Alberta is probably a price-taker as its export volumes are unlikely to influence export prices. However, in the case of two products - sulphur and natural gas - Alberta probably does face a downward sloping export demand curve. An increase in export volumes of these products might lead to a fall in producer prices.

In the case of imported goods, the province is almost certainly a price-taker. Provincial consumption of manufactured products is a sufficiently small share of rest of Canada, and certainly rest of world production, that variations in Alberta's demands for imports have no effect on import prices.

Thus the Alberta economy faces, for the most part, a terms of trade - the price of exports relative to the price of imports - which is externally determined. Any model of the Alberta economy has to be sure to capture the mechanisms of price determination and capture all of the direct links between exports and imports and the domestic economy.

"Openness" in Markets for Labour and Capital

In the markets for labour and capital the province is also a price-taker, at least in the long-run. However, in analyzing factor market responsiveness the time dimension of the discussion is critical. The importance of the short-run/long-run distinction will be discussed in greater detail shortly. The assumption that Alberta is a price-taker in capital markets clearly follows from the overwhelming body of evidence that indicates that Canada is itself a price-taker. If the interest rate and the price of capital goods are both set exogenously in the rest of the world, then it follows that the rental rate of capital is also set exogenously in the long-run, once all factor market responses have worked themselves out.

The available evidence also suggests that the province faces highly responsive supplies of labour from the rest of the country (Winer and Gautier, 1982; Mills, Percy, and Wilson, 1983). Since the province's share of national population is only 9.2 percent (Alberta 1988, 4) it is unlikely that Alberta faces an upward sloping supply curve of labour in the long-run.

The Alberta economy has experienced large swings in net migration that have tended to mirror swings in energy prices. In the period 1976-1981, Alberta experienced net interprovincial migration of 197,650. But in the period 1981-1986, net interprovincial migration was -27,670. The Alberta labour supply thus appears to be very responsive to differentials in interprovincial economic activity. The high degree of integration of Alberta's capital and labour markets with national ones requires that any model specification incorporate factor mobility explicitly into the analysis.

However, it must be recognized that net out migration, and disinvestment are all in the nature of long-run responses. In the short-run, capital is fixed, and workers, if unemployed, will often engage in job search. Consequently, modelling the Alberta economy also requires a focus on the short-term adjustment of capital and labour markets. These short-run adjustments are a critical element in determining the need for longer-term interregional adjustments in factor markets.

Our review of the provincial economy focused primarily on those elements of structure critical to model specification. For the policy simulator to be accurate it has to capture the salient features of the Alberta economy. Our review of the Alberta forest products sector has much the same objective. The aim is to provide an overview of the key elements of the sector, recent developments, and highlight those aspects that are particularly important with respect to policy concerns.

## 1.3 AN OVERVIEW OF ALBERTA'S FOREST RESOURCE

### The Forest Resource Base[1]

In 1970 the Alberta Forest Service (AFS), Alberta Forestry Lands and Wildlife, initiated the province's third forest land inventory - the Phase 3 Inventory. Completed in 1984, this inventory updated previous inventories and provided the AFS with more detailed information about the extent, nature and condition of the forest resource.

Alberta's forests occupy an area of 349,000 $km^2$ or around 54% of the total provincial land area. The Phase 3 Inventory covers 90% (322,307 $km^2$) of the forested land. Forested areas reserved for provincial and federal parks, townsites, private lands, wilderness areas and Indian and Metis lands account for the remaining 10%.

The area covered by the inventory can be divided into four land classes: water, potentially productive forest, non-productive forest and productive forest. Figure 1 shows the distribution of the total inventoried area amongst these classes in terms of both area and percentage of total area. Productive forest land, which occupies nearly 60% of the inventoried area, can be further

[1] Unless noted otherwise, the source of the information presented in this section was the Alberta Forestry, Lands and Wildlife publication Alberta Phase 3 Inventory: An Overview, (1985).

partitioned into three cover types: coniferous, mixed wood and deciduous. The distribution of the area of productive forest amongst these cover types is shown in Figure 2. Since it is the area of productive forest land which is allocated to timber production the remainder of this overview focuses on the productive forest land resource.

The Phase 3 Inventory indicates that the total merchantable wood volume on productive forest land is 2,768,124 thousand cubic metres (M $m^3$). A little over 60% of merchantable volume is coniferous species; deciduous species account for the balance (refer to Figure 3). Of the coniferous volume, 86% is White Spruce and pine; 9% is Black Spruce; and 5% is comprised of Balsam fir, Douglas fir and larch. Aspen is the dominant deciduous species, accounting for 70% of the hardwood volume.

The volume distribution of major species by age class is shown in Figure 4. This graph illustrates the fact that a large proportion of Alberta's merchantable timber volume is between the ages of 41 and 120.

## The Annual Allowable Cut

### i. The Physical Annual Allowable Cut

Alberta's total annual allowable cut (AAC) from productive forest land is 25,760 M $m^3$. 56% (14,326 M $m^3$) of the total AAC is softwood; the remaining 44% (11,434 M $m^3$) is for hardwood species (WRA, 1987, p 30). Figures 5, 6 and 7 show that a growing portion of the AAC has been committed to timber production over time.

Still, by 1986-87 only 7,429,022 $m^3$ of the coniferous AAC and 800,852 $m^3$ of the deciduous AAC were allocated to timber production. The Alberta government has recently announced several new resource commitments which now means that, at least in principle, 85-90% of the provincial AAC has been allocated.

The dramatic increase in the deciduous sawlog harvest level over the seven years to 1987 reflects the increasing use of hardwood species in a variety of forest products. Prior to 1983 the production of waferboard by Weldwood of Canada Ltd. in Slave Lake accounted for most of the deciduous harvest: harvest levels increased sharply in 1983 with the start-up of Pelican Spruce Ltd.'s OSB mill in Edson. Further increases in the deciduous harvest will accompany the opening of new reconstituted panel mills now under construction and the increasing demand for aspen as a component in the wood furnished for pulp manufacture.

Deciduous pulpwood harvests fluctuated over the period 1977-87 as Proctor and Gamble Cellulose Ltd., the province's only deciduous pulpwood user, experimented with the use of hardwoods in their product mix (Dunagen, 1988). It is evident from Figure 6 that demand for a mixed softwood/hardwood pulp has been relatively strong since 1983.

Figures 5 also illustrates that the demand for coniferous pulpwood by the province's existing pulpmills has been gradually declining since 1977. This is the result of the mills' increasing use of softwood chips, in preference to pulpwood, in their production processes (Dunagen, 1988). For example, in 1975 Champion

Forest Products Ltd. constructed a sawmill next to their existing pulpmill: this enabled them to utilise the sawtimber from their harvesting operations and, subsequently, use the chips in their pulping operations. This change was justified on the basis of increased wood utilisation, and hence lower raw material costs. Figure 8 shows the increasing provincial demand for chips.

ii. Economic Annual Allowable Cut

So far this overview has focused entirely on the "physical" timber supply. However, it is unlikely that all of the forest stands included in estimates of the physical timber supply can be extracted at a positive profit. For example, stands of low quality timber located far from existing infrastructure may not be economically accessible and should not be included in estimates of the "economic" timber supply. The AAC should, therefore, be adjusted to reflect economic accessibility. This is of particular importance now, as a growing proportion of the province's estimated physical AAC becomes committed.

