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PRO 29

**EMPLOYMENT DECLINE
IN
TIMBER DEPENDENT REGIONS**

**Anthony M. Rufolo
James G. Strathman
Lois Martin Bronfman**

**FINAL REPORT
December 1988**

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EXECUTIVE SUMMARY

Employment in the wood products industry in Oregon has declined over the past decade despite the resurgence in demand for the products of the industry in the last few years. Because of the dependency of rural regions on this industry, the Ford Foundation funded the authors to undertake a study of the causes and consequences of employment decline within the industry. Such information can contribute to the development of strategies for improving the economic viability of these regions.

Timber dependent regions in Oregon fit the classic export-base model of economic development. These areas produce wood products for export to other parts of the country. The comparative advantage in this endeavor is based on an endowment of high-quality timber. In reviewing data on employment and productivity over the last decade, it is apparent that wood products employment in the state has been reduced as the productivity in the industry has increased. Thus, in Oregon the industry processed more timber in 1986 than it did in 1979, but with about fifteen percent fewer workers. Further, there are indications that timber supply will be reduced in the near future. This would limit the level of output and further reduce the level of employment.

This study investigates the dynamics of employment in the industry using three different approaches. The first approach interprets econometric analysis addressing the factors of production in relation to labor productivity. The second approach investigates the relationship of the wood products industry to the state using an input-output model (IMPLAN) to explore the effects of structural changes in the industry on output, income and employment. Finally, the study narrows its geographic focus to a timber dependent region (Jackson, Josephine and Klamath Counties) in southern Oregon, and investigates the perceptions and activities of those who work in the industry or are affected by it. In-depth interviews were conducted with managers of lumber and plywood mills, corporate executives, labor representatives, employees and local government officials to gather qualitative information on the production activities, employee characteristics and choices, and the relationship of the industry to local communities.

The study finds that the decline in wood products employment in Oregon between 1977 and 1986 was attributable to various causes, including a reduction in the amount of timber processed by the industry (20% of the employment lost); a shift in the end uses of timber, resulting in a higher proportion of logs devoted to lumber production and log exports and a lower proportion devoted to plywood production (25% of the employment lost); and labor productivity improvements in lumber and plywood production (55% of the employment lost).

There has been an on-going increase in labor productivity associated with substituting capital for labor, which appears to have accelerated during the 1982-85 period. The analysis indicates that this increase in productivity does not represent major structural change in the industry, but rather a normal response of the industry to a recession. To be sure, the early 1980's recession was an unusually severe one for the industry, and it followed an unusually high cyclical peak. But there is little evidence of a significant departure from long-term trend lines for the industry with respect to labor productivity. It is our conclusion that during the late 1970's, a number of firms undertook major capital improvements to increase productivity and, simultaneously, increased their use of labor in response to rising stumpage prices. When the recession came, the decline in wood products demand led to an adjustment which involved closing many of the most labor intensive plants in the industry and reducing labor usage in the others. The labor

productivity gains associated with these actions were then complemented by the (recession - delayed) implementation of new labor-saving capital equipment in the subsequent recovery.

We observe that the issue of labor productivity is clouded by the apparent decline in the quantity and quality of stumpage processed. Managers indicate that they are processing more output with fewer and lower quality logs. To accomplish this, they rely not only on better equipment to improve recovery, but also on labor. From their perspective, new machines do not automatically lead to reductions in employment, as the poorer quality of stumpage may require more preparation or handling. At the same time, if one holds capital stock constant, efforts are being made to improve the output per worker, and by this measure productivity is increasing and the level of employment has declined.

The study found evidence of the considerable dependency of the survey area on the wood products industry for jobs, income and tax revenues. The downturn resulted in severe direct and indirect economic losses. At the same time, we found evidence of extensive resiliency in the communities. Six years after a major recession, unemployment is relatively low and there are few experienced wood products workers looking for jobs. While there was net out-migration during the downturn, this can be explained more by the reduction of the number of people moving to the area, than by an increase in residents moving away.

Because the dependency relationship has not changed dramatically in either direction, we conclude that future cyclical changes (in the absence of continued economic diversification) will affect the communities much as they have in the past. Planned reductions in the amount of timber sold by the Forest Service would have an impact on employment beyond normal cyclical effects. How great this impact will be is a matter of interpretation of the change in harvests from private forests in response to constraints in the national forests.

Our study found evidence that firms within the survey area have been foreseeing a reduction in the supply of timber for a number of years. In some instances, this has resulted in an increase in employment, as firms sought ways to increase recovery from smaller quantity and lower quality stumpage. While managers anticipate the closure of a least one and possibly three plants in the region, they are certainly not projecting the collapse of the industry in the survey area. Future closures will be the result of existing inefficiencies (e.g., an inability to process poorer quality logs) and anticipated reductions in timber supply.

While not wanting to downplay the trauma of individual plant closures on the employees, the recession did not result in chronic structural unemployment among wood products workers. Rather, there were fewer new workers entering the industry, and there were probably more early retirements than might otherwise occur. More recently, the industry seems to be facing a shortage of experienced labor.

While automation has eased the work for unskilled workers, it does not appear to have appreciably changed the mix of skilled to unskilled workers in this industry. In only one skilled occupation (electrician) has there been an increase in demand. The interview data indicates that workers are concerned about the stability of the industry, but this concern does not appear to be the result of changes in the conditions of their employment in the 1980's. Moreover, most of the workers hold fairly steady jobs and seem attached to the industry. They perceive that the best opportunity for good pay and benefits for those who live in timber dependent regions continues to be found in the wood products industry.

The study concludes that changes in production activities have brought changes in employment conditions for the worker. Some of these changes have resulted in work conditions which are physically less demanding of the worker. New strategies have also been introduced to increase productivity, whose impacts are hard to assess without more comprehensive study. We do conclude that these changes have blurred the distinctions between union and non-union mills in terms of the quality of the work environment, the level of pay and the responsiveness of management.

Finally, there have been programmatic responses by the state to the hardships of timber and resource dependent communities. The projected effects of these programs are not likely to be great enough to offset anticipated future employment losses in the wood products industry. Also, some of the most promising avenues of development (e.g., tourism) are cyclically sensitive and, as a result, are as unstable as the wood products industry. To the extent that less cyclically sensitive types of diversification are feasible, we conclude they are more preferable for the communities.

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1. Introduction

Much of rural Oregon is heavily dependent on the wood products industry. Employment in the industry is a major source of income in the forested areas, and the spending by those employed in the wood products industry creates a large amount of indirect employment. In addition, local governments receive substantial sums either through direct taxes on property or through various subventions from higher levels of government relating to timber harvests. The expenditure of these funds creates both direct and indirect employment as well.

Conventional wisdom regarding the economic conditions facing Oregon's timber dependent regions in the coming years can be briefly summarized. The supply of timber will decline over the next decade and output per worker will increase, so employment will decline even more sharply than output. The decline in this sector will have an extensive multiplier impact on other employment. Hence, the conventional wisdom is that the total employment outlook is bleak and that these regions face serious economic problems.

This characterization of the future persists despite the fairly strong performance of Oregon's wood products industry since 1984. This perception may be due to the major improvements in labor productivity which occurred from 1979 to 1986. In 1986, the industry was producing more output than in 1979 but with about fifteen percent fewer workers. Thus, many people believe that there have been major structural changes and that the industry will continue to automate and reduce employment.

The rapid increase in labor productivity in the industry is not consistent with trends over the last thirty years; and changes prompted by a major recession can lead to mistaken long term projections. Hence, an objective of this report is to evaluate whether the observed changes in output per worker represent a major structural shift in the industry.

Whatever the causes of the employment changes in the wood products industry, the downturn in the early 1980's created substantial disruptions in the timber dependent communities. These problems have led to an interest in identifying and promoting alternative types of economic activity. There have been attempts at both the state and local levels to encourage other activities as sources of export employment. Even if there is potential for other types of economic development in the timber dependent regions, there are important questions which have not yet been addressed. These questions regard the nature of those looking for jobs and the types of employment which would keep them in the region. Previous downturns have resulted in population losses, and it is important to know if this has been caused by highly paid people leaving the region to look for other jobs or if there is some other explanation. Thus, the second major focus of the report is to determine the status of the workers in the industry. In particular, we try to assess if there is continuing structural unemployment in the industry and if there are alternative employment opportunities which would be attractive to those currently working in the industry.

While the downturn of the early 1980's was devastating for many people in rural Oregon, the wood products industry has been cyclically sensitive throughout its history. Wood products employment has declined substantially in previous periods as well, but despite these ups and downs in the industry, total employment in Oregon has shown an upward trend.

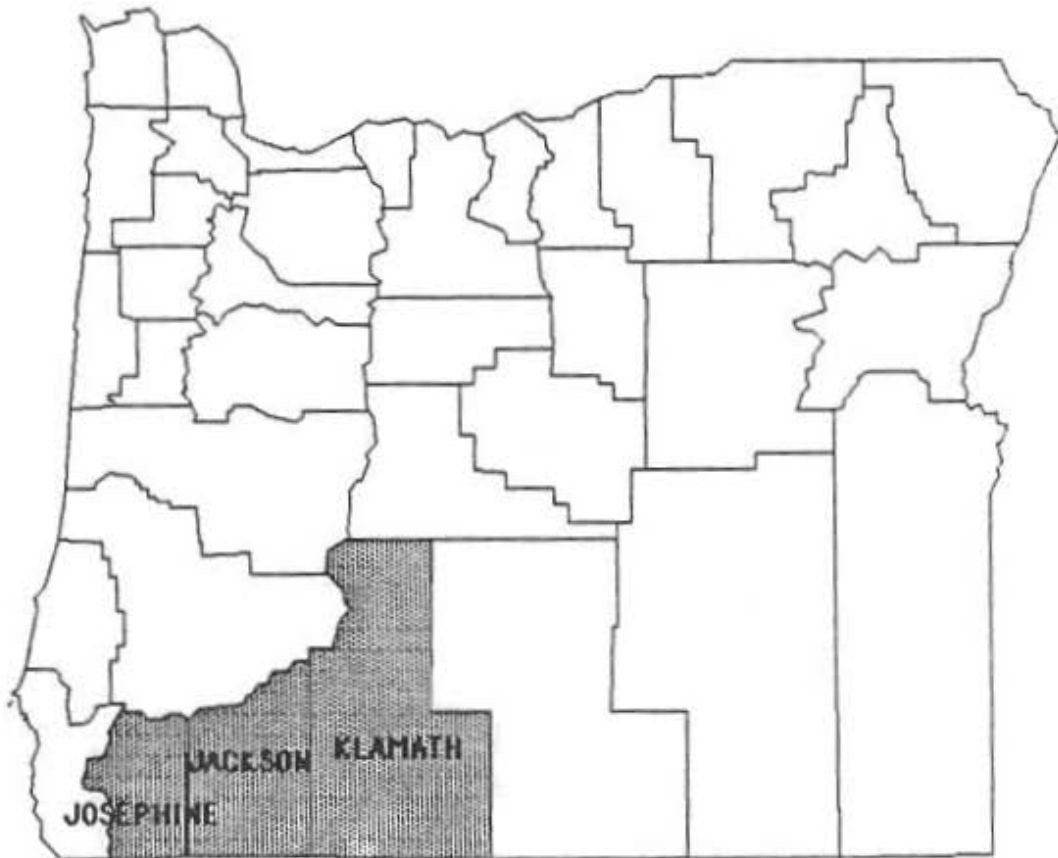
The divergence between wood products employment and total employment could reflect either more or less sensitivity of total employment to the wood products industry.

If the divergence represents diversification of the state's export base, then the region would become less sensitive to the changes in wood products employment. However, if the ratio of total employment to wood products employment simply reflects a greater multiplier impact of the wood products industry on the region, then this divergence might actually signify more sensitivity of the region to the cycles in wood products. Hence, a third focus of the report is to determine changes in the relation of total employment to wood products employment.

The methodology of the study reported here is quite different from most studies of the wood products and other industries. Previous statistical studies suffer from serious data problems, resulting in a wide range of estimates for key structural parameters. Hence, better information about the industry and communities is needed. Alternatively, individuals in the industry and communities are often unaware of important forces which are affecting them. Thus, their ability to analyze the changes around them are also limited. This report represents an attempt to combine the two approaches in evaluating the changes which have occurred in both the wood products industry and the communities dependent on it.

Statistical studies and various interpretations of recent trends are used to identify key information which would be useful in refining the interpretation of statistical results. A series of interviews was conducted in Jackson, Josephine and Klamath Counties (see Figure 1.1) to determine how people involved in the industry and communities viewed these issues. The information from the interviews was then used to "color" the interpretation of the statistical data. While this method is neither purely statistical nor purely dependent on information from experts, it offers the opportunity to substantially improve our understanding of the industry and the forces affecting it. By combining statistical data with interview information, the study attempts to identify the causes of previous changes in the industry and the factors which will influence future changes.

FIGURE 1.1
THE SURVEY AREA



1.1 Study Scope and Methodology

There have been a variety of studies of the wood products industry, its employment, and the economies of the regions which are dependent on this industry. Most of these studies tend to focus on the particular item which is being considered to the exclusion of the other factors which affect employment in the industry and the region.

Statistical studies are sometimes open to conflicting interpretations; and the interview part of this study is designed to elicit information which will allow researchers to focus on the results which are most consistent with the perceptions of those directly involved in the industry and the communities. Interview results alone may be unreliable in identifying the underlying causes of change because individuals often focus on a limited set of information and lack knowledge about the interaction among various forces in the economy; however, an interview which focuses on questions raised by statistical studies can provide qualitative information which lends support to one interpretation or another of the statistical data. The interview protocols used in this research were designed to elicit information which would be combined with the results of statistical studies to generate a more complete understanding of the changes which have occurred in the timber dependent regions and the responses of the people involved.

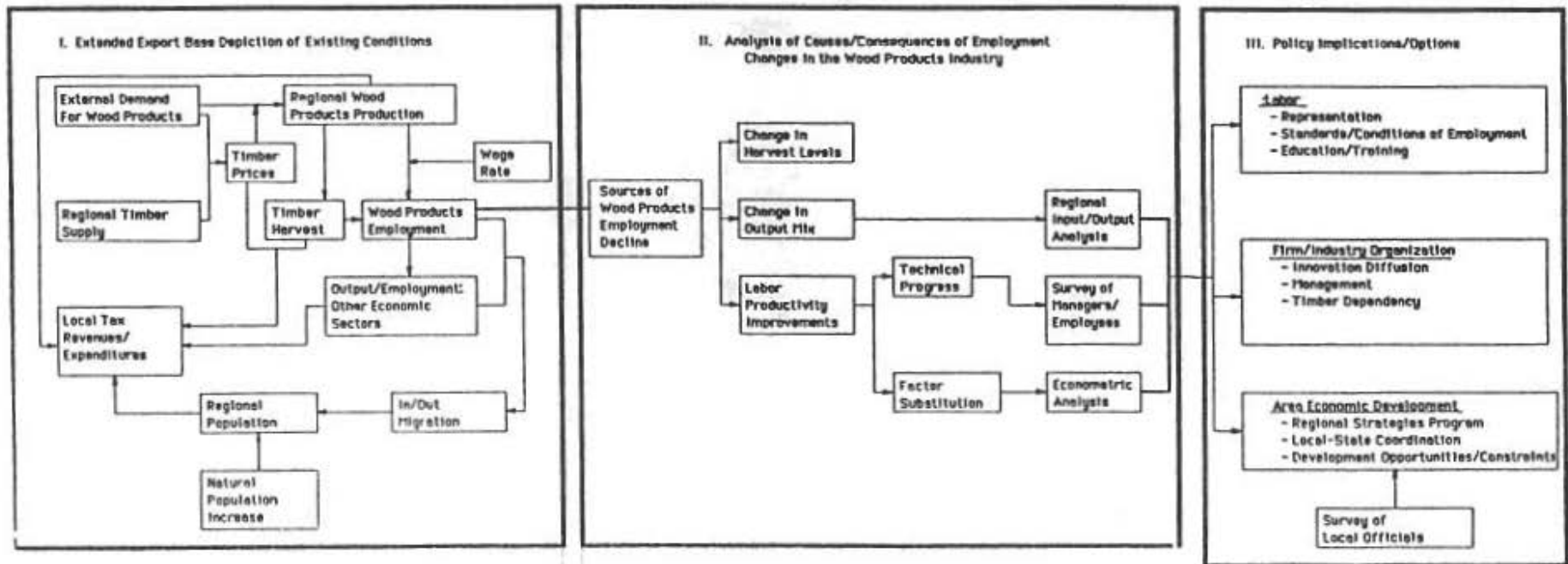
An overview of the study methodology is shown in Figure 1.2. Block I shows the major interactions which determine employment, population growth and local government finance in a timber dependent region when major structural relationships are fixed. In particular, employment is assumed to be proportional to output; and the ratio of employment in the wood products industry to total employment is assumed to be stable. Even with these assumptions, the model as depicted leaves out many important interactions. Yet, it forms the analytical basis for most studies of the impact of the wood products industry on economic and demographic activity in a region.

The major structural determinants in this phase of the modeling process are the demand for wood products and the supply of timber. These are shown as determining timber prices and the level of wood products production; and these are the factors which people focus on most often when analyzing the wood products industry. In this system the production level, timber harvest and wages, determine the level of wood products employment which, in turn, determines the overall level of employment in the region. Changes in total employment can be expected to influence migration into or out of the region; however, this is seldom modeled explicitly. The level of overall employment combines with the timber harvest to determine revenues to local governments which, in turn, may have feedback effects on the local economy; but this too is seldom modeled directly.

The model depicted in Block I of the figure does not account for structural shifts in the wood products industry. Hence, it does not perform well in explaining the decline in employment relative to output. Thus, we move to Block II in Figure 1.2 which shows the breakdown of alternative causes of employment decline in the industry.

The impact of changes in harvest levels must be noted, since this is a major factor affecting employment; however, it is not directly analyzed in this study. Rather, we emphasize the impact which the use of the timber has on employment. In particular, timber can be exported unprocessed or it can be processed into plywood, lumber and other products. Each use of timber has a different employment impact. An input-output model is used to estimate the effects of changes in the product mix on employment in the wood products industry relative to output.

FIGURE 1.2 STUDY METHODOLOGY



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The third major category affecting employment is the change in productivity in the industry. Changes in labor productivity can occur because labor is replaced with machinery or because there are changes in the ability to derive more output from a given level of inputs. The latter change is known as technological progress while the former is factor substitution. Factor substitution is sensitive to price differences among the factors of production, while pure technological progress is not reversed in response to price changes. Thus, it is important to distinguish the impact of technological progress from the impact of factor substitution. These are topics which generate considerable uncertainty based on statistical studies alone; and it is here that the information obtained in the interviews with managers and employees is most needed to supplement the statistical studies.

Block III in Figure 1.2 shows the three major areas of policy concern which the study ultimately is aimed to address. Labor, industry organization, and economic development options will be addressed in the context of the information generated by the study. Particular emphasis will be placed on the potential uses of information generated from the study in evaluating policy options.

1.1.1 Delineation of The Survey Area

While the issues to be considered relate to large parts of the Pacific Northwest, much of the data had to be limited in geographic coverage for consistency. It was decided that the interviews should also be limited in the geographic area covered to assure that variations in responses were not caused by area specific differences in circumstances.

