FORESTRY IN ONTARIO:

FROM RESOURCE TO MARKET

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ABSTRACT

This report outlines the major interactions among the resource, harvesting, manufacturing and market sectors of Ontario's forest economy. The influence of economic as well as biological factors upon the available size of the wood resource is demonstrated. The interaction of wood supply with harvesting costs in Ontario is determined and compared to other North American wood-producing regions. The resultant effect of wood costs upon manufacturing is outlined. The size and extent of current markets for Ontario's forest products are also described.

Future trends in all four sectors of Ontario's forest economy are discussed and suggestions are made concerning the possible short-run and long-run effects of alternative forest management strategies. The comparative advantage of Ontario with respect to other wood-producing regions in North America is also discussed, and conclusions are drawn which apply to Ontario and eastern Canada.

The extreme importance of nontimber uses of forest lands is recognized but these are beyond the scope of this report.

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INTRODUCTION

The Great Lakes Forest Research Centre conducts research designed to provide solutions to forest management problems. The bulk of the research focuses on problems of regenerating, growing, protecting and harvesting the forest in order to fulfill Ontario's and Canada's industrial fibre requirements. The economic conditions which govern the viability of the major roundwood users play a unique role in determining the priorities of forest management problems. This study was therefore undertaken to examine the various sectors of Ontario's forest economy in order to isolate those factors which influence the use of roundwood by the major forest industries in Ontario, thereby facilitating effective forest management and research planning.

Figure 1 presents a schematic model of the major segments of Ontario's primary forest industries including paper mills. The economy is divided into four main sectors: the resource sector, the logging sector, the manufacturing sector and the market. This provides a logical breakdown of the forest economy and the outline of the paper follows this form.

The relative sizes of the industry boxes in the manufacturing and market sectors of Figure 1 serve to illustrate the relative importance of the various industries in terms of total value of production and total value of shipments for manufacturing and marketing, respectively. At the primary industry level, the value of production is a good proxy for the volume of wood consumed by industrial users.

As is illustrated by Figure 1, this study is primarily concerned with the influence of the major roundwood users upon the management of the forest resource. For this reason, the furniture industry and miscellaneous other secondary wood-using industries have not been considered. The authors also feel that conditions in the veneer and plywood industry approximate those in the sawmill industry closely enough that separate treatment is unwarranted.[1] Therefore, the pulp and paper and sawmill industries will be the prime focus of this study. Even though this paper is restricted to the industrial forest economy, the authors recognize the importance of alternative uses of the forest resources, and the fact that effective forest management plans must make provision for a variety of alternative uses. However, they also feel that the topic at hand is sufficiently important and complex to warrant exclusive attention in this study.

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[1] In many cases veneer and plywood production and sawmilling are found as integrated operations.

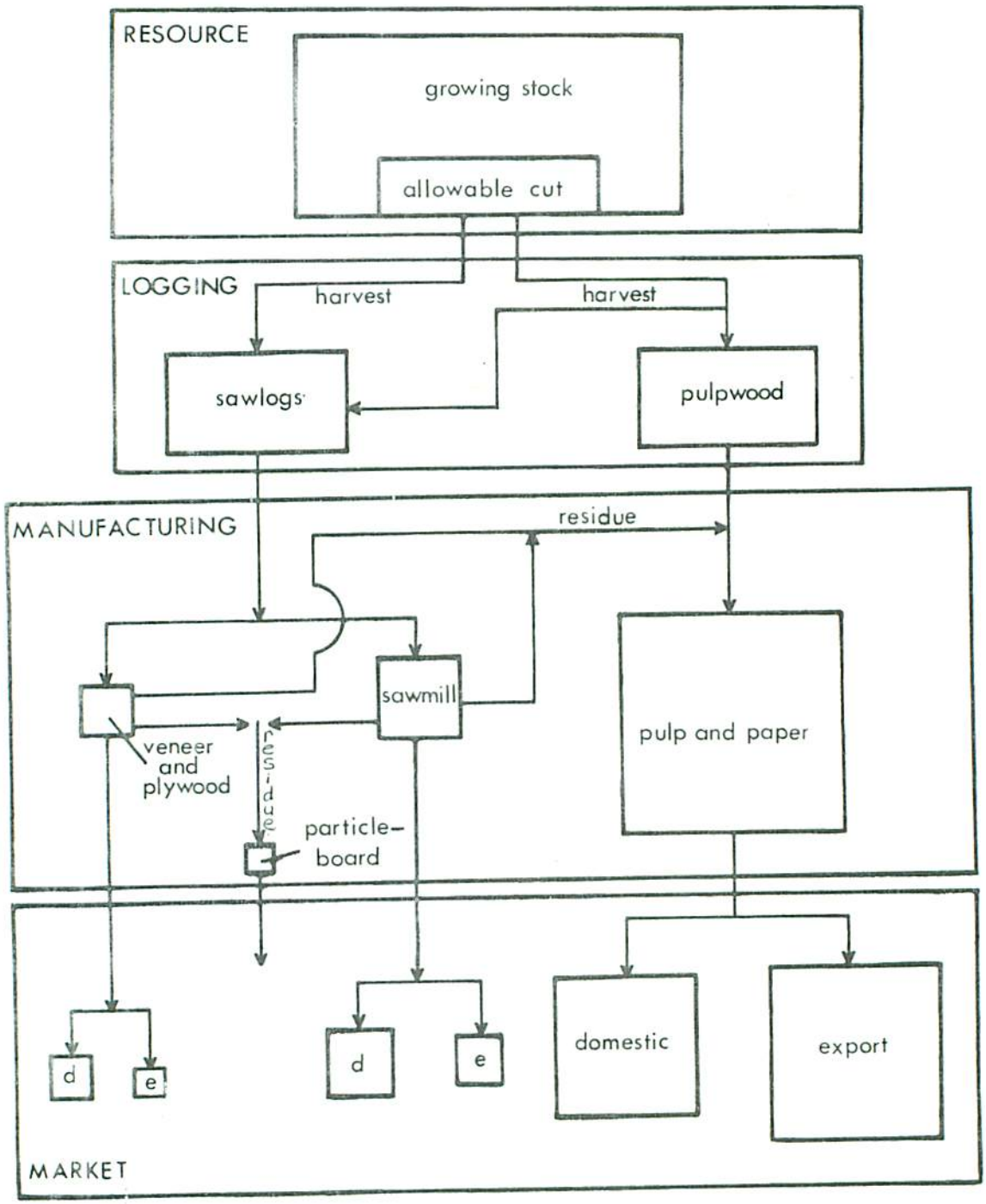

Figure 1. Model of Ontario's primary forest industry.

THE RESOURCE SECTOR

Land Base

The Province of Ontario encompasses 413,000 square miles, of which 310,000 or 75 per cent are forest land (Table 1). One hundred and sixty-four thousand square miles of the forest area are classed as productive, the remaining 146,000 as nonproductive.[2] The forest lands are found within three broad forest regions: Deciduous, Great Lakes-St. Lawrence and Boreal. As seen in Figure 2, the Boreal forest region dominates the land area of Ontario.

The Province has been subdivided into three areas on the basis of accessibility and primary land use: Southern Agricultural, Exploitable forest and Potentially Exploitable forest (Fig. 3, Dixon 1963). The Southern Agricultural area is primarily urban and agricultural land, with just 30 per cent of its total land area classed as forest land. The Exploitable and Potentially Exploitable areas have 97 and 98 per cent, respectively, of their total land areas classed as forest land. The separation of the latter two areas reflects the economic inaccessibility of the Potentially Exploitable forest area owing mainly to existing mill location, current market prices and logging costs. This implies that some changes in the economic parameters governing the forest industry must occur for the Potentially Exploitable area to become operable. Such changes may come in the form of higher product prices or lower transportation costs. While the separation between the two areas is somewhat arbitrary, it would appear to be quite logical at this time. Thus the currently operable productive forest land (82.8 million acres, Table 1) is located in the Exploitable and Southern Agricultural areas.

The ownership of productive forest lands varies between areas, with the entire Potentially Exploitable area owned by the crown and the Exploitable and Southern Agricultural areas having 92.0 and 27.4 per cent, respectively, of their acreage held by the crown. This ownership pattern gives the Provincial government (Ontario Ministry of Natural Resources) direct management responsibility for the vast majority of Ontario's productive forests.[3]

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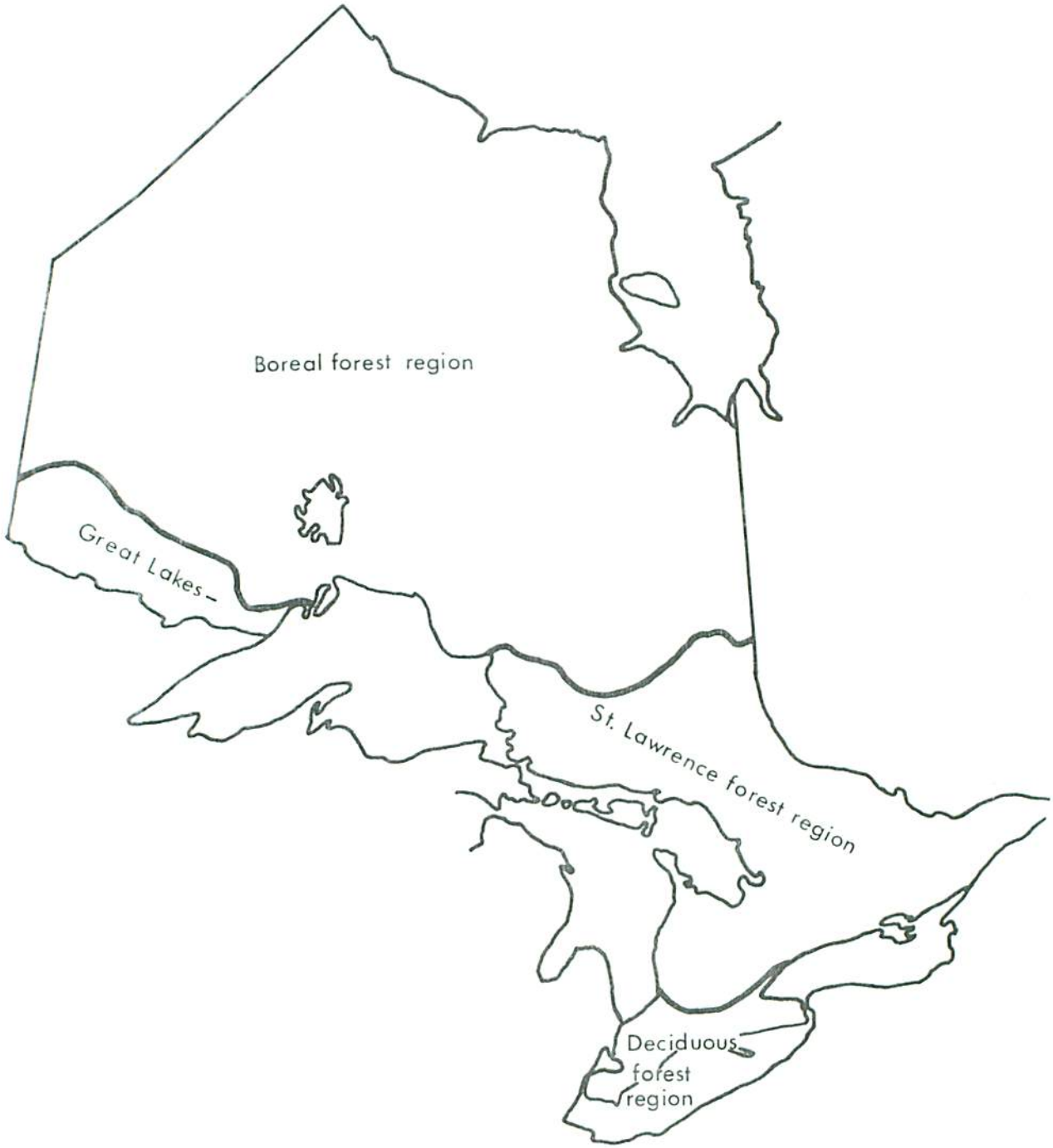
[2] The use of the words "productive" and "nonproductive" refer strictly to the forest production capability of the land and do not reflect its potential for other uses.

[3] The Province also assumes management responsibility on some patent lands under the Woodlands Improvement Act, 1966 and Section 2 of the Forestry Act.



Source: J.S. Rowe, Forest Regions of Canada, 1959.

Figure 2. The forest regions of Ontario.

Source: R.M. Dixon, Forest Resources of Ontario, 1963.

Figure 3. The forest areas of Ontario.

Species Composition

The productive forest lands support 151 billion cubic feet of growing stock. The predominant tree species by volume in Ontario are black spruce (*Picea mariana* [Mill.] B.S.P.) (29.4 per cent), poplar (*Populus* L.) (18.7 per cent), jack pine (*Pinus banksiana* Lamb.) (13.3 per cent), white birch (*Betula papyrifera* Marsh.) (10.8 per cent) and balsam fir (*Abies balsamea* (L.) Mill.) (6.3 per cent) (Table 2). Within the Exploitable and Southern Agricultural areas, the total growing stock is approximately 128.5 billion cubic feet or 86 per cent of the total for all three areas (Table 2). The gross annual allowable cut for Ontario's forests has been estimated at 2.7 billion cubic feet (Dixon 1963) (Table 3). Coniferous species account for approximately 51 per cent of this volume and hardwoods 49 per cent (Dixon 1963). These figures do not represent the actual available wood supply, since they include the stemwood of all living trees 3.6 inches DBH and larger, and tops, stumps and defective wood which are not classed as merchantable material (Ontario Department of Lands and Forests 1967, now the Ontario Ministry of Natural Resources). To obtain an estimate of the annual net merchantable allowable cut, an adjustment was made. The adjusted volumes are presented in Table 4.[4] Black spruce and jack pine are the major coniferous species, amounting to over 40 per cent of the total net merchantable allowable cut. Poplar is the most abundant hardwood species, making up almost 30 per cent of the total allowable cut.

Annual Cut

The annual cut from Ontario was 5.9 million cunits in 1970 (Table 5). Table 5 illustrates the extreme variability of the annual cuts, although from 1961 through 1970 they appear to have stabilized somewhat. The ratio of wood cut on crown land to that cut on patent land is approximately two to one. It appears that the differential is increasing in favour of crown lands. The proportion of the cut coming from crown lands should continue to increase over time, since the primary wood-using industries are located for the most part in northern Ontario where most of the forest lands are under crown ownership. The dense population centres in southern Ontario also place pressure on the forest lands for uses other than that of timber growing. These pressures may cause the withdrawal of lands from timber production, necessitating greater reliance on northern crown lands as the source of fibre.[5]

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[4] It should be noted that the factors used to obtain net merchantable from gross allowable cut are subject to change because of changing management practices or utilization standards. This indicates the rather arbitrary nature of analysis based upon calculated allowable cuts.

[5] Forest lands in northern Ontario are susceptible to the same pressures for alternative uses, especially when they are located near populated areas. However, it seems highly unlikely that these removals will be large enough to have any significant impact on roundwood production.

A typical cutover in the Boreal forest region.

Table 6 presents a breakdown, by species, of wood cut from crown land.[6] In 1971, black spruce and white spruce (*Picea glauca* [Moench] Voss) comprised 52 per cent of the total cut while jack pine accounted for an additional 29 per cent. The conifers accounted for 88 per cent and hardwoods 12 per cent of wood cut from crown land. The overwhelming importance of the conifer species (especially the spruces and jack pine) reflects the relative importance of the pulp and paper industry vis-à-vis other wood-using industries in the Province.