The "economic" timber supply can be defined as the rate at which timber is made available for harvesting in response to changes in product prices and extraction and processing costs. To date, few attempts have been made in Alberta to identify the extent of the economically recoverable timber resource and its responsiveness to changes in the economic environment. Woodbridge, Reed and Associates (1987) arbitrarily defined the economic AAC to include all allocated AAC (existing and future) and some of the areas within the unallocated region. Using this definition they found the economic AAC for hardwoods and softwoods in Alberta to be 12.4 million $m^3$ and 7.3 million $m^3$ respectively. Unfortunately their analysis does not say anything about the effect of changing product prices and production costs on the economic AAC.

Beck et. al. (1987) estimated marginal and average cost curves, relating the economic AAC to delivered wood cost constraints, for two Forest Management Units (FMUs) in Alberta. Figures 9 and 10 show the estimated relationships. Their results indicate that higher unit delivered wood costs are associated with increased annual economic harvests. Clearly, higher product prices (and hence the price of wood delivered to the mill) or a downward shift in the marginal recovery cost curve would result in a larger volume of economically recoverable timber.

The marginal cost curves in Figures 9 and 10 can be viewed as the industry's wood supply curve: they trace the effect of a change in output price (i.e. the price of logs) on the amount harvested (AAC). The supply elasticity measures the percent change in the AAC that results from a 1% change in price. The elasticities for the two FMUs (FMU E1 and FMU R4) were calculated, for price changes in the range of $\$25/m^3$-$\$26/m^3$, to be around 3.9 and 8.8 respectively. This implies that the economic AACs for both FMUs are highly responsive to price changes. However, the study by Beck et. al. also shows that the price sensitivity of supply varies considerably between FMUs; this suggests that care should be exercised in applying the results of this study to other FMUs in the province.

Structural Change in the Alberta Forest Industry

Volatile oil prices, depressed grain prices, a strong sellers' market for most forest products, and a large uncommitted timber resource has induced the Alberta government to expand the domestic timber industry in recent years. Table 1 documents several changes in the forest industry between 1985 and 1987. Most of these changes occurred in the sawmilling industry with the construction of 79 new mills. Two new panel mills - an OSB mill in Drayton Valley and Canada's first MDF mill at Blue Ridge - were also established. These projects have generated an additional 1200 person direct employment opportunity; raising total direct employment in the industry to 10,000. In addition, the industry now contributes an additional $70 million/year to Alberta's gross domestic product.

The contribution of the forest industry to the economy of Alberta is already significant: and it will become of still greater importance as the large number of proposed capacity expansions and new mills start-up production. Recently announced investments in forestry development are expected to value $3.5 billion and create 12,000 new jobs. Many of the new developments are described below.

1. Millar Western Pulp Mills Ltd. has constructed a $194 million chemithermomechanical (CTMP) mill in Whitecourt. Construction of this mill began in February, 1987 and was completed in August, 1988 with the first shipment of pulp going out in the first week of September. The mill has the capacity to produce 210,000 metric tonnes of pulp per annum and is capable of producing a wide variety of pulp products; 90% of the products will be shipped to the United States, Asia/Pacific Rim and Europe (50,000 tonnes/year has already been committed to Scott Paper Co. of Philadelphia). At full

capacity the mill will use 90,000 BDUs of hardwood chips. (Source: AFS Info. Update #2, 23 April 1988).

2. Weldwood of Canada Ltd. is expected to complete the expansion of its bleached kraft pulpmill by 1989. Once completed, the mill will be capable of producing 384,650 metric tonnes of pulp per annum; this represents a twofold increase over the existing capacity. The cost of the new expansion has been estimated at $361 million. (Source: Alberta Government News Release #051, 8 March 1988).

3. Alberta's first CMTP newsprint mill will undergo construction in the fall of 1989 by the Alberta Newsprint Company. This mill will be constructed near Whitecourt, and is expected to start-up in the spring of 1990. The cost of the mill will be about $360 million. The mill will require about 600,000 cubic metres of roundwood (80% softwood and 20% hardwood) per year to produce 220,000 finished metric tonnes of newsprint per annum. (Source: Alberta Government News Release #051, 8 March 1988).

4. Daishowa Canada Co. Ltd., the subsidiary of the Japanese based Daishowa Paper Manufacturing Co. Ltd., is constructing a $500 million greenfield bleached kraft pulp mill near Peace River; production is expected to start in the fall of 1990. The mill will use 1.8 million cubic metres of raw wood materials (70% deciduous roundwood and the 30% softwood chips) per year for the production of 1,000 air dried metric tonnes of pulp per day. The majority of the product will be shipped to the parent company in Fuji City, Japan with the rest being sold in the domestic and international markets. (Source: AFS Info. Update #11, 21 March 1988).

5. In October, 1988 a proposal by Sunpine Forest Products Ltd. to construct a sawmill, a wood treatment plant, a planermill, a remanufacturing centre and a pole plant in Rocky Mountain House and possibly a fibreboard mill near Burnstick Lake in the Municipal District of Clearwater was approved. The sawmill and treatment plant will have capacities of 80 and 40 MM FBM per year respectively. The fibreboard plant will be capable of producing 100 MM sq.ft. 1/8" annually. Construction should begin within nine months at a cost of $32.5 million. Production is expected to begin in two years. The mills will use about 348,900 $m^3$ of softwood and 8,600 $m^3$ of hardwood timber per year from the Brazeau Timber Development area. (Source: Alberta Government News Release #090, 7 October 1988).

6. In addition to the expansion of their Hinton pulp mill, Weldwood of Canada Ltd. announced that they were going to replace their existing Hinton sawmill with a new $50 million dollar sawmill. The new sawmill will be able to produce 200 MM FBM annually which is an increase of 75 MM FBM from the existing mill. Construction of the mill will begin in the summer of 1989 and is expected to be completed in mid-1990. (Source: Alberta Government

News Release #095, 9 November 1988).

7. The Erith Tie Co. Ltd. has plans to construct a $20 million, 80 MM FBM sawmill in Edson. (Source: Alberta Government News Release #14 September 1988).

8. Grand Cache Forest products Ltd. is modernising its sawmill in Grand Cache at a cost of $5 million. The mill is capable of producing 100 MM FBM annually. The mill will be owned and operated by a subsidiary of British Columbia Forest Products Ltd. (Source: Alberta Government News Release #009, 20 July 1987).

Production and Markets for Alberta Produced Forest Products

In 1985 Alberta's forest industry produced approximately 1.5 billion FBM of lumber; 800 thousand bone dry units (BDUs) or 1.4 MM $m^3$ of wood chips; 594 MM sq.ft. 3/8" basis of panel products; and 489 tonnes of bleached kraft pulp (Table 2). The majority of this production was destined for domestic and United States markets. As the recently announced production facilities start operating it is expected that 10-20% of total production could be shipped to offshore markets (FIDDS, October 1988); this would represent a significant increase from the one percent that is currently shipped offshore. Nonetheless, United States markets will likely remain the primary consumers of Alberta produced forest products.