Many factors influenced the choice of the survey area. The most important consideration was that the region be large enough to represent the types of communities which are dependent on the wood products industry. The region also had to be far enough from the major metropolitan areas that the communities in it could indeed be classified as timber dependent. In particular, this eliminated communities located in or near the Portland-Salem-Eugene corridor.

For statistical purposes, the survey region had to be at least one county in size; and more than one county would be desirable to provide a broader perspective on the issues. In particular, some areas of the state have recovered from the recession much better than others. This is partly because the wood products industry has had a stronger comeback in some areas, but there are also areas that have experienced more success in diversifying and attracting other types of activity. To the extent that conditions in the wood products industry influence or were influenced by these other activities, it is important to provide coverage of a range of possibilities. Offsetting the benefits of a diverse set of communities are the costs of data collection and the problems of assuring that differences are accounted for in analyzing the data. The size of the data set for each community becomes a constraining factor on the number of communities included.

Since the county would be an important focus for some aspects of the study, it was necessary to identify counties which have a substantial dependence on the wood products industry. This was taken to mean that both a large number of workers were employed in the industry and that the fraction of all workers directly engaged in the wood products industry was large. Counties meeting this condition also have a dependence on the industry for revenue. Some of this dependence is based on direct payments associated with severance and property taxes on timber, and some is associated with the general impact of changes in the economy on government revenue and demand for services.

While Douglas fir is the most important timber species in the Pacific Northwest, a substantial amount of other species are also cut and processed. Thus, it was desirable to define the area to include regions dependent on Douglas fir and regions dependent on other species. That meant including areas on both sides of the Cascades. Most of the land west of the Cascades supports Douglas fir while the land east of the Cascades is largely other species. Related to the concern about species differentiation was a concern that the survey area conform as much as possible to national forest boundaries. The policies in the various forests differ to some extent, and this might have an effect on the study results. Hence, it was desirable to both conform to boundaries and cover a variety of forests and species.

The final choice of Jackson, Josephine and Klamath Counties as the focus of the surveys and interviews represents an attempt to conform to the criteria specified. Essentially, they are all highly dependent on the wood products industry, but they are diverse in most other respects. They include areas that have been relatively prosperous and others that have still not fully recovered from the downturn of the early 1980's. There are a variety of forests and species covered. They are large enough to allow some generalization, but small enough to be studied fairly thoroughly. In short, they are representative of the rural communities that are dependent on the wood products industry in Oregon.

1.1.2 Identification of Major Socioeconomic Linkages

An important aspect of the analysis of regional economic growth focuses on the question of whether jobs follow people or people follow jobs. Clearly, the wood products industry depends on the timber grown in the region. Yet the industry would not be able to process that timber competitively if there were few workers available. One of the troubling aspects of the decline in the early 1980's was the decline in population in many of the areas dependent on the wood products industry. This loss in population raises a number of important questions. Have those who remained behind done so because they found other work or thought the industry would come back, or did they stay because they perceived no viable alternative elsewhere? Is the industry providing jobs for younger workers, or is it largely staffed by older workers who are essentially locked in? Have the problems in the industry spilled over into other aspects of life in the communities?

An important focus of the study is the impact of changes in the industry on the workers in the affected regions. A reduction in the wood products labor force may not be traumatic if it is accomplished largely by older workers retiring and new workers choosing not to enter the industry. However, it could be extremely disruptive if there are many older workers thrown out of work and they have few alternatives for employment. In the latter situation there are a variety of training programs and economic development initiatives which might be beneficial, whereas they would probably be unnecessary (if not counter productive) in the former case.

The interviews are designed to generate information on existing workers, workers who identify with the industry but are currently unemployed, and those who have left the region to look for better opportunities. The questionnaires are designed to ask the workers these questions directly; however, information on the impact of changes in the industry on workers is also obtained through the questionnaires administered to managers and government officials. Thus, information would be available on how workers viewed the issues and on how others viewed the workers.

Even those who remain employed can be affected if compensation or job security is reduced, or if working conditions are changed substantially. Again, the effect may be noted by the workers themselves, but it is also helpful to generate other views of how such changes are affecting workers and the future employment prospects in the industry. Such issues as the skills required in the industry and the common progression among jobs are raised to determine how those in the industry view its current status and future prospects. A number of questions also focus on how the workers viewed these changes and future prospects. In particular, they are questioned about the circumstances which would cause them to take work in another industry. This information is important in assessing the possibilities for other types of economic development in the area.

When communities are very dependent on one industry, the declining fortunes of that industry can have a profound effect on all aspects of community life. Young people may flee as soon as possible, leaving an aging population with a deteriorating infrastructure and other problems. Alternatively, the area may be so attractive that workers do not want to leave. The existence of a stable labor pool might serve to attract other industries to the region or allow for other expansion of employment. The area which is sustained only by high wages keeping workers in the industry can be very susceptible to downturn; and any area with a large downturn can have other problems surface.

Even such issues as whether workers are likely to stay when they retire can be important for isolated, one-industry communities. The stimulus to the local economy associated with the retirees' spending and their demands on the local government for services are important issues in determining how a community is able to cope with its problems. These issues are addressed through the interview procedure and, to a lesser extent, through the analysis of secondary data.

1.1.3 Analysis of the Decline in Employment

Timber affects employment in the region under study in a variety of ways. The most obvious is the direct employment of workers in the industry. Yet this may be only a fraction of the workers who are actually affected by the industry. Both the firms and their workers make expenditures in the region. Thus, the industry indirectly supports many others who are serving the workers and are suppliers of the industry. This indirect employment can be quite substantial, but even this does not capture the full impact of the industry on employment. Whenever timber is cut, payments are made to the local governments. The largest source of such payments are the sharing of revenues by the federal government with county governments for timber sold from the national forests and federal lands. This money is then used to hire workers by the government; and these jobs can also be attributed to the wood products industry.

The linkages between the industry and local employment can be difficult to discern because they are not all direct. Hence, an important focus of the research methodology is to determine more precisely what the linkages between the industry and local employment are. This would allow for better predictions about the impact of various changes in the industry on employment.

The major focus for determining employment impacts is the statistical data and the input-output model. By looking at changes in labor productivity and relating them to the alternative causes, it is possible to make more accurate predictions about likely changes in future employment in the industry. For example, output per worker could increase because machines replace workers or because both existing machines and workers become more

efficient. If the workers are replaced by machines then the relative cost of workers and machines becomes an important determinant of the future rate of change in output per worker. However, if the technological progress is unrelated to the relative cost of the inputs, there is much less opportunity to change the trend in employment. Hence, more careful analysis of the relationship between productivity improvements and the relative cost of inputs could be important in making employment projections.

2. Wood Products and the Regional Socioeconomic System

This chapter discusses the major linkages between the wood products industry and other social and economic activity in the survey area and state. Particular attention is given to changes in the structure of the industry and its relationship to other activity over the past decade. Both the survey area and the state are evaluated, providing a basis for comparison on issues of structural change. The primary dimensions of structural change to be discussed with respect to the industry include output, employment, timber harvests, labor intensity, and timber taxes. The role of the industry in the economies of the survey area and the state is also explored in terms of sectoral diversification, levels of income and unemployment, population growth, migration, and changes in demographic composition.

2.1 Industry - Economy Trends

2.1.1 Output and Employment

Lumber output in Oregon declined from 7.3 to 5.1 billion board feet (BBF) between 1976 and 1982, and by 1986, production had recovered to 8.1 BBF (see Table 2.1). The state's share of U.S. lumber production during the same period declined from 24 to 23 percent, hitting a low of 19 percent during the 1982 recession. This trend reflects a long term relative decline in the industry's fortunes in Oregon, extending over the past 30 years (Strathman et. al., 1985). There are several reasons for this decline; 1) regional lumber demand shifted generally from west to east, particularly during the 1970's, favoring producers in other regions; 2) Canadian lumber imports into the U.S. gradually increased over time, gaining a larger share of the U.S. lumber market; and 3) timber supply limitations in the Pacific Northwest region prevented substantial expansion of wood products output.

The decline in plywood production in Oregon in both absolute and relative terms is readily apparent. Output declined from 8.1 billion square feet (BSF) in 1977 to 7.8 BSF in 1986. Nationally, plywood production grew at an annual rate of 1.8 percent during the same period. Thus, the state's share of U.S. production fell from nearly 42 to 34 percent during the decade, representing an annual loss of 2.2 percent in market share. The relative decline of the plywood sector in Oregon reflects long term gains by Southern plywood producers, initiated in the early 1960's by the introduction of smaller diameter log peeling technology in the South, and by heavy competition in more recent years with producers of flakeboard and related structural panels.

Log exports from both Oregon and West Coast ports have grown at a moderate rate over the 1977-86 period, with annual increases averaging 4.0 and 2.1 percent respectively. Much of the expansion in log exports has occurred since 1984, and reflects the declining value of the U.S. dollar in international exchange. Oregon's share of West Coast log exports increased from 21 to nearly 25 percent during this period.

TABLE 2.1

Lumber and Plywood Production and Log Exports, 1976-86

	<u>Lumber</u> (MMBF)			<u>Plywood</u> (MMSF)			<u>Log Exports</u> (MMBF)		
	<u>Oregon</u>	<u>% of U.S.</u>	<u>U.S.</u>	<u>Oregon</u>	<u>% of U.S.</u>	<u>U.S.</u>	<u>Oregon</u>	<u>% of U.S.</u>	<u>U.S.</u>
1976	7,335	24.2	30,274	-	-	18,440	545	-	-
1977	7,509	23.3	32,159	8,109	41.9	19,376	553	21.0	2,628
1978	7,416	22.8	32,585	8,226	41.2	19,966	606	20.7	2,922
1979	7,312	22.9	31,942	7,929	40.3	19,653	18.7	18.7	3,301
1980	5,784	21.4	26,966	6,179	38.0	16,272	546	19.3	2,826
1981	5,115	20.5	24,956	5,561	33.3	16,681	455	21.0	2,163
1982	4,682	19.4	24,098	5,114	32.4	15,804	596	21.1	2,830
1983	6,579	21.9	29,991	6,719	34.4	19,541	534	18.5	2,889
1984	7,202	23.1	31,192	6,779	34.1	19,900	580	19.3	3,003
1985	7,211	23.1	30,853	6,750	33.3	20,257	773	23.0	3,368
1986	-	-	-	7,826	34.4	22,735	786	24.9	3,158
AAR	-.2	-.5	.2	-.4	-2.2	1.8	4.0	1.9	2.1

Source: U.S. Forest Service

Wood products and total employment in the survey area are related to Oregon and national figures in Table 2.2. Between 1956 and 1985, the industry gained about a thousand jobs in the survey area, resulting in an annual increase of about one half percent. At the state and national levels, employment in wood products declined .6 and .2 percent annually, respectively. The annual rate of increase in total employment was the same for both the survey area and the state (3.1%), and this rate exceeded the national job growth rate (2.4%) due primarily to relatively rapid economic expansion in Oregon in the 1970's.

TABLE 2.2
Covered Employment Trends, 1956-85
(000's)

	<u>Survey Area</u>		<u>Oregon</u>		<u>U.S.</u>	
	<u>Wood Prod.</u>	<u>Total</u>	<u>Wood Prod.</u>	<u>Total</u>	<u>Wood Prod.</u>	<u>Total</u>
1956	8.8	25.8	71.0	352.5	689	40,305
1959	8.6	27.4	65.5	359.2	579	41,904
1965	8.9	31.5	68.8	448.4	573	47,743
1970	8.4	34.9	61.7	535.1	555	57,265
1975	9.3	42.7	60.4	619.5	568	60,564
1980	11.2	61.2	69.4	845.2	709	74,836
1985	9.8	62.3	59.2	850.5	657	81,119
AAR (%)	.4	3.1	-.6	3.1	-.2	2.4

Source: U.S. Census Bureau

2.1.2 Income and Unemployment

Average annual earnings for wood products employees at the local, state, and national levels are presented in Table 2.3. Average earnings for all employees are also given for the state and nation. In the survey area, nominal earnings increased from 6.1 thousand in 1965 to 24.3 thousand in 1985, an annual rate of increase of 7.2 percent. Earnings of wood products employees at the state and national levels grew at slightly smaller and higher rates. Earning trends in the industry demonstrate a small degree of convergence between the state and national levels over the time period, although state average earnings in 1985 remained considerably higher (33%) than the national average. Average earnings for all employees grew slower at the state level than they did nationally over the period. Given that state and national average earnings were roughly equivalent in 1965, this has resulted in a growing disparity in incomes over the time period.

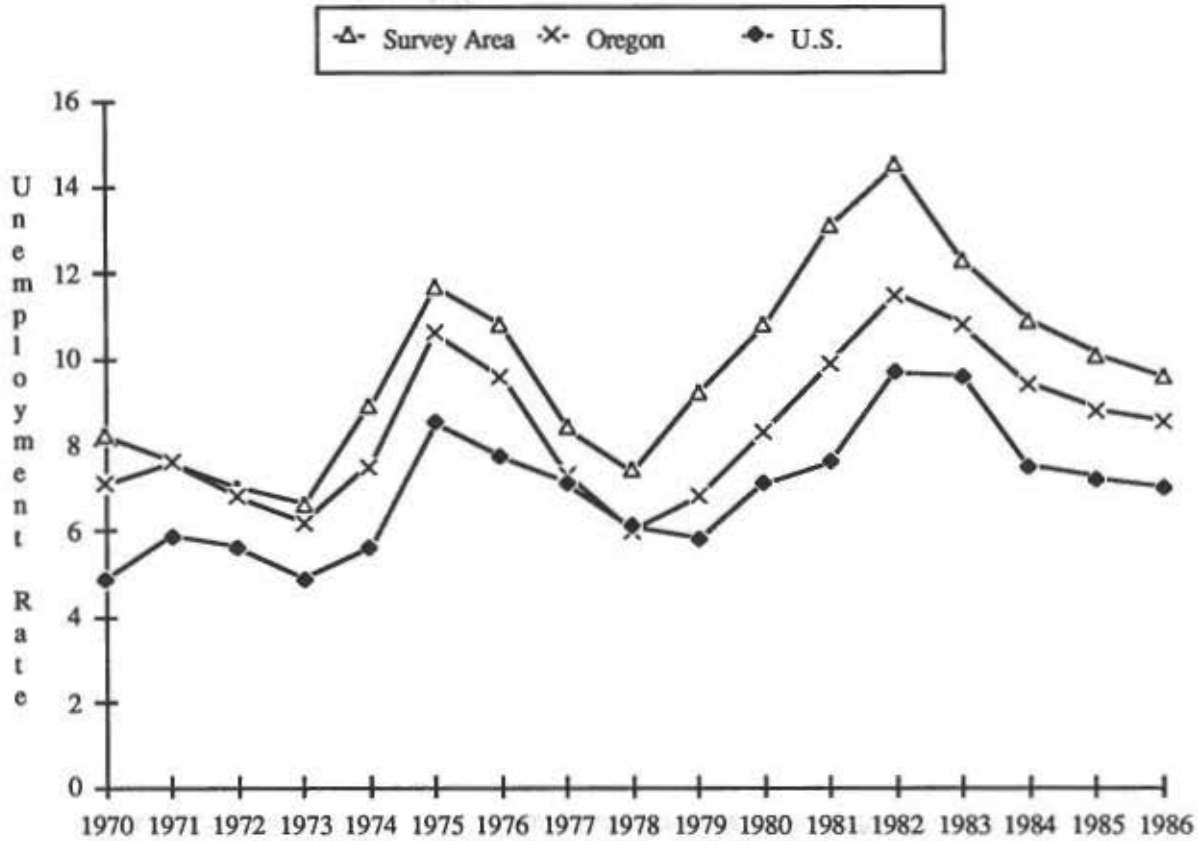
TABLE 2.3
Average Annual Earnings, 1965-85
(000's)

	<u>Survey Area</u>	<u>Oregon</u>		<u>U.S.</u>	
	<u>Wood Prod.</u>	<u>Wood Prod.</u>	<u>All Empl</u>	<u>Wood Prod.</u>	<u>All Empl</u>
1965	6.1	5.8	5.1	4.2	5.1
1970	7.9	7.6	6.4	5.6	6.6
1975	13.2	12.4	9.7	9.4	9.8
1980	17.4	17.3	13.5	12.6	13.9
1985	24.3	22.9	17.1	17.2	18.7
AAR (%)	7.2	7.1	6.2	7.3	6.7

Source: U.S. Census Bureau

Since 1970, the unemployment rate in the survey area has consistently exceeded the rate for Oregon (see Figure 2.1). The state, in turn, has exhibited a higher rate of unemployment than the U.S. in all years but 1978. The disparity in unemployment rates for the survey area and Oregon versus the U.S. also widened during recessionary periods (1970, 1974-76, 1979-84) due to the greater cyclical volatility in construction, the major end market for wood products. Between 1979 and 1986, the survey area maintained an unemployment rate at least 2.5 percentage points higher than the U.S. Given a sustained period of relative increases in unemployment rates, one would expect to find a corresponding increase in out-migration of the area's population. This issue will be addressed in Section 2.2.2.

FIGURE 2.1
Unemployment Rates, 1970-86
(Percent)

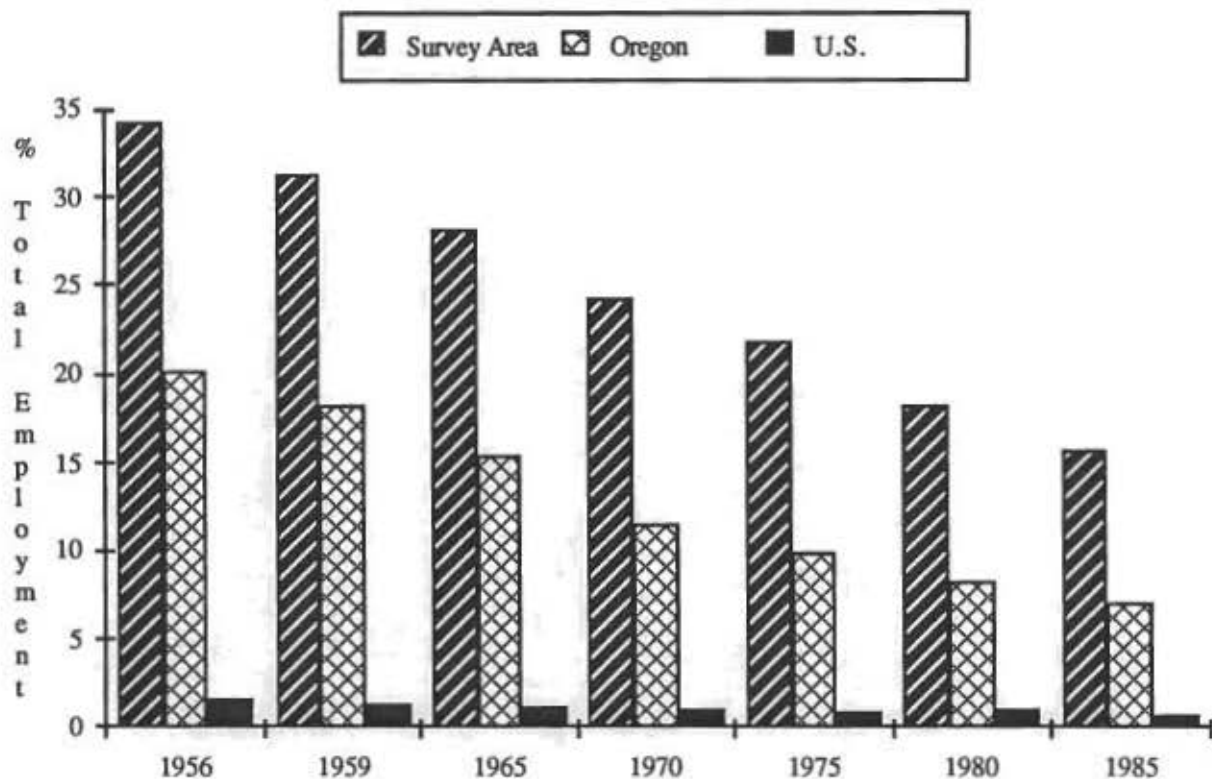


Source: Oregon Employment Division

2.1.3 Economic Diversification

Both the survey area and Oregon are very dependent on the wood products industry for employment. The magnitude of this dependency has declined over time, however, as illustrated by Figure 2.2. In 1956, for example, 34 percent of total covered employment in the survey area and 20 percent of total state employment was engaged in wood products manufacturing. By 1985, the respective percentages had declined to 16 and 7. At the national level, the percentage of total employment engaged in the wood products sector fell from 1.7 in 1956 to .8 in 1985.