The demand for hardwoods from crown lands has been relatively insignificant (0.5 million cunits *vs* 3.5 million cunits for conifers in 1971).[7] Table 6 shows that the hardwood cut has increased from 217,000 cunits to 478,000 cunits between 1947 and 1971 (i.e., from 7 to 12 per cent of the total cut). As the conifer cut approaches its total annual allowable cut, the use of hardwoods should increase, and probably at a faster rate than was evident in the past. A significant increase in the use of hardwoods, especially poplar and white birch (the most abundant species), will depend largely upon the pulp and paper industry.[8] The necessary technology is already available, as evidenced by the utilization of hardwoods in parts of the United States, notably Minnesota.

Forest Drain

In order to assess the present and future viability of the forest resources in terms of their ability to sustain or increase the current level of economic activity, it is necessary to compare the levels of wood usage and losses, defined as "forest drain", with wood

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[6] A similar species breakdown of wood cut from patent lands is unavailable. Thus the authors have limited their discussion of forest yields primarily to the yield from crown land.

[7] The relatively small proportion of hardwoods in the total cut does not indicate their importance to Ontario's forest industry. There is a strong demand for species such as birch, maple, cherry and ash, and the unit value of sawlog- and veneer-quality hardwoods is far higher than that of softwoods. The volume and value of the hardwoods are further obscured because much of the harvest is obtained from private land, and this portion is not included in the cut figures compiled by the Ontario Ministry of Natural Resources.

[8] Increases in particleboard and plywood output will create a demand for hardwoods, but hardwood consumption by these industries is not nearly as great as consumption by the pulp and paper industry.

supply reflected by the net merchantable annual allowable cut.[9] A more detailed definition of forest drain would be "the annual volume of wood that is removed from the forest resource by insects, disease, and fire, as well as that removed by harvesting (industrial removals), and the additional volume that is lost because of the logging activity itself". Insect, disease and fire losses need little explanation and they are directly reflected in the estimates of allowable cut.[10] Industrial removals reflect the scaled volume removed during logging. Volume losses due to the logging activity are not as straightforward and require further explanation. They may consist of losses of sound, felled timber owing to breakage in felling, excessive trim allowance, cutting inordinately high stumps or large top diameters and leaving sound logs in the woods, or the abandonment of sound, standing timber which is economically inaccessible owing to low stand density, remoteness of the stand or roughness of the terrain (Wilson 1966). All such losses will be reflected in appropriate depletion factors.

Table 7 presents the adjustment of Ontario's actual cut by depletion factors to obtain an estimate of the total drain for 1971. Table 8 shows forest drain as a percentage of annual net merchantable allowable cut by species on crown lands between 1947 and 1971. These estimates are intended to illustrate which species are currently being utilized up to or beyond their capacity and to indicate what has happened over time.

White pine (*Pinus strobus* L.) and red pine (*Pinus resinosa* Ait.) have been and are being utilized at a rate well over that considered optimal for sustained yield. These species have been cut heavily in Ontario since the last half of the nineteenth century, reaching their peak in the period 1875-1920 (Drysdale 1966). The chronic drain of allowable cut has resulted in a decline in their availability and a resultant decline in the red and white pine sawmill industry.

Black and white spruce are the most important commercial species in Ontario. Table 8 indicates that up to 74 per cent of the annual allowable cut for the spruces is being drained. While data are not available on the breakdown between white and black spruce, it seems reasonable to assume that white spruce may be the more heavily utilized species because it grows on more accessible sites and because it has a dual role as a sawlog and pulpwood species.

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[9] Another method would be to compare forest drain with the annual growth (which ultimately determines the level of the harvest). However, where good growth data are lacking and where the forest resource is underdeveloped, an inventory measure of available wood supply is adequate (Wilson 1966).

[10] Insect and fire losses which are inordinately high in any given year may alter this analysis.

The high level of spruce drain should be of major concern to the forest manager for several reasons. The spruce resource has been and still is the backbone of Ontario's pulp and paper industry. In view of the high spruce depletion factors, it would appear that the scope for growth, by expansion of capacity or by the introduction of new mills, is limited if it is to be based on the spruce resource.

An acceptable Provincial aggregate drain may also mask regional overcutting. Since certain areas of the Province have higher concentrations of industrial capacity than others, it is reasonable to expect that in some areas spruce is being drained at a rate up to or above the annual allowable cut. If this supposition is correct, shortages in certain areas will necessitate an expansion of existing resource either by bringing new areas into production or by increasing the productivity of existing areas. Wood transfers from outside the area may also be a viable solution. The alternative to this is a gradual outward shift of the industry from such areas.

Jack pine is the next most important coniferous species in Ontario. From 1947 to 1971, the cut from crown lands has increased from approximately 0.8 million cunits to over 1.2 million (Table 6). This increase can be attributed to the growth of the spruce-jack pine sawmill industry and, more significantly, of the chemical pulp industry. Table 8 indicates that the drain on jack pine is well below its potential at 54 per cent of net merchantable annual allowable cut in 1971. Increased use of this species will be dependent upon increased growth in the sawmill and the kraft pulp industry.

Balsam fir and other conifers make up the remaining 12 per cent of the conifer net merchantable annual allowable cut.[11] The total cut of these species amounted to 134,000 cunits in 1971 (Table 6), which was only 4 per cent of the conifer cut. The most important of these in terms of availability is balsam fir with an annual net merchantable allowable cut of 700,000 cunits. The drain of balsam fir in 1971 was 33 per cent (Table 8). This species is not generally considered of high value in Ontario, although future shortages of other conifers may make it more so. In addition, the percentage of balsam fir growing stock may be increasing, given effective fire control and selective cutting in the central boreal forest regions (MacLean 1960).

Over all, the conifer cut from crown land increased from 3.1 to 3.5 million cunits between 1947 and 1971 (Table 6). The total level of drain of conifers in 1971 was 61 per cent (Table 8). The total annual net merchantable allowable cut is 6.8 million cunits and given the

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[11] Exclusive of the Potentially Exploitable area.

aggregate depletion factor (91 per cent) this represents about 6.2 million cunits of scaled wood. Thus, the conifer cut can increase by about 70 per cent from its present level of 3.5 million cunits.

The drain of hardwoods from crown lands is relatively low (17 per cent in 1971). Given the relatively heavy drain of the desired conifers (especially the spruces), poplar and white birch must be considered major raw material sources of any large-scale expansion of Ontario's forest industry, especially pulp and paper. If such an expansion does not materialize, this resource will probably remain substantially underutilized in the foreseeable future.

The level of drain of the remaining hardwood species is much higher than that of poplar and white birch. Table 8 shows that during the 1960's approximately 75 per cent of the annual allowable cut for yellow birch (*Betula alleghaniensis* Britton [*Betula lutea* Michx. f.]) was utilized and while it decreased in 1969, 1970 and 1971, it remains one of Ontario's most valuable sources of veneer and hardwood lumber. The same effect can be seen with the "other hardwoods", only to a greater extent. These figures obviously reflect a strong demand and the limited supply of high-value, high-quality hardwoods in southern Ontario.

Because of limited data on cuts by species from patent lands, the rate of depletion is rather difficult to estimate. However, taking the actual 1970 cut of 2.0 million cunits (Table 5) and dividing that by an estimated depletion factor of 60 per cent, the estimated drain is 3.3 million cunits. This represents 128 per cent of the net merchantable allowable cut for patent lands, indicating a reduction in growing stock, and would lead one to suspect that the annual cut from patent land is likely to decrease.

Discussion

The foregoing discussion of actual *vs* allowable cut indicates the apparent demand by species in Ontario and illustrates the demand and supply relationship.[12] However, the analysis has several shortcomings. First, the allowable cut formula used by the Province is the French Method of 1883, which is considered conservative by many. Thus, some other formula may yield larger allowable cut estimates. Second, for many species the annual allowable cut estimates become meaningless on a Province-wide basis because of relatively low levels of forest drain. In effect, a situation exists in which large portions of the resource are left relatively untouched because of limited harvesting

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[12] "Supply" in this instance is defined as net merchantable allowable cut.

activity or selection cuts for more highly valued species.

This situation has several important ramifications: (1) The quality of the resource becomes questionable. For instance, the poplar resource may be composed of an inordinately high proportion of over-mature stands which have little commercial value because of high cull factors. This situation will result in a significant devaluation of the stand. (2) Productive sites may be lost because of the high cost of reclaiming them. (3) The lack of intensive management may result in a substantial change in stand composition. This is particularly true for the aspen-birch-spruce-fir type where balsam fir may become a dominant species (MacLean 1960). Because balsam fir is a less desirable species than spruce, the entire stand value may be reduced.

The accuracy of the analysis is also affected by the amount of cutover land which is regenerated. Any calculation of "allowable cut" assumes adequate regeneration of cutover sites. This may not be the case. In Ontario, close to 400,000 acres of crown land are cut over annually. Of this amount, approximately one third is expected to regenerate naturally, one third is artificially regenerated and the remainder is not regenerated (Ontario Department of Lands and Forests 1970). The magnitude of the problem of nonregenerated, cutover land varies from site to site. Inadequate regeneration within a reasonable time period causes, at best, a lengthening of rotation and a resultant decline in allowable cut. At the extreme, nonregenerated sites may be effectively removed from the inventory of productive forest land.

All of these factors have a bearing on the above analysis. The loss of white spruce sites to overabundant balsam fir regeneration, or the loss of black spruce sites as a result of inadequate regeneration make a drain level of nearly 80 per cent for spruce appear much more critical. While poplar appears to represent an abundant, underutilized resource, the overall quality of this resource is suspect.

Several conclusions can be drawn from the above analysis. First, the forest industry's heavy reliance on the coniferous species may be altered in the future because of supply constraints. The apparently inadequate rate of (coniferous) regeneration suggests that this is probable. Second, the hardwoods (especially the intolerant hardwoods) appear to represent the major opportunity for expansion of the industry, in view of the fact that conifer resources are approaching full drain.

If a shift in demand does not occur the forest manager will be under increasing pressure to provide adequate supplies of conifers to ensure the continued viability of an industry that is crucial to the Ontario economy (Hedlin and Menzies 1969).

The forest manager has several options available for increasing wood supply. The first would appear to be an expansion of the existing, economically operable, forest area into the Potentially Exploitable area. This would probably require some type of government subsidy to industry in order to offset inordinately high wood-procurement costs.

Another option open to the forest manager is the shortening of the rotation ages of the coniferous species in order to increase allowable cuts. In the short run this alternative will benefit sawmills by increasing their available wood supply, thus allowing them to take advantage of currently buoyant lumber markets (see The Manufacturing Sector). However, the long-run effect will be to ensure the demise of the industry as it is known today. The long-run effect on the pulp and paper industry will be an increased wood supply in the presently operable area.

A third option is the encouragement and support of closer forest utilization through technological development of more efficient harvesting and/or manufacturing processes (Lassen and Hair 1970). This would include the development of production processes to handle a wider range of species and a wider quality of raw material input. For example, given existing cull and depletion factors, for every 100 cubic feet of gross merchantable allowable cut of spruce standing in the forest, only 60 cubic feet reach the mill.

A fourth option open to the manager is the promotion of more intensive management techniques in order to boost the growing stock. Current management practices may be considered maintenance management on an extensive scale. However, more intensive management, probably on selected, high-productivity sites, with progressively lower levels of management and lower degrees of utilization on the less-productive sites, may prove to be a more efficient alternative strategy for maintaining and increasing the supply of wood fibre.

As an alternative to increasing the supply of conifers, the industry could be encouraged to utilize more hardwoods. This may or may not be a workable alternative depending upon the quality and location of the hardwoods and whether or not the industry can absorb more hardwoods and still maintain a viable product.

None of the above alternatives should be considered in isolation, since all of them are or will be implemented to a greater or lesser degree. However, the effectiveness of the manager's efforts to maintain and increase the wood supply depends to a great extent upon the level of expenditure the government is prepared to make and the effectiveness of that expenditure. The allocation of funds by the government of Ontario is a political and economic decision, outside the direct control of the forest manager. However, achievement of the optimum use of the available funds depends upon the skill of the

researcher and forest manager in developing and implementing efficient forest management techniques. Thus the options available should be assessed and research pursued in order to ensure an adequate raw material supply.

Taylor Drum Colter planting machine working on a typical jack pine cutover

Table 1. Land classification by geographic area and ownership class in Ontario

Classification	Southern Agricultural			Exploitable			Potentially Exploitable			Ontario total		
	crown	patent	total	crown	patent	total	crown	patent	total	crown	patent	total
	('000 acres)											
Productive forest land	1,587	4,206	5,793	70,844	6,156	77,000	22,469	--	22,469	94,900	10,362	105,262
Nonproductive forest land	226	968	1,194	8,522	762	9,284	82,896	--	82,896	91,644	1,730	93,374
Total forest land	1,813	5,174	6,987	79,366	6,918	86,284	105,365	--	105,365	186,544	12,092	198,636
Nonforest land	63	15,959	16,022	675	1,627	2,302	1,670	--	1,670	2,408	17,586	19,994
Total land area	1,876	21,133	23,009	80,041	8,545	88,586	107,035	--	107,035	188,952	29,678	218,630
Water	6,956	--	6,956	27,762	--	27,762	8,991	--	8,991	43,709	--	43,709
Total area	8,832	21,133	29,965	107,803	8,545	116,348	116,026	--	116,026	232,661	29,678	262,339

Source: Dixon, R. M. 1963.

Table 2. Primary growing stock by species, ownership and area in Ontario

Species	Ontario			Southern Agricultural			Exploitable			Potentially Exploitable
	crown	patent	total	crown	patent	total	crown	patent	total	total
	('000 cu. ft)									
White pine	3,227,820	668,933	3,896,753	192,851	303,128	495,979	3,034,969	365,805	3,400,774	--
Red pine	1,014,842	106,599	1,121,441	18,260	25,173	43,433	996,583	81,426	1,078,008	--
Jack pine	19,557,452	567,109	20,124,561	384	662	1,046	16,562,670	566,447	17,129,117	2,994,398
White spruce	7,335,088	563,926	7,899,014	66,488	104,190	170,678	6,668,421	1,459,736	7,128,148	600,188
Black spruce	42,694,292	1,571,172	44,265,464	7,322	12,322	19,644	29,439,901	1,558,850	30,998,751	13,247,069
Balsam fir	8,663,936	760,519	9,424,455	107,265	172,101	279,366	7,481,216	588,418	8,069,634	1,075,455
Other conifers	3,446,027	1,187,901	4,633,928	212,758	691,516	904,274	3,141,248	496,385	3,637,633	92,021
Total conifers	85,939,457	5,426,159	91,365,616	605,328	1,309,092	1,914,420	67,324,998	4,117,067	71,442,065	18,009,131
Sugar maple	4,115,585	2,291,033	6,406,618	439,992	1,147,575	1,587,567	3,675,593	1,143,458	4,819,051	--
Yellow birch	3,383,637	802,261	4,185,898	90,795	186,995	277,790	3,292,842	615,266	3,908,108	--
White birch	15,029,736	1,185,615	16,215,351	117,068	239,892	356,960	13,412,541	945,723	14,358,264	1,500,127
Poplar	25,130,391	2,952,641	28,083,032	334,611	676,952	1,011,563	22,085,570	2,275,689	24,361,259	2,710,210
Other hardwoods	1,459,638	2,967,304	4,426,942	574,169	2,465,321	3,009,490	915,469	501,983	1,417,452	--
Total hardwoods	49,118,987	10,198,854	59,317,841	1,526,635	4,716,735	6,243,370	43,383,015	5,482,119	48,864,134	4,210,337
Total	135,058,444	15,625,013	150,683,457	2,131,963	6,025,827	8,157,790	110,707,013	9,599,186	120,306,199	22,219,468

Source: Dixon, R. M. 1963.