## 1.4 AN OVERVIEW OF ALBERTA'S TIMBER DISPOSITION AND STUMPAGE SYSTEM

To date virtually all commercial timber harvesting is on Crown land. The Alberta Forest Service is charged with the management of Alberta's forest lands. Their mandate is to preserve in perpetual supply of timber and maintain a high quality environment.

Harvesting of Crown timber is conducted under several tpyes of disposition issued under the authority of the Forests Act. Each one is discussed in turn.

Harvesting of Crown timber in Alberta is conducted under several types of disposition issued under the authority of the Forests Act. Forest Management Agreements (FMA) are awarded, to those willing and able to shoulder complete responsibility for the management of a prescribed area, for the development of large, integrated operations. FMAs, therefore, are of long duration (20 years), are renewable, are fully negotiated, and must receive approval by Cabinet or an order-in-council.

FMA holders pay an annual Holding and Protection charge per square kilometre of FMA area. Charges vary between agreements and are adjusted according to a prescribed index (such as the Implicit Index for Current Government Expenditures). FMA holders must also pay an Assignment Fee of 0.25 cents per cubic metre of authorized annual cut prior to finalization of their assignment. The agreement holder is totally responsible for all costs associated with growing/managing/and harvesting timber and cutover areas must be regenerated satisfactorily to Provincial standards. The implicit cost of the reforestation responsibility is determined from the costs experienced by the Forest Service in carrying out these activities ($2.30 per cubic metre harvested). The stumpage prices for timber cut under the authority of a FMA are negotiated in advance as part of the Agreement. While particular Agreements may provide formulas for adjusting stumpage rates over time no appraisal adjustment is made for factors which determine logging chance. FMAs, it is argued, include a variety of timber quality and areas of varying accessibility, enabling the holder to balance his costs by developing cutting areas in a rational manner.

Quota Certificate is a long-term (up to 20 years) right to harvest a share of the annual allowable cut within an Alberta Forest Service management unit. Each five years the quota holder is notified of the volume of timber to which his share entitlement corresponds. The actual land from which timber is to be removed, the species and the utilization standards are specified in a Timber Licence.

Timber Quotas are either i) earned or ii) sold by competitive bid. Earned quotas refer to those dispositions which were granted to existing operators in 1966, the time of the system's inception. A system of competitive, lump-sum bidding is now used to allocate quota certificates. The bonus bid is the total amount bid by the successful party. The bonus bid becomes the purchase price of the quota certificate which must be paid in full within ten days of teh sale. Quota holders also pay an Assignment Fee (0.25 cents per cubic metre of authorized annual cut), while associated Timber Licences carry with them a $50.00 assignment fee and an Issuance charge (average of 0.07 cents per cubic metre in 1985/86) for mapping, cruising and advertising expenses. Quota holders pay an annual Holding and Protection charge of 0.15 cents per cubic metre of authorized annual volume and a reforestation levy of $2.30 per cubic metre of timber harvested. Holders of quotas in excess of

34,000 $M^3$ must perform reforestation activities at their own expense.

The stumpage price paid by holders of quota rights consists of two parts; a Regulation Rate (or general rate of Crown dues) and an appraised adjustment factor. Regulation rates vary with tree size, species and condition and can be changed at any time as a result of Government review and an order-in-council. Regulation rates have not changed for at least the last three years. The regulation rate is adjusted, to account for variance in individual harvesting chance, to arrive at the actual rate of timber dues. Appraisal factors are calculated to reflect average haul distance, average gross volume per harvestable acre, average gross volume per tree and average cut as a percentage of gross volume. Appraisal factors are fixed for the life of the disposition to a maximum period of five years. The current version of the appraisal system is dated 1976-78. Although inflation has changed average figures it is maintained that the relativity in the system has been preserved. Actual rates of stumpage cannot be reduced to less than 25% of the Regulation rate or above 175% for positive appraisals. The principal function of the appraised adjustment procedure is to establish the variance of individual dispositions from the Provincial average.

Smaller volumes of Crown timber are allocated under <u>Commercial Timber Permits</u> (CTP). CTPs are short-term (averaging 2-3 years) dispositions which convey the right to harvest a prescribed volume of timber from a specified area. They are generally allocated via public auction. Bidding is in terms of a rate per cubic metre to be paid for stumpage in addition to the adjusted regulation rate. In 1985-86 the weighted average bonus bids for CTPs was 0.05 cents per cubic metre. CTPs also pay annual Holding and Protection charges (0.25 cents per hectare), and initial issuance and assignment fees. They are also subject to the $2.30 per cubic metre reforestation fee.

Local Timber Permits (LTPs) are used to authorize the harvest of small volumes of timber (for example, no more than 750 $M^3$ of green coniferous), from areas specified on the permit. LTPs are issued for one year or less, on a first-come, first-served basis, or, where demand is high, on a draw basis. Stumpage is charged at the Regulation Rate in effect at the time the permit is issued. Reforestation charges are paid if the volume is over 130 $M^3$ at a rate of 0.35 cents per cubic metre.

A Forest Product Tag is a 30-day, non-renewable permit to cut small amounts of miscellaneous timber for the permittee's own use. These are issued on request in areas designated by the Forest Service. Stumpage is charged at the Regulation Rate.

A Christmas Tree Permit is a one-day entitlement to cut a single Christmas tree from a specified area.

## 1.5 IMPLICATIONS OF REGIONAL AND INDUSTRIAL STRUCTURE FOR MODEL SPECIFICATION

The perspective of Alberta as a small open economy must be placed in the context of the Canadian economic union. As a province in Confederation, Alberta has no control over monetary policy and exchange rates; nor can it erect tariff barriers to interprovincial trade. The existence of trans-national firms and national branch banks means that many interregional financial transfers are undertaken at the level of the firm and do not seem to enter any explicit regional balance of payments framework. However, membership in an economic union does not mean that international trade theory is not useful in understanding how regional economies respond to economic shocks, particularly those affecting export or import-competing goods sectors. In fact, quite the reverse is true. We must draw heavily on international finance and trade theory if we are to model correctly the response of the Alberta economy to economic shocks.

## Spending and Resource Movement Effects of a Booming Sector

The relatively poor macroeconomic performance displayed by many resource abundant countries during the period of rising resource prices in the 1970's prompted much investigation of the links among trade, industrial structure and resource exploitation. The catalyst for this research was the apparent de-industrialization associated with booming resource sectors. This phenomenon, known variously as the "Dutch Disease" or the "Gregory Thesis" is dealt with at the level of the national economy in the literature. However, the conclusions extend naturally to regional economies, once allowance is made for their distinctive features, and will prove very useful in understanding the links between the forest industry and the Alberta economy and the model specification to follow.

The literature on booming resource sectors distinguishes two basic effects of shocks to the export sector - the resource movement and the spending effects (Corden, 1982). The spending effect arises from the increases in the aggregate incomes of factors employed in the booming sector when the shock took place. Some portion of this increase will be spent internally by workers, landlords, the owners of capital and government (if taxes and royalties are levied on Crown-owned resources). Spending will be allocated across sectors according to relative income and price elasticities of demand. The greater the former value, and the less the latter, the greater is the resultant increase in demand for any given product and the greater is the impetus to expand output.