FIGURE 2.2
Percentage of Total Employment in Wood Products, 1956-85



Source: U.S. Census Bureau

The location quotient (Isard, 1960) provides a relative measure of sectoral dependency, relating the proportion of total employment in one area (i.e., the survey area or the state) to its counterpart in another area (i.e. the nation). The location quotients for the wood products sector for the survey area and Oregon, as related to the U.S., are given in Table 2.4.

TABLE 2.4
Wood Products Sector Location Quotients, 1956-85

	<u>Survey Area</u>	<u>Oregon</u>
1956	20.2	11.9
1959	22.4	13.0
1965	23.4	12.8
1970	24.2	11.5
1975	24.2	10.9
1980	18.3	8.2
1985	19.6	8.8

The interpretation of the location quotient values is relatively straightforward. For example, we note that in 1956 the survey area was slightly more than 20 times more dependent on the wood products sector than was the nation, and that Oregon was nearly 12 times more dependent on wood products employment than was the nation. In contrast with the trend portrayed in Figure 2.2 reflecting a gradual decline in the relative importance of wood products employment within the survey area and the state, we see that its importance when related to sectoral change at the national level has essentially remained constant over the past 30 years for the survey area. At the state level, however, the relative dependence on the industry has declined by approximately 25 percent.

The diversification index (Isard, 1960) provides yet another measure of the structure of economic activity in an area. This index addresses the composition of economic activity across all economic sectors, relating the sectoral distribution of activity in a given region to the corresponding distribution at the national level. The theoretical value of the index ranges from zero to one, with a value of one indicating that the distribution of employment across sectors in the regional economy exactly matches the sectoral distribution at the national level. Values of the diversification index for the survey area and Oregon are given in Table 2.5

TABLE 2.5
Diversification Indices, 1956-85*

	<u>Survey Area</u>	<u>Oregon</u>
1956	.608	.745
1959	.652	.772
1965	.659	.804
1970	.679	.842
1975	.699	.874
1980	.740	.883
1985	.783	.907
AAR (%)	.900	.700

* Based on the following configuration of sectors: Agriculture, Forestry, Fisheries and Mining; Construction; Lumber and Wood Products; Other Manufacturing; Transportation, Communications and Utilities; Wholesale and Retail Trade; Finance, Insurance and Real Estate; Services; Activity Not Elsewhere Classified.

The trend for both the survey area and the state indicates increasing diversification over time, with the rate of increase in the survey area slightly higher than in the state. As one would expect, however, the absolute degree of diversification remains much greater in the state economy.

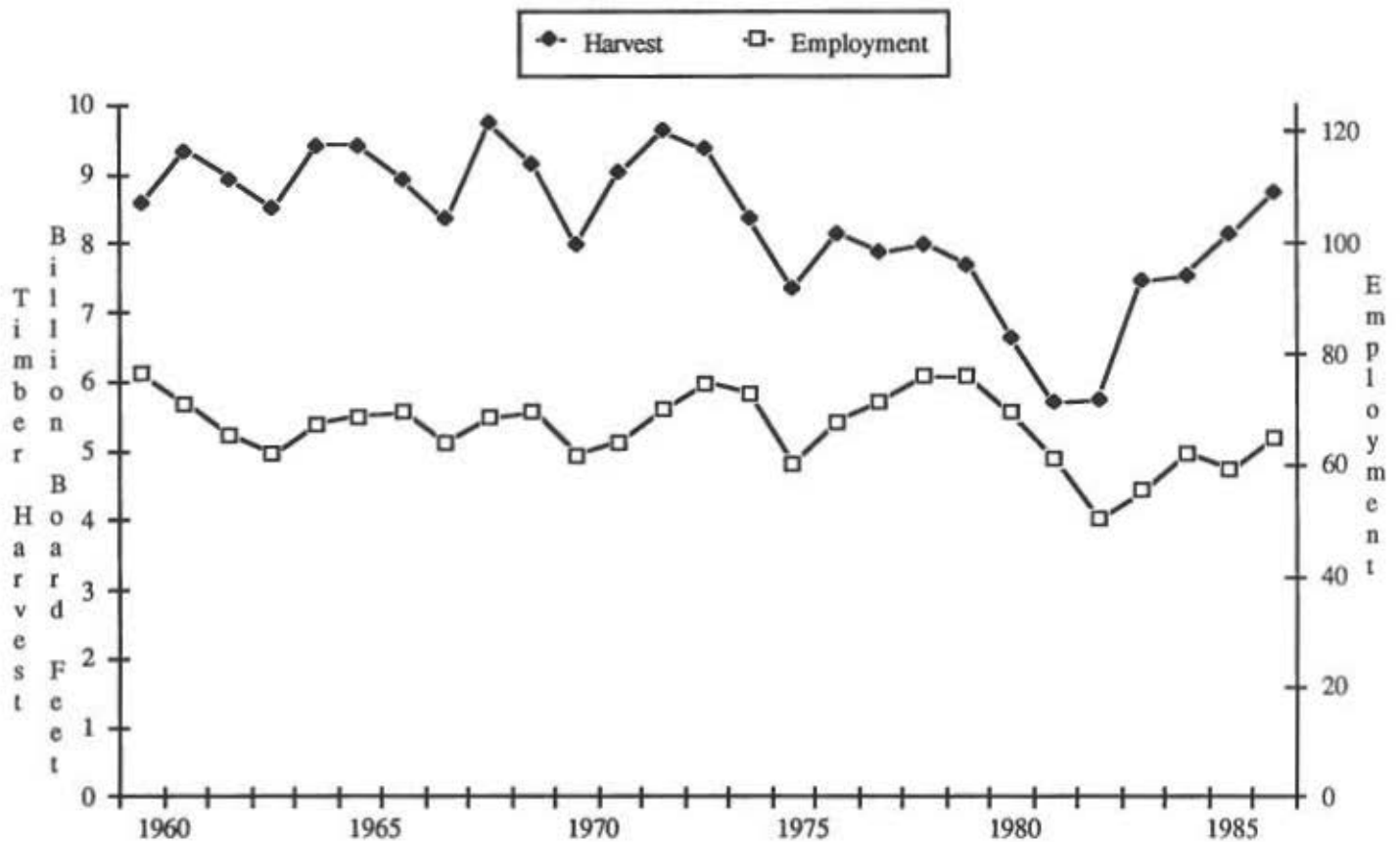
Greater economic diversity can be viewed as desirable for both the state and survey area given that diversity can act to offset the cyclical volatility of the wood products sector. It should be noted, however, that diversification can also result from a relative decline in wood products employment and output. In this case, the benefits of diversification are less apparent, given the comparatively higher wages paid to workers in the wood products industry.

2.1.4 Timber Harvests and Labor Utilization

Trends in timber harvests and labor utilization in the wood products industry in Oregon are analyzed in several different ways. First, we consider changes in labor intensity in relation to the amount of timber harvested and processed in the state. This provides a view on the intensity with which labor is employed in converting a given amount of timber to the various end products produced in the wood products sector, which allows us to determine whether the processing of timber has become more or less labor intensive over time. Second, we analyze trends in labor utilization in relation to the production of lumber and plywood, the two primary outputs of the wood products sector. Finally, we discuss changes in the disposition of timber among alternative processing sectors (e.g., lumber, plywood, log export), and relate changes in the disposition of timber consumption to the implications for employment in the wood products industry.

Harvest levels between 1960 and 1979 show a gradual decline from about 9 to 8 BBF (see Figure 2.3). During the same period, the wood products employment trend was roughly steady to slightly upward, suggesting an increase in the intensity of labor

FIGURE 2.3
Oregon Timber Harvest and Wood Products Industry Employment, 1960-86

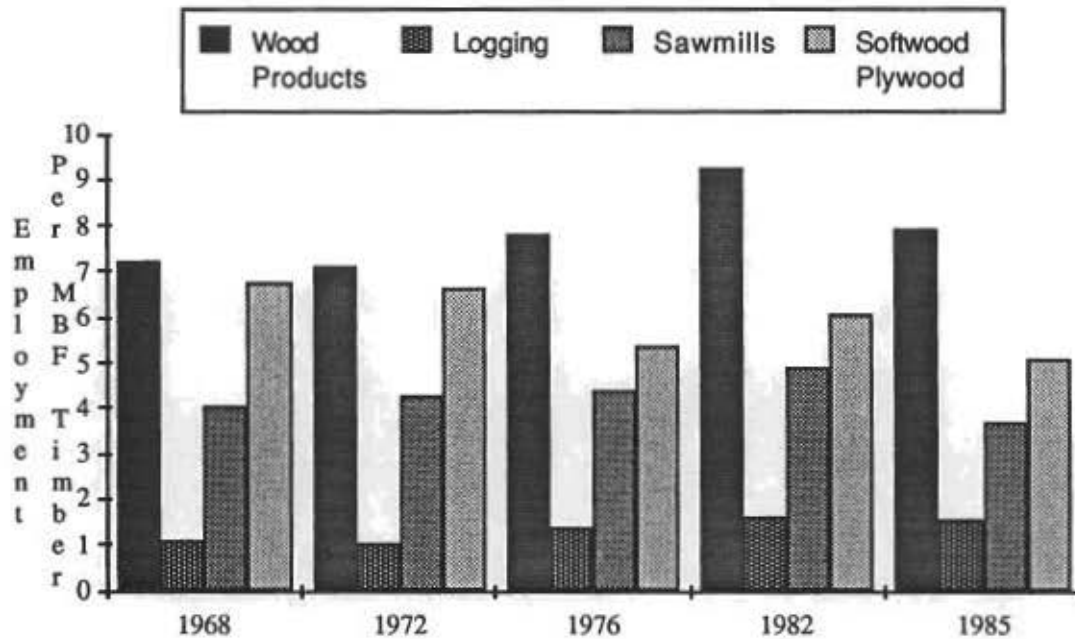


Source: Oregon Department of Forestry
U.S. Census Bureau

utilization. Harvest levels and employment fell significantly from 1979 to 1982, reflecting the national construction recession. Employment and harvest levels in 1982, in fact, were the lowest seen in Oregon since the Great Depression. The post 1982 recovery in the industry also reveals a reversal of the previous increase in labor intensity; in other words, harvest levels rose more rapidly than employment. Thus, the 1986 timber harvest was more than one billion board feet larger than the 1979 harvest (an increase of nearly 14 percent), while employment fell by more than 11 thousand jobs (a decline of 15 percent). Changes in the relationship between timber harvests and wood products employment between 1979 and 1986 are the subject of the analysis reported in Chapter 3.

Labor utilized per million board feet of timber are represented for the industry overall and its major subsectors logging, sawmills (softwood lumber) and softwood veneer and plywood in Figure 2.4.

FIGURE 2.4
Employment Per Million Board Feet of Timber
Processed in Oregon, 1968-85



Sources: U.S. Census Bureau
U.S. Forest Service
Oregon Department of Forestry

These utilization rates are based on reported employment in relation to the amounts of timber consumed (whether harvested in state or imported), as reported in mill surveys (USFS, various years). Labor utilization rates for the logging sector reflect state timber harvests (rather than state timber consumption) in relation to logging employment.

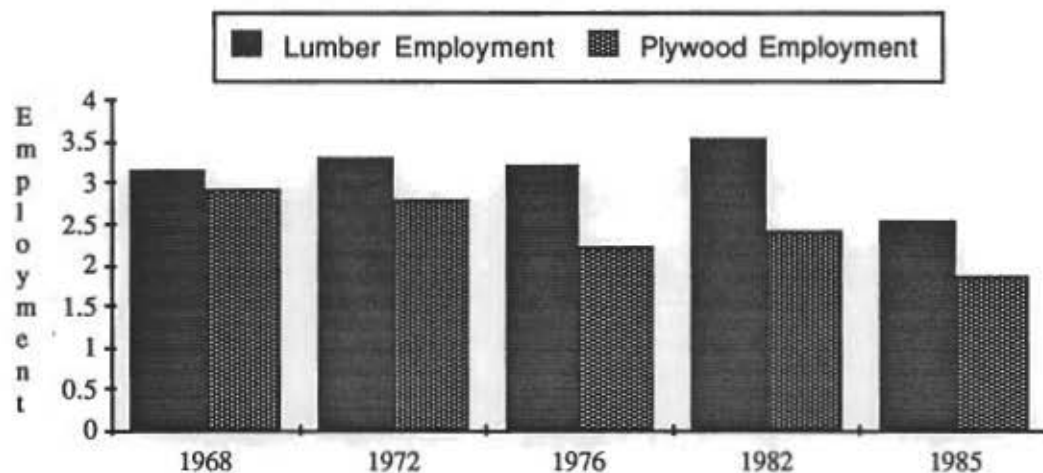
As Figure 2.4 indicates, labor intensity increased between 1968 and 1982 for the industry overall and the logging and sawmill sectors, while it declined slightly in the plywood sector. The average annual percentage rates of change in labor intensity for these

respective sectors during the period were 1.7, 3.0, 1.4, and -.8 percent. In contrast, labor intensity declined - in most cases rapidly - between 1982 and 1985. For the industry overall, employment per MBF timber processed fell at an annual rate of 5 percent during this period. For logging, the annual rate of decline was 1.4 percent, while for sawmills and plywood mills, it was 8.8 and 5.5 percent, respectively.

While labor utilization rates based on the processing of timber provide a useful picture of employment in the industry in relation to timber harvests, the analysis of labor productivity requires measuring labor inputs in relation to sectoral outputs. The primary outputs of the wood products industry in Oregon are softwood lumber and plywood. A measure of labor intensity related to these products would indicate the number of employees required to produce a fixed amount of lumber and plywood. It should be expected that rates of change in labor utilization per unit of output would be greater than rates per unit of timber input because the quantity of output produced from a given amount of timber (i.e., the recovery ratio) has increased over time (Adams et. al., 1987).

Measures of labor intensity in relation to lumber and plywood output are presented in Figure 2.5. The years covered are the same as in Figure 2.4 to allow comparison. We note that labor intensity in lumber production still shows an upward trend between 1968 and 1982, increasing at an annual rate of .8 percent. In the plywood sector, labor intensity declined at an average rate of 1.4 percent over the same time period. Between 1982 and 1985 labor intensity declined rapidly in both sectors; 10.4 percent annually for lumber and 7.9 percent annually for plywood.

FIGURE 2.5
Lumber and Plywood Employment Per MBF and MSF Output
in Oregon, 1968-85



Sources: U.S. Forest Service
U.S. Census Bureau

Gleaning from the information presented in Figures 2.4 and 2.5, we find that labor productivity improvements in the 1982-85 period were substantial, and in the lumber and logging sectors exhibited a reversal from the trend characterizing the 1968-82 period. Average annual rates of productivity growth between 1982 and 1985 were 1.4 percent in

logging, 10.4 percent in lumber production and 7.9 percent in plywood production. The reasons for these improvements are explored in Chapter 3.

At this point it may be useful to point out some of the possible sources of the recent productivity improvements in the industry. One source is termed "technical progress" and it covers productivity gains related to improvements in labor skills and changes in the condition of employment. Improvements in labor skills can result from the fact that workers retained during and following the past recession were generally more experienced and productive than those who were not retained. Further, there has been relatively less opportunity for entry of new workers in the industry in the 1980's, whose skills and productivity would be below those of more experienced workers. Changes in working conditions would include greater emphasis in linking pay, benefits and bonuses to productivity or production targets, providing an incentive for employees to increase their efforts. Another change in working conditions could involve expanding the number of hours worked.

Cyclical considerations may also have a bearing on labor productivity. The 1968-80 period was characterized by increasing capacity utilization in the industry, particularly during the latter half of the 1970's. Labor productivity is negatively affected as the limits of capacity are approached. Conversely, during a recession productivity tends to improve when less efficient capacity is idled.

Technical substitution between labor, capital and timber can also affect labor productivity. The rapid run-up in stumpage prices during the 1970's, for example, provided an economic incentive to utilize labor more intensively in processing relatively more valuable timber. Technically, this represents a substitution of labor for timber, with consequent negative implications for labor productivity gains. The reversal of stumpage price trends in the 1980's would have the opposite effect, generating relatively greater productivity improvements. The same argument would apply regarding the cost of capital in relation to labor or timber.

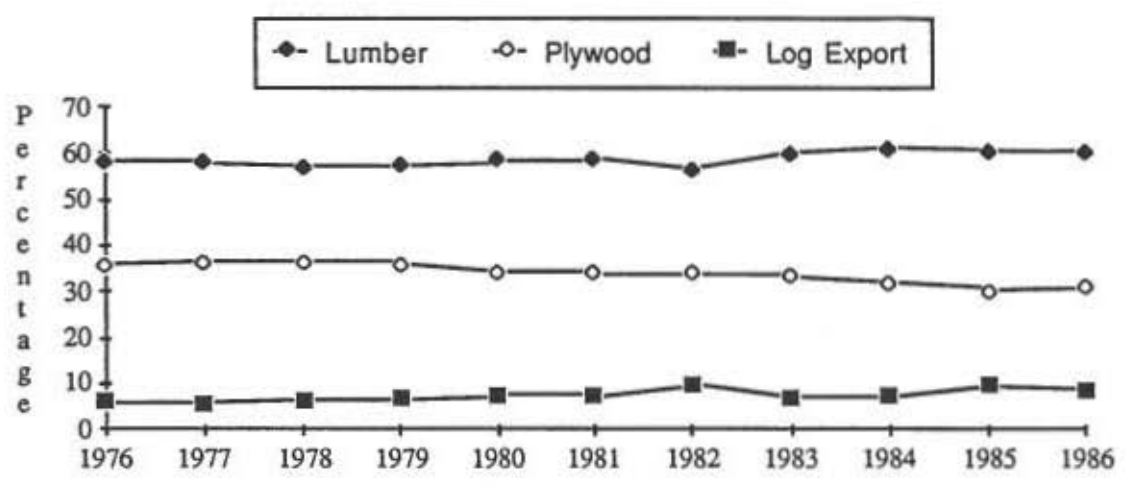
The classification of workers in the industry can also influence the measure of labor productivity. Firms in the industry report all full time employees for which they are required to provide social security coverage. Contract employees may be covered by firms classified elsewhere (e.g. in the Business Services sector). Thus, an increase in the proportion of contract employment may give the appearance of a change in productivity when, in fact, no change has occurred. A change in the mix of products within a sector can also produce changes in labor productivity. Lumber output can vary by grade and species over time, while variations in plywood output are mostly confined to grade. At the industry level, output is clearly not homogeneous, and changes in the mix of lumber, plywood, shipments of unprocessed logs and other wood products have occurred over time. Given that labor requirements vary substantially among the products in the industry and that rates of productivity improvements over time vary across products as well, the consequences of changes in product mix can be large for the industry.