Table 3. Gross annual allowable cut by species, ownership class and area in Ontario

Species	Ontario			Southern Agricultural			Exploitable			Pctentially Exploitable
	crown	patent	total	crown	patent	total	crown	patent	total	total
	('000 cu. ft)									
White pine	32,254	13,737	45,991	128	6,315	6,443	32,126	7,422	39,548	--
Red pine	13,871	3,216	17,087	3	787	790	13,868	2,430	16,298	--
Jack pine	413,427	16,332	429,759	12	31	43	332,903	16,301	349,204	80,512
White spruce	105,027	12,711	117,738	86	3,256	3,342	93,680	9,454	103,134	11,261
Black spruce	551,794	21,943	573,737	40	257	297	344,768	21,686	366,454	206,985
Balsam fir	139,345	19,912	159,257	137	5,378	5,515	116,803	14,534	131,337	22,405
Other conifers	23,383	18,972	42,355	324	11,941	12,265	21,600	7,031	28,631	1,460
Total conifers	1,279,101	106,823	1,385,924	730	27,965	28,695	955,748	78,858	1,034,606	322,623
Sugar maple	30,476	42,957	73,433	1,870	21,517	23,387	28,606	21,440	50,046	--
Yellow birch	37,858	12,534	50,392	507	2,922	3,429	37,351	9,613	46,964	--
White birch	263,626	31,863	295,489	148	7,497	7,645	228,482	24,367	252,849	34,995
Poplar	702,313	140,798	843,111	636	42,309	42,945	600,642	98,489	699,131	101,035
Other hardwoods	9,919	72,274	82,193	2,119	59,655	61,774	7,801	12,617	20,418	--
Total hardwoods	1,044,192	300,426	1,344,618	5,280	133,900	139,180	902,882	166,526	1,069,408	136,030
Total, all species	2,323,293	407,249	2,730,542	6,010	161,865	167,875	1,858,630	245,384	2,104,014	458,653

Source: Dixon, R. M. 1963.

Table 4. Net merchantable annual allowable cut on crown land by species and area in Ontario

Species	Tops,[a] stumps and cull factor (%)	Ontario[b]		Southern Agricultural[b]		Exploitable[b]		Potentially Exploitable[b]	
		Vol ('000 cu. ft)	%	Vol ('000 cu. ft)	%	Vol ('000 cu. ft)	%	Vol ('000 cu. ft)	%
White pine	40	19,352	1.2	77	2.4	19,276	1.5	--	--
Red pine	40	8,323	0.5	2	0.1	8,321	0.7	--	--
Jack pine	20	330,742	20.9	10	0.3	266,322	21.1	64,409	18.5
White spruce	30	73,519	4.6	60	1.9	65,576	5.2	7,883	2.3
Black spruce	30	386,256	24.4	28	0.9	241,338	19.2	144,890	41.6
Balsam fir	40	83,607	5.3	82	2.6	70,082	5.6	42,049	12.1
Other conifers	40	14,030	0.9	194	6.0	12,960	1.0	876	0.3
Total conifers		915,828	57.9	453	14.1	683,875	54.3	260,107	74.6
Sugar maple	50	15,238	1.0	935	29.1	14,303	1.1	--	--
Yellow birch	50	18,929	1.2	254	7.9	18,676	1.5	--	--
White birch	35	171,357	10.8	96	3.0	148,513	11.8	22,747	6.6
Poplar	35	456,503	28.8	413	12.9	390,417	31.0	65,673	18.8
Other hardwoods	50	4,960	0.3	1,060	33.0	3,901	0.3	--	--
Total hardwoods		666,987	42.1	2,758	85.9	575,810	45.7	88,420	25.4
Total, all species		1,582,815	100.0	3,211	100.0	1,259,685	100.0	348,527	100.0

Source: [a] Ont. Dep. Lands Forests, 1966. Report of the Forestry Study Unit.

[b] Dixon, R. M. 1963. Forest resources of Ontario. Ont. Dep. Lands Forests.

Table 5. Wood cut in Ontario 1947-1970

Year	All lands[a]	Crown land[b]	Patent land[c]
	('000 Cunits)		
1947	5935	3648	2287
1948	5652	3326	2327
1949	4555	2507	2048
1950	5163	3668	1496
1951	6004	4613	1391
1952	5643	3218	2425
1953	5042	3151	1890
1954	4973	3348	1625
1955	5420	3799	1621
1956	5474	3951	1523
1957	3650	3368	2282
1958	4835	2956	1879
1959	5315	3481	1834
1960	5413	3471	1942
1961	4940	3256	1684
1962	5194	3459	1736
1963	5351	3601	1750
1964	5698	3762	1936
1965	5671	3858	1813
1966	6009	4235	1775
1967	6071	4359	1711
1968	5910	3961	1948
1969	6216	4304	1913
1970	5933	3958	1975

Source: [a] D.B.S. Canadian forestry statistics. Cat. No. 25-202.

[b] Ont. Dep. Lands Forests. Annual report of the Minister.

[c] The patent land figures are residuals, derived by subtracting crown land figures from figures for all lands.

Table 6. Wood cut on crown land in Ontario by species, 1947-1971

Fiscal year ending Mar 31	Black and white spruce	Jack pine	Red and white pine	Balsam fir	Other conifers	Total conifers	Poplar	White birch	Yellow birch	Other hardwoods	Total hardwoods	Total, all species
						('000 cunits)						
1947	1,886	790	256	116	71	3,118	142			75[a]	217	3,335
1948	2,087	855	263	150	74	3,430	116			102[a]	218	3,648
1949	1,747	819	305	138	80	3,088	137			101[a]	238	3,326
1950	1,343	582	256	94	63	2,341	60			106[a]	166	2,507
1951	2,073	856	306	125	75	3,435	125			107[a]	232	3,668
1952	2,518	1,089	343	161	139	4,249	220			144[a]	364	4,613
1953	1,559	816	346	119	94	2,935	143			142[a]	285	3,218
1954	1,634	755	276	132	68	2,866	158			127[a]	285	3,151
1955	1,757	818	305	141	77	3,097	130			121[a]	251	3,348
1956	2,053	867	337	144	83	3,484	169			149[a]	315	3,799
1957	2,074	1,000	323	138	79	3,614	192	13	63	68	336	3,950
1958	1,800	782	252	122	57	3,014	202	15	72	66	354	3,368
1959	1,575	684	216	110	57	2,643	177	13	62	61	314	2,956
1960	1,869	782	285	131	62	3,123	198	14	74	73	358	3,481
1961	1,911	769	242	48	147	3,115	184	18	70	85	356	3,471
1962	1,781	709	229	123	37	2,879	213	18	69	78	377	3,256
1963	1,823	785	280	112	28	3,028	229	23	88	91	431	3,459
1964	1,838	822	309	102	37	3,108	260	37	90	106	493	3,601
1965	1,950	896	321	115	39	3,320	207	33	90	112	442	3,762
1966	1,979	994	315	100	34	3,422	212	32	83	110	436	3,858
1967	2,235	1,118	280	114	35	3,792	213	30	74	127	443	4,235
1968	2,206	1,079	313	145	42	3,785	277	57	84	157	574	4,359
1969	1,990	1,142	220	122	31	3,504	225	34	58	140	457	3,961
1970	2,214	1,214	189	137	28	3,782	250	22	46	203	522	4,304
1971	2,039	1,153	154	115	19	3,480	213	17	41	207	478	3,958

[a] Includes yellow and white birch.
Source: Statistics 1972.

Table 7. Estimated per cent depletion of net merchantable annual allowable cut from crown lands in the Exploitable and Southern Agricultural areas of Ontario, 1971

Species	Net merchantable allowable cut on crown land[a] ('000 cunits)	Actual cut[b] ('000 cunits)	Depletion factor[c] (%)	Forest drain ('000 cunits)	Forest drain as percentage of net merchantable allowable cut
Spruce	3,070	2,039	90	2,266	74
Jack pine	2,663	1,153	80	1,441	54
White and red pine	277	154	80	193	70
Balsam fir	701	115	50	230	33
Other conifers	131	19	50	38	29
Total conifers	6,843	3,480	91	4,168	61
Poplar	3,907	213	40	533	14
White birch	1,486	17	40	43	3
Yellow birch	190	41	60	68	36
Other hardwoods	203	207	60	345	170
Total hardwoods	5,785	478	53	989	17
Total, all species	12,628	3,958	77	5,517	41

[a] See Table 5.

[b] See Table 6.

[c] Source: D. Hughes, Ont. Minist. Nat. Res. (personal communication).

Table 8. Forest drain as a percentage of net merchantable annual allowable cut from crown land in the Exploitable and Southern Agricultural areas of Ontario, 1947-1971

	Spruce	Jack pine	Red and white pine	Balsam fir	Other conifers	Total conifers	Poplar	White birch	Yellow birch	Other hardwoods	Total hardwoods	Total
1947	68	37	116	33	108	55	9	a	a	a	a	a
1948	76	40	119	43	113	61	7	a	a	a	a	a
1949	63	38	138	39	122	55	9	a	a	a	a	a
1950	49	27	116	27	96	56	4	a	a	a	a	a
1951	75	40	138	36	114	61	8	a	a	a	a	a
1952	91	51	155	46	212	77	14	a	a	a	a	a
1953	56	38	156	34	143	53	9	a	a	a	a	a
1954	59	35	125	38	104	51	10	a	a	a	a	a
1955	64	38	138	40	117	55	8	a	a	a	a	a
1956	74	41	152	41	126	62	10	a	a	a	a	a
1957	75	47	146	39	120	64	8	2	55	56	13	41
1958	65	37	114	35	87	53	13	3	63	54	13	35
1959	57	32	98	31	87	47	11	2	55	50	12	31
1960	68	37	129	37	94	56	13	2	65	60	13	36
1961	69	36	109	14	225	55	12	3	62	70	13	36
1962	65	33	104	35	56	51	14	3	61	64	14	34
1963	66	37	127	32	43	53	15	4	77	75	16	36
1964	67	39	140	29	56	55	17	6	79	87	19	33
1965	71	42	145	33	59	58	13	6	79	92	16	39
1966	72	47	142	29	52	60	14	5	73	90	16	40
1967	81	53	127	33	53	66	14	5	65	104	16	43
1968	80	51	141	41	64	67	18	10	74	129	21	46
1969	72	54	99	35	47	62	14	6	51	115	17	41
1970	80	57	85	39	43	66	16	4	41	167	19	45
1971	74	54	70	33	29	61	14	3	36	170	17	41

[a] Estimates not available.

THE LOGGING SECTOR[13]

The past 25 years have witnessed something of a technological revolution in logging in eastern Canada. In the late 1940's the chain-saw was introduced to logging. The late 1950's and early 1960's saw the horse being replaced by the articulated-frame wheeled skidder. From the early 1960's to the present, industry has pushed for the development of fully mechanized logging systems. The old cut-and-pile method has largely been displaced by shortwood, tree-length and full-tree systems geared to the more mechanized state of the art. Transportation of round-wood has similarly undergone drastic changes. The traditional water drive is being replaced by truck hauls.

Mechanization

The changes in logging techniques reflect the reaction of the industry to a relatively labour-intensive operation. In 1970 wages represented 38.4 per cent of the value of production in logging (Table 9), compared with 24.7 and 19.4 per cent, respectively, for the sawmill and pulp and paper industries. The high wage bill reflects a number of conditions which favour the substitution of capital for labour: 1) Because labour costs have risen sharply since the war[14], one logical way to decrease wood costs is to increase labour productivity. The vehicle used to achieve this has been mechanization. 2) The post-World War II emergence of the southern United States and British Columbia as major pulp and paper producing areas has exerted tremendous competitive pressures on the eastern Canadian mills. In terms of production, the growth area has been kraft pulp. The high wood input into kraft pulp[15] and the relatively lower wood procurement costs in British Columbia and the southern United States appear to be major factors in the growth in these areas. This advantage appears to have largely offset the eastern Canadian producers' traditional advantages, namely their close proximity to the major United States markets and extensive wood supplies. While all areas have attempted to offset rising wood procurement costs, a reduction is most critical for eastern Canada.

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[13] Reference is made here only to the logging sector as identified for national accounting purposes, which excludes the value added by farmers and small woodlot owners. Their value of shipments is identified only as a portion of purchased wood.

[14] The rise in woods-labour wage rates can be attributed to a shrinking rural labour supply and to unionization.

[15] Kraft pulp uses about 2 cords of wood per ton of pulp, compared to newsprint which requires only 1 cord per ton of paper.

Veneer logs being loaded for transportation to the mill

Labour Productivity

The effect of increased mechanization on labour productivity is evidenced by a 15 per cent drop in man-hours paid compared with a 19 per cent rise in real output from 1963 to 1970 (Table 10) in the logging activity. Labour input per unit of output has dropped by 29 per cent in this period, while wage rates have risen by 67 per cent. The result of these changes was a 19 per cent increase in labour costs per unit of output (Table 10). The effect of increased labour productivity and wage rates on labour cost per cunit is reflected in Figure 4(A). Figures 4(B) and 4(C) show that a similar situation exists in the rest of Canada. These figures indicate that mechanization has been quite effective in controlling labour costs, especially through 1969.[16]

Factor Costs

Ultimately the competitive position of the industry depends on the total cost per cunit of output. Table 9 reflects the magnitude and percentage share of the various factor inputs in logging compared with total value of production. Between 1963 and 1970, the percentage shares of the factor input have remained relatively stable. Labour costs are the largest component, followed by materials used in production. Surplus, the third largest input, is composed of costs of capital, miscellaneous business costs and return to capital (profit). In the case of logging, surplus primarily reflects cost of capital.

With integrated ownership of logging by sawmill and pulp and paper establishments, firms generally transfer logs from their logging establishments to the mill at cost; thus little profit is credited at the logging level.

Table 11 compares the cost of the factor inputs per unit of output with the per unit value of production. Between 1963 and 1970 the per unit value of production rose by 24 per cent. During the same period labour costs rose by 19 per cent. On a relative basis, wages rose the least of the three major factor inputs. Figure 5 illustrates this much more clearly by comparing changes per unit value of production with changes in per unit factor costs from 1963 to 1970. Of the three factor inputs shown, materials and surplus have had a relatively greater impact than wages on the increase in value of production. From Table 9, it appears that the relative shares of the factor inputs have remained nearly constant; however, a gradual shift is taking place with labour cost assuming a smaller proportion of the total

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[16] In 1970, total production fell off quite drastically. As a result the figures on labour costs rose and productivity fell. Whether this reflects a long-run period of increasing costs or is simply a short-run bearish market remains to be seen.