The resource movement effect arises because the initial shock to the booming sector - say, an improvement in the terms of trade or a new resource discovery - raises the marginal products of capital, labour and intermediate inputs used in the sector. The rise in factor prices that results permits the booming sector to attract mobile factors employed elsewhere in the economy. If factors are not mobile interregionally or internationally then their source is employment in other sectors in the region. Output in sectors loosing factors must decline as a result of this resource movement. However, if capital and labour can be drawn into production from outside the region, then less internal resource reallocation will be required, and the impact of the resource movement effect will be less.

The net effect of a resource boom on the equilibrium output levels of a given sector of the economy is therefore uncertain. The spending effect tends to increase output levels through expanding demand while the resource movement effect tends to reduce them by reducing supply capabilities. However, some general predictions can be made. The spending effect is likely to increase the output of service industries relative to those of goods for two reasons. First, income elasticities for services are often very high. Second, many services are non-traded - their prices are determined within the region and in the absence of import competition. Second, the absence of import competition also means that price elasticities of demand are likely to be lower for domestically produced tradeable goods.

The resource movement effect will also likely increase the output of services relative to domestic goods production. Any expansion of the booming sector must draw on capital and labour from somewhere and, in the short-run at least, it is probably from other sectors of the regional economy. Non-tradeable services can increase output prices in response to rising factor costs: this is unlike tradeable goods activities, where opportunities to pass on higher costs are restricted, or in the limit, non-existent (i.e. exogenously set import and export prices). Moreover, the services sector may be an intermediate input to the booming sector; hence the absolute impact of the resource movement effect on services production is uncertain.

These points can be reinforced by examining polar cases where only the resource movement effect or the spending effect operates. A pure spending effect would exist if all the additional capital and labour required directly by the booming sector, and indirectly by sectors expanding output in response to final or intermediate demands, were obtained from outside the region. In this case the shock to the booming sector does not affect domestic or regional factor markets directly; no capital or labour must be drawn out of one sector to permit the expansion of another. This example highlights the critical role played by factor supply elasticities in the adjustment of a regional economy to an economic shock.

A pure resource movement effect exists if all goods are tradeable at exogenous world prices or, alternatively, all non-tradeable goods have zero income elasticities of demand. The extra income produced by expansion of incomes in the booming sector would still be spent, but the demand would be met either by imports or diverting exports to domestic consumption. This polar case highlights the critical importance of distinguishing tradeable and non-tradeable outputs and ensuring reasonable values for income and price elasticities of demand.

<u>Booming Sectors, Regional Adjustment, and the "Real Exchange Rate"</u>

The ratio of traded to non-traded output prices - the real exchange rate - plays a fundamental role in the adjustment of a regional economy to the impact of a booming sector. This ratio, the relative price of tradeables, depends on the relative importance of the spending and resource movement effects. Regional economic adjustment to a booming sector often proceeds via a rise in the real exchange rate - a fall in the prices of tradeables relative to non-tradeables. Non-tradeables are often highly labour intensive and their relative expansion, via the spending effect, puts significant upward pressure on nominal wages. Thus some authors prefer to view the nominal wage rate as the equivalent of the real exchange rate.

It was argued above that in the short-run the resource movement effect will result in an intersectoral reallocation of labour within the region; while in the long-run the region can draw upon interregional flows. This ability to draw upon interregional labour supplies would seem to reduce the pressure on non-traded prices and nominal wages. However, interregional migration has an immediate impact on the demand for population sensitive capital formation, all of which is produced in the non-traded sector. Thus interregional migration accompanying a resource boom can exacerbate the pressure on non-traded prices and nominal wages - at least in the short-run, when capital formation is underway but not yet contributing to increased output.

While all booming sectors, whether resource or industrial, can bring about the adjustments outlined above they are most visible in the case of resource sectors. Resources are often Crown owned and in most cases governments are relatively efficient rent collectors. Resource booms in Canada are often associated with a sharp rise in government revenues. Although the resource movement effect is typically small (resource sectors are not labour intensive), the spending effect is large. Moreover, since the Crown often captures much of the income in the booming sector (through royalties and bids) the government sector expands during periods of rising resource revenues. The level of government activity is revenue driven. The absolute and relative expansion of a sector, which is both labour intensive and non-traded, leads to a large resource movement effect and large-scale crowding out of the import competing goods, non-booming export sectors, and tradeable services.

Thus at the provincial level in Canada, booming resource sectors are often accompanied by rising non-traded prices; the equivalent of an appreciation of the real exchange rate. This move in relative prices is an important mechanism in achieving regional balance of payments equilibrium. The initial phase of a boom is often associated with an increase in the value of exports relative to imports. The crowding out of non-booming export sectors and sectors producing import competing goods, brought about by the appreciation of the real exchange rate, reduce any net trade surplus that the region might be running with its partners. In the longer term, wealth effects also come into play and lead to further movements towards balance of payments equilibrium.

Furthermore, to the extent that a region's demand for capital exceeds its own savings requirements, it will be forced to borrow outside its borders. The influx of capital, and the increase in the demand for non-tradeables (construction etc.) which it induces, will lead to a further rise in non-traded prices (and nominal wages) and even further crowding out of non-booming sectors. This appreciation of the real exchange rate leads to an increase in the value of imports relative to exports and ensures that real resources are transferred to the capital importing region.

It must be emphasized that the key role played by the prices of non-traded goods at the regional level is in ensuring that relative prices within the region move in the direction that leads to convergence to a new balance of payments equilibrium. While national economies can use exchange rate policies to accommodate balance of payments shocks, regional economies must rely on automatic market mechanisms, such as movements in the so called real exchange rate.

Symmetry holds in the case of contracting sectors in a region. During a slump in resource prices, or a contraction in resource supply, the fall in the real exchange rate promotes expansion of the import competing goods sector and traditional export sectors, including tradeable services. Thus the initial deficit in the merchandise account brought about the resource slump is offset, in part, by the fall in the relative price of tradeables - the depreciation of the real exchange rate.

## Implications for Model Specification

The object of this review of trade theory and its application to regional economies was to highlight the features required of any model simulating the links between a booming (or contracting) resource sector and the regional economy. First, any model must be able to capture the resource movement and spending effects. In the case of the latter, the disposition of income among competing ends must be carefully modelled; the former effect requires inter-industry linkages to be fully specified. Second, the model must be able to capture movements in relative prices, especially the real exchange rate - the relative price of tradeables. The real exchange rate is an important mechanism of adjustment for regional economies experiencing balance of payments shocks, especially those that are resource based.

Finally, the role of government has to be modelled carefully. It is not sufficient to model the government sector's capture of resource revenues; one must also model how they dispose of the resource revenues. Whether the revenues are distributed back to the population as lump-sum income transfers, embodied in a greater level of government output, used to lower taxes, or applied against the provincial debt has important implications for the magnitude of resource movement and spending effects.

One final issue in model specification must be addressed; time and interregional factor market adjustment. A regional economy faces a supply of labour which is highly responsive to inter-regional differences in real wages. However, this response is usually a longer-run phenomenon, and in the short-term the resource movement effect operates primarily through the realm of intersectoral labour reallocations within the region. Once a model focuses on long-run scenarios and incorporates interregional factor market integration in its specification, three very difficult issues emerge.