Changes in product mix are indicated in Figure 2.6, which shows the composition of timber allocated to lumber and plywood production and log exports in Oregon. Between 1976 and 1986 the percentage of timber processed into lumber increased from 58 to 61. Log exports accounted for about 8 percent of total timber consumption in 1986, up from 6 percent in 1976. The percentage of timber processed into plywood, in turn, declined from about 36 to 31 over the decade.

The pattern associated with the change in mix illustrated in Figure 2.6 can be characterized as a shift from more labor intensive to less labor intensive processing of

timber in Oregon. Thus, apart from other factors affecting labor productivity in the wood products sector, changes in the sectoral mix of products had negative implications for employment in the industry. This issue will be explored further in Chapter 3.

FIGURE 2.6
Composition of Timber Consumption in Oregon, 1976-86
Percentage of Total Timber Consumption



Source: U.S. Forest Service

2.1.5 Timber Taxes and Fiscal Dependency

Revenues from timber harvests represent an important component of county government finance in Oregon. Harvest revenues are derived from a number of different sources and are governed by various tax laws. A distinction can be made on the basis of timber ownership, with private timber subject to state timber tax law and federally managed timber subject to payment provisions specified in Congressional legislation. Timber harvested from state forests provides a relatively small flow of payments to county governments, particularly in the survey area.

Three state timber tax laws underpin payments to county governments from privately-owned forests in Oregon. The Western Oregon Forest Land and Severance Tax applies to all counties west of the Cascades. Private timber harvested in these counties is subject to a 6.5 percent tax on stumpage value. Forest land is taxed separately on an annual basis, and is assessed at its true cash value for forest use. Alternatively, for owners of less than 2,000 acres containing trees averaging less than 40 years or smaller than 8 inches in diameter, the Western Oregon Small Tract Optional Tax may pertain. In this program, forest land is defined according to a site classification system with five timber quality - distinguishing categories. The true cash value of the land is then determined on the basis of site classification. Timber harvested under this program is not subject to the severance tax. The Eastern Oregon Severance Tax program covers privately owned timber in counties east of the Cascades. A tax of 5 percent is levied against the stumpage value of timber harvested. The value of forest land was set at \$25 per acre in 1982 and in subsequent years has been adjusted consistent with changes in timber values.

Harvests from the national forests provide revenues to local governments under the provisions of the National Forest Revenue Act of 1908, as amended. In this program, 25 percent of the receipts from federal timber sales are returned to counties containing the forest land. Seventy-five percent of the revenues received by the counties must be dedicated to roads, and the remaining 25 percent to education.

Harvests from the revested Oregon and California (O&C) Railroad lands also provide revenue to counties. Seventy-five percent of the harvest receipts are remanded to counties based on the distribution of O&C lands. No restrictions are placed on the use of two-thirds of these revenues, while the remaining third is earmarked for road construction and tree planting.

From the harvest receipts of state forests, 25 percent is earmarked for the county school fund and 40 percent is returned to the counties with no restrictions on spending.

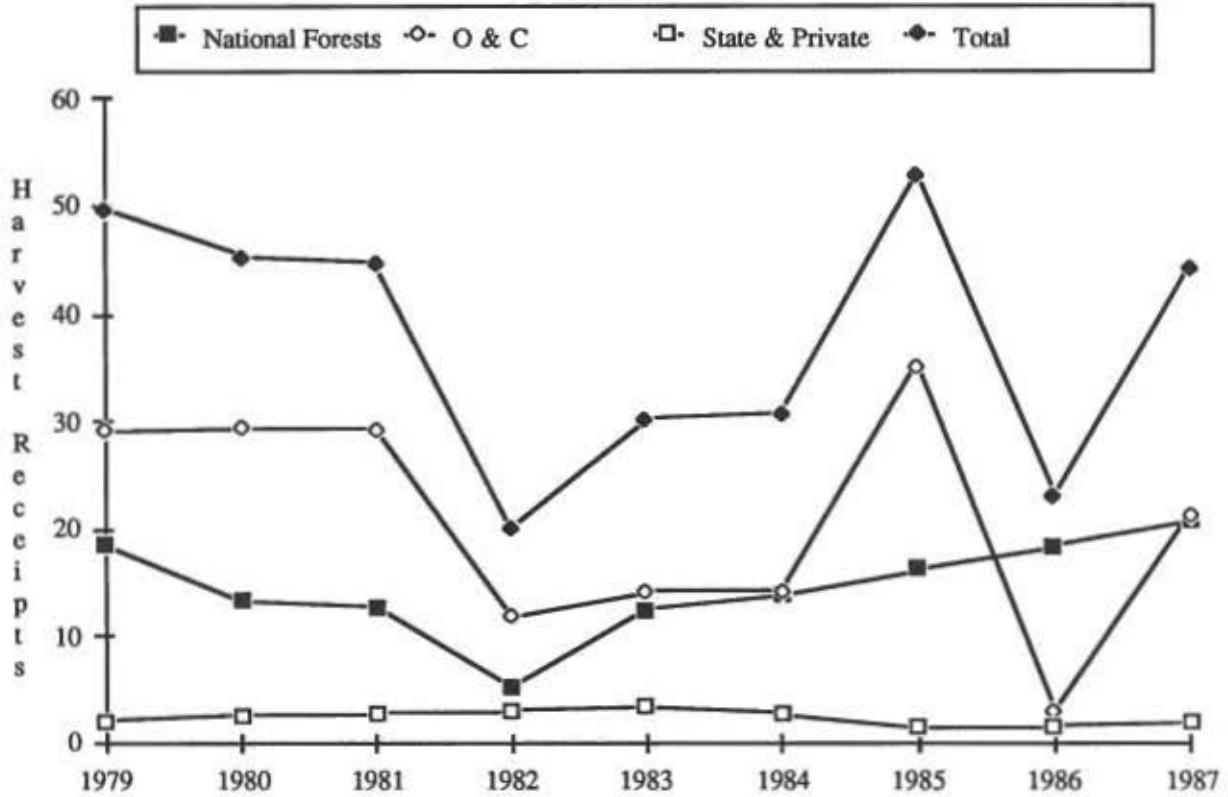
Payments to counties in the survey area from timber harvest receipts under the various programs mentioned above are presented in Figure 2.7. O&C payments from the Bureau of Land Management represent the largest source of harvest revenue to county governments, followed by receipts from the national forests and, to a much lesser extent, receipts from private and state harvests. The effect of the 1982-84 recession is quite evident in the trend of payments. Total receipts in 1982 were 60 percent lower than they were in 1979. The 1985-86 figures are skewed due to a BLM payment to counties in the latter part of FY 1985 that would normally have been made in FY 1986.

County revenues reported in the 1982 Census of Governments can be related to the timber harvest receipts to determine the extent of fiscal dependence on timber harvests. Revenues from all sources for the three counties in FY 1982 totalled \$73.8 million. Thus, timber harvest receipts accounted for 27 percent of all county revenues in that year. This percentage probably understates the dependency of the counties on timber harvest receipts given that 1982 was characterized by record low harvests and low stumpage values. Peterson (1980), for example, reported that national forest and O&C payments represented 69 percent of Jackson County's budget in FY 1978.

In addition to harvest receipts, counties derive property tax revenues directly from the industry (from its industrial property and forest land) and its employees (from residential property), and indirectly from the local service activity generated as a multiplier effect of wood products production. Considering harvest receipts as well as direct and indirect property tax revenues, it would be reasonable to conclude that local governments are highly dependent fiscally on timber processing activities.

Cyclical fluctuations in the revenue stream from these activities have been particularly problematic in the 1980's. The amplitude of the county timber revenue cycle has been greater than that for the harvest, production and employment cycles because low/high harvest levels are accompanied by low/high stumpage prices. Planning and administration of public services under these conditions is difficult.

FIGURE 2.7
 Survey Area Timber Harvest Receipts, FY 1979-87
 (\$millions)



Sources: U.S. Forest Service
 Bureau of Land Management
 Oregon Department of Revenue

2.2 Demographic Trends

2.2.1 Population Growth

The wood products industry represents a major source of export earnings for the survey area and Oregon. These earnings in turn support the retail and local service activities of other sectors of the economy in what can be characterized as an economic base system. From an employment standpoint, the dependency of the survey area and the state on the industry can be defined to include workers directly employed in wood products production and workers whose jobs rely on the local expenditures of the industry and its employees.

The labor force and their dependents represent the bulk of an area's population. When exports from an area increase over time, direct and local service employment

opportunities grow as well. These employment opportunities are satisfied by new workers entering the labor force from the resident population in addition to workers attracted to the area by the prospect of becoming employed. Alternatively, when exports decline over time employment opportunities vanish, and residents entering the labor force find job prospects unpromising. Finding employment may well require moving to another region. In short, this characterizes the economic basis for migration and population growth in an area. Not all moves are job-related, obviously, with retirees providing an example of relocation based on perceptions of natural amenities, cost of living and quality of life. Generally though, job-related moves represent the great majority of relocations.

The focus on migration in relation to area population growth is warranted by the fact that regional in and out-migration now represent a greater source of population change in the U.S. than does the net change due to natural increase among regional residents. This is especially the case for the regions experiencing cyclical volatility in their primary export sectors.

The economic basis for population change is quite apparent in Table 2.6, which presents population trends for the survey area, Oregon and the U.S. covering a near 30 year span. The populations of both the survey area and the state grew more rapidly during this period than the U.S., with rates of increase being 80 and 50 percent higher, respectively, than the U.S. These higher growth rates imply a net positive flow of people into the survey area and the state, partly in response to perceived economic opportunities.

The differences in growth rates between the survey area and state, and the U.S. are most pronounced during the 1970's. In this decade, the population in the survey area grew three times more rapidly than the nation, while the state growth rate was twice the national rate. Conversely, the 1980's have witnessed relatively smaller rates of growth for the survey area and state, with the survey area growing at 50 percent of the national rate and the state growing at only 30 percent of the national rate. These differentials suggest a reversal of the population flows to the survey area and the state. The periods of inflows and outflows of people to the survey area and state correspond well with the boom and bust periods in the wood products industry, reflecting the demographic sensitivity of the region to the economic health of one of its more important export sectors. Survey area and state migration flows are discussed in greater detail in the next section.

TABLE 2.6
Population Trends, 1960-87

	<u>Survey Area</u>		<u>Oregon</u>		<u>U.S.</u>	
	<u>Pop. (000's)</u>	<u>AAR%</u>	<u>Pop. (000's)</u>	<u>AAR%</u>	<u>Pop. (000,000's)</u>	<u>AAR%</u>
1960	151.4		1,768.7		179.3	
		1.8		1.7		1.3
1970	180.2		2,091.5		203.8	
		3.3		2.3		1.1
1980	250.5		2,633.2		227.3	
		.5		.3		1.0
1987	260.3		2,690.0		243.4	
AAR (%)						
1960-87		2.0		1.6		1.1

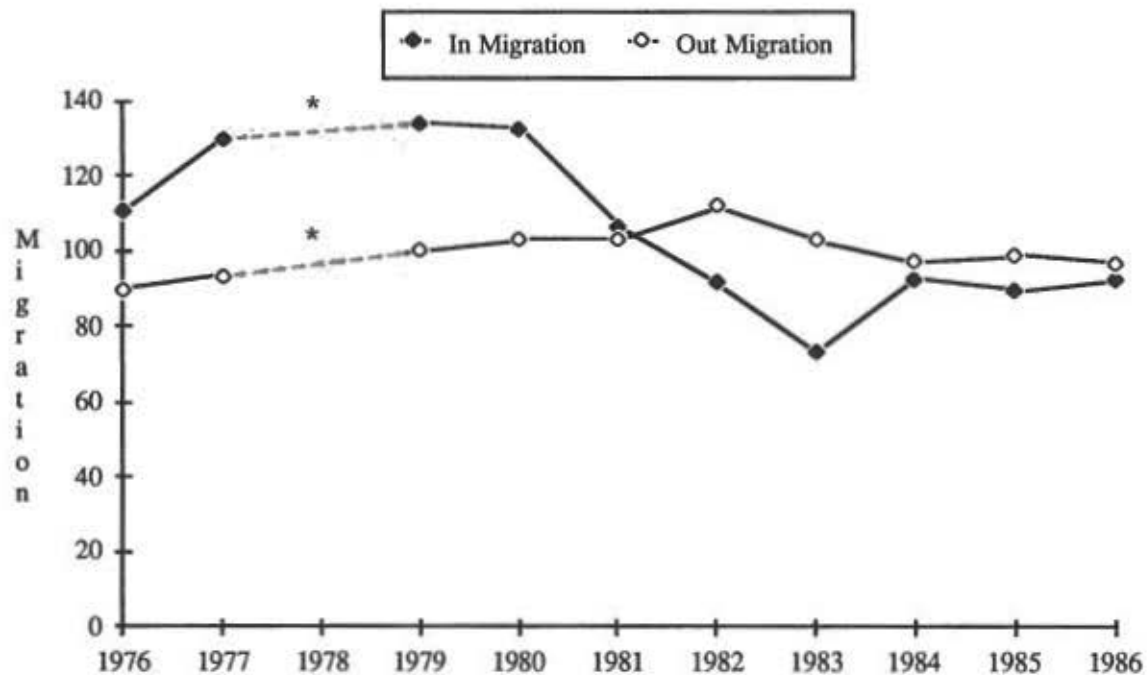
Source: Center for Population Research and Census

2.2.2 Migration

The effects of migration in response to economic conditions in the survey area and Oregon were especially apparent in the population growth profiles of the 1970's and 1980's presented in the last section. In this section, we focus more specifically on those flows and their implications. In this regard it is important to distinguish population inflows from outflows and to characterize the conditions of migration, particularly during the 1980's. For example, it is important to know whether the down-turn and high unemployment rates experienced in the survey area and the state during this time acted as "push" factors, motivating residents to look elsewhere for employment, or whether these conditions simply reduced the attractiveness of the region (the "pull" factors) to potential migrants from other regions.

Between 1976 and 1980, Oregon experienced a net gain from migration averaging about 30,000 annually (see Figure 2.8). By 1981, population inflows and outflows were roughly equivalent, and between 1982 and 1986 net outflows averaged nearly 14,000. The reason for the reversal in net migration is apparent in the figure: inflows between 1982 and 1986 dropped thirty percent from the average experienced between 1976 and 1980, while average outflows increased by only five percent for the same periods. Thus, it can be said that the effect of the economic downturn in reducing the attractiveness of Oregon to residents of other states was about six times greater than its effect in motivating Oregon residents to move elsewhere.

FIGURE 2.8
Oregon In and Out-Migration, 1976-86
(000's)



Source: Internal Revenue Service
* Migration data not reported for 1978

Migration flows for the survey area in 1980, 1983, and 1984 are presented in Table 2.7. The flows in the table are disaggregated into three components; intrastate, covering flows between the survey area and other counties in Oregon; intraregional, involving flows between the survey area and other states in the Western Census Region; and interregional, covering flows between the survey area and other Census Regions. Like the state, the survey area experienced a shift from net in-migration in 1980 to net out-migration in 1983. By 1984, however, the pattern of net inflows returned.

TABLE 2.7
Survey Area Migration Flows, 1980-84

	<u>Intrastate</u>		<u>Intraregional</u>		<u>Interregional</u>		<u>Total Flow</u>	
	<u>In</u>	<u>Out</u>	<u>In</u>	<u>Out</u>	<u>In</u>	<u>Out</u>	<u>In</u>	<u>Out</u>
1980	6,881	9,958	20,185	10,844	3,693	2,639	30,759	23,441
1983	3,591	3,979	6,904	7,616	1,493	1,897	11,988	13,492
1984	5,457	4,175	8,089	6,284	1,893	1,424	15,439	11,883

Source: Internal Revenue Service

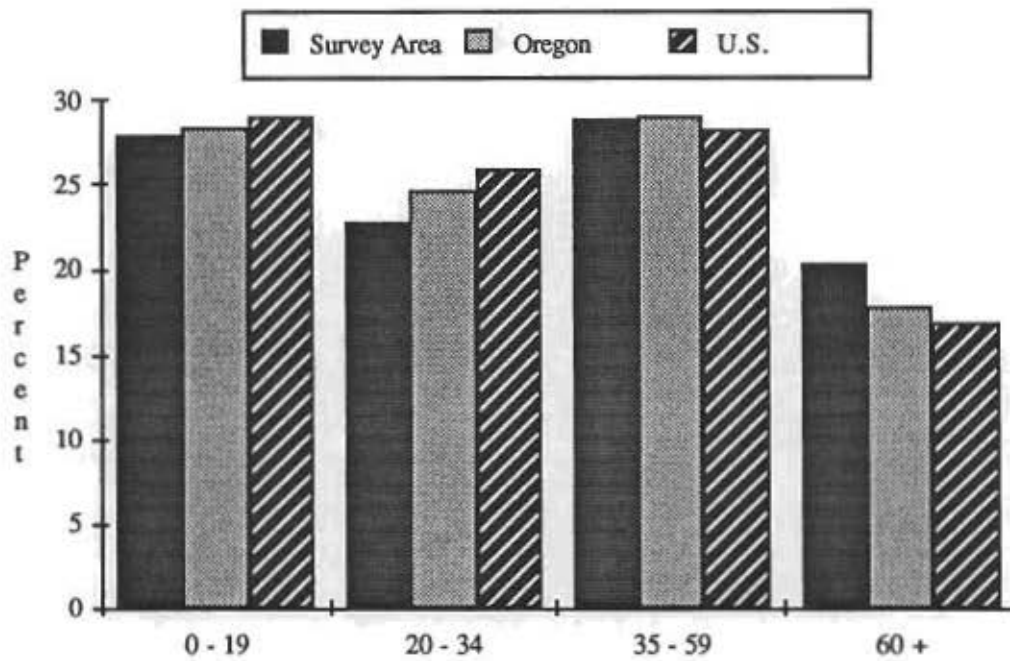
Another distinguishing feature was that the magnitude of outflows actually declined by an average of 46% in 1983 and 1984 from the 1980 level. Net out-migration occurred in 1983 only because the decline in inflows from 1980 - 61% - was so precipitous. It thus appears that push factors in the form of high unemployment rates exerted little effect in the survey area. Furthermore, while the survey area gained over 7,000 residents overall from migration in 1980, it actually lost about 3,000 in net migration to other counties in Oregon. In other words, net gains from intra and interregional migration more than offset net losses to other Oregon counties. For 1980, at least, this would suggest that non-economic factors may have been important in the perceptions of in-migrants from other states. Alternatively, it is possible that migrants to the survey area from other states did not adequately perceive the recessionary conditions that pertained there. In any respect, by 1983 the survey area suffered a net loss of population at the intra-state, intra-regional and inter-regional scales. This loss was a one-year phenomenon, and by 1984, net gains from migration were witnessed at all geographic scales.