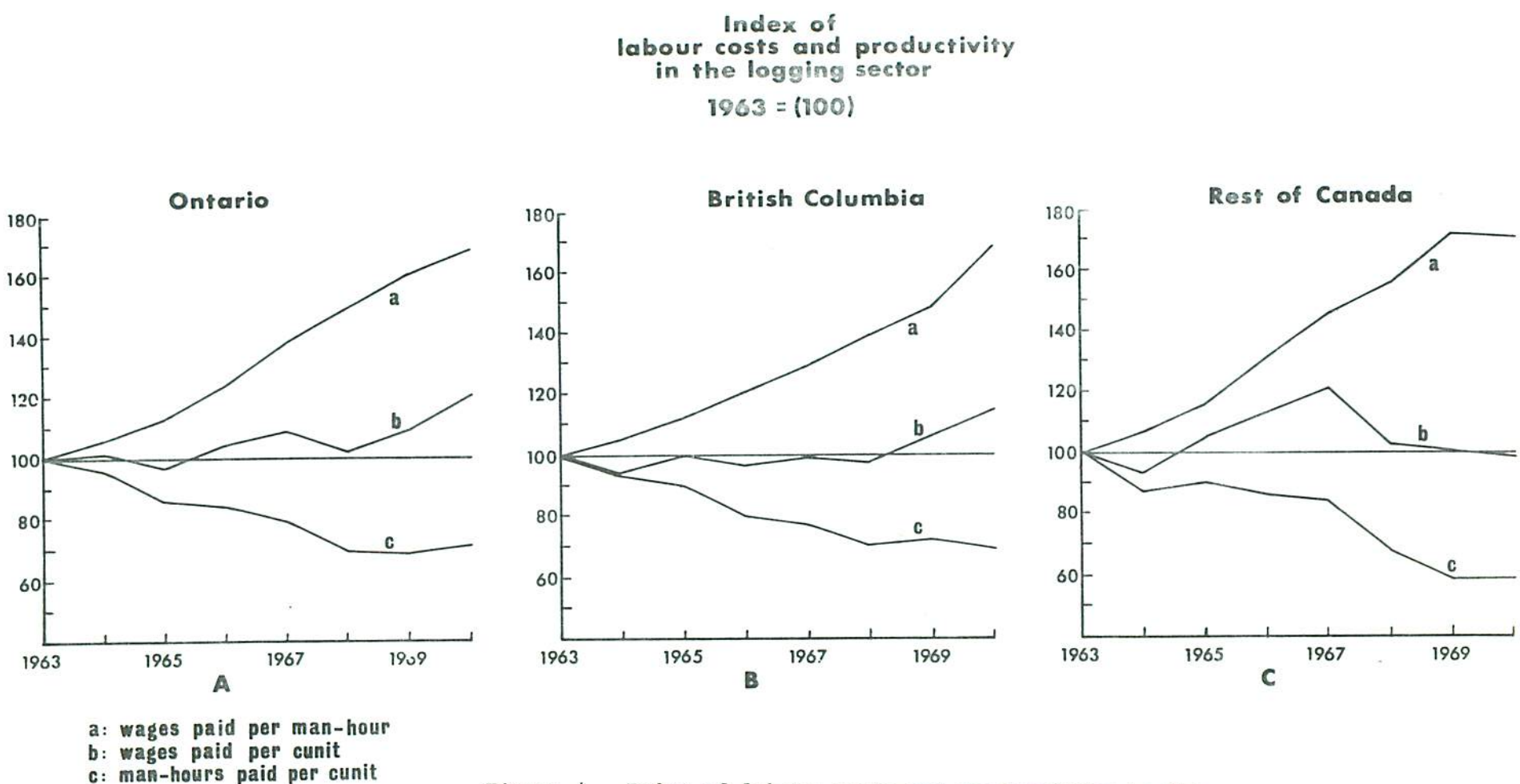

Figure 4. Index of labour costs and productivity in the logging sector, 1963-1970.

A. Ontario

B. British Columbia

C. Rest of Canada

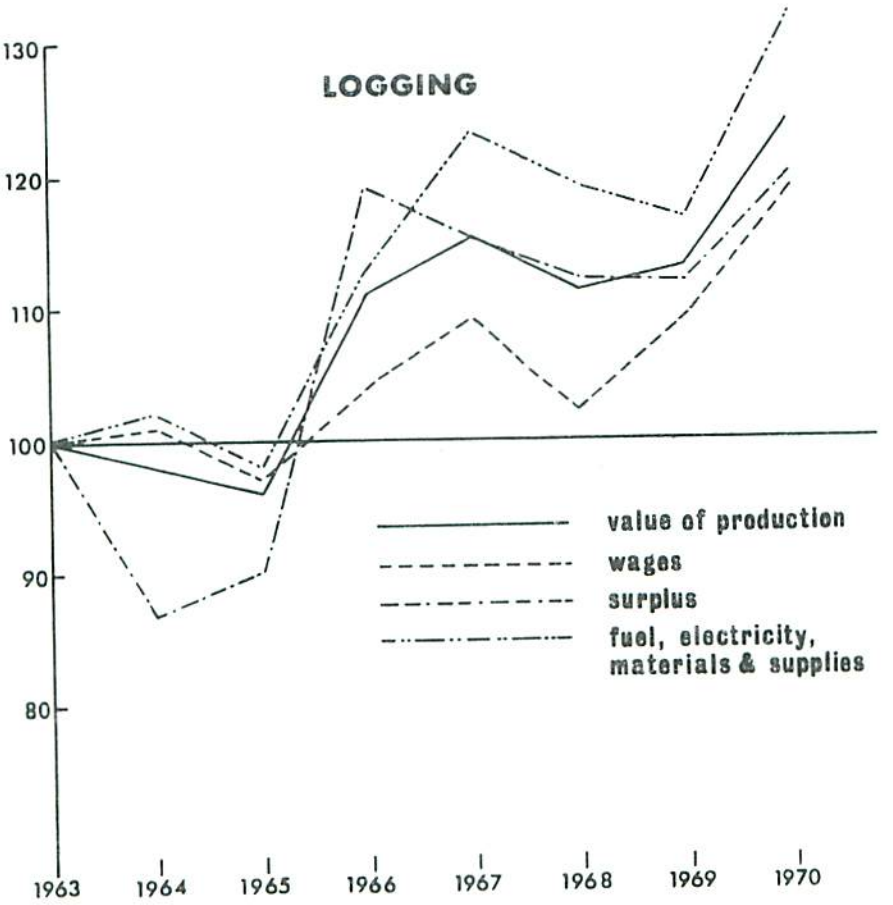

Figure 5. Index of factor costs and value of production per unit of output in Ontario logging, 1963-1970 (1963 = 100).

input cost. This result is to be expected, given the increase in mechanization and the fact that mechanization is effective in increasing labour productivity. But it is also evident that wood costs continue to rise even when labour costs are controlled.

In summary, it appears evident that the industry has been able to increase labour productivity by means of increased mechanization. To the extent that labour supply shortages are a problem, this is encouraging. However, whether the substitution of capital for labour will result in decreased wood costs remains a key question, the answer to which is beyond the scope of this paper. But it should be kept in mind that the increasing use of capital involves increasing costs of capital and these may more than offset any labour cost savings.

Table 9. Total cost of the factor inputs in the logging activity and their percentage of total value of production in Ontario, 1963-1970

Year	Total value of production[a] ($'000)	Wages ($'000)	(%)	Fuel and electricity ($'000)	(%)	Materials Used: Stumpage and royalties ($'000)	(%)	Operating and maintenance ($'000)	(%)	Amount paid to others for work done ($'000)	(%)	Total ($'000)	(%)	Surplus[b] ($'000)	(%)
1963	119,264	47,629	39.9	4,739	4.0	10,436	8.8	13,733	11.5	12,578	10.5	36,747	30.8	30,149	25.3
1964	121,725	50,338	41.4	5,031	4.1	12,143	10.0	13,051	10.7	13,934	11.5	39,128	32.1	27,229	22.4
1965	132,434	53,650	40.5	5,319	4.0	12,048	9.1	14,792	11.2	15,025	11.3	41,865	31.6	31,600	23.9
1966	159,894	59,723	37.4	6,129	3.8	13,227	8.3	20,413	12.8	16,945	10.6	50,585	31.6	43,457	27.2
1967	162,880	61,359	37.7	6,009	3.7	13,479	8.3	22,734	13.4	18,265	11.2	54,478	33.5	41,034	25.2
1968	157,495	57,918	36.8	5,770	3.7	12,851	8.2	22,553	14.3	17,759	11.3	53,163	33.8	40,645	25.8
1969	174,587	67,403	38.6	6,722	3.9	14,253	8.2	23,166	13.3	19,002	10.9	56,421	32.3	44,041	25.2
1970	175,567	67,433	38.4	5,224	3.0	11,625	6.6	31,811[c]	18.1	16,452	9.4	59,888	34.1	43,022	24.5

[a] Value of production = value of shipments ± inventory changes - purchased wood.

[b] Includes
i) cost of capital
ii) profits
iii) taxes
iv) miscellaneous business expenses, i.e., insurance, advertising, etc.

[c] Includes all materials and supplies used by small establishments (For explanation see Statistics Canada. 1970. Logging. Cat. No. 25-201, 1970.)

Source: D.B.S. 1963-1969. Logging. Cat. No. 25-201.

Table 10. Labour cost and productivity in Ontario: logging activity, 1963-1970[a]

Year	Production of own manufacture[b] (cunits)	Man-hours paid ('000 hr)	Wages paid per hour ($)	Man-hours paid per cunit (hr)	Wages paid per cunit ($)
1963	3,536,503	23,186	2.05	6.56	13.47
1964	3,682,992	23,250	2.17	6.31	13.67
1965	4,109,407	23,244	2.31	5.66	13.06
1966	4,263,919	23,384	2.55	5.48	14.01
1967	4,184,340	21,718	2.83	5.19	14.66
1968	4,224,276	19,005	3.05	4.50	13.71
1969	4,588,321	20,500	3.29	4.47	14.69
1970	4,202,956	19,637	3.43	4.67	16.04
		Indexes of labour costs and productivity			
1963	100	100	100	100	100
1964	104	100	106	96	101
1965	116	100	113	86	97
1966	121	101	124	84	104
1967	118	94	138	79	109
1968	119	82	149	69	102
1969	130	88	160	68	109
1970	119	85	167	71	119

[a] Source: D.B.S. 1963-1969. Logging. Cat. No. 25-201.

[b] Does not include wood purchased and resold.

Table 11. Cost of the factor inputs per unit of output (cunits) in the logging activity in Ontario, 1963-1970

Year	Value of production[a] per unit of output	Wages per unit of output	Fuel and electricity per unit of output	Materials Used: Stumpage and royalties per unit of output	Materials Used: Operating and maintenance per unit of output	Materials Used: Amount paid for work done per unit of output	Materials Used: Total materials per unit of output	Surplus[b] per unit of output
			(A) Factor inputs per unit of output ($)/cunit					
1963	33.72	13.47	1.34	2.75	3.88	3.56	10.39	8.53
1964	33.05	13.67	1.37	3.30	3.54	3.78	10.62	7.39
1965	32.23	13.06	1.29	2.93	3.60	3.66	10.19	7.68
1966	37.50	14.01	1.44	3.10	4.79	3.97	11.86	10.19
1967	38.93	14.66	1.44	3.22	5.43	4.37	13.02	9.81
1968	37.28	13.71	1.37	3.04	5.34	4.20	12.59	9.62
1969	38.05	14.69	1.47	3.11	5.05	4.14	12.30	9.60
1970	41.77	16.04	1.24	2.77	7.57	3.91	14.25	10.24
			(B) Index of factor inputs per unit of output					
1963	100	100	100	100	100	100	100	100
1964	98	101	102	120	91	106	102	87
1965	96	97	96	107	93	103	98	90
1966	111	104	107	113	123	112	114	119
1967	115	109	107	117	140	123	125	115
1968	111	102	102	111	138	118	121	112
1969	113	109	110	113	130	116	118	112
1970	124	119	93	101	195	110	147	120

[a] See footnote a, Table 9.

[b] See footnote b, Table 9.

Source: D.B.S. 1963-1969. Logging. Cat. No. 25-201.

THE MANUFACTURING SECTOR

Manufacturing is concerned with transforming fixed and variable inputs into primary and secondary outputs which are different in form and utility from all the parent inputs. This section will deal specifically with the manufacturing process, including the products, the materials used, and productivity of the firms manufacturing lumber and pulp and paper products in Ontario.

Ontario's sawmills produce a variety of sawn products including red pine, white pine, jack pine, and spruce lumber of varying construction and interior grades, along with hardwood lumber tailored to the furniture industry. The production of sawmill residues in the form of wood chips and shavings has also become profitable.

Pulp and paper mills manufacture a variety of consumer and industrial products. In Ontario, newsprint accounts for the major portion of output. Wood pulp, paper boards, fine and book paper, wrapping paper, and tissue and sanitary paper also contribute significantly to the total output of Ontario's pulp and paper mills. Table 12 shows the tonnages of these products manufactured in Ontario between 1961 and 1970.

Sawmill Industry

Ontario's sawmill industry is characterized by a large number of relatively small production units. In 1970, there were 292 sawmills in Ontario (D.B.S., Table 13) with an average yearly output of 2.5 million board feet.[17] However, a trend to larger and fewer production units is evidenced by a 32 per cent decline in the number of mills and a doubling of average mill output since 1961 (D.B.S. Cat. No. 35-204). Table 14 gives a more historic picture of Ontario's lumber production and shows an increase from 673 MMBF in 1946 to 849 MMBF in 1970. A quick inspection reveals a long-run upward trend with large internal fluctuations from year to year, ranging from a low of 583 MMBF to a high of 910 MMBF.

Pulp and Paper Industry

Pulp and paper mills, on the other hand, are large production complexes with fixed investments totalling millions of dollars. They are characterized by high capital-to-labour ratios[18] in relation to

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[17] *Cf.* an average yearly mill production in British Columbia of 18.7 MMBF in 1970.

[18] Estimates show that the capital-to-labour ratio in the pulp and paper industry is $225,000 per employee, which is the second highest of all industries in Canada (D.W.K. Boulter, Economist, Dep. Reg. Econ. Expansion, personal communication).

other forest products industries. In 1970 Ontario's 36 pulp and paper mills employed 17,832 workers and generated a value added of $343,000,000 (D.B.S. Cat. No. 36-204). This compares with 292 sawmills employing 4,677 workers and generating a value added of $47,000,000 (D.B.S. Cat. No. 35-204).

Ontario's pulp mills produced an estimated 3.97 million tons of wood pulp in 1970, of which groundwood pulp was the largest component at 1.76 million tons (Table 15). Over the period 1950-1970 Ontario's pulp production increased by 73 per cent (Table 15). This compares with a national increase of 116 per cent (Table 16), showing Ontario's growth to be considerably below the national figure. Tables 15 and 16 also show that sulphate pulp (kraft) has been the major growth product and that Ontario has fallen behind the national growth rate in sulphate pulp production. This can be attributed largely to the higher wood costs of eastern Canada. The sulphate pulping process requires a wood input of 1.88-2.05 cords per ton of finished wood pulp while the groundwood process requires only .95 cords per ton of output (D.B.S. Cat. No. 36-204). As a result British Columbia has an advantage over Ontario with respect to sulphate pulp production because its wood costs are much lower. For instance wood cost per cord in British Columbia averaged $21.38 in 1970 compared with $32.82 in Ontario (D.B.S. Cat. No. 36-204). For residues, which make up over half of British Columbia's wood input, the cost was $18.63 per equivalent cord in British Columbia compared to $29.24 in Ontario (D.B.S. Cat. No. 36-204). Such differentials help explain the rapid growth of sulphate pulp output in British Columbia and the much slower increases in Ontario and eastern Canada.