The first issue concerns the problem of closure. When modelling national economies it is assumed that the value of exports equals imports in the long-run or, if they differ, that it is to the extent of long-term capital movements. At the regional level in the Canadian context, federal transfer and equalization programs permit some regions, such as the Maritimes, to run chronic deficits in their merchandise trade accounts with the rest of the country and the world. Conversely, some regions, such as Alberta and Ontario, appear to maintain merchandise trade surpluses almost indefinitely. Imposing a balance of payments constraint on a regional unit of an economic union is somewhat difficult to justify as many federal policies appear designed to offset, rather than accommodate, some of the forces which operate to achieve regional balance of payments equilibrium. Any constraint imposed incorporates strong assumptions regarding federal policies at the regional level. In the short-run, automatic mechanisms of market adjustment, such as movements in the real exchange rate, come into play. While these mechanisms lead to movements towards balance of payments equilibrium, they do not necessarily attain it. Imposing a regional balance of payments constraint may yield economic adjustments which are just not realistic in the context of the Canadian economic union and the politics of Confederation.

The second issue related to undertaking long-run simulation exercises of regional economies relates to the endogeneity of the population base in the long-run. Usually, one uses a policy simulator to assess the impact of a particular policy on the current residents of a specific region. That is, the policy analyst is interested in the impact on regional incomes and employment of the shock in question. The focus is on the welfare of a specific set of residents at a particular point in time. Once we permit interregional migration, we are dealing with the welfare of two different groups of people - the pre-shock and post-shock populations of the region.

The final, and perhaps most complex problem, relates to the mechanism through which trade theory assumes factor price equalization can be attained. In theory, factor mobility or commodity flows are perfect substitutes for ensuring that factor prices in different regions can be equalized. Once we adopt a particular closure rule for balance of payments equilibrium, and specify factor supply elasticities in the long-run specification of the model, we are imposing a particular set of assumptions regarding the efficacy of trade in factors and in commodities as mechanisms for achieving factor price equalization. Since in the real world lags exist in how quickly commodity markets and factor markets respond to shocks, the dynamics of the adjustment process are very important in determining which mechanism - commodity vs. factor flows - contributes most to the process of interregional adjustment.

Thus the model, ALTIM 1.0, that is constructed focuses on two basic time periods. The first is the short-run impact of various economic shocks. We will examine the impact of various shocks to the forest sector on the existing population of Alberta; it is the welfare of the **current** residents of the province which is of concern in this set of simulations.

Moreover, by restricting our analysis to the so called short-run, when capital is sector specific, it is also possible to focus on the political economy of various economic shocks to the province. Capitalized changes in rental rates of sector specific capital correspond to changes in economic wealth derived from a particular sector. To the extent that the operation of pressure or lobby groups is based on economic factors, changes in rental rates of sector specific capital (a proxy for wealth) will often be an excellent predictor of the response of these groups to economic change. For example, those changes which yield higher rental rates to a particular sector will be vigorously supported by owners of capital in that sector even if the shock in question reduces aggregate real income. By focusing on the short-run it is possible to examine both the **efficiency** and **income distribution** consequences of a particular shock.

The second time period implicit in the analysis is the medium term, when interprovincial supplies of labour and capital can respond to differentials in factor returns but long-run constraints on balance of payments closure have not been completed.

## CONCLUSIONS

In this paper we described the economics context for the

General Equilibrium Model of the Alberta economy, as well as the most important characteristics of the Alberta forest sector. For successful analyses it is crucial the model captures the relevant features of the economy, at the same time abstracting from irrelevant complexities. The relevant features of the Alberta economy are its specialization in energy and agriculture, its volatility and its openness in flows of goods and services and factor inputs. To this we should add the considerable weight of the Government sector and government interventions, particularly in rent collection mechanisms in the energy sector, and in efforts to diversify the economy.

The forest sector is characterized by an abundance of uncommitted timber, mostly hardwoods, small importance in the economy but good prospects for growth, and public ownership of the forest resource. Those features of the economy and the sector constrain the specification and structure of the model, help define ranges of issues to be investigated, and provide insights into the responses that can be expected from exogenous economic shocks and policy interventions.

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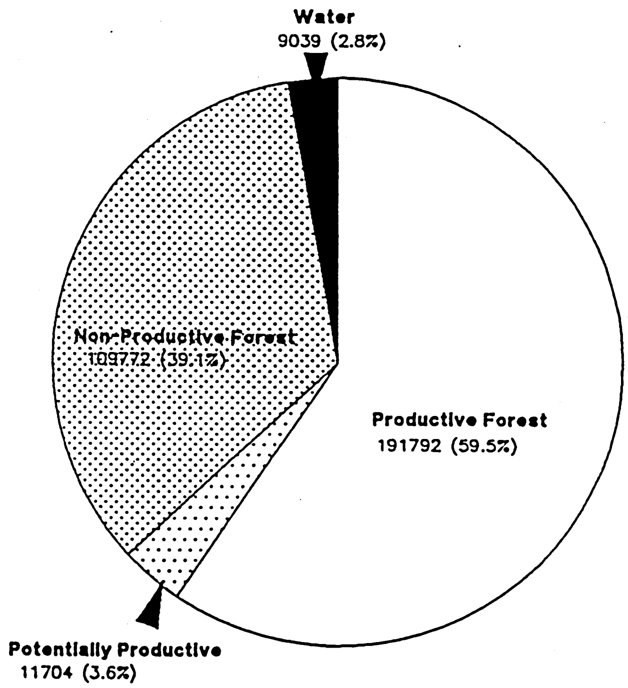
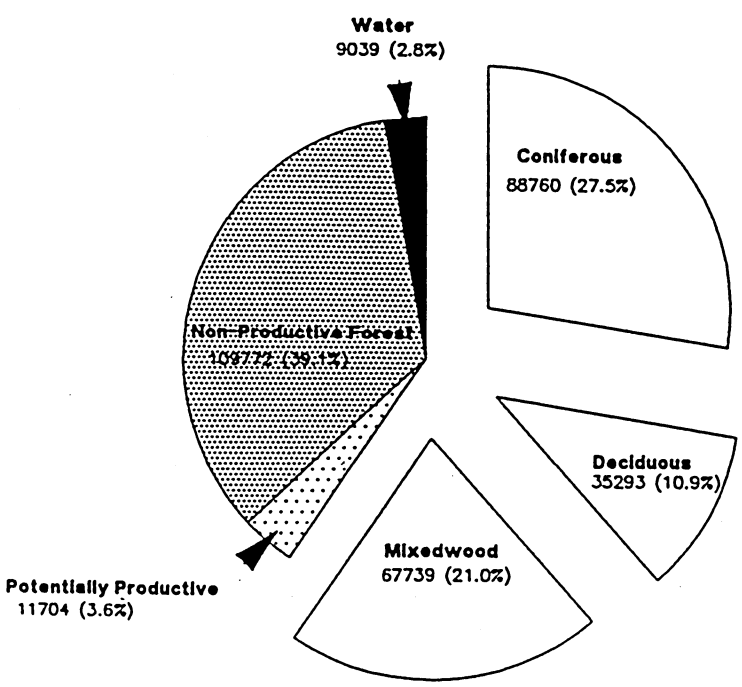
**Figure 1: Total Inventory Area By Land Class**
**Square Kilometres (%)**