While the examination of population flows provides insight on the effects of general economic conditions in Oregon and the survey area, it does not reveal much about the characteristics of the movers themselves. It is generally known from the economic literature on migration that employment motivated movers tend to be younger, better educated, more productive and earn higher incomes than those who do not move. The age distribution patterns illustrated in Figure 2.9 are thus quite interesting. Given the relatively higher rates of population growth in the survey area and state until the early 1980's, the economic perspective on migration would suggest an age distribution with a relatively higher concentration of population in the younger to middle age brackets. For the survey area, however, we see a higher concentration in the 60+ age group and a lower concentration among those younger than 35. This would imply that the movers to the survey area can be more generally characterized as retirees rather than job-seekers, and this has very important implications for the analysis of structural changes in the local economy.

In effect, retirees generate "export" earnings for the local economy, given that their incomes from pensions, transfer payments and other sources are derived from outside the region. Growth in this segment of the population can, to some extent, offset losses from

other export sectors. Also, the income stream associated with this group is less sensitive to the business cycle, and it thus provides a buffer against the volatility inherent in the wood products market and local economies dependent on wood products exports.

FIGURE 2.9
Age Distribution of the Survey Area, Oregon, and U.S. Populations, 1987
(Percent)



Source: Center for Population Research and Census

3. Analysis of the Decline in Wood Products Employment

In this chapter, we investigate causes of the decline in wood products employment in recent years. The consequences associated with this decline are also examined from the standpoints of community development, labor productivity and aggregate changes in economic activity. The losses of jobs attributable to changes in the quantity of timber processed, shifts in the mix of products produced by the industry, the reduction in labor intensity and changes in secondary processing are derived in Section 3.1. This is followed by an analysis of the general economic effects of changes in the mix of products processed from timber (Section 3.2). Changes in labor productivity are the subject of analysis in Section 3.3. The analysis of productivity gains is divided into two segments. The first provides a critical review of the economic research focusing on the structure of the production technology employed in the industry. The main concern in this review is to assess the influence of conventional economic determinants of labor productivity improvements in the industry, and to relate this assessment to the recent experience of the industry in this region. The second segment provides information on labor productivity changes obtained from a survey of mill owners, managers and employees. The purpose of the survey is to provide a more direct view of labor-affecting changes that have been implemented in recent years. In Section 3.4, interview responses of local officials in the survey area are presented to provide insight on the community development consequences of structural change in the industry. The major research and survey findings are presented and synthesized in the final section of the chapter.

3.1 Decomposition of the Employment Decline

In 1979, Oregon's wood products industry processed 9.2 billion board feet of timber, employing a work force of 76,000. Following a serious recession in the early 1980's, the industry recovered to the point where, in 1986, it processed 9.3 billion board feet of timber. However, only 65,000 workers were engaged in processing this timber. A major concern in this study is to identify changes in the industry that led to the reduction in employment, and to assess whether these changes represent a departure from historical trends. As discussed in the introductory chapter, the possible causes of employment decline include pure productivity improvements, substitution of other factors of production for labor, changes in the mix of products produced and, finally, changes in the total amount of timber processed by the industry. In this section we decompose the reduction in employment consistent with the alternative causes listed above. This is intended to provide a general perspective on the relative importance of these various causes in explaining job loss in the industry.

Methodologically, the approach used to disaggregate the decline in wood products employment isolates the various causes in a "partial" context. That is, parameters defining changes in labor utilization, product mix and the quantity of timber processed are applied to determine the marginal effect of a given cause on total employment, while holding the effects of other causes constant. The parameters defining changes in labor utilization, product mix and the quantity of timber processed are taken directly from the information presented in the previous chapter.

The period chosen for analysis extends from 1977 to 1986. The reasons for selecting these years are as follows:

- 1). The total amount of timber processed in these years was roughly equivalent. Thus, structural changes that could be related to the scale of production in the industry are less likely to be present.
- 2). The time span is long enough that the prospects of observed employment changes being the result of short-term aberrations and adjustments are minimized.
- 3). The two years correspond to similar points on their respective business cycles, thus reducing the chance that observed employment changes may be due to cyclical adjustments.

Wood products employment in 1977 totalled 71,434, while in 1986 it was 64,791. The employment loss thus amounted to 6,643 jobs. The components of this employment change are defined as follows (see Appendix A for technical documentation):

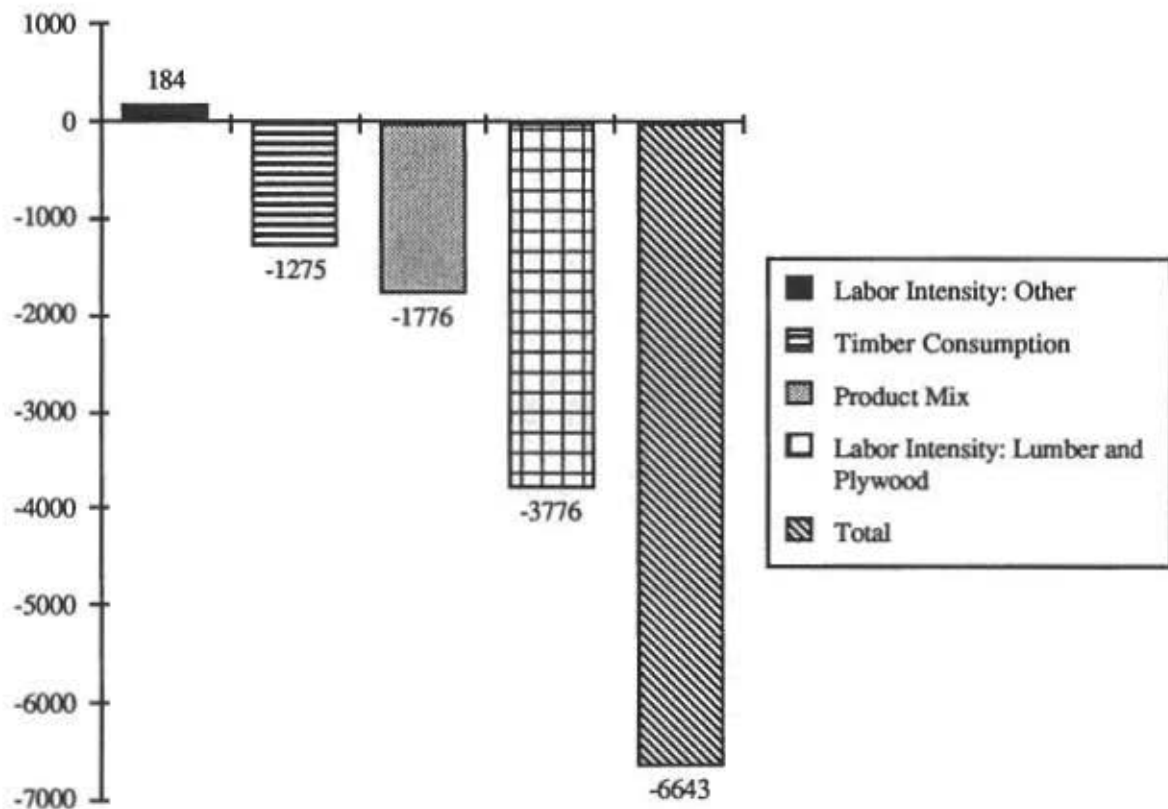
- A. Losses due to the reduction in timber consumption. About 170 million board feet less timber was processed in 1986 as compared to 1977. The first component estimates the reduction in employment due to this change, holding product mix and labor productivity at their 1977 values.
- B. Losses due to the change in the lumber/plywood mix. In 1977, lumber and plywood production accounted for 58 and 36 percent of all timber processed in the state. In 1986, their respective shares were 61 and 31 percent. The second component estimates the reduction in employment resulting from the shift in timber processing from a more labor-intensive (plywood) to a less labor-intensive (lumber) product, holding labor intensity for the two products constant at their 1977 values .
- C. Losses due to reductions in labor intensity in lumber and plywood production. In 1977, the industry required 4.3 workers to process a million board feet of timber input into lumber output and 5.8 workers to process the same amount of timber into plywood. By 1986, these requirements fell to 3.7 and 5.5 workers, respectively. The third component of employment change estimates the loss of jobs attributable to the reductions in labor intensity in lumber and plywood processing, with timber consumption and product mix set at their 1986 levels.
- D. Change in other wood products processing activity. This component of employment change deals with workers not engaged in lumber and plywood production (e.g., logging, secondary processing, etc.), and estimates the change in employment due to the collective change in labor intensity associated with these activities, setting the total amount of timber processed at its 1986 level.

The changes in employment in the wood products industry associated with the four categories described above are presented in Figure 3.1. The loss of employment due to the reduction in labor intensity in lumber and plywood production amounts to 3,776 jobs, representing about 55 percent of all losses experienced during the period. The second largest source of lost employment is associated with the shift in timber processing from plywood to lumber. This shift led to a loss of 1,776 jobs, or about 26 percent of all losses. A reduction in the total amount of timber processed by the industry accounted for the loss of 1,275 jobs, almost 19 percent of total losses. Other wood processing activities actually experienced an increase in labor intensity, resulting in a gain of 184 jobs. Given the

diversity of products contained in the "other" category, this increase most likely reflects a shift in product mix toward more labor intensive secondary processing.

Estimates of the components of employment change presented in this section provide a general breakdown of the role of selected factors influencing labor utilization in the wood products industry in Oregon. In the following sections, the two most important factors associated with the changing employment scene in the industry - shifts in product mix and labor productivity improvements - are analyzed in greater detail.

FIGURE 3.1
Components of Employment Change, 1977-86



3.2 Analysis of the Change in Product Mix

To estimate the effects of changes in the mix of wood products on output, employment, income and tax revenues in Oregon, the U.S. Forest Service IMPLAN model (Alward, 1985), an input - output model of inter - industry relations in the state, was adopted. The input - output framework is well suited for this type of analysis because it provides a very detailed representation of inter - industry linkages between the wood products industry and the other sectors of the state's economy. Hence, it allows us to

examine the effects of changes in the wood products sector on the output, employment and income of other sectors linked directly and indirectly to it.

The analysis includes log exports in addition to lumber and plywood. Log exports were excluded from product mix consideration in the last section because this activity cannot be specifically related to the established industrial classification of employment. Rather, log export activity involves harvesting and hauling, debarking/canting, brokering and port services. The difficulties in relating log export activities to the classification of sectoral activities also carry over to their treatment in the input - output framework; that is, there is no log export sector in the model. This can be resolved by adopting a "bill of goods" approach, wherein the producer price margins for the various activities noted above are determined and used to allocate corresponding values to their originating sectors (i.e., logging, transportation services, business services and sawmills). However, information on the producer price margins for log export activity does not exist. As a result, the approach adopted in the analysis is to allocate log export activity entirely to the logging sector, which captures the largest price margin for this activity. The end effect of this approach will be to underestimate the overall level of economic activity associated with log export activity, and this should be kept in mind in evaluating the outcomes of the input - output analysis.

The IMPLAN model is used to evaluate four alternative scenarios addressing changes in product mix in the wood products industry. In the first scenario ("1976 Mix") we estimate the net change in economic activity in Oregon that would result from allocating the timber processed in 1986 to the sectors producing lumber, plywood and log exports in the same relative proportion as in 1976 (see Figure 2.6). The remaining three scenarios address the economic trade-offs resulting from a marginal shift of timber (one percent of the total amount processed) from one product to another. The marginal shifts evaluated include (1) "plywood to lumber"; (2) "log export to lumber"; and (3) "log export to plywood." Given that each trade-off scenario implies its reciprocal, all possible trade-offs among lumber, plywood and log exports are covered.

The changes in sectoral timber consumption for the four scenarios are presented in Table 3.1. In the first scenario, the amount of timber processed into plywood increases by 440 million board feet. This is offset by reductions of 204 and 236 million board feet of timber devoted to lumber production and log export. The three trade-off scenarios involve shifts of 94 million board feet of timber between the relevant sectors.

TABLE 3.1
Net Changes in Timber Consumption for Alternative Scenarios
(million board feet)

<u>Scenario</u>	<u>Sawmills</u>	<u>Plywood Mills</u>	<u>Log Export</u>
1. "1976 Mix"	-204	440	-236
2. "Plywood to Lumber"	94	-94	0
3. "Export to Lumber"	94	0	-94
4. "Export to Plywood"	0	94	-94

In order to execute the input - output analysis it is necessary to convert the timber consumption changes in Table 3.1 to corresponding changes in the values of sectoral final demand. This involves the following steps (see Appendix B for technical documentation):

- A. The sectoral changes in timber consumption are converted to changes in sectoral employment.
- B. The changes in sectoral employment are converted to changes in sectoral gross output.
- C. Sectoral changes in final demand are derived from sectoral gross output changes.

The changes in sectoral final demands associated with the four scenarios are given in Table 3.2.

In the first scenario, where timber consumption reflects the pattern that existed in 1976, a net increase in final demand of \$42 million results. This increase is the result of gains in the value of plywood final demand more than offsetting losses in lumber and log export final demand. Of the three trade-off scenarios, only the "export to plywood" alternative generates a net increase in final demand. That the "export to lumber" trade-off produces a net reduction in total final demand is, on the surface, surprising. This outcome was the result of relative differences in the inter - industry linkages for the two sectors rather than their individual contributions to gross output (as is evident in the end results).

TABLE 3.2
Changes in Final Demand for Alternative Scenarios
(millions, 1982 dollars)

<u>Scenario</u>	<u>Sawmills</u>	<u>Plywood Mills</u>	<u>Log Export</u>	<u>Net Change</u>
1. "1976 Mix"	-98.535	283.478	-142.480	42.463
2. "Plywood to Lumber"	44.571	-60.698	0	-16.127
3. "Export to Lumber"	43.821	0	-54.563	-10.742
4. "Export to Plywood"	0	60.499	-55.713	4.786

The net changes in gross output, total income, state and local government tax revenues* and employment resulting from the changes in final demand for the four scenarios are summarized in Figure 3.2. In regard to the "1976 Mix" scenario, the results indicate that had the timber processed in 1986 been converted into the product mix in the same relative proportions that existed in 1976, gross output in Oregon would have been \$153 million higher, total income would have increased by \$56 million, tax revenues would have increased by \$5 million and 2400 more jobs would have been generated. For the three trade-off scenarios, the "plywood to lumber" shift produces reductions in gross output, income, tax revenue and employment totaling \$35 million, \$12 million, \$1.2 million and 380 jobs. The "export to plywood" scenario, alternatively, results in increases of roughly the same magnitude. The "export to lumber" scenario shows a slight increase in economic activity.

* Estimates of the change in state and local government tax revenues were derived by multiplying the change in total income reported by IMPLAN by the average tax rate on all income in Oregon in 1982 (ACIR, 1983). Tax revenue estimates for the scenarios should be viewed as an approximation, given that they do not reflect the compositional differences in income earned within and across sectors by proprietors and employees.

FIGURE 3.2
Net Change in Gross Output, Total Income, Tax Revenues and Employment
For Alternative Input - Output Scenarios
(millions, 1982 dollars; Full-Time Equivalent Jobs)

FIGURE 3.2 a.
"1976 Mix" Scenario

Gross Output:	152.708
Total Income:	55.627
Tax Revenue:	5.345
Employment:	2,428

FIGURE 3.2 b.
Trade-Off Scenarios

SHIFT FROM

	Lumber	Plywood	Export
TO	N.A.	Gross Output: -35.008 Total Income: -12.201 Tax Revenue: -1.172 Employment: -381.0	Gross Output: .002 Total Income: 1.032 Tax Revenue: .099 Employment: 294.0
Plywood	Reciprocal of "Plywood to Lumber"	N.A.	Gross Output: 34.190 Total Income: 12.943 Tax Revenue: 1.244 Employment: 672.0
Export	Reciprocal of "Export to Lumber"	Reciprocal of "Export to Plywood"	N.A.

Tables 3.3, 3.4, 3.5 and 3.6 provide more detailed information regarding the direct, indirect and induced economic linkages between the wood products sectors and other sectors of the Oregon economy. This disaggregation facilitates evaluation of the distributional consequences of the alternative scenarios apart from their aggregate effects. For example, in Table 3.3, reductions in output, income and employment are observed for the agriculture, forestry, fisheries and mining, and the construction sectors (along with the scenario - driven reductions in log exports and lumber sectors) in the "1976 Mix" scenarios, even though changes in the economic aggregates are quite positive. This indicates that the direct, indirect and induced linkages between these two sectors are relatively strong. This pattern is seen to hold through all the scenarios. Conversely, the Services and Retail Trade sectors exhibit relatively stronger linkages to the plywood sector, given the greater labor intensity associated with plywood production.

Gross output, employment and total income multipliers for the logging, sawmill and plywood sectors, and for the four alternative scenarios are presented in Tables 3.7 and 3.8. These multipliers represent the change in gross output, employment and income that would result from a corresponding unit change in their respective final demand values. Given a million dollar increase in final demand in the logging sector, for example, the multiplier in Table 3.7 for that sector indicates that this change would lead to a \$1.76

million increase in gross output in the Oregon economy. The differences between the total increase in gross output and the increase in final demand is attributable to the indirect and induced economic activity in logging and other economic sectors that results from the direct increase in final demand for the logging sector's product. To satisfy an increment in the demand for its product the logging sector must purchase the products of other sectors in the regional economy. The most important transactions in this regard involve, in order of decreasing magnitude, the following sectors: Agriculture, Forestry and Fisheries; Wholesale and Retail Trade; Primary and Secondary Metals Manufacturing; Transportation, Communication and Utilities; and Business Services. In expanding their output in response to demands from the logging sector, these sectors also place demands on their suppliers. Thus, a marginal change in the output of one sector triggers a diffusion of transactions throughout the economy, with the pattern of diffusion determined by the structure of inter - industry linkages. Finally, each sector must employ additional workers to produce an increment in output. The wages paid to these workers are, in turn, spent to satisfy household consumption needs, resulting in another source of diffusion of economic activity (termed the "induced" effect). The output multipliers in Table 3.7 for the sawmill and plywood mill sectors are considerably higher than the multiplier for the logging sector, indicating that their indirect and induced linkages to other sectors in the regional economy are more extensive.

The multipliers in Table 3.8 represent the magnitude of the net change in output, employment and income resulting from a net unit final demand change among the logging, plywood mill and sawmill sectors. Because the scenarios examine shifts in the allocation of timber among the three sectors, these multipliers reflect the composite effect of the direct, indirect and induced increases associated with sectors receiving marginally more timber, minus the direct, indirect and induced reductions associated with sectors receiving marginally less timber. Given the differences in sectoral multipliers, the differences in the values of the alternative products that can be recovered from a fixed amount of timber and the pattern of inter - industry linkages among the three wood products sectors, a marginal shift in timber consumption from one sector to another can result in scenario multipliers that exceed the individual sectoral multipliers. For example, the output multiplier for the "1976 Mix" scenario is 3.60. The magnitude of this multiplier is attributable to two effects: 1) a shift of timber from a sector with a lower multiplier (logging) to a sector with a higher multiplier (plywood) occurred; and 2) the value of output that can be generated from given amount of timber input is greater in the plywood sector than in the logging and sawmill sectors.