Industry Interactions

The sawmills and pulp and paper mills in Ontario interact both as competitors and as complementors. Competition arises over the use of the sawlog resources found on the timber limits of pulp companies which in the past could effectively exclude lumber companies from access to the sawlogs on vast areas. This problem is partially offset by third-party agreements which give lumber companies access to the sawlog materials on pulp company limits. Another solution has been the entry of pulp companies into the sawmill business. This latter trend should become more of a norm, especially since wood chips and shavings have become an important roundwood substitute. Both industries benefit because sawmill residues are relatively cheap inputs to the pulp mill and they provide the sawmill with a supplementary source of revenue.

Shipments of wood chips from sawmills (Table 13) and the consumption of wood chips by pulp and paper mills (Table 17) show well over a threefold increase in both sawmill wood chip shipments and pulp mill chip consumption between 1961 and 1970. While it is expected that

the pulp and paper industry will continue to use these products, it is important to note the limited availability of wood chips from sawmills in Ontario. The increase from 1961 to 1970 in wood chip production came in the face of only a 32.3 per cent increase in volume of wood sawn. Firms are converting from burning and dumping residue to chipping. This conversion has allowed the rapid increase in wood chip production and shipment. Assuming that the volume of wood chips produced per MBF of lumber is nearly constant, increases in the availability of wood chips from sawmills in Ontario are ultimately limited to increases in lumber output.

Production Characteristics

As stated earlier, manufacturing is a transformation process where inputs are combined to produce a new product which is unlike its parent inputs in form and utility. A further look at this definition with respect to both sawmills and pulp and paper mills will help to identify the characteristics and suggest future developments of both industries.

In any manufacturing process the variable raw material inputs undergo the greatest physical transformation. Variability in the input mix permits greater flexibility in the production process and greater control over the products manufactured. Generally the more technical substitutability among inputs and the greater the degree of transformation in the manufacturing process, the less the grade of raw materials affects the quality of final products.

The sawmill industry does not enjoy great technical substitutability among inputs nor does the final product undergo a great degree of transformation. Like most industries, sawmills cannot control the quality of raw material available in the market. But unlike most industrial products, the grade of lumber produced is determined to a great extent by aesthetics or visible defects, e.g., the number of knots, worm holes, discolouration from stain, etc. The manufacturer is constrained by the fact that knots, worm holes and a multitude of other quality factors are inherent in the growing tree and he cannot compensate for these factors through transformation of the raw materials. This severely limits the ability of the sawmill operator to control the grade of his final output. As a corollary, the cost of producing rough lumber may be exactly the same for similar logs of different grades, while the resultant lumber varies widely in value. This is contrary to the normal production process where higher-quality products cost more to manufacture.

Compared with lumber production, the manufacture of pulp and paper products requires a great deal of technological sophistication. Final products are obtained only after the variable inputs are both

Ontario veneer on its way to market.

physically and chemically transformed. Unlike sawmilling, the shape and size of the standing tree are insignificant parameters in the production process. In pulp and paper manufacturing the quality of the final product can be controlled and quality is directly related to cost of production. This again differs from sawmilling.

Another major difference between sawmills and pulp and paper mills is reflected in their respective levels of capital formation and use. A recent study (Manning and Thorburn 1971) suggests that "in comparison with wood products industry, the pulp and paper industry is progressive", i.e., about five times more technological change has occurred in the pulp and paper industry than in the sawmill industry between 1940 and 1960. However, the report suggests that during the same period other major industries were more innovative than pulp and paper firms.

In summary, sawmilling may be described as a technologically naive production process, being constrained mainly by the physical characteristics of the raw material input (roundwood). On the other hand, pulp and paper production may be described as a technologically sophisticated process, being constrained more by the availability and age of mills and machinery than by the physical characteristics of the raw material inputs.

Production Costs

Tables 18-19 present a breakdown of the factor inputs which go to make up value of production in Ontario's sawmills and pulp and paper mills. Over the period 1961-1970 it appears that a shift has occurred in the relative importance of the production cost components. In sawmilling the total value of production has risen by nearly 72 per cent, while wages and surplus have risen by over 100 per cent and wood cost by 64 per cent. Wood costs are the largest single input, but their relative importance is declining slightly. Nearly the same shift in relative shares is observed for pulp and paper mills (Table 19). During the same period total value of production rose by 53 per cent, while wages and other materials rose by 74 and 65 per cent, respectively. When pulpwood and wood residues are combined the share of the total cost of fibre input into the pulp and paper industry remains relatively constant over the period.[19]

The above changes reflect several factors common to both industries. First, as pointed out in the Logging Sector, logging costs

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[19] When total wood cost is broken down it is interesting to note the rise in residue as an input.

have been kept to a minimum, thus contributing to the relatively low increases in wood cost to the industry. Second, hourly wages have risen by 76 and 60 per cent for sawmills and pulp and paper mills, respectively, and total man-hours paid have risen by 18 and 8 per cent, respectively, while real output per man-hour paid (productivity) has risen by only 32 and 20 per cent, respectively (Tables 20-21).

Profitability

A bleak profit picture for pulp and paper mills contrasts with the relatively optimistic financial record for sawmills. Surplus figures in Tables 18-19 show the difference.[20] In sawmills, surplus is growing 1.75 times faster than value of production while in pulp and paper mills it is growing only .6 times as fast. The buoyant surplus for sawmills results from the strong market demand for lumber products. The demand displays an inelastic character which allows price rises[21] large enough to offset cost increases. This, combined with the trend to fewer and larger mills, demonstrates that the industry is becoming more efficient and better able to remain viable.

For the pulp and paper industry, the decline in the relative share of surplus, especially since 1966, reflects a general downturn in the profitability of the industry. The downturn is characteristic of the total industry, and especially of the firms located in eastern Canada.

Figure 6 illustrates the main reason for the downturn. The trends of the major factor inputs show that since 1961 the industry has experienced a cost-price squeeze. Over the period, per unit price rose by almost 17 per cent (D.B.S. Cat. No. 62-002). At the same time labour costs rose by 33 per cent per dollar of real output, other material costs by 26 per cent and wood costs by nearly 18 per cent (Fig. 6). These three factors represent approximately 66 per cent of the total value of production (Table 19). In retrospect, wood costs per dollar of real output have risen the least of the three main factor costs, and if wood costs are broken down into roundwood and wood residues, the roundwood costs per dollar of real output have risen by only 8.9 per cent while residue has risen by nearly 200 per cent. Figure 7

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[20] Surplus contains both profit and the cost of capital. Increases in the cost of capital between 1961 and 1970 cause profits to be somewhat lower than surplus would indicate.

[21] A composite, industrial selling-price index for lumber has risen by 23 per cent between 1961 and 1969.

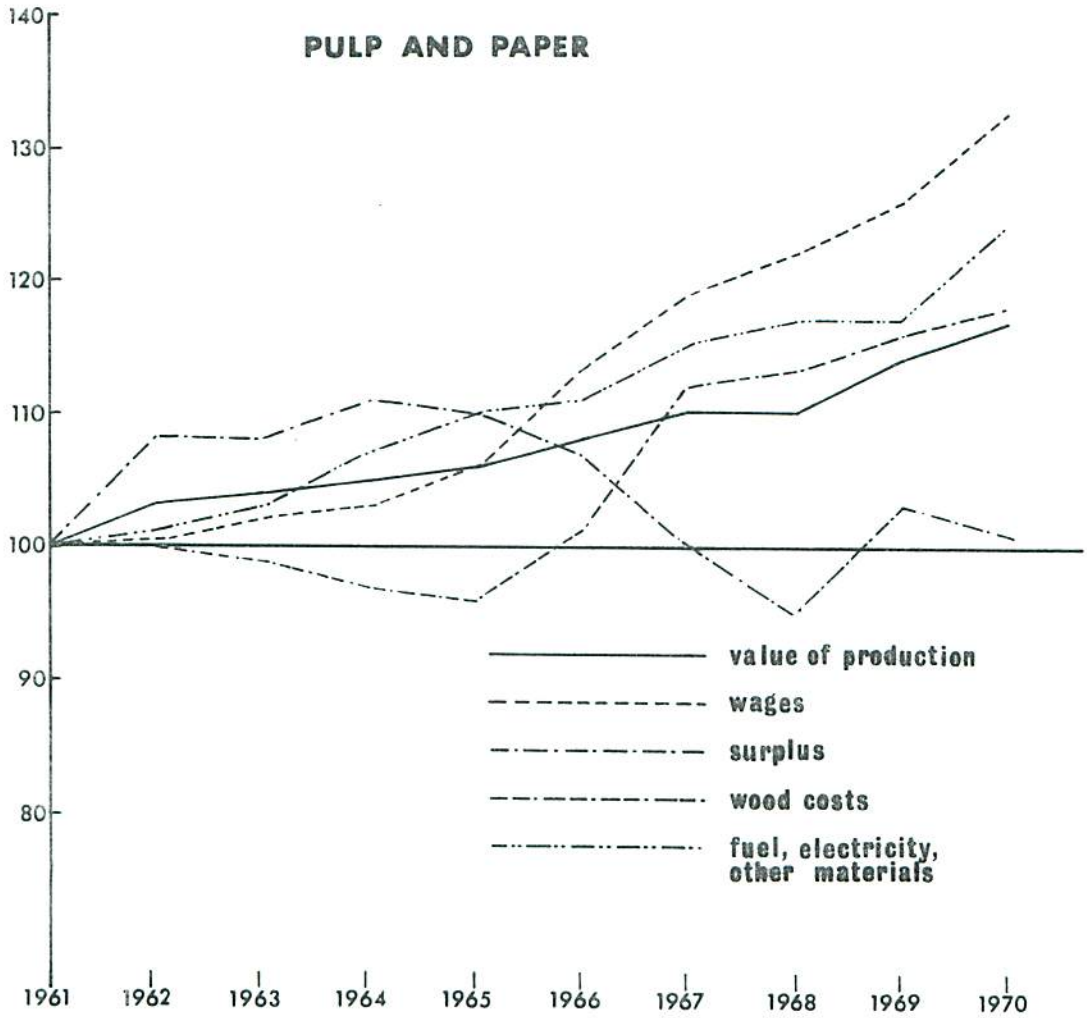

Figure 6. Index of factor costs and value of production per dollar of real output in Ontario pulp and paper industry, 1961-1970 (1961 = 100).

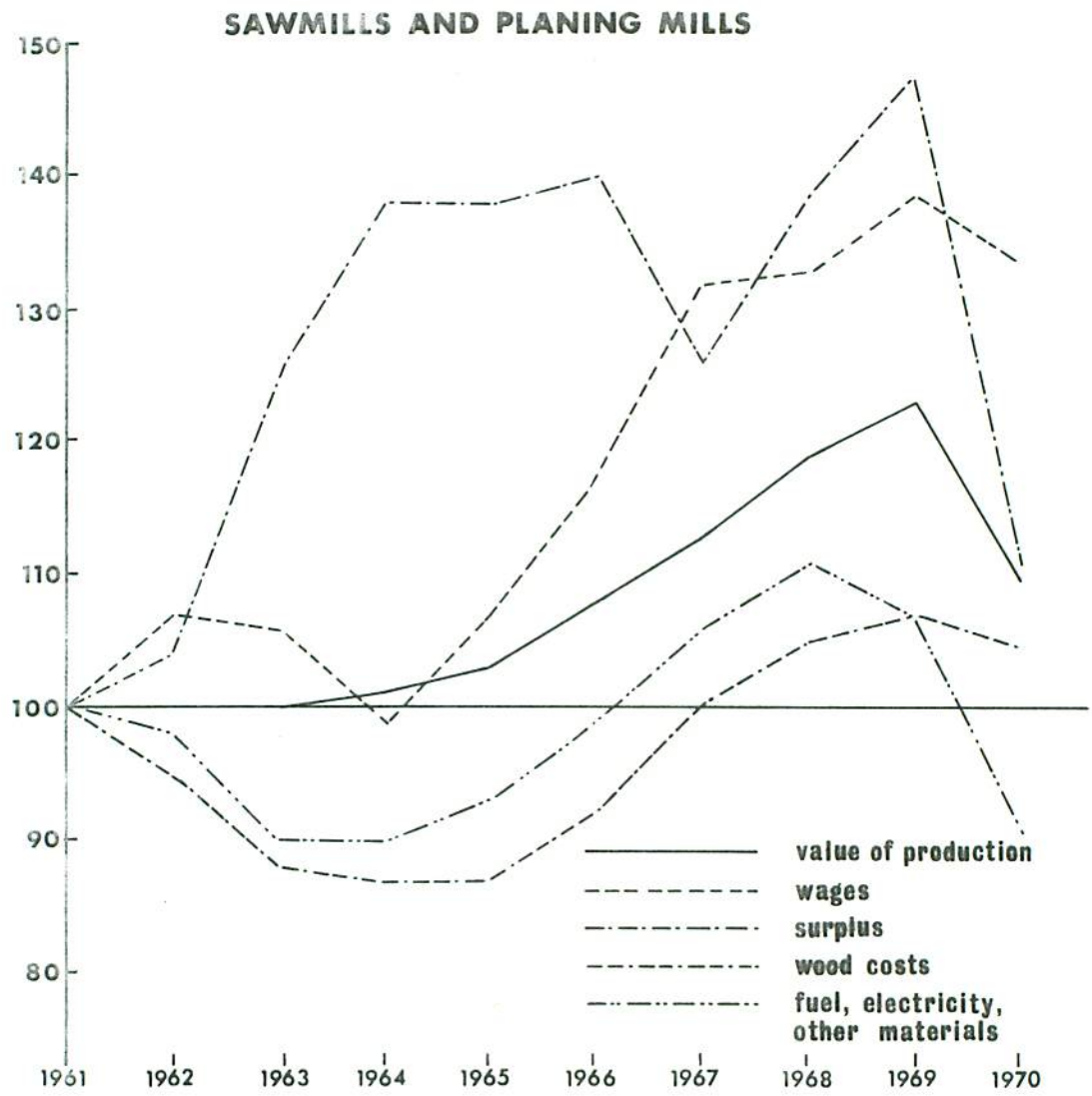

Figure 7. Index of factor costs and value of production per dollar of real output in Ontario sawmills and planing mills, 1961-1970 (1961 = 100).

shows that the roundwood cost for sawmills has risen by only 5 per cent, again indicating that both industries have been successful in controlling wood costs.[22]

Labour costs and "other materials" appear to be the major contributers to the cost-price squeeze in the pulp and paper industry. Table 21 shows that between 1961 and 1970 wages rose by 60 per cent per hour worked, while real output per man-hour paid rose by only 20 per cent, resulting in a 33 per cent increase (Fig. 6) in labour cost per dollar of real output. Over the same period costs of "other materials" per unit of output increased by 26 per cent. The lack of increase in labour productivity can be explained in part by Ontario's older plant capital, the large number of groundwood mills which are more labour intensive, and the fact that mills have been operating at substantially less than full capacity.

Recent depressed markets have helped generate the cost-price squeeze. The situation is complicated even further by newer mills which add extra capacity to an already overcapitalized industry. The net effect is felt more by the older mills in eastern Canada. In addition, high wood costs are pushing up production costs for these mills in comparison to those in western Canada and the southern United States.