Source: Alberta Phase 3 Inventory: An Overview

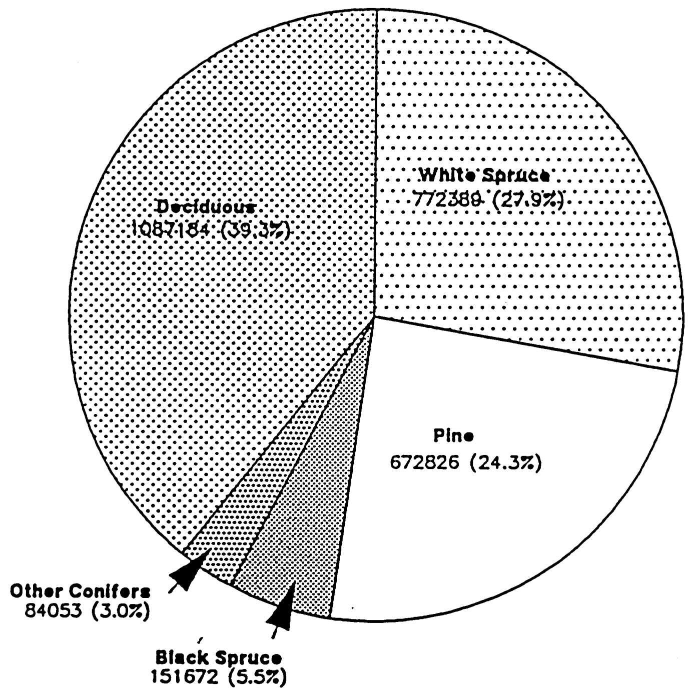
**Figure 2: Total Inventory Area By Land Class And Cover Group**
**Square Kilometres (%)**




Source: Alberta Phase 3 Inventory: An Overview

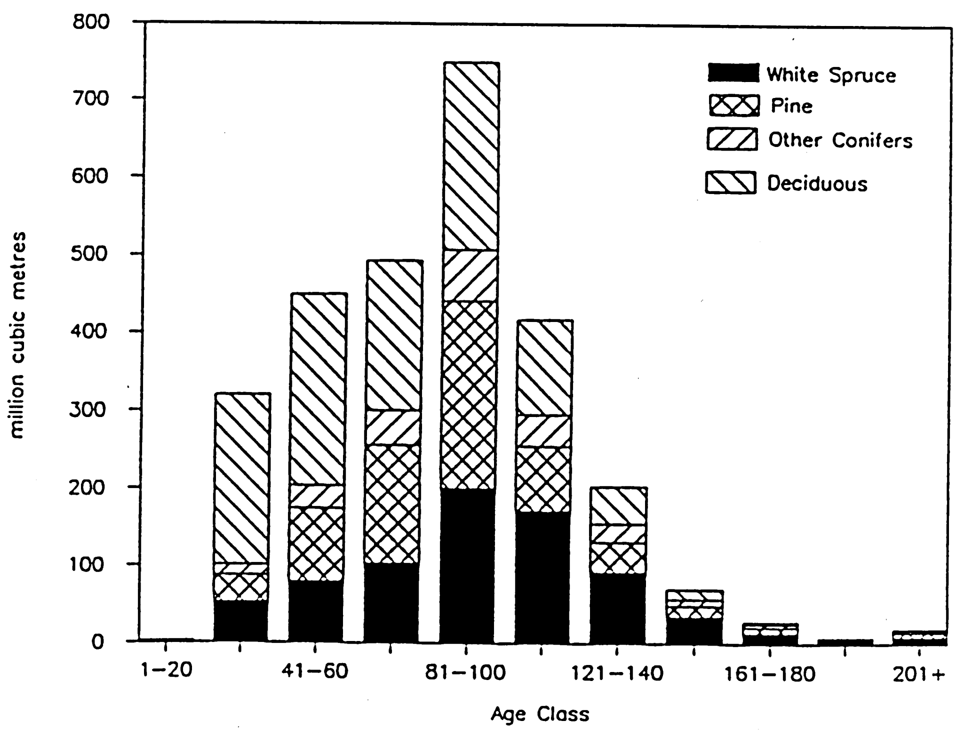
**Figure 3: Volume Distribution By Species**