The "Export to Lumber" scenario actually resulted in a negative scenario multiplier for output and income, which is quite unusual. What this means is that the net indirect and induced changes in output and employment run counter to and more than offset the net change in final demand. In this case the net reduction in final demand resulting from shifting timber from exports to lumber production is more than offset by the indirect and induced increases in output and income. As the employment multiplier for this scenario indicates, the shift from exports to lumber resulted in a net increase in final demand employment.

TABLE 3.3

Results of the "1976 Mix" Input - Output Scenario

	Change in Gross Output (millions, 1982 dollars)	Change in Total Income (millions, 1982 dollars)	Change in Employment
Agr, Forestry, Fisheries, Mining	-28.571	-13.044	-276.34
Construction	-.652	-.297	-8.73
Wood Products			
Logging	-91.112	-26.848	-360.76
Sawmills	-97.747	-33.534	-1068.72
Veneer & Plywood	312.108	101.458	3096.56
Other Wood Products	5.432	1.474	62.64
Other Manufacturing	5.395	1.538	47.07
Trans., Comm. & Utilities	11.409	5.010	107.03
Wholesale - Retail Trade	13.472	7.533	365.83
Fin., Insurance & Real Estate	9.964	5.934	81.54
Services	11.651	5.798	334.65
Gut. Enterprises & Industry	1.256	.502	18.05
Activity N.E.C.	.103	.103	28.97
TOTAL	152.708	55.627	2427.76

TABLE 3.4

Results of the "Plywood to Lumber" Input - Output Scenario

	Change in Gross Output (millions, 1982 dollars)	Change in Total Income (millions, 1982 dollars)	Change in Employment
Agr, Forestry, Fisheries, Mining	-586	-242	-5.76
Construction	-256	-116	-3.42
Wood Products			
Logging	-1,239	-365	-4.90
Sawmills	45,076	15,464	492.84
Veneer & Plywood	-66,712	-21,686	-661.88
Other Wood Products	-1,162	-322	-13.84
Other Manufacturing	-1,514	-456	-13.67
Trans., Comm. & Utilities	-1,920	-842	-17.82
Wholesale - Retail Trade	-2,678	-1,497	-72.72
Fin., Insurance & Real Estate	-1,703	-1,008	-14.58
Services	-2,114	-1,040	-57.82
Govt. Enterprises & Industry	-184	-75	-2.63
Activity N.E.C.	-16	-16	-4.54
TOTAL	-35,008	-12,201	-380.74

TABLE 3.5

Results of the "Export to Lumber" Input - Output Scenario

	Change in Gross Output (millions, 1982 dollars)	Change in Total Income (millions, 1982 dollars)	Change in Employment
Agr, Forestry, Fisheries, Mining	-11.661	-5.281	-112.93
Construction	-.664	-.303	-8.89
Wood Products			
Logging	-36.166	-10.657	-143.20
Sawmills	45.093	15.470	493.02
Veneer & Plywood	.220	.072	2.18
Other Wood Products	.003	.001	.07
Other Manufacturing	-.507	-.197	-5.98
Trans., Comm. & Utilities	1.055	.468	10.30
Wholesale - Retail Trade	.548	.306	14.88
Fin., Insurance & Real Estate	.968	.586	6.82
Services	.944	.487	31.70
Govt. Enterprises & Industry	.177	.068	2.57
Activity N.E.C.	.012	.012	3.51
TOTAL	.022	1.032	294.05

TABLE 3.6

Results of the "Export to Plywood" Input - Output Scenario

	Change in Gross Output (millions, 1982 dollars)	Change in Total Income (millions, 1982 dollars)	Change in Employment
Agr, Forestry, Fisheries, Mining	-11.379	-5.177	-110.13
Construction	-.431	-.196	-5.77
Wood Products			
Logging	-35.857	-10.566	-141.98
Sawmills	.784	.269	8.57
Veneer & Plywood	66.716	21.688	661.92
Other Wood Products	1.162	.322	13.84
Other Manufacturing	.973	.244	7.31
Trans., Comm. & Utilities	2.970	1.307	28.08
Wholesale - Retail Trade	3.197	1.788	86.81
Fin., Insurance & Real Estate	2.650	1.582	21.20
Services	3.017	1.511	88.76
Gut. Enterprises & Industry	.360	.143	5.19
Activity N.E.C.	.028	.028	8.01
TOTAL	34.190	12.943	671.81

TABLE 3.7
Oregon Wood Products Sectoral Multipliers

<u>Sector</u>	<u>Output</u>	<u>Employment</u>	<u>Income</u>
Logging	1.76	3.38	2.14
Sawmills	2.16	2.09	2.32
Plywood Mills	2.14	2.27	2.37

Source: U.S. Forest Service

TABLE 3.8
Input - Output Scenario Multipliers

<u>Scenario</u>	<u>Output</u>	<u>Employment</u>	<u>Income</u>
"1976 Mix"	3.60	1.57	3.40
"Plywood to Lumber"	2.17	1.81	2.75
"Export to Lumber"	-.10	1.26	-.99
"Export to Plywood"	2.70	1.51	3.80

Changes in product mix have been found to account for about one-fourth of the reduction in employment in Oregon's wood products industry. The trade-off analysis also reveals the types of structural shifts that tend to produce job losses, both directly and indirectly. The marginal shifts in product mix resulting in reduced employment are, in order of increasing magnitude, (1) lumber to export; (2) plywood to lumber; and (3) plywood to export.

To this point, we have addressed the economic consequences of changes in product mix, rather than the causes of the change. Conceptually, it can be argued that the shifts represent an example of "factor mobility," wherein timber is processed into alternative products in correspondence with the relative returns that can be obtained in the market from the sale of those products. Given a change in the relative returns to timber among alternative products, one would expect a shift in timber allocation toward products where the relative returns are increasing. This would imply that the returns to timber processed into lumber and log exports are increasing relative to the returns from plywood. A cursory view of the relative product price trends for lumber, plywood and log exports over the post-1982 period tends to support this perspective. Thus, it can be said that the observed change in product mix has been consistent with conventional economic theory, as well as in the best interests of Oregon's wood products industry. The consequences of the shift for employment in the state's timber dependent regions, however, have not been favorable. Some structural displacement of jobs has resulted, along with the need to address strategies of adjustment to these changes.

3.3 Analysis of Labor Productivity Changes

Labor productivity is normally represented by measures of output per unit of labor input. Increases in labor productivity for the economy as a whole are essential for a rising standard of living. Yet, increasing productivity in a particular industry may also be associated with declining employment, as a given level of output is created with fewer and fewer workers. Some productivity improvements are associated with finding better ways to do things. These productivity improvements are referred to as technological change; but increases in labor productivity can also result from changing the mix of inputs. For example, many workers who lift and carry objects might be replaced by one worker with a machine. This substitution of capital for labor leads to a higher level of output per worker.

Productivity changes associated with a change in the mix of inputs are different from those associated with technological progress because they may be reversed. Once we know a better way of doing something, there is no reason to revert to the older, less productive way of doing it. Thus, technological progress implies a permanent increase in output relative to inputs. However, changes in inputs associated with relative price differences for the inputs can be reversed if the price ratios change. Other characteristics of the inputs may also be of importance in determining their relative use in the production process; but these are usually small effects relative to those created by factor price differences.

Labor productivity in the wood products industry has risen substantially in the 1980's. There are many possible explanations for this increase in productivity. For example, workers may be more productive because they are working more efficiently, or because they have been replaced by machinery, or because of various work rule changes.

Alternative causes of increases in worker productivity imply different things about future labor requirements in the wood products industry in Oregon. One possibility is that the loss in employment merely represents a change in the structure of the industry. For example, if there is more contracting of work to other companies rather than direct hiring of the workers, then these employees might show up as service workers rather than wood products workers in the official statistics. Thus, the decline may be more apparent than real. Another possibility is that the decline in employment may be associated with a reduction in the availability of labor rather than a reduction in the demand for labor. This might occur if the potential workers see other opportunities as either more rewarding or more stable.

The specific reasons for the decline in wood products employment will largely determine the extent of the problems faced by the timber-dependent regions and the appropriate types of policy responses by local and state governments. If the decline in employment is associated with reduced demand for labor, then attempts to retrain workers or attract alternative types of employment may be quite beneficial. However, if the decline is associated with the reduction in the supply of workers, then either training or new job prospects are likely to create further labor problems for the industry.

3.3.1 Labor Productivity

As noted, the simplest measure of labor productivity is output per unit of labor. However, even such a simple measure faces problems of measurement and definition. The first is that the output we want to consider is not homogeneous, so it is necessary to either

look at the value of the output or to lump together dissimilar products in determining the amount of output produced. Either approach can have serious disadvantages. The use of product value can distort the view of output in an industry when prices fluctuate significantly. However, the use of a volume measure often masks differences in the types of output which are aggregated together. This can be a problem, for example, if we must aggregate logs, lumber, plywood, mobile homes and millwork, among other products, as outputs. Each product requires a different amount of labor per unit of output; and the mix of outputs may change over time or over the business cycle.

Once a measure of output has been chosen, we face the problem of measuring the labor input. This is complicated by a number of factors. The most serious measurement problems revolve around the number of workers when something happens that changes the way in which an industry counts workers. For example, if changes in the structure of the industry cause an increase in the use of contract labor relative to direct hires, then the measured labor usage in the industry would decline. If firms which previously hired accountants directly were now to purchase accounting services, actual employment would remain the same, but the accountants would no longer be counted as employees in the original industry. Another problem arises if the number of hours worked per worker changes substantially. For example, if the measurement is output per person-year and each person starts working ten percent more hours each year, the observed productivity increase would not be the same as if there were ten percent more output with the same number of hours worked.

There are several reasons why labor productivity could increase even after adjusting for all measurement problems. Substituting capital for labor is perhaps the most significant reason for such an increase. At the extreme, a fully automated plant might require only a few workers to produce the same output that would require hundreds of workers in a less automated plant. Another major cause of increases in output per worker is the use of new methods and new machines. For example, the increased use of computers may improve work scheduling so that each worker spends less time waiting or looking for parts. While these are the things most people think about when they consider increases in labor productivity, there are a variety of other factors which also show up as an increase in output per worker but which may not have the same implications as increases in capital or improved work methods.

If there are rigid work rules, labor productivity tends to be fairly low. Changes in work rules can cause an increase in labor productivity without any change in either capital per worker or in the quality of the equipment used. While these changes may lead to an increase in productivity, it is unlikely that they can be repeated at regular intervals. Thus, changes in work rules lead to a one-time increase in productivity rather than a change in the trend of productivity improvements. A related effect occurs if management adopts new techniques to use labor more effectively or to better motivate workers. Again, such changes tend to have one-time effects rather than changes in the trend of productivity.

Finally, the measured productivity of labor also will depend on choices made about the use of labor in the industry in response to relative prices of inputs and outputs. If the value of output and the cost of timber are high, it makes economic sense to recover more product from each unit of timber processed. While this also requires marginally more labor, the value of the additional output recovered can compensate for such costs. Alternatively, if the cost of timber is low then it may be less expensive to purchase more timber inputs and allow lower recovery to conserve on the use of labor. Thus, the measure of labor productivity is likely to be sensitive to the cost of other inputs and the price of the output. It is also likely to be sensitive to the quality of the input. High quality inputs used to create valuable end products justify more expenditure on labor to recover as much output

as possible and to ensure the quality remains high. A low quality input does not warrant the same amount of effort.

There are three predominant input prices in the wood products industry: the price of labor, the price of capital, and the price of stumpage. Changes in any of these prices relative to the others can affect the input mix. Thus, a rise in the price of capital might make it cost efficient to use more labor intensive methods of production; or a rise in the price of stumpage might make it worthwhile to use additional capital and labor to get more output out of each unit of timber processed.

It would not be possible to determine the exact causes of the changes in the ratio of labor to output in the past. It is possible, however, to estimate the contribution of changes in input prices on the use of inputs. Residual changes in output per unit of input can be attributed to the effects of changes in technology. This information can then be used to refine forecasts of labor productivity.

Most studies find that capital and labor are weak substitutes for each other in the wood products industry. However, the empirical estimates of the rate of substitution between capital and labor cover a very wide range. For example, Stier (1980) reports estimates of the elasticity of substitution between capital and labor in the wood products industry ranging from a low of 0.03 to a high of 2.5 (p. 479). This means that a rise of one percent in the relative price of one input could lead to changes in the use of the other input ranging from close to zero to over two and one-half percent. Such a wide range of estimates means that these parameters must be used very cautiously. However, the statistical estimates do provide useful information which can be supplemented with other information to provide a more precise estimate of what has been happening in the wood products industry.

While the elasticity of substitution between capital and labor is the most important statistical parameter for determining why employment is declining relative to output, there are a variety of other estimates which also provide useful information. An alternative method for recovering the relationship between capital and labor is to estimate the effect on labor of an increase in the capital stock. By this method of estimation, an increase in the capital stock of one-percent was found to lead to a 0.18 percent increase in the amount of labor used; in addition, there is an estimated 0.28 percent increase in the amount of lumber produced. Thus, the capital-labor ratio increases and the output-labor ratio also increases by a small amount (Constantino and Haley, 1987).

Similarly, the level of output per worker is dependent on the relative cost of the stumpage input. When the price of stumpage increases, less output is likely to be produced; but the reduction in labor input is not likely to be as great as the reduction in output. One study estimated that an increase of one-percent in stumpage prices would cause a decrease of 1.13 percent in lumber output, but a decrease of only 0.52 percent in labor input. Thus, the amount of labor per unit of output would increase by about 0.59 percent (Constantino and Haley, 1987). The increase in labor relative to output is associated with attempts to recover more marketable product per unit of stumpage. Thus, stumpage productivity would increase while labor productivity would decrease.

The ability to substitute labor for the raw material as an input is surprising to some, but it offers one of the more important potentials for maintaining employment in the wood products industry in Oregon. Most forecasters expect stumpage prices to rise relative to wages over time, and it will make economic sense to use additional labor to process more output per unit of raw material.

3.3.2 Factor Substitution and Productivity Effects

There are several studies of the impact of changes in the ratio of capital to labor in producing output in the wood products industry at the national level. Jorgenson (1988) reports that from 1948 to 1979 output in the lumber and wood products sector grew at a compound annual rate of 2.9 percent per year. Virtually all of this growth in output was associated with increases in the capital and intermediate inputs rather than the labor input. In fact, employment in the industry declined slightly over the period. After controlling for substitution effects, labor productivity growth was found to be negligible.

The Bureau of Labor Statistics (1986) finds nationally that output per employee hour in Sawmills and Planing Mills was nearly constant from 1970 to 1979, and that it then rose by almost 30 percent between 1979 and 1984. Alternatively, output per employee hour rose steadily from 1970 to 1984 in Veneer and Plywood Mills, except for the late 1970's (1986, pp. 9 and 13). Over the entire period the national productivity gain was at an annual rate of 1.7 percent per year in Sawmills and Planing Mills and 2.5 percent per year in Veneer and Plywood Mills (p. 11).

The data indicate that there has been an increase in output per worker over time, but that the major cause of this increase appears to result from the substitution of capital for labor. However, there was a substantial difference between what happened before and after 1979. The major increase in output per worker that occurred in the early 1980's is not substantial enough to invalidate the information based on long term trends. However, there are still many possibilities as to the cause of the observed shift. Further, the wide range of elasticity estimates reported and the sensitivity of these estimates to specification of the production process render the statistical results somewhat ambiguous. Thus, the observed changes in output per worker over the time period could be as much associated with productivity improvements in the industry as with changes in the input mix.

The situation is further complicated by consideration of the other stumpage input. Recent studies (Constantino and Halley, 1988) conclude that the labor input is very sensitive to changes in the quality of the timber input. As the quality of timber declines, more labor is required per unit of output. Further, they find that input quality has been consistently declining in the Pacific Northwest over time. Thus, real labor productivity gains are likely to be understated by studies which do not take timber input quality into account. The improvements in capital stock relative to labor were at least partly offset by declines in the average quality of the timber processed.

Another area which was investigated as part of this study concerned the mix of workers, especially between the skilled and unskilled segments. A typical effect of technological change or of substituting capital for labor is to increase the use of skilled relative to unskilled labor. This effect would also be consistent with the higher than expected increases in output per worker in the industry. Surprisingly, in analyzing the occupational structure of employment in Oregon's wood products industry for the years 1977 to 1985, no support for this hypothesis was found. The gross breakdown of workers between skilled, unskilled, and management showed that there was a slight decrease in unskilled and management workers relative to skilled workers; but this change was of little significance. This characterization was further supported in the interviews, where the nature of the work and training were not perceived to have changed substantially following the introduction of new capital equipment. Rather, the perception was that there have been increases in productivity, but no real change in the skills needed to operate the machinery.

The statistical analyses of the effect of changes in prices and quality of inputs provide important information. However, the statistical results are not reliable enough to stand on their own in analyzing recent employment changes in the wood products industry. Thus, information from the interview part of the study is needed in conjunction with the statistical results to permit drawing final conclusions.

3.4 Interview Results

Scattered though the valleys of Jackson, Josephine and Klamath Counties are the lumber and plywood mills of Southern Oregon. They are built near the railroads and waterways of the region, and draw on the resources of the great forests of pine and fir. Their presence dominates the landscape; they can be seen along the highways, in the center of towns, and at the edge of residential areas. Their huge stockpiles of logs extend over acres of land.

The mills are an integral part of the communities. They provide jobs and "good money" to those with little education and few specialized skills. Their production activities have created a relationship of dependency linking the economic well being of the communities with that of the mills. Signs of this dependency are seen up and down the main highways where businesses function to supply or feed off the operations of the mills.

Housed within large metal or wood frame structures, the mills often provide a harsh working environment. The temperatures within are determined by the outside weather and the heat generated by the machines. In the summer, when outside temperatures of 110 degrees are not uncommon, plants have registered temperatures as high as 140 degrees in some work areas, while in the winter, they can fall to as low as 40 degrees. The industrial process is deafening when logs are peeled or cut. Wood scraps layer the floors, dust fills the air and cobwebs line the rafters. Cleanup is a continual activity. The advent of computers and automated production lines has modified the environment somewhat. Computers frequently need controlled, cool temperatures to operate, and so they are housed with their operator in air-conditioned structures next to the production line. New production lines carry much of the scrap off to be processed. Government regulations have required employers to provide earplugs to reduce the impact of noise, and masks and/or filtration systems to control dust.

In the early part of the century, there were hundreds of mills throughout the valley. In the summer of 1988 (when the interviews were conducted) twenty six lumber and plywood mills with more than 50 employees were identified (14 lumber and 12 plywood), operated by fifteen different firms. Twelve of these firms (including 11 lumber and 12 plywood mills) were interviewed. Some of the mills are operated by large integrated firms such as Weyerhaeuser or Boise Cascade. Others are family businesses, as in the case of Gilchrist Lumber and Rough and Ready. Some are run by intermediate size corporations with a regional base, such as Medford Corporation (which was bought by a Texas businessman in 1984). Most of the mills (16) are non union . However, those that are union represent the largest employers in the area. Three of the firms, one integrated, one intermediate and one small have relied on private holdings to provide for some of their stumpage needs in the last 10 years. More recently, one mill (Crater Lake Lumber) was closed for a year following a fire, and another (Southern Oregon Plywood) closed permanently during the course of the interviews.