In contrast, Ontario's sawmills have avoided the cost-price squeeze mainly because of buoyant markets which allow large enough price rises to overcome factor cost increases. But the above analysis is distinctly short run in outlook.

The long-run character of these industries appears to be somewhat different. While the pulp and paper industry, especially in the production of newsprint, is currently struggling with short-run production and market problems, the flexibility of the production process and the ubiquitousness of the required raw materials[23] plus the forecast growth in demand for most paper products indicate that this industry should outlast its current difficulties.

Long-run growth in the sawmill industry would appear to be somewhat restricted. The lack of suitable long-run sawlog supplies

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[22] As noted earlier the logging sector does not reflect profit because in integrated operations the profits or losses are shifted to manufacturing. Therefore, if a profit were involved in the price of wood as it is in the price of all other materials, these percentages would be slightly higher.

[23] Cellulose fibre, whether from woody or nonwoody plants, is the basic raw material.

puts an ultimate constraint on the industry's growth. Evidence also suggests that the long-run supply of lumber is decreasing and becoming more inelastic both in the United States (Zivnuska 1955) and in Canada.[24] The correspondingly rapid rise in lumber prices will help initiate the substitution of cheaper building products for high-priced lumber (Pap. Trade J. 1971; Swan 1971).[25] To date, rising lumber prices have offset rising factor costs and allowed the industry to remain profitable.

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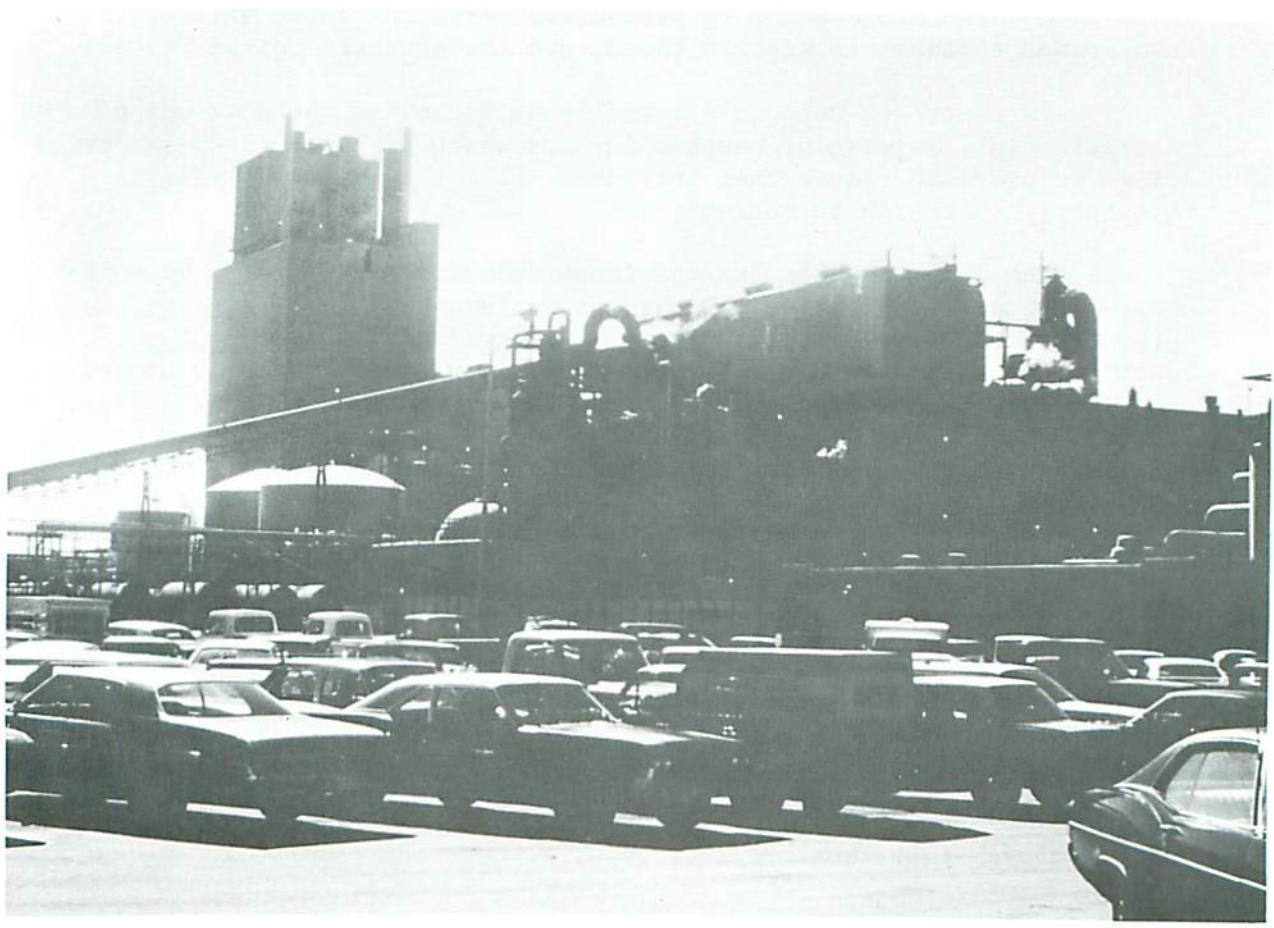
[24] This is based upon the application of Zivnuska's method to Canadian data.

[25] Rising real estate and construction costs which favour multidwelling structures, containing less wood, over single-family homes will probably have a stronger influence on lumber demand than lumber prices themselves.



Pulp mills such as this are common in Ontario

Table 12. Production of basic paper[a] and paperboard in Ontario, 1961-1970

	Newsprint	Book and writing paper[b]	Wrapping paper	Paper-board[c]	Tissue paper[d]	Other[e]	Total
				(Tons)			
1961	1,598,000	275,000	70,000	483,000	53,000	12,000	2,491,000
1962	1,602,284	292,452	72,493	524,237	50,837	15,539	2,557,842
1963	1,566,720	314,973	78,848	536,189	52,603	13,932	2,563,265
1964	1,714,166	322,979	83,695	579,194	52,574	15,818	2,768,426
1965	1,743,406	344,742	85,728	581,199	51,225	12,806	2,819,106
1966	1,848,946	430,935	86,718	541,779	53,174	18,688	2,980,240
1967	1,815,823	424,419	84,884	548,905	72,457		2,946,488
1968	1,759,814	447,668	92,158	555,593	97,916		2,953,149
1969	1,923,842	469,401	95,127	574,075	119,219		3,181,664
1970	1,857,570	532,619	70,551	593,229	105,007	19,061	3,178,037

[a] Excludes building board.

[b] Includes groundwood printing, speciality papers and fine papers.

[c] Includes wet machine boards.

[d] Includes sanitary papers.

[e] Includes special industrial papers and building papers.

Source: D.B.S. Pulp and paper mills. Cat. No. 36-204.

Table 13. Shipments of the major products manufactured in Ontario sawmills, 1961-1970

Year	No. of mills	Lumber			Sawn ties	Wood chips	Mine timbers
		Softwood	Hardwood	Total	(No.)	(Tons)	MBF
			MBF				
1961	430	392,696	130,904	523,600	420,353	186,000	19,279
1962	436	448,862	159,887	608,749	407,320	192,146	25,601
1963	431	448,077	162,098	610,175	417,273	251,372	15,241
1964	425	498,383	191,769	690,152	428,640	291,482	16,930
1965	371	539,981	208,407	748,388	550,988	333,165	17,626
1966	351	542,639	224,104	766,743	776,648	362,435	17,747
1967	328	488,763	201,651	690,414	662,203	389,801	19,931
1968	303	524,355	211,947	736,302	676,187	511,937	20,147
1969	296	538,067	213,669	751,736	283,233	555,322	14,529
1970	292	526,982	203,467	730,449	512,050	704,270	15,378

Source: D.B.S. Sawmills and planing mills. Cat. No. 35-204.

Table 14. Total production of sawn lumber by all industries for Ontario and Canada, 1946-1970

Year	Ontario (MBF)	Ontario (Index)	Canada (MBF)	Canada (Index)
1946	673,441	100.0	5,083,280	100.0
1947	733,129	108.9	5,877,901	115.6
1948	760,198	112.9	5,908,798	116.2
1949	793,039	117.8	5,915,443	116.4
1950	819,835	121.7	6,553,898	128.9
1951	820,696	121.9	6,948,697	136.7
1952	840,484	124.8	6,807,594	133.9
1953	823,721	122.3	7,305,958	143.7
1954	721,742	107.2	7,243,855	142.5
1955	759,976	112.8	7,920,033	155.8
1956	776,745	115.3	7,739,603	152.3
1957	671,551	99.7	7,099,758	139.7
1958	583,315	86.6	7,179,080	141.2
1959	620,960	92.2	7,591,419	149.3
1960	628,744	93.4	8,012,226	157.6
1961	641,298	95.2	8,236,613	162.0
1962	653,090	97.0	8,829,380	173.7
1963	748,785	111.2	9,877,326	194.3
1964	790,626	117.4	10,363,319	203.9
1965	833,530	123.8	10,815,355	212.8
1966	909,816	135.1	10,599,475	208.5
1967	822,741	122.2	10,329,425	203.2
1968	893,407	132.7	11,351,449	223.3
1969	894,870	132.9	11,538,269	227.0
1970	848,517	126.0	11,263,320	221.6

Source: D.B.S. Canadian forestry statistics. Cat. No. 25-202.
D.B.S. Sawmills and planing mills. Cat. No. 35-204.

Table 15. Estimated wood pulp production by kind in Ontario, 1950-1970

	Ontario Production									
	Groundwood		Sulphate		Sulphite		Other		Total	
	('000 Tons)	Index (1950 = 100)	('000 Tons)	Index (1950 = 100)	('000 Tons)	Index (1950 = 100)	('000 Tons)	Index (1950 = 100)	('000 Tons)	Index (1950 = 100)
1950	1156	100	455	100	490	100	197	100	2298	100
1951	1205	104	507	111	553	113	220	112	2485	108
1952	1202	104	457	100	445	91	205	104	2309	101
1953	1179	102	485	107	448	91	254	131	2324	101
1954	1206	104	480	106	474	97	261	133	2421	105
1955	1247	108	533	117	504	103	318	161	2602	113
1956	1364	118	549	121	547	112	275	140	2735	119
1957	1339	116	568	125	569	116	270	137	2746	119
1958	1311	113	598	131	534	109	390	198	2833	123
1959	1340	116	632	139	491	100	405	206	2868	125
1960	1459	126	676	149	536	109	299	152	2967	129
1961	1472	127	648	142	558	114	303	154	2981	130
1962	1469	127	698	153	554	113	331	168	3052	133
1963	1409	122	717	158	586	120	362	184	3074	134
1964	1570	136	733	161	614	125	401	204	3318	144
1965	1640	142	749	165	581	119	387	196	3357	146
1966	1700	147	937	206	551	112	399	203	3587	156
1967	1713	148	994	219	553	113	359	182	3619	157
1968	1669	144	1076	237	504	103	395	201	3644	159
1969	1844	164	1176	259	518	106	373	189	3961	172
1970	1761	152	1204	265	584	119	420	213	3969	173

Source: Estimated from D.B.S. Pulp and paper mills. Cat. No. 36-204.

Table 16. Wood pulp production by process in Canada, 1950-1970

	Groundwood		Sulphate		Sulphite		Other		Total	
	('000 Tons)	Index (1950 = 100)	('000 Tons)	Index (1950 = 100)	('000 Tons)	Index (1950 = 100)	('000 Tons)	Index (1950 = 100)	('000 Tons)	Index (1950 = 100)
1950	4998	100	1054	100	1875	100	512	100	8473	100
1951	5285	106	1217	115	2136	114	677	132	9315	110
1952	5248	105	1092	104	1994	106	634	124	8968	106
1953	5248	105	1206	114	1968	105	655	128	9077	107
1954	5451	109	1386	131	2181	116	655	128	9673	114
1955	5606	112	1471	140	2415	129	659	129	10151	120
1956	5894	118	1597	152	2561	137	682	133	10734	127
1957	5727	115	1706	162	2397	128	596	116	10425	123
1958	5543	111	1896	180	2143	114	555	108	10137	120
1959	5829	117	2234	212	2130	114	639	125	10832	128
1960	6039	121	2442	232	2291	122	689	135	11461	135
1961	6014	120	2697	256	2414	129	654	128	11779	139
1962	6038	121	2926	278	2406	128	762	149	12133	143
1963	6009	120	3136	298	2566	137	763	149	12474	147
1964	6627	133	3420	324	2872	153	822	161	13742	162
1965	6989	140	3904	370	2924	156	756	148	14573	172
1966	7526	151	4605	437	3066	164	760	148	15958	188
1967	7462	149	5068	481	2827	151	500	98	15857	187
1968	7550	151	6034	572	2643	141	534	104	16762	198
1969	8284	166	6945	659	2794	149	567	111	18590	219
1970	8262	165	6707	636	2815	150	524	102	18308	216

Source: D.B.S. Pulp and paper mills. Cat. No. 36-204.

Table 17. Wood residue (chips) used by process in Ontario, 1961-1970

Year	Mechanical[a]	Sulphite	Sulphate (cords)	Defibration	Total
1961	14,000	26,000	151,000	12,000	203,000
1962	11,720	28,118	160,263	11,207	211,308
1963	21,618	31,775	186,804	14,359	254,556
1964	30,389	27,116	226,926	18,708	303,139
1965	61,259	20,414	278,322	--	359,995
1966	110,389	15,133	370,332	--	495,854
1967	75,116	13,625	411,429	--	500,170
1968	59,892	--	545,486	--	605,378
1969	63,208	--	564,728	--	627,936
1970	64,748	--	610,559	--	675,307

[a] After 1964 includes defibration or explosion processes.

Source: D.B.S. Pulp and paper mills. Cat. No. 36-204.

Table 18. Variable inputs into the manufacturing activity of the sawmill and planing mill industry in Ontario, 1961-1970

Year	Total value[a] of production ($'000)	Wages ($'000)	(%)	Fuel and electricity ($'000)	(%)	Wood costs ($'000)	(%)	Other ($'000)	(%)	Surplus[b] ($'000)	(%)
1961	58,076	11,866	20.4	1502	2.6	25,973	44.7	5701	9.8	13,024	22.4
1962	62,127	13,685	22.0	1736	2.8	26,415	42.5	5799	9.3	14,492	23.3
1963	63,535	13,720	21.6	1554	2.4	24,979	39.3	5484	8.6	17,798	28.0
1964	75,271	14,966	19.9	1812	2.4	28,983	38.5	6579	8.7	22,931	30.5
1965	79,911	16,925	21.2	2027	2.6	30,225	37.8	6861	8.6	23,873	29.9
1966	90,524	19,963	22.1	2385	2.6	34,193	37.8	7813	8.5	26,170	28.9
1967	90,437	21,557	23.8	2254	2.5	35,857	39.6	8222	9.1	22,547	24.9
1968	100,133	22,882	22.9	2791	2.8	39,573	39.5	8771	8.8	26,116	26.1
1969	107,291	24,818	23.1	2834	2.6	41,804	39.0	8822	8.2	29,013	27.0
1970	100,073	24,750	24.7	2474	2.5	42,582	42.6	7776	7.8	22,492	22.5
				Indexes of factor inputs							
1961	100.0	100.0		100.0		100.0		100.0		100.0	
1962	107.0	115.6		115.6		101.7		101.7		111.3	
1963	107.4	115.6		103.5		96.2		96.2		136.7	
1964	129.6	126.1		120.6		111.6		115.4		176.1	
1965	137.6	142.6		135.0		116.4		119.9		183.3	
1966	155.9	168.2		158.8		131.6		134.7		200.9	
1967	155.7	181.7		150.1		138.1		143.6		173.1	
1968	172.4	192.8		185.8		152.4		154.8		200.5	
1969	184.7	209.2		188.7		161.0		153.6		222.8	
1970	172.3	208.6		164.7		163.9		136.4		226.4	

[a] Total value of production = total shipments ± inventory adjustment.