**Thousand Cubic Metres (%)**



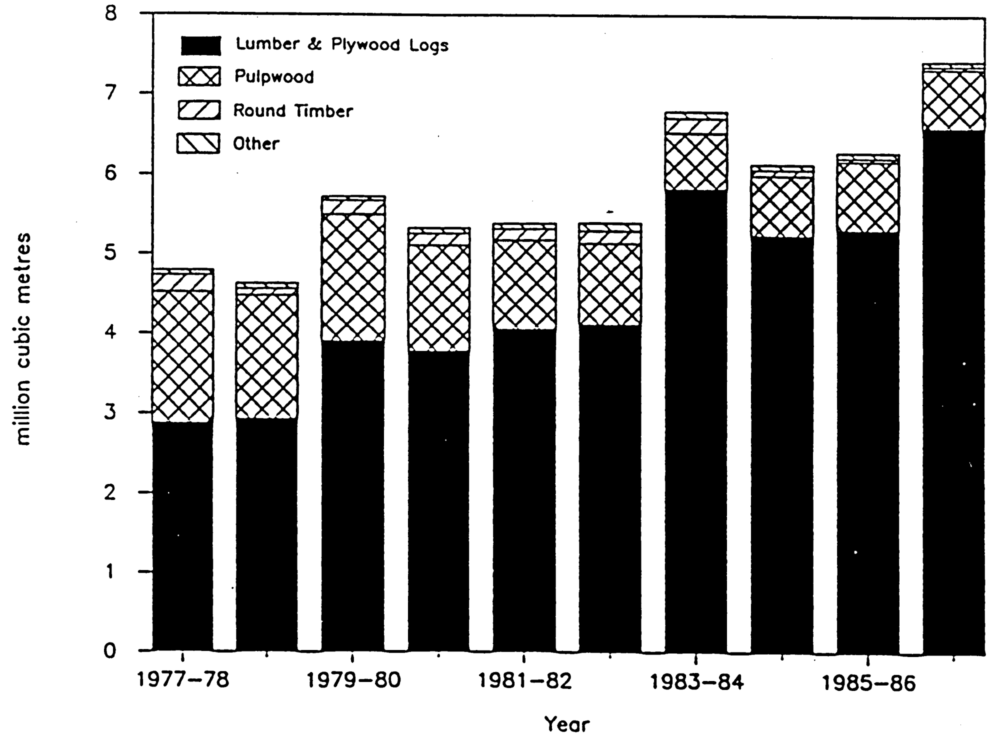

Source: Alberta Phase 3 Inventory: An Overview

**Figure 4: Species Volume By Age Class**



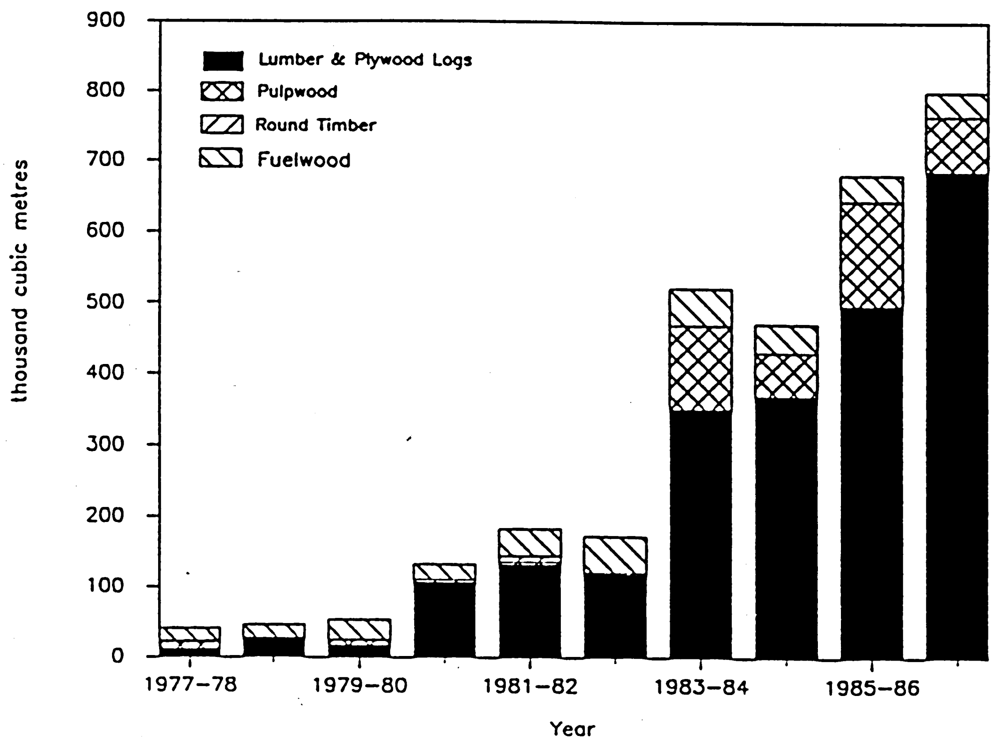

Source: Alberta Phase 3 Inventory: An Overview

**Figure 5: Coniferous Harvest Levels in Alberta**



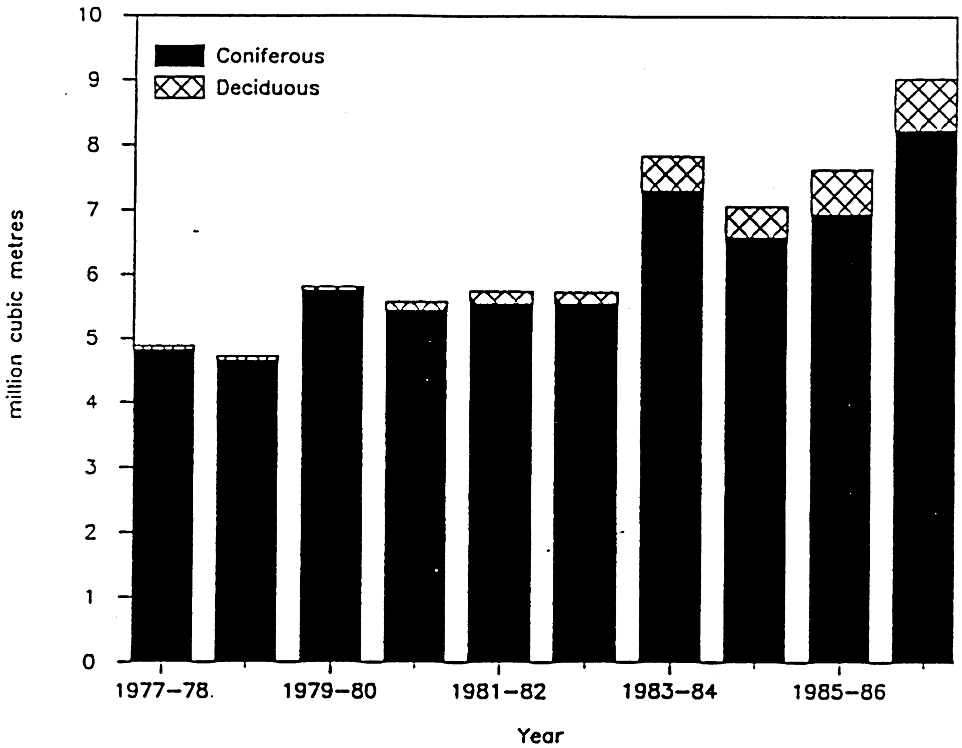

Source: A.F.S.:Ten–year production summary 1988

**Figure 6: Deciduous Harvest Levels in Alberta**



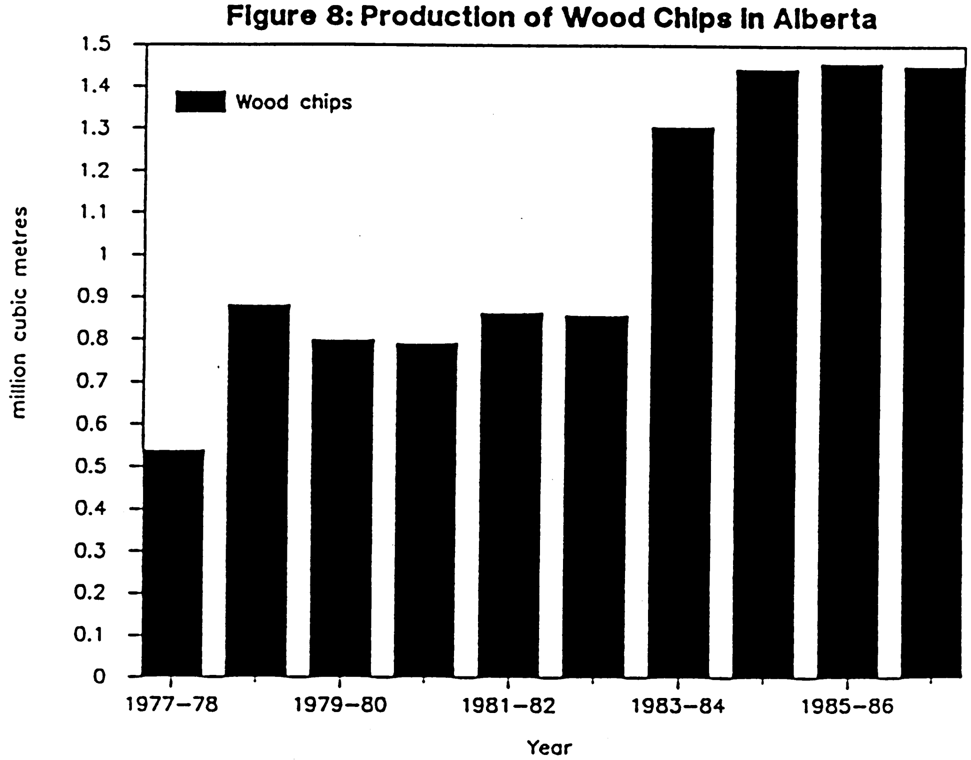

Source: A.F.S.:Ten–year production summary 1988

# Figure 7: Total Harvest Levels in Alberta




Source: A.F.S.:Ten–year production summary 1988

# Figure 8: Production of Wood Chips in Alberta




Source: A.F.S.:Ten–year production summary 1988

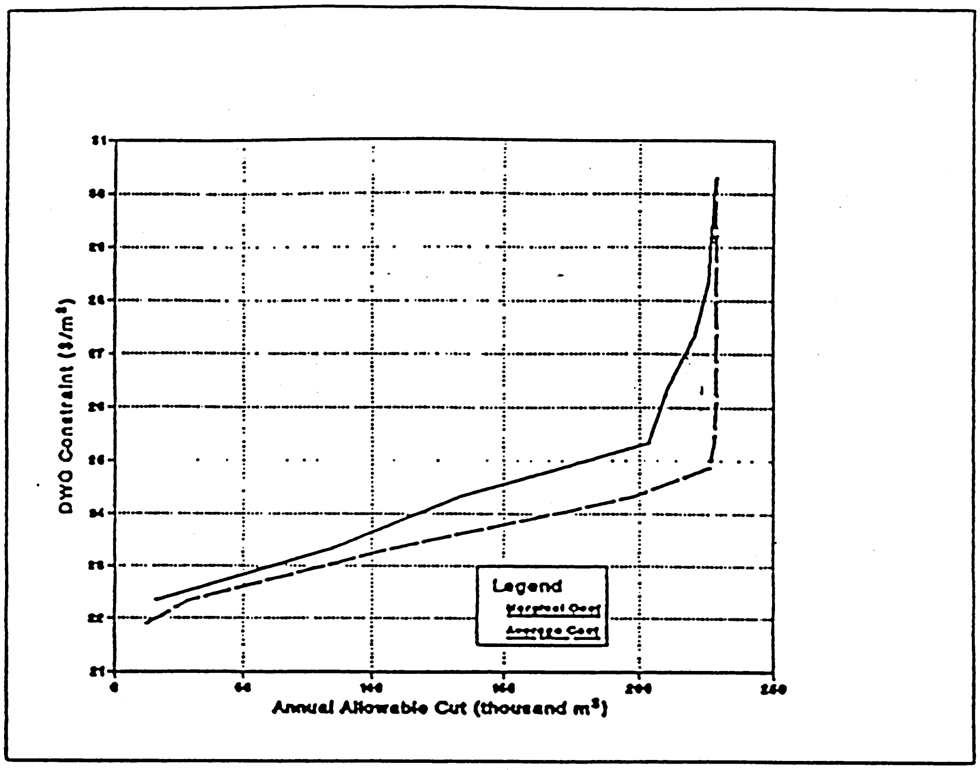



Figure 9 FMU E1 full land base DYNAMIC cost curve

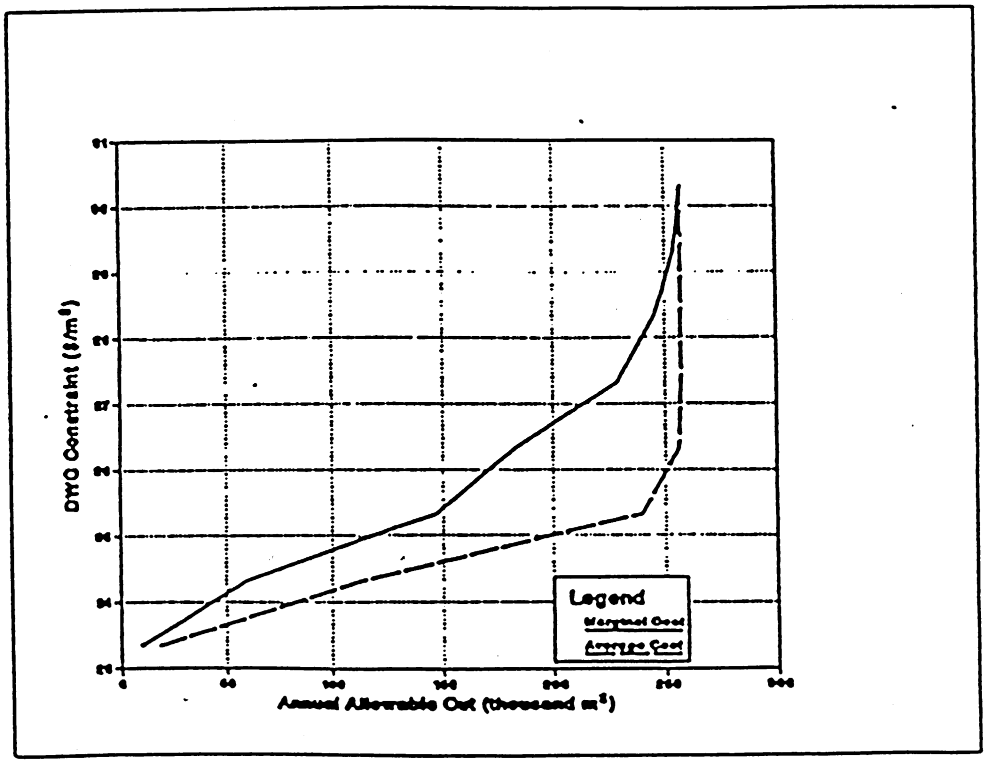



Figure 10 FMU R4 full land base DYNAMIC cost curve

Table 1: A Look At Alberta's Forest Products Industry

| Number of: | 1985 | 1987 | Future (1988-1990) |
|---|---|---|---|
| Sawmills | 171 | 250 | 252 |
| Panel Products | 5 | 7 | 8 |
| Plywood | 3 | 3 | 3 |