The recession of the early 1980's affected all of the mills interviewed. Two closed during this period and were later reopened by other firms(Croman and WTD Industries).

Several were shut down temporarily for a span of two weeks to ten months. Others went to shorter work weeks, imposed layoffs, or cut wages (which in most instances were restored in the last few years).

3.4.1 Managers

The following discussion reflects the information and perceptions of the managers of the mills on a variety of issues related to employment and production. A final section presents their policy concerns. While numbers are cited in the following discussion, the reader should appreciate the qualitative nature of the information presented. Moreover, it represents a fragmented picture of the operations of the mills in the region over the last 15 years. We have not interviewed managers of mills which have closed down, nor can we be certain that the mills in this region are representative of mills throughout Oregon. We have not focused on other mills engaged in secondary processing or mills which are producing other timber derivative products (e.g., particle board or hard board). We do believe, however, that the information gathered provides a more detailed picture of production and employment conditions defined in other sections of the report.

Employment. A majority of the lumber mills surveyed have experienced a slight decline in employment over the last 10 years. The actual reduction in employees ranged from two people in a small firm to seventy five people in one of the largest mills in the region. According to the mill managers, the reductions in employment were primarily the result of the introduction of new production technologies. At the same time, two mills with some technological innovation experienced an increase in employment due to overall expansion of production.

While permanent layoffs sometimes occurred with technological upgrading, the more common method of handling reductions was through attrition (e.g., retirements) and by moving displaced workers to other activities in the mill. Moreover, many managers were of the opinion that the new technologies often reduced labor requirements in one production area, but increased requirements in other areas. For example, a new technology might increase total production, which in turn increases the need for more workers at the finishing end of the production cycle.

As for their outlook over the next five years, most managers envision employment remaining at the current levels. In two cases the managers indicated that employment might decline, and in one case that a lumber mill would most likely close. Two factors were mentioned as most likely affecting employment and closures in the future: timber supply (in terms of volume and diameter) and an expected downturn in the construction industry.

In the plywood mills the employment experience has been somewhat different. Half of the mills have had an increase in employment over the last 10 years due to an increase in production. The remaining mills experienced a decline in employment, and one mill closed down permanently during the time in which the interviews were conducted.

The effect on employment of the introduction of new technologies in the plywood mills is not as apparent as with lumber because several that modernized also experienced an increase in production. That the new technologies reduced the demand for workers in certain job categories was, however, recognized by mill managers. The opinion was also expressed that the mills which closed in the early 1980's were those in which few or no technological changes had been made.

As for the future, most of the plywood mill owners and managers felt that employment would stay the same or decrease. Almost all noted that log supply, both in terms of quantity and size, would have the most effect in determining whether employment actually declined. The lack of technological improvements for some firms was also mentioned as a factor which made certain mills more vulnerable to changes in log supply. At the same time, one firm mentioned that consideration was being given to building a new plywood layup plant which would employ 200 people. Only one firm stated emphatically that employment would increase. In this case, the expected increase was due to the introduction of a new product line.

Stumpage. Mills in the three county region use any one of the many species of timber found in the forests in the area including Douglas fir, white fir, Ponderosa pine, lodge pole pine and sugar pine in the production of lumber and plywood. While the larger firms have in the past relied extensively on their own private forests for stumpage (up to 90 percent for some of the mills), the trend is toward reversing the historical proportions of private and public. There were two explanations given for this shift. First, the larger firms are shifting to public lands in order to obtain the larger diameter logs which are no longer readily available on private lands. Second, one firm in the area is shifting to public lands because its own lands were depleted of harvestable timber over the last five years in order to pay off buy-out debts incurred by new owners.

For the smaller firms (less than 500 employees), only one has extensive private holdings which provide 30 percent of its stumpage requirements. For most of the smaller firms, an estimated 95 percent of the stumpage comes from public lands, and much of the remainder purchased from private sources originates from harvests off public lands.

There are no clear geographic boundaries to be drawn among the mills in terms of competition for stumpage. Major sources of stumpage for lumber and plywood mills in the region are the national forests (Rogue, Winema, Siskiyou, Klamath, Fremont, Deschutes, Six River, Shasta Trinity) and Bureau of Land Management lands in southern and eastern Oregon and northern California. While forests on the eastern side of the mountains generally supply mills in eastern Oregon, there is some cross-over from the west to the east. It is expected that if timber becomes more scarce, cross-overs from east to west will increase. As a consequence, each firm or mill views itself in competition with other mills in the region for timber. At the same time, there is considerable exchange of resources through resale of logs not required for production.

The level of competition is perceived by both large and small firms to be increasing. The shift in demand from private to public timber by the larger firms means that there are "more big dogs competing for the same bone." At the same time, the supply of timber from public lands is perceived as having been reduced substantially over the last 5 years (despite the reported harvest figures). Not only have some managers seen the amount of harvestable acreage reduced in some forests from which they purchase timber, but they also have seen a reduction in the amount of the useable timber (both in terms of species and log diameter) which can be retrieved. All of these factors, coupled with expected future reductions in the allowable cut by the Forest Service, are perceived as putting many mills in a vulnerable position. From the perspective of the owners and managers, a minimum requirement for existing mills is to make every effort to improve log recovery. Future harvest reductions by the Forest Service are expected to close some mills. The number of closures anticipated range from one to three.

While reliance on the national forests provides access to old growth timber, most mill managers did not describe their stumpage requirements in terms of old growth vs. new

or second growth timber. They tended to discuss the diameter of the logs which they required for processing, and they noted that old growth can mean both large and small diameter logs these days. Others observed that with the exception of a few special areas, all of the timber harvested was second or third growth.

Having defined the importance of the diameter of the log, all of the managers observed that the average diameter of the logs being processed has been declining and that for firms to stay competitive they have to eliminate waste in processing the logs and/or shift to machinery which can process the smaller logs. Over half of the lumber mills interviewed have or are in the process of converting to equipment that is capable of processing small diameter logs (less than 14 inches). Slightly less than half of the plywood mills have adopted small diameter log peeling technology.

Technology. For most of the mills in the region technological upgrading has been a continuous activity since construction. Only one firm identified in the survey area had not been improved since it was first built in 1949, and this mill closed during the period in which the study was being conducted. The addition of the latest technological advances in lumber production has occurred since 1981 for most mills. Two of the most advanced lumber mills in the region undertook these changes in the late 1970's. The most advanced plywood layup system in the region was constructed in 1975.

Within this region, the smaller lumber mills have adopted new technologies earlier and have made more extensive improvements than the larger mills. With the plywood mills, the pattern of adoption is not as clear. Smaller mills are more likely to be state of the art, although there are examples of larger mills which are ranked high or moderately high. However, the lowest ranked mills belong to the larger firms.

Given the wide range of technological options available, the managers were asked to evaluate their own mills in terms of known state of the art technologies. Typically, a manager would view an automated sawmill with automated sorter capacity and the ability to process large and small logs as indicators of a "high tech" facility. A moderately high facility might have an automated sawmill but not an automatic sorter or scanners for certain aspects of the process. In the plywood mills, x-y chargers (a system for centering logs for peeling), rotary clippers, computerized clipping, steam vats and automated stacking were considered indicators of a state of the art facility. With the layup facilities, any system that automates the layup process by eliminating hand feeding is considered state of the art. Other technologies which were considered high tech include stitchers, automated stackers, computerized kilns and automated packaging. Of the lumber mills, two were ranked high, four labeled their mills as moderately high; and five considered their mills average to moderately low. With respect to the plywood mills, four ranked their mills high, three moderately high, and three average to moderately low. Two plywood mills were rated low.

While many of the technological improvements were made on the floor of the mill, there were also changes occurring in other areas. Within the managers' offices, many mills have adopted special software designed to improve production planning. For example, several firms have adopted linear programming packages which enable managers to identify problem areas in production and to optimize the mix of labor, capital and raw materials. In addition, some mills are attempting to cut costs by adopting cogeneration facilities, and a few managers noted capital improvements which do not benefit production but which control the noxious effects of the facilities on the environment (e.g, scrubber systems).

Production and Productivity. Most of the lumber and plywood mills interviewed had experienced an increase in production over the last several decades. The recession in the early 1980's brought a decrease in production for all mills and the closure of some. Since then, production has recovered for all but the largest mills, although not always to the levels enjoyed in the late 1970's.

While noting the complexity of measuring productivity, nearly all of the mill managers felt that productivity had increased in their mills in the last five years. They cited a variety of indicators, including output per worker or man-hour, increased recovery from raw materials, and reduced unit cost. The changes in productivity were considered to be the result of specific initiatives undertaken by management to deal with perceived changes in the competitive environment in which the mills operate. The recession of the early 1980's, which saw a number of mills shut down, coupled with competition from alternative products exposed the vulnerabilities of the firms and led managers to evaluate changes in product lines.

Strategies for increasing productivity were variable from one firm to the next, and depended on the firm's perceived position in the market in the future. The adoption of new technology was a major factor in increasing productivity and competitiveness for several firms. For most firms, however, management's choices over the last few years involved a mix of adopting new machinery, utilizing old machinery in a more effective manner, and striving to "get more work" out of the employee.

Pursuing the goal of boosting productivity led to a plethora of alternative approaches. Managers were selective in choosing new machinery and software. When new machinery was not purchased, efforts were made to improve the performance of existing machinery either through better maintenance, upgrading parts (e.g., using thinner cutting blades) improving the interface between the worker and the machine (e.g, relocating machines or providing boxes for short workers to stand on) and by speeding up the machines.

Strategies focused on workers themselves were also diverse. A key concept for all but two managers involved improving "communication" between management and the workers. Managers said that they were spending more time explaining to workers what they were trying to do and why. In one instance, a mill had taken some of its workers to visit its wholesalers. Another firm allowed workers to choose the color of the machine on which they worked. Profit sharing and production incentive payments are also becoming common incentives for getting workers to "buy into the production process." While incentive payments often come in the form of cash, the gift of a television set or a breakfast with the boss has also been used.

Promoting safety is another widely accepted technique for improving productivity. Most managers noted that accidents are costly. As with safety, a clean work environment was discussed as a factor that can improve productivity. Only a few mills in the region have a reputation of maintaining a clean work environment, however.

Finally, a considerable effort has been made to reduce the overall cost of labor. Labor requirements are being reduced by giving workers the training and experience to allow them to move easily from one job to the next routinely. Such a strategy has in some instances involved changing work rules and redefining jobs. Work rules in several mills have also been changed to reduce absenteeism. Whereas most mills in the region had no absenteeism policy prior to the mid 1980's, several mills are now instituting restrictions on the number of absent days permitted. Rule changes have also enabled employers to require workers to work weekends without overtime pay and, in one instance, to use part-time

workers for entry level positions. Contract workers are another alternative chosen by most of the mills to reduce overall labor requirements. Employed by an agency that pays their non-wage costs, these individuals fill in on a daily basis at different mills. While their use is limited primarily to temporary replacement of sick or injured workers, their presence in the mills is a recent phenomenon in this region. Labor costs have also been reduced by across-the-board pay reductions in some of the larger union mills. Finally, one of the largest firms has committed itself to affirmative action "in order to compete world wide," since it is assumed that increasing the labor supply pool will reduce labor costs.

Changes in Characteristics of the Workforce. Traditionally, lumber and plywood mills have employed unskilled males with little or no college education. Where specialized skills were required, training frequently occurred on the job. Individuals worked their way through a progression of jobs from greenchain to millwright gaining experience, and in some instances, specialized skills. Until two years ago, the mills could draw from an unemployed pool of experienced workers. A scarcity of experienced workers now exists, and the mills are resorting to hiring younger inexperienced workers.

The introduction of technologies which computerized or mechanized parts of the production line has not fundamentally altered the skill requirements of the mills. Mill managers still rely on unskilled labor for most of the jobs in the mill, and most training is acquired on the job. There have been some minor changes. As noted previously, technology has reduced the absolute number of workers required for certain jobs. Its other major impact on labor requirements has been to increase the demand for electricians. As one interviewee observed, "It used to be when a machine broke down, anyone with experience could jury-rig the thing and get it going. Now, with the computers, you need a good electrician or a specialist has to be brought in." Nevertheless, learning to operate the computers can be accomplished on the job with minimal training.

While in a few cases mill managers felt that their work force was becoming more skilled, a majority of interviewees did not accept this proposition. Although all managers agreed that technology has reduced the requirements for manual labor, the need for skilled labor is a question of interpretation. Managers recognized that workers are being asked to learn more about the operation of the mill, for example noting that "jobs require more thought" and that work rules in some instances have been changed to permit workers to do a variety of activities not previously included in their job descriptions. It was in this sense that the jobs were seen as more skilled. On the other hand, being strong and hard working were still thought to be major factors in determining the success of a young person starting out in the mill. Only one firm had changed its minimum qualification for new workers, by requiring a high school education.

While technology has not significantly changed the type of worker required on the floor of the mill, its impact in the managers' offices is more apparent. Managers have to evaluate their needs for technological improvement. They may adopt or be asked to adopt computerized management tools designed to improve production decisions. "Keeping up" can be stressful, particularly for the manager who has come from the mill floor, is near retirement and now must learn his job all over again. There is some indication that these new requirements are leading to a new generation of "professional managers" with college degrees in business and little previous experience on the mill floor.

Technology is not the only factor which has the potential for affecting workforce characteristics or requirements. An obvious change in the workforce is the increase in the number of women working in the mills. Whereas fifteen years ago there were very few women in the mills, now, according to the managers, there are quite a few women on the

production line. In one mill women accounted for twenty percent of the workers. Among the other mills their representation was as low as two percent. Estimates for minorities were not as forthcoming. A walk through the mills provided evidence of a noticeable presence of women engaged in a variety of jobs.

Management responses were variable on the subject of worker retention. Stability and low turnover currently characterize the workforces of most of the smaller and some of the larger mills. While for a few of the smaller mills this situation has always been the case, low turnover has for many mills been a product of the 1980's, as the opportunities for changing jobs have declined with the closing of many mills. Only one mill (a unionized large employer) reported high turnover, and this was due to its lost position as one of the highest paying employers in the region.

Because of the stability factor, some of the mills reported that their workforces were getting younger (under 35 years old), while others reported they were getting older. The response depended on when workers were hired. For example, in some mills the workforce was getting younger because a large portion of their workforce retired recently. The workforce in other mills was getting older because of low turnover. Despite the requirements for demanding manual labor in the past, however, millwork is not necessarily a young man's job. Increased mechanization and computerization of production should reinforce this conclusion.

With respect to the availability of labor, managers made two observations. They noted that for the last two years there has been a scarcity of experienced wood products workers. Thus, they have had to hire younger untrained workers. These workers, they note, "are not like they used to be." Entry level workers were sometimes described as unwilling and/or unable to do hard manual labor, irresponsible, inclined to take drugs, and too demanding of attention. Some managers felt that there wasn't much difference between a twenty year old worker now and one twenty years ago, however. Several acknowledged that workers are now more educated and more aware of other options. They noted that as a consequence, management's approach also has changed, with such changes having had positive effects on production. One change has been to gradually introduce workers to the manual labor tasks. For example, a person starting work on the green chain may be asked to pull for only three hours for an initial period of time until "he gets in shape." This was viewed positively by management because it reduces accidents and promotes lower job turnover.

As for the future, managers expect little change in terms of labor requirements or characteristics. They foresee increasing numbers of women and minorities in the mills. The demand for the skilled labor of electricians will continue. However, most of the jobs will continue to be filled by individuals with few skills and little education. The ability to perform heavy manual labor will become less important as more mills automate the production process. Training will still occur on the job, and advancement through the mill will be based on a willingness to work and seniority.

Attitudes Toward Public Policies. The issue of timber supply was universally important to the managers and owners interviewed, but it was not always mentioned as a public policy of concern when they were asked to identify policies which impede the industry. One manager took the position that the Forest Service policies have been very supportive of the wood products industry. The policy that was mentioned most often as impeding the industry concerned workman's compensation, which was viewed as overly costly to the firms and has led to more use of contract workers. In addition, almost all of the managers

mentioned environmental protection requirements, which they felt have been abused and have given excessive leverage to environmental groups.

Other policies mentioned as impeding the industry when they have been misadministered are the Equal Employment Opportunity laws and the Clean Air Act. For the most part, the firms and managers were accepting of the regulations which required the industry to clean up the work environment and, as in the case of the Occupation Health and Safety Act, to protect the health and safety of the employee.

Managers were generally hard-pressed to identify policies which assist the industry, with the exception of the Small Business Set-Aside program. This program, which reserves a portion of the allowable cut in the national forests for firms with fewer than 500 employees, is viewed by the smaller firms as major factor in allowing them to compete with the larger integrated firms. Conversely, some of the larger firms noted that the set aside provision gave an unfair advantage to the smaller firms, and they wanted to see it eliminated. Finally, one manager noted a cooperative effort between the Forest Service, Oregon State University and the industry to improve reforestation techniques. He viewed this effort as an example of a positive public policy effort which should be undertaken more often.

3.4.2 Employees

Interviews with ten employees were conducted with the cooperation of the mill managers and the union local (in the unionized mills). Opportunities to discuss experiences informally with another ten employees also arose during tours of the mills and elsewhere. Employees were asked to discuss their work experiences in the mills, their expectations and aspirations, and their options. Because opportunities also arose to talk with employees in less structured situations, the following discussion draws on both formal as well as the informal interviews. In addition, the closure of Southern Oregon Plywood provided an opportunity to interview several individuals who were just laid off.

The employees formally interviewed ranged in age between 25 and 60 years, with most over 30. Only one had less than five years of mill experience; one had an advanced technical degree; one was a skill tradesman (a mechanic); two had a year of college; and the others had not completed high school. Three of the individuals with whom we talked were women. Over half of the people suffered from some hearing loss.

For many, working in the mills has been more a consequence of circumstance than choice. The absence of other work alternatives and the necessities of providing for family led to taking a job in the mill in their twenties or before. All of the workers with whom we talked thought that the mills provided an opportunity to "make a good living" and the means to support a family. The two women, for example, started working in the mills after becoming single parents. The older workers have accepted their choices. For the middle aged worker, the possibility of moving to other jobs is still there. They noted, however, that to leave would require comparable wages and more training, unless they have a specialized skill.

For the individual with a trade or a skill which could be transferred (e.g., a mechanic or forklift operator), the options were seen to be much greater both within and outside of the industry. Thus, when Southern Oregon Plywood closed, the older experienced but unskilled workers were concerned about their prospects of obtaining another job in the mills, and even more concerned as to the options which might be open

outside the industry. The skilled workers were confident of their ability to find work in other mills or elsewhere.