[b] See Table 9 for explanation.

Source: D.B.S. Sawmills and planing mills. Cat. No. 35-204.

Table 19. Variable inputs into the manufacturing activity of the pulp and paper industry in Ontario, 1961-1970

Year	Total value of production[a] ($'000)	Wages ($'000)	Wages (%)	Fuel and electricity ($'000)	Fuel and electricity (%)	Materials used: Pulpwood ($'000)	Pulpwood (%)	Materials used: Wood residue ($'000)	Wood residue (%)	Materials used: Other materials ($'000)	Other materials (%)	Surplus[b] ($'000)	Surplus[b] (%)
1961	482,197	82,262	17.1	33,528	7.0	106,920	22.1	5,060	1.1	102,917	21.3	151,510	31.4
1962	510,980	84,943	16.6	34,954	6.8	110,259	21.6	5,195	1.0	107,312	21.0	168,317	32.9
1963	522,517	88,034	16.8	35,463	6.8	110,065	21.1	6,022	1.2	111,854	21.4	171,078	32.7
1964	560,368	93,559	16.7	38,516	6.9	112,263	20.0	7,507	1.3	122,946	21.9	185,578	33.1
1965	574,379	97,958	17.1	39,490	6.9	111,610	19.4	9,042	1.6	128,393	22.4	187,886	32.7
1966	623,306	112,029	18.0	41,389	6.6	125,441	20.1	10,699	1.7	139,436	22.4	194,311	31.2
1967	630,044	116,244	18.5	43,303	6.9	134,613	21.4	13,559	2.2	142,396	22.6	179,929	28.6
1968	650,322	122,999	18.9	44,270	6.8	136,727	21.0	17,897	2.8	151,939	23.4	176,490	27.1
1969	718,676	135,828	18.9	48,812	6.8	150,424	20.9	18,667	2.6	160,578	22.3	204,367	28.4
1970	738,240	143,157	19.4	53,295	7.2	152,782	20.7	19,743	2.7	169,470	23.0	199,793	27.1
						Index of factor inputs							
1961	100.0	100.0		100.0		100.0		100.0		100.0		100.0	
1962	106.0	103.3		104.3		103.1		102.7		104.3		111.1	
1963	108.4	107.0		105.8		102.9		119.0		108.7		112.9	
1964	116.2	113.7		114.9		105.0		148.4		119.6		122.5	
1965	119.1	119.1		117.8		104.4		178.7		124.8		124.0	
1966	129.3	136.2		123.4		117.3		211.4		135.5		128.2	
1967	130.7	141.3		129.2		125.9		268.0		138.4		118.8	
1968	134.9	149.5		132.0		127.9		353.7		147.6		116.5	
1969	149.0	165.1		145.6		140.7		368.9		156.0		134.9	
1970	153.1	174.0		159.0		142.9		390.2		164.7		131.9	

[a] See footnote a, Table 18

[b] See footnote b, Table 9.

Source: D.B.S. Pulp and paper mills. Cat. No. 36-204.

Table 20. Labour costs and productivity in the sawmill industry in Ontario, 1961-1970.

Year	Real output[a] ($'000)	Index (1961 = 100)	Man-hours[b] paid ('000 hr)	Index (1961 = 100)	Real output per man-hour paid ($)	Index of real output per man-hour paid	Wages	
							($ per hr)	Index (1961 = 100)
1961	58,076	100.0	8,751	100.0	6.64	100.0	1.36	100.0
1962	62,439	107.5	9,845	112.5	6.34	95.5	1.39	102.2
1963	63,408	109.2	9,455	108.0	6.71	101.1	1.45	106.6
1964	74,526	128.3	10,154	116.0	7.34	110.5	1.47	108.1
1965	77,508	133.5	10,851	124.0	7.14	107.5	1.56	114.7
1966	83,432	143.7	11,945	136.5	6.98	105.1	1.67	122.8
1967	79,891	137.6	11,641	133.0	6.86	103.3	1.85	136.0
1968	84,075	144.8	11,588	132.4	7.26	109.3	1.97	144.9
1969	87,442	150.6	11,491	131.3	7.61	114.6	2.16	158.8
1970	90,580	156.0	10,355	118.3	8.74	131.7	2.39	175.7

[a] Real output was estimated by deflating value of production by composite of lumber price indexes taken from D.B.S. Cat. No. 62-589 and 62-002. The index components and weights were as follows: lumber, softwoods, spruce (east of the Rockies) .35; lumber, softwoods, white pine .23; lumber, softwoods, jack pine .19; lumber, hardwoods, maple .16; lumber, hardwoods, yellow birch .06.

[b] D.B.S. Sawmills and planing mills. Cat. No. 35-204.

Table 21. Labour costs and productivity in the pulp and paper industry in Ontario, 1961-1970

Year	Real output[a] ($'000)	Index (1961 = 100)	Man-hours[b] paid ('000 hr)	Index (1961 = 100)	Real output per man-hour paid ($)	Index of real output per man-hour paid	Wages	
							($ per hr)	Index (1961 = 100)
1961	482,197	100.0	35,501	100.0	13.58	100.0	2.32	100.0
1962	496,097	102.9	35,421	99.8	14.01	103.1	2.40	103.4
1963	504,300	104.6	36,101	101.7	13.97	102.9	2.44	105.2
1964	533,176	110.6	37,501	105.6	14.22	104.7	2.50	107.8
1965	542,379	112.5	37,778	106.4	14.36	105.7	2.59	111.6
1966	578,743	120.0	39,676	111.8	14.59	107.4	2.82	121.6
1967	571,728	118.6	38,856	109.5	14.71	108.3	2.99	128.9
1968	590,665	122.5	37,917	106.8	15.58	114.7	3.24	139.7
1969	632,637	131.2	39,532	111.4	16.00	117.8	3.44	148.3
1970	631,514	130.9	38,512	108.5	16.40	120.8	3.72	160.2

[a] Total value of production deflated by industry selling-price index for pulp and paper mills, D.B.S. Cat. No. 62-528 and 62-002.

[b] Source: D.B.S. Pulp and paper mills. Cat. No. 36-204.

THE MARKET

Market Distribution

The forest-based industries of Ontario[26] shipped over $866 million worth of forest products in 1970 (Table 22). Nearly 60 per cent of the combined value of all major forest products manufactured in Ontario were sold in foreign markets. Sales of pulp and paper products were above this average with over 61 per cent going to foreign markets. However, veneer and plywood are distinctly oriented to the domestic market with only 30 per cent foreign sales. Domestic markets also take the majority of sawmill products with only 36 per cent of sales to foreign consumers in 1970 (Table 22).

Table 22 also shows that Canada as a whole is even more heavily committed to foreign markets, with 67 per cent of Canada's forest products being exported. Ninety per cent of the exported materials go to the United States (77 per cent), the United Kingdom (10 per cent) and Japan (3 per cent) (Manning 1971). Ontario's dependence upon the United States is even greater, with 91.1 per cent of foreign sales going to United States customers, while sales to the United Kingdom and Japan amounted to 2.7 and 0.5 per cent, respectively, of total foreign trade (Table 23).

Newsprint and lumber shipments make up approximately 37 per cent of the total value of forest products shipped from Ontario mills (D.B.S. 1970. Cat. No. 35-204 and 36-204). Newsprint sales are heavily dependent upon foreign markets with approximately 82 per cent of total tonnage produced being exported in 1970 (Table 24). However, between 1961 and 1970 domestic consumption of newsprint produced in Ontario increased from 13 to 17 per cent. Most lumber produced in Ontario is sold domestically, with 57 per cent being consumed in Canada in 1970 (Table 25). However, since 1965 export sales have risen from 23 to 37 per cent of the total production, indicating a trend toward greater foreign sales.

Tables 26 and 27 present a much more complete picture of the quantities and values, respectively, of selected forest products exported from Ontario to all countries from 1965 to 1970. The major export items are paper for printing[27], wood pulp and lumber. These products account for roughly 88 per cent of Ontario's total exports of forest products (Table 28). The dominance of these three commodities reflects the tariff bias which most importing countries have against

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[26] In this discussion only pulp and paper mills, veneer and plywood mills, and sawmills and planing mills are included.

[27] Paper for printing includes newsprint and book papers (D.B.S. Standard commodity classification manual. Cat. No. 12-502).

highly manufactured items, because such items compete with domestic industries and, if manufactured locally, contribute a higher value added to the importing country. However, most importing industrial countries allow free or nearly free entry of raw materials and primary products such as lumber and wood pulp. Canadian newsprint also enters the United States market under the same conditions as raw materials.

Recent adjustments in tariff rates as a result of the Kennedy Round Agreements have lowered the barriers on most forest products. Nevertheless, the barriers still exist on the majority of highly manufactured items. Whether Ontario's producers can enter the United States market with such items depends largely upon their ability to overcome the tariff bias with manufacturing and transportation systems more efficient than their United States counterparts.

Because the United States is the single largest consumer of forest products manufactured in Ontario, its market structure warrants a more detailed investigation. The geographic destination of Ontario's forest products exported to the United States is given in Table 29. The bulk of these go to the east-north central states or the middle Atlantic states (Fig. 8). Over 80 per cent of Ontario's lumber and wood pulp exports going to the United States are concentrated in these two regions. In addition, these areas consume 65 per cent of Ontario's paper for printing which is exported to the United States with an additional 28 per cent going to the west-north central states (Fig. 8). Contractual arrangements between mills and consumers, and competition from Quebec, with its large newsprint capacity, places Ontario's newsprint (the largest item under "paper for printing") into the more western United States market.

Ontario's United States market is, therefore, geographically limited to the states immediately south of the international border. Such a narrow market can be explained partially by the geographic location of Ontario with respect to other competing areas.

The current schedule of freight rates also plays a major role in determining the range and accessibility of particular products in the United States market. A recent report shows freight rates on newsprint to be much higher than those on bulk materials such as wood pulp (Daly 1969).[28] Under existing rate schedules bulk products can be moved farther and more cheaply; therefore, the potential market for wood pulp

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[28] The freight rate from Thunder Bay to New York City was $21.45/ton for wood pulp, while newsprint charges were $24.25/ton. The differential is much greater from coastal mills in British Columbia to distant United States locations, i.e., $19.40/ton for wood pulp to Dallas, Texas *vs* $32.20/ton for newsprint.

Figure 8. United States census subdivisions.

is much greater than that for newsprint. Unless the rate schedules are modified, Ontario's concentration in newsprint production effectively limits its market area to the three regions outlined above.

The future of Ontario's forest products industries depends in large part upon their ability to expand their markets in the United States. For Canada as a whole, Japan is forecast as the growth market, and it should take over second place from the United Kingdom before the year 2000 (Manning 1971). But Ontario's geographic location may severely limit its entry into the Japanese market (Table 23). To a lesser extent the same is true for the European markets.

Market Potential

In order to assess the growth potential of the industry it is necessary to consider what the demand for forest products, especially newsprint, is likely to be in the relevant United States market areas. Projections show that not only will the total demand for newsprint in the United States increase, but per capita consumption will increase as well (Hair 1967).[29] Whether the newsprint industry's exports from Ontario to the United States will increase in proportion to this burgeoning consumption depends largely upon: 1) the geographic centres of population growth within the United States, 2) the possible effect of recycled newsprint paper upon virgin fibre newsprint demand within the geographic areas served by Ontario, and 3) the influence of other substitutes, e.g., synthetic paper.

Recent estimates show that since the mid-1950's United States domestic producers have been supplying an increasing share of their nation's newsprint requirements (Newsprint Information Committee 1972). Furthermore, recycling of newspapers into newsprint is causing the Canadian market share to decline slightly. Estimates show that the total consumption of newsprint in the United States will increase by over 50 per cent from 1970 to 1985, while the total tonnage of Canadian newsprint exports to the United States is expected to increase from 22 to 30 per cent during the same period.[30] Ontario should hold its own with an estimated 18-31 per cent increase in newsprint exports to the United States, and it is estimated that Quebec and British Columbia will experience an increase of 19-31 and 38-47 per cent, respectively.

Another major factor affecting the viability of the pulp and paper industry in Ontario is the industry's inability to attract and

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[29] The authors updated Hair's figures to 1970 and recalculated the regression parameters.

[30] Tucker, T. L. Pap. presented at Midwest Forest Econ. Meet. Sept. 7, 1972.

generate sufficient new capital. This is especially true because a substantial growth in the Canadian exports of wood pulp (kraft) to the United States is projected (Manning 1971). High wood costs restrict the conversion of Ontario's mills to kraft pulp production. Until this situation changes, Ontario's relative share of the market pulp export trade will probably continue to drop.[31]

The large percentage of old plant capital in Ontario aggravates this problem. Generally old mills are forced to switch to high-value products to maintain viability in the face of obsolescence. This typical evolution occurred in many older mills in Michigan. The same is true in Ontario as evidenced by the recent move of Abitibi Paper Company in Sault Ste. Marie to switch from newsprint production to higher-value products.

As noted earlier these higher-value products are restricted to domestic consumption because of tariff barriers. Domestic consumption ultimately depends upon population growth, income and tastes. Projections indicate a 68.9 per cent increase in the Canadian population between 1966 and 2000 and a 92.8 per cent increase in Ontario's population over the same period (Systems Research Group 1970). Assuming that the per capita consumption of all papers remains nearly constant, older Ontario mills could gradually switch to higher-value products and remain viable, if other factors such as location and mill size are favourable, and pollution abatement costs are not prohibitive. But again Ontario needs new capital to capture more of the bulk products market represented by kraft pulp.

If the tariff barriers are removed, the market opportunities for fine paper and other higher-value products could certainly increase. However, a reduction in tariff barriers will be reciprocal, thus opening the Canadian market to foreign competition.

The market outlook for lumber products appears to be much brighter than for pulp and paper products. Manning has forecast a strong lumber demand both in the United States and in Canada (Manning 1970, 1971). The decrease in the number of mills and the increase in output in Ontario indicate that capital is flowing into the industry in response to a strong demand. Also, increases in Ontario's lumber exports from 25.3 per cent of total production in 1965 to 37.5 per cent in 1970 indicate increasing capital investment in kilns and reflect bullish economic conditions (Table 25). To enter the United States market, lumber must be kiln dried; therefore, expansion of exports to the United States is dependent upon investment in kilns.

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[31] Between 1961 and 1970, British Columbia's production of wood pulp increased by 100 per cent as compared with 33 per cent in Ontario.

The major long-run constraint to continued growth in the sawmill industry appears to be lack of an adequate wood supply. However, Ontario's sawmill industry would appear to be in a relatively good market position for the next 20-30 years.[32]

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[32] Assuming that lumber price rises are not so great as to encourage widespread substitution of nonlumber and nonwood building materials, and that labour costs and land values do not force widespread multiresident and mobile-home living.