| Oriented strand Board | 2 | 3 | 3 |
| Medium Density Fibreboard | 0 | 1 | 1 |
| Fibreboard | 0 | 0 | 1 |
| Pulpmills | 2 | 2 | 5 |
| Bleached Kraft | 2 | 2 | 3 |
| CTMP | 0 | 0 | 2 |
| Construction Paper | 2 | 2 | 2 |
| Treated Wood Products | 9 | 9 | 10 |
| Direct Jobs | 8,766 | 10,000 | 11,820 |
| Revenues Generated ($ millions) | 960 | 1,030 | 2,000 |

Source: Alberta Forestry, Lands and Wildlife
Forest Industry Development Division - October, 1988

Table 2: Destination Of Alberta Produced Forest Products

| PRODUCT | Alberta (%) | Rest of Canada (%) | United States (%) | Other Countries (%) |
|---|---|---|---|---|
| | DESTINATION | | | |
| Dimension Lumber (Mfbm) | 12 | 23 | 65 | 0 |
| Other Lumber (Mfbm) | 13 | 22 | 65 | 0 |
| Softwood Chips (BDU) | 100 | 0 | 0 | 0 |
| Plywood (M sq.ft. 3/8") | 6 | 93 | 1 | 0 |
| Oriented Strandboard (M sq.ft. 3/8") | - | 40 - | 60 | 0 |
| Waferboard (M sq.ft. 3/8") | - | - | - | - |
| Bleached Kraft Pulp (ADMT) | 0 | 0 | 98 | 2 |
| Buidling Paper (Tonnes) | 3 | 94 | 3 | 0 |
| Insulation Board (M sq. ft. 1/2") | 0 | 100 | 0 | 0 |

Source: Directory of Primary Wood-Using Industries in Alberta - 1986