Table 22. Value of shipments of primary forest products from Ontario and Canada by industry and by market, 1970

Industry	Ontario				
	Domestic ($'000)	Total shipments (%)	Exports ($'000)	Total shipments (%)	Total shipments ($'000)
Pulp and paper	283,433	38.7	448,991[a]	61.3	732,424
Sawmill	62,741	63.4	36,281[b]	36.6	99,022
Veneer and plywood	24,360	69.5	10,715	30.5	35,075
Total	370,534	42.8	495,987	57.2	866,521
	Canada				
Pulp and paper	800,456	28.1	2,050,380[a]	71.9	2,850,836
Sawmill	412,660	36.3	722,717[b]	63.7	1,135,377
Veneer and plywood	189,191	72.2	72,927	27.8	262,118
Total	1,402,307	33.0	2,846,024	67.0	4,248,331

[a] Includes the value of: wood pulp, paper for printing, fine paper, tissue and sanitary paper, wrapping paper, special industrial and coated paper, paperboard, building paper and board, and converted paper (Standard Commodity Classification Index).

[b] Includes the value of: pulp chips, lumber, railroad ties, and other sawmill products (Standard Commodity Classification Index).

Source: D.B.S. Canadian forestry statistics revised Cat. No. 25-502.
D.B.S., Extern. Trade Div., special tabulation.

Table 23. Value of Ontario's primary forest products exported to the United States, United Kingdom, and Japan, 1970

Products	United States	United Kingdom ($'000)	Japan	Other	Total, all countries
Lumber	29,596	1,098	2,333	1,258	34,285
Railroad ties	32	--	--	--	32
Other sawmill products	1,229	116	57	1	1,403
Veneer	9,450	216	--	381	10,047
Plywood	585	47	--	36	668
Other wood-fabricating materials	2,743	898	3	290	3,934
Wood pulp	129,032	5,056	34	6,820	140,942
Paper for printing	264,982	46	3	6,253	271,284
Fine paper	7,092	3,169	--	7,295	17,556
Tissue and sanitary paper	1,151	984	--	460	2,595
Wrapping paper	2,080	375	--	602	3,057
Special industrial and coated paper	198	75	--	402	675
Paperboard	1,189	192	--	1,009	2,390
Building paper and board	1,551	83	--	529	2,163
Converted paper	3,683	1,011	148	3,487	8,329
Logs round and roughly squared	1,009	36	--	215	1,260
Round timber	584	--	--	61	645
Pulpwood	3,391	--	--	--	3,391
Pulp chips	561	--	--	--	561
Other crude wood materials	894	--	--	2	896
Total	461,032	13,402	2,578	29,101	506,113
Per cent of Total	91.09	2.65	.51	5.75	100.00

Source: D.B.S., Extern. Trade Div., special tabulation.

Table 24. Newsprint production and shipments from Ontario, 1961-1970

	Shipments[a]			Production	Production[b]	
	Exports (1) (tons)	Domestic (2) (tons)	Total (3) (tons)	(4) (tons)	(1/4) (%)	(2/4) (%)
1961	1,385,022	210,978	1,596,000	1,598,000	86.67	13.20
1962	1,388,871	215,849	1,604,720	1,602,284	86.68	13.47
1963	1,351,748	218,425	1,570,173	1,566,720	86.28	13.94
1964	1,463,406	242,645	1,706,051	1,714,166	85.37	14.16
1965	1,496,395	249,562	1,745,957	1,743,406	85.83	14.31
1966	1,584,151	260,955	1,845,106	1,848,946	85.68	14.11
1967	1,533,669	276,449	1,810,118	1,815,823	84.46	15.22
1968	1,468,380	292,936	1,761,316	1,759,814	83.44	16.65
1969	1,607,936	315,453	1,923,389	1,923,842	83.58	16.40
1970	1,524,555	329,402	1,853,957	1,857,570	82.07	17.73

[a] Adjustments for interprovincial trade not included in shipments.

[b] Does not equal 100% because of inventory (production - shipments).

Sources: Total shipments and production from: D.B.S. Cat. No. 36-204. Pulp and paper mills
Domestic consumption from: C.P.P.A. provincial quarterly data for newsprint.

Table 25. Lumber[a] production and shipments from Ontario, 1965-1970

	Shipments[b]			Production	Production[c]	
	Exports (1) (MBF)	Domestic (2) (MBF)	Total (3) (MBF)	(4) (MBF)	(1/4) (%)	(2/4) (%)
1965	200,517	547,871	748,388	792,994	25.29	69.09
1966	254,243	512,500	766,743	869,059	29.25	58.97
1967	204,503	485,911	690,414	770,781	26.53	63.04
1968	270,301	466,001	736,302	841,642	32.12	55.37
1969	298,418	453,318	751,736	840,938	35.49	53.91
1970	288,952	441,497	730,449	771,000	37.48	57.26

[a] Includes only lumber produced by sawmills and planing mills.

[b] Adjustments for interprovincial trade not included in shipments.

[c] Does not equal 100% because of inventory (production - shipments).

Sources: Total shipments and production from: D.B.S. Cat. No. 35-204. Sawmills and planing mill and special tabulation of sawmill reporting data.
Exports from: D.B.S., Extern. Trade Div., special tabulation.

Table 26. Quantities of selected forest products exported from Ontario, 1965-1970

Year	Lumber (MBF)	Wood pulp	Paper for printing	Fine paper	Tissue and sanitary paper	Wrapping paper	Special industrial and coated paper	Paperboard	Building paper and board	Converted paper
					(tons)					
1965	200,517	723,027	1,722,429	21,371	2,933	10,104	1,577	43,229	17,651	n.a.
1966	254,243	751,891	1,848,418	19,485	5,468	15,549	1,939	25,205	14,596	3,871
1967	204,503	819,981	1,818,739	18,933	8,048	12,310	1,943	17,662	9,083	4,046
1968	270,301	872,199	1,762,585	22,504	7,224	10,458	1,483	17,219	21,042	5,648
1969	298,418	966,801	1,951,203	44,169	10,012	12,459	2,885	11,577	20,010	6,115
1970	288,952	862,214	1,869,914	62,236	8,923	13,013	1,845	22,725	22,155	6,387

n.a. - not available.

Source: D.B.S., Extern. Trade Div., special tabulation.

Table 27. Value, in dollars, of selected primary forest products exported from Ontario, 1965-1970

Year	Lumber	Wood pulp	Paper for printing	Fine paper	Tissue and sanitary paper	Wrapping paper	Special industrial and coated paper	Paperboard	Building paper and board	Converted paper	All forest products
1965	24,604,241	98,693,000	213,886,329	5,945,325	700,808	2,436,468	675,468	5,364,560	1,934,453	2,839,184	387,182,186
1966	30,220,027	102,388,636	236,969,537	5,509,474	1,300,646	3,781,056	789,175	3,299,468	1,806,133	3,701,951	419,859,148
1967	27,712,693	111,039,758	239,175,687	5,586,851	1,866,990	3,071,749	852,732	2,360,141	1,176,894	4,315,682	426,117,836
1968	34,131,160	114,293,538	246,266,772	6,328,783	1,744,999	2,544,077	566,574	2,065,642	2,125,478	6,528,630	445,428,119
1969	39,776,840	131,009,253	284,841,029	11,764,022	2,661,128	3,043,021	1,030,624	1,415,047	2,280,001	7,486,638	512,499,105
1970	34,284,759	140,942,139	271,283,502	17,555,527	2,594,826	3,057,136	675,187	2,390,370	2,163,425	8,329,310	506,111,548

Source: D.B.S., Extern. Trade Div., special tabulation.

Table 28. Major forest products exported from Ontario, 1965-1970

Year	Paper for printing, wood pulp and lumber ($'000)	% of total	Other products ($'000)	% of total	Total exports ($'000)
1965	337,183	87.1	49,999	12.9	387,182
1966	369,578	88.0	50,281	12.0	419,859
1967	377,929	88.7	48,189	11.3	426,118
1968	394,692	88.6	50,736	11.4	445,428
1969	455,627	88.9	56,872	11.1	512,499
1970	446,511	88.2	59,601	11.8	506,112

Source: D.B.S., Extern. Trade Div., special tabulation.

Table 29. Percentage of selected forest products exported from Ontario to the United States by United States census subdivision, 1970

United States census subdivision[a]	Lumber	Wood pulp	Paper for printing	Fine paper	Tissue and sanitary paper	Wrapping paper	Special industrial and coated paper	Paperboard	Building paper and board	Converted paper
New England	2.961	5.999	0.545	7.119	43.213	0.089	72.503	2.717	0.104	3.073
Mid-Adlantic	21.301	17.016	16.424	34.150	21.624	8.789	11.949	66.418	15.917	63.277
East-north central	63.231	68.113	49.183	36.534	0.511	51.816	13.303	29.507	72.315	24.486
West-north central	4.362	3.845	27.640	0.443	0.193	20.304	1.903		0.004	1.576
South Atlantic	2.931	4.148	3.647	21.182	0.016	9.570	0.340	1.358	11.543	2.555
East-south central	2.719	0.439	1.565	0.571	33.415	8.895				0.310
West-south central	1.129	0.142	0.536			0.536			0.116	1.158
Mountain	0.175	0.180	0.422							0.406
Pacific	1.189	0.118	0.033		1.028					3.159
Not specified	0.002		0.005	0.001		0.001	0.002		0.001	
Total value ($)	29,595,630	129,031,745	264,981,761	7,092,115	1,151,480	2,080,339	198,219	1,188,514	1,551,036	3,682,790

[a] See Figure 8.

Source: D.B.S., Extern. Trade Div., special tabulation.

SUMMARY

The foregoing analysis points up several factors which concern the present and future viability of Ontario's forestry sector. While this report is primarily descriptive, the aim of the analysis has been to isolate those factors that appear to have a strong bearing on the future of forestry and the forest industry in Ontario. Thus the following discussion will centre on what appear to be the key points brought out in this study.

With respect to the resource base, the available evidence indicates that the drain on the conifer resource, especially spruce, is approaching a maximum, given the existing level of forest management. Thus large increases in industrial consumption of conifers will require either a movement into the currently unexploitable area or more intensive management within the existing operating area in an effort to increase supply. These alternatives will involve increasing costs to the manager and consumer, and it is these costs combined with the real price of final products that will determine the extent of any increase in conifer usage.

The intolerant hardwoods form the other large element in the supply picture of Ontario's forests. While the use of hardwoods in the pulp and paper industry (in Ontario) has been relatively insignificant in the past, it is expected that their use will increase. Industrial growth based upon hardwood may relieve some of the pressure on the conifer resource caused by expansion of the forest industry in Ontario. However, significant increases in the use of hardwoods depend upon the availability and quality of the resource and upon the development of markets for hardwood-based pulp products.

In Ontario the majority of logging is done as an integrated operation in both the pulp and paper and the sawmill industries. The costs incurred during logging are of major importance to both industries and have a large impact upon profitability. This situation is particularly critical for the pulp and paper industry because its market is more continental and less subject to local influence than the sawmilling industry. Thus it is subject to competitive pressures from areas where the wood cost structure is significantly different.

In an effort to offset rising wood costs, the logging industry has become highly mechanized. To date, this has been reasonably successful. However, it is not clear what will happen to wood costs in the future, because increased mechanization involves increasing capital costs. In order for increased mechanization to be effective in controlling logging costs, significant increases in productivity must be achieved.

Ontario's pulp and paper producers operate at a wood cost disadvantage in comparison with the southern United States and

British Columbia. It is for this reason that the latter two areas have enjoyed most of the growth in wood pulp output since World War II. While it does not appear likely that this disadvantage will disappear, it is not clear to what extent it can be overcome by the relative locational advantage of Ontario with respect to densely populated eastern United States markets. The answer depends upon what happens to operating conditions in the competing areas.

The present and future prospects of Ontario's two main forest-based industries, pulp and paper and sawmilling, are apparently quite different. Sawmilling is a typical boom-and-bust proposition, which is reflected by somewhat erratic price movements and cyclic demand for durable goods, e.g., housing. However, the long-run real price for lumber is rising and so, too, is Ontario's output. Apart from year-to-year fluctuations, buoyant housing demand and the inelastic demand curve for lumber point to a rather bright picture for the sawmill industry in the foreseeable future. However, the declining supplies of sawtimber severely limit the long-run viability of sawmilling as we know it. With the approaching disappearance of available sawlog-sized conifers, it would appear that the lumber industry will be forced to rely on some form of reconstructed wood products such as laminates and particleboard.

In addition, the substitution of other wood and nonwood building materials for lumber, multidwelling homes which use less lumber, and a reduced birth rate in North America, will severely constrain the long-run viability of sawmilling.

In the short run, the pulp and paper industry in Ontario faces several major problems. Since World War II, the southern United States and British Columbia have emerged as the major producing areas in North America. One reason is the wood cost advantage of these areas which favours kraft pulp producers because of the higher wood content per ton in chemical pulps. Kraft pulp is a growth product and increases in capacity in Ontario depend largely upon wood cost parity with other areas. The industry is also characterized by older mills, and this tends to worsen its competitive position.

The long-run possibility of technological advancement in the pulp and paper industry, both in the woodlands and in the mills, is encouraging; hence, Ontario's future outlook is improved. The vast area of land which is available largely on a single-use basis for the production of timber would appear to give Ontario a distinct long-run advantage over the southern United States. As populations grow, especially in the southern states, land values should rise and competing uses for the land and water resources will limit the available acreage for growing roundwood.

Ultimately in any discussion of resources and industries, one must deal with demand and the market. In 1970 the pulp and paper,

sawmill, plywood and veneer industries in Ontario shipped over $866 million in forest products with 43 per cent being sold domestically and the remainder exported. Over 90 per cent of all exports or over 50 per cent of total production is shipped to the United States. Furthermore, the majority of forest products shipped from Ontario penetrate only limited areas within the United States, i.e., the east-north central states, the middle Atlantic states and to a much lesser extent the west-north central states. Freight rates, contractual arrangements and competition from Quebec, the southern United States and British Columbia tend to restrict Ontario's market.

A large groundwood capacity and a high proportion of old plant capital restrict Ontario's competitive position, especially in the rapidly growing kraft pulp market. Under current freight structures kraft pulp can be transported longer distances with a lower charge than newsprint. Ontario's older groundwood mills also have problems competing in the newsprint markets and are forced to produce higher-value products to maintain viability. Such products, however, face tariff restriction which limits them almost exclusively to the domestic market.

Ontario's sawmills are investing in new capital equipment and are taking advantage of buoyant United States demand. Lumber exports increased from 25 per cent of Ontario's total lumber production in 1965 to 38 per cent by 1970. The inelastic demand for lumber (which allows price increases large enough to offset factor-cost increases) also places sawmills in a relatively good market position in the short run in comparison with pulp and paper mills.

When the percentage of old capital in Ontario's pulp and paper industry is reduced, and when the market becomes buoyant, the long-run picture for pulp and paper producers should be much better than for sawmills. Long-run real increases in lumber prices, decreasing saw-timber resources, and the lack of flexibility in sawmilling are expected to restrict the long-run growth of the sawmill industry.

For the pulp and paper industry, stable, long-run real prices, flexibility in raw material needs, and the manufacturing process itself, all appear to brighten a rather bleak picture. However, the emergence of synthetic paper, recycling of waste paper, and pollution-abatement measures will necessitate shifts in mill location, production processes, resource requirements and product lines. The long-run character of the entire forest products industry in Ontario as well as in North America will be very different from what it is today.

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