The picture of employment drawn by the workers is of a tradition bound industry. Individuals begin work in entry level positions (e.g., greenchain or cleanup) and progress through a series of jobs to that of millwright. In a few instances, an individual may rise to the level of mill manager (three of the managers we interviewed had advanced via this route). There is, however, very little flexibility in the system, whether in a union facility or not. One seldom moves up unless "dues" have been paid in the form of hard work and experience. Moreover, when a person moves from one mill to another, he often has to start over, although the time required to move up may be shortened by turnover. From the workers perspective, the way to get ahead is to "learn every job you can" and "work hard."

The stability of employment was considered variable, although far more stable than we had anticipated. Several had worked for only one firm and, with the exception of the recession in the early 1980's, had experienced no lay-offs. One individual did note that he seemed to "close mills down" until he came to his last employer seventeen years ago. Even in the recession many were not laid off, although they did see a reduction in hours worked or in pay. Those who were from one mill were laid off for nearly a year. All of the workers felt that the future of the wood products industry was uncertain. Their advice to someone just starting out was to go back to school and get an education. If that couldn't be done, and one wanted to stay around the area, mill work was seen as their best opportunity.

The workers could provide little information about their cohorts who fared worse than they in the recession. They were aware that some people left the area, but the most common response was that they didn't know or didn't remember.

As for the nature of the work in the mills, these workers described a situation very similar to that described by the managers. Mill work was viewed as relatively difficult labor, even with the introduction of new machines, which can be done by any strong, hard working person with little education and few skills. Workers saw some changes in how the work is done. Machines were replacing manual labor, and more thinking was required on the job. In addition, they saw changes in managements' approach to workers. Many felt that management is paying much more attention to safety, to communicating with workers, to providing incentives and to upgrading the work environment. The workers expressed little or no concern about work rule changes, with the exception of some objections to the new absenteeism policy.

Workers use a variety of criteria to evaluate a mill: management style (i.e., fair, innovative, responsive), fringe benefits, safe and clean working environment and "good" wages. Interestingly, union workers felt that the work environment of the non union workers was much worse than their own, in that the managers took advantage of them in salaries and benefits. In contrast, non union workers felt that union workers had the worse situation to the extent that there was more conflict, less incentive to work and less efficiency. Union or non union, the mills with the worst reputations were ones in which management was perceived as being unfair.

3.4.3 Analysis of Community Responses

In interviewing the local government officials, an effort was made to obtain responses from individuals in county and city government, and from active participants and

staff of local or regional economic planning boards. While cooperation was extensive among the mill owners and managers, local government officials were sometimes less accessible and more difficult to interview.

Community officials considered their local economies and local governments to be highly dependent on the economic well-being of the wood products industry. They identified direct links between mill activities and the communities. They described the mills as a primary source of manufacturing jobs for workers in the counties and, through salaries, taxes, and local purchases, a stimulant of indirect employment in both the public and private sectors. They were conversant with the details of the revenue relationship between timber harvest receipts and county government budgets. They observed that while the roads and schools budgets are the principal beneficiaries of these revenues, the number of employees which the government can employ is also affected, as is the general level of service.

City officials, whose budgets are not directly dependent on timber receipts, described a more indirect relationship between the well-being of the wood products industry and the economic well-being of local government. While they receive no timber receipts, downturns in the wood products industry have brought an increase in property tax delinquencies and reductions in revenues.

Interviewees also perceived differences in the extent to which local economies are dependent on the wood products industry. Klamath County was described as having a relationship which is much more dependent on the industry than either Josephine or Jackson Counties. Moreover, Klamath County was still seen to be recovering from the downturn of the early 1980's, as it was affected later than the other two counties. Interviewees explained some of the differences between the counties in terms of the relative diversification of industry. Within cities there also appeared to be some variability in economic and fiscal conditions. Ashland, although recognizing the importance of Croman Lumber for employment, has buffered its revenue base with the sale of electricity and with user fees for selected public services. In addition, tourism generated by the Ashland Shakespearean Theater Company provides jobs and income for many of its citizens.

The downturn in the wood products industry in the early 1980's hit all of the survey area communities hard and, according to interviewees, made them aware of the diverse ways in which they are dependent on the industry. They specifically noted the loss of employment opportunities in businesses and activities directly and indirectly related to the industry (e.g., one county laid off 50 percent of its staff, and construction of new homes stopped). The out-migration of younger, and/or highly skilled workers from the region, the increase in demand for some social services (e.g., library services) and the decline in revenues were noted.

The upturn in the industry in the last few years, they observed, has not brought a return to the old days. Employment is lower in the wood products industry, they explained, due to increased automation. Likewise, employment in county government has not returned to previous levels for the same reason. Moreover, factors not necessarily related to the wood products industry have changed the composition of the area population. There are now more retirees and other people who have little or no attachment to the wood products industry. Thus, the interviewees noted that the dependence of the area economy on the wood products industry does not translate into the political agenda being controlled by those aligned with the industry. They identified a variety of issues related to many different interests (e.g., wood products, environmental, recreational, artistic) which compete for attention on the agenda and vie for the resources of the communities.

The common outlook for the future among those interviewed is that if another downturn in the wood products industry occurs, the communities will be affected in much the same way as they have been before. Some diversification has occurred; cottage industries have emerged to produce food and craft products, and there is now more tourism and recreational and service activities for the retirees. There is also an illegal drug economy which seems to pump some dollars into the economy. None of these activities is sufficient to fundamentally alter the relationship between the wood products industry and the economic well-being of the communities, however.

All of the respondents had been involved with or were aware of efforts to develop a regional strategy for economic development. Because of perceived differences in problems and opportunities, Klamath County has associated with Lake County, and Josephine and Jackson Counties have linked up with Douglas and Curry to formulate regional strategy proposals. In the view of most officials, their efforts to attack the problem of economic development have been greatly enhanced by Governor Goldschmidt's emphasis on a regional approach, and by the opportunity to obtain lottery monies. Officials in the three counties talked about previous efforts to develop other industries and to diversify their economic base, but most were thought unsuccessful. They spoke of some problems in "dealing with Salem," but for most the biggest problem was getting the various county officials, agencies and local interests to work together.

All of the counties planned to broaden their economic base by diversification. The appropriate form of this diversification has been the subject of some disagreement. Those with ties to the wood products industry saw potential in continuing to rely on the industry by increasing the number of firms which add more value to the timber resources. Others believed that the best strategy was to reduce dependency by promoting activities unrelated to the wood products industry.

3.5 Discussion of Major Findings

Perhaps our most striking finding is that despite the major disruption caused by the employment decline from 1979 to 1982, the industry appears to be fairly stable today. While there are substantial concerns about the future availability of timber in the region and the cyclical nature of the industry, major fears about the viability of the wood products industry in Oregon were not found. Moreover, while there is much talk about new technology and the need to invest in more capital equipment, the industry does not seem poised for further large scale substitutions of capital for labor. In fact, there is some concern about the ability to attract workers to meet current labor requirements.

With the perspective gained from the interviews it is possible to go back to the statistical studies and reinterpret what has been happening in the industry. During the 1970's real wages in the industry were increasing. This was largely driven by an increase in the demand for workers in the industry. High and rising product prices led to increasing competition for the inputs. The relatively fixed supply of timber caused stumpage prices to rise, and this in turn created demand for additional capital and labor to get more output from each unit of timber input.

Capital improvements take time to implement, so the short-run responses to the increased demand for inputs were largely met by increasing the amount of labor used in processing timber. At the same time plans were made for capital improvements, and the data for the late 1970's show substantial increases in net investment in the wood products

industry. The tight labor market situation also allowed for workers to avoid repercussions for certain types of unproductive behavior (e.g., frequent absences from work).

The new capital equipment was being brought into production just as the demand for wood products plummeted. Since capital is a fixed cost, the most capital intensive firms tended to operate during the downturn. Thus, the recession hit labor proportionately more than output. In addition, the slack labor market allowed managers to implement new work rules and productivity - enhancing incentives.

Changes in management behavior toward workers and in the incentives which were given to workers appear to have increased the productivity of workers. For example, reduced absenteeism means that the same amount of work can be done by fewer workers, since each will work more days per year, and since there is less need to have reserve workers to deal with fluctuations in the number of people showing up each day. Another tactic is for greater use of contract workers. These workers serve when there are short-term increases in demand. Since they do not work directly for the company, the company can achieve lower total labor costs given reductions in costs for fringe benefits.

The combination of large capital stock and work rule changes was augmented by reduced need to process low quality inputs. The downturn in the total amount of stumpage being processed in the early 1980's meant that purchasers need only purchase the better quality timber, which also contributed to the reduction in labor per unit of output.

The lower real wages for workers resulting from the recession have increased the cost effectiveness of labor relative to capital. This has slowed the rate of substitution of capital for labor in the industry. Further, the high demand for output is now causing relatively more low quality timber to be processed. Thus, at least two factors are contributing to the recent improvements in the employment picture.

The combination of the interviews and the statistical data are consistent with the conclusion that the industry went from a very heated cyclical boom to an extreme cyclical bust in a very short time period. The decline in employment per unit of output is consistent with long term trends associated with the substitution of capital for labor. This will most likely continue, based on forecasts of the relative prices of labor and capital inputs. The rate of substitution is likely to be much slower in the immediate future because of the reductions in inflation-adjusted labor costs and the changes in work rules. However, these changes are not likely to forestall a return to the long term trends for long.

Alternatively, the rapid increase in output per worker is not likely to be continued. The severe recession has made producers more cautious about investment in the industry, so the rapid increase in capital input seen in the late 1970's is not likely to be repeated soon. But the timber quality decline is likely to continue, and this will be at least partially offset by relative increases in other inputs, including labor.

The changes in employment associated with the change in product mix were not found to be as large as those associated with productivity improvements, but they may be more of a concern in the future. In particular, the region is likely to continue to face intense competition in the production of plywood. Since plywood is a relatively labor-intensive product, the employment implications are somewhat negative. Also, further increases in the export of unprocessed logs is likely to have some negative employment consequences.

On the whole, the employment outlook for the industry is not as negative as the conditions during the early 1980's made it appear. The amount of labor per unit of output is likely to continue to decrease over time, but the rate of decrease should be in line with

historical trends. Perhaps a more pressing concern than the decline in employment opportunities should be the attractiveness of the wood products industry to employees, given the cyclical instability which it faces and the reduction of new entrants into the labor force anticipated for the future.

4. Policy Implications

The late 1970's were a boom period for Oregon's wood products industry. High and rapidly increasing prices for wood products caused increases in the demand for all inputs. For timber, the major impact of the increase in demand appears to have been an increase in price. Thus, other inputs were used more intensively to recover more output per unit of timber input. The increase in demand for labor led to an increase in both wages and employment. The shift from a very high demand situation to a very severe recession led to a large drop in employment in the wood products industry.

This study was undertaken to address a variety of questions regarding the employment decline in the wood products industry, especially the factors leading to the substantial increase in output per worker. It was also directed to determining the impact of employment decline on both the workers and timber dependent communities. The problems of the industry, its workers, and the communities have attracted efforts by government to offset the decline and associated problems. A better understanding of the forces leading to the observed changes can assist in designing more effective policies.

The research was addressed at a number of specific issues. We start by summarizing what we have learned about some of these issues. We note again that much of what we conclude is based on an informal integration of data from a variety of sources. For those looking for definitive answers, this study can not provide them. However, we believe that the conclusions are based on more thorough coverage of statistical data and insights from those involved than previous studies.

One of the first issues which we addressed was the cause of the observed rapid increase in labor productivity in the wood products industry in Oregon. Our conclusion is that it was essentially the result of a typical response of the industry to a recession. To be sure, the recession was an unusually severe one for the industry, and it followed an unusually high cyclical peak; but there is little evidence of a dramatic change from long-term trend lines for the industry with respect to labor productivity.

In most industries, a downturn in the business cycle leads to a reduction in observed labor productivity because firms are slow to pare their workforce. Thus, the industry produces less output with about the same number of workers. During an upturn the firms are also slow to hire additional workers, so output per worker tends to increase. This pattern does not appear to fully characterize the wood products industry during the period from 1979 on. Rather, the decline in demand in 1979 led to an adjustment which involved closing the most labor intensive plants in the industry. Thus, output per worker increased rather than decreased.

The output per worker measures were further clouded by the impact of the boom of the 1970's. Prior to this, output per worker had been gradually increasing in Oregon's wood products industry. However, heated demand and high prices induced firms to increase output. This involved processing timber which was of relatively lower quality and recovering more. Each of these actions resulted in an increase in the amount of labor per unit of output. Thus, the late 1970's saw output per worker actually decline in the wood products industry. The movement back to the trend line meant large job losses for the industry, and the recession caused more than a movement back to trend.

The declining quality of timber is another issue which is often mentioned with respect to the increase in productivity in the industry. Timber is often characterized as

being divided between "old growth," which consists of very large diameter, high quality logs versus "new growth" or "second growth" timber, which results from replanting previously logged forests. Since the latter timber is cut at a younger age, it tends to be smaller and more uniform in size. These smaller logs are thought to be more amenable to processing in automated plants. Thus, the shift to smaller logs would involve less labor per unit of output. We find that the situation is more complex than the one just described. While it does appear that smaller logs are more amenable to automated handling, they are also not as easy to process into wood products. Hence, the labor input per unit of output might increase rather than decrease because of such a shift. Further, smaller diameter logs appear to be associated with both "old growth" and "new growth" timber because the best and most accessible old growth has already been harvested. Hence, the remaining old growth tends to be less accessible and of lower quality than what was cut previously.* Each of these factors tends to increase the use of labor to process the logs.

The decline in wood products employment is seen by many as leading to the decline of communities dependent on this industry. Using a concept as simple as the ratio of total employment to employment in the wood products industry, it would seem that the communities would suffer proportionate declines with the loss of employment in wood products. However, this need not occur. Over time the ratio of non-manufacturing to manufacturing employment has been increasing for the economy as a whole. Thus, the decline in direct wood products employment might be offset by increased service sector employment in the communities. The increase in economic diversification observed in the survey area provides evidence that this has happened to some extent. Thus, there may not be a decline in total employment if the wood products sector experiences only moderate reductions.

The second potentially important factor is that the decline in employment per unit of output is not necessarily linked to a decline in employment. While it does not appear to be feasible to increase the amount of output (since the timber supply is declining), it does appear that there may be opportunities for the industry to process the wood products more before they are shipped out of the region. Part of the decline in employment has been traced to a shift to less labor-intensive forms of wood products output. While the observed shift corresponds with the changing markets and competition which the industry faces, there is evidence that new markets can be developed for more specialized products.

The development of more labor intensive outputs for the industry hinges on the ability to be cost effective. The real wage for workers in the industry has declined over the * decade, and the relaxation of work rules has allowed for more efficient production; however, rising wages or other competition for the work force may make the more labor intensive production less feasible in the region.

The last point brings us to the workers in the industry. Much concern has been expressed about the possibility that wood products workers face a bleak and uncertain future, with many of them leaving the region and others facing structural unemployment. This perspective is at odds with what was found in the interviews. Workers are indeed concerned about the stability of the industry, but this concern does not appear to be greater than that in any other cyclical industry.

* Accessibility is an important issue given that the costs of harvesting and hauling timber are now approximately equal to the stumpage value (Adams et. al., 1987).

Most of the workers in the industry seem to hold fairly steady jobs and appear attached to the industry itself. These workers would consider other types of employment, but the wages in this industry are higher than they would expect to get elsewhere. Layoffs are a substantial problem, especially for older workers, since many mills require that new workers (with the exception of skilled tradesmen) start out at the worst jobs. The method of advancement is based largely on seniority within a particular mill. Thus, an experienced worker from a closed mill becomes a beginner again in a new mill. This is particularly difficult for older workers.

Skilled workers do not seem to face the same problems as unskilled workers. They can move more freely between mills and to other industries. But a large percentage of the work force remains essentially unskilled. While automation has eased the work for unskilled workers, it does not appear to have appreciably changed the mix of skilled to unskilled workers. Thus, there continues to be a large pool of workers who face serious disruptions as individual mills close. However, the surveys suggest that the decline in the industry was not met by structural unemployment among these workers. Rather, there were fewer new workers entering the industry, and there was probably more early retirement than might otherwise occur. If anything, the industry seems to be facing a shortage of labor during the current peak. This would not occur if there were existing structural unemployment problems in the industry.

4.1 Labor Issues

4.1.1 Occupational Training and Education

The type of worker employed in the wood products industry has not fundamentally changed with technological improvements. Mills still provide an opportunity for relatively high paying work for individuals with little education and few skills. At the same time, the industry is tradition bound. Individuals move through a progression of jobs gaining experience in different aspects of the production process and training on the job. Because of costs and custom, the experienced worker is valued more than the inexperienced worker, and preference in employment is given to the former. When labor is cheap relative to other production costs or when output is very high, this bias is not as readily apparent. However, when such conditions do not prevail the opportunities for the inexperienced younger worker are more limited than for the experienced workers. Even when output is high some young workers may find themselves unable to get full time employment in the industry, and they move from one contract job to another. Although the number of contract workers used by individual firms is relatively small, their use has increased over the last few years.

In timber dependent rural regions with few alternatives for comparable wage opportunities, the experience bias works against the communities' efforts to maintain an environment which can successfully support the younger generation of workers. It should be noted that this is mitigated somewhat by the recent affirmative action efforts which have resulted in the increased employment of women in the mills. While such efforts clearly expand opportunities for work for some individuals, for others (i.e., young males) the variables of experience and skill become even more important and limiting. Thus, the burden is placed on communities to find alternatives for these young people over the long term. In the short term the communities may want to find (and there are some services which already exist) ways to deal with the disruptions caused by mill closures and the cyclical swings of the industry.

Interestingly, mill managers in the survey region observed that for the last two years, when the industry has been operating at relatively high production levels, the supply of experienced wood products workers has disappeared (more in Jackson and Josephine Counties than in Klamath). This suggests that adjustments in supply occur fairly rapidly in the industry. Experienced workers have either left the region or, as is more likely the case, have been absorbed by other mills and by natural attrition (e.g., retirement).

While the production activities in the mills require few skilled workers, a few do exist (e.g., mechanic, electrician). These individuals are in high demand. When Southern Oregon Plywood closed in Josephine County, most of the skilled employees reported offers of employment by the next day. Moreover, if they can't shift to a similar position in the wood products industry, they are also more likely to find work outside of the industry.

Although providing opportunities for employment for skilled workers is not a particular problem that the communities face, supplying skilled workers may be an issue. All of the managers in the survey observed that there is a scarcity of electricians to maintain and repair the new automated equipment. Moreover, one young electrician who was trained at a local technical institute observed that the school gave him little training to prepare for working in the wood products industry. He concluded that the institute prepared its students "to work at Boeing" and not in the lumber and plywood mills in the region.

4.1.2 Standards and Conditions of Employment

The surveys suggest that there have been many changes in the production activities of the mills over the last decade which have brought changes in employment conditions for the worker. Some of these changes have resulted in work conditions which are physically less demanding. Automation has reduced the amount of manual labor required for some jobs. Moreover, some workers now spend most of their time within the confines of climate controlled booths from which they punch buttons that control the production process. On the other hand, while modern plywood layups have eliminated the hand feeding process, the system still requires considerable hands-on work.

Strategies to increase the productivity of workers have also altered the work environment. Evaluation of the totality of the different strategies is a difficult task. As with the impact of new technology, there is considerable variation from one mill to the next. Also, the impact of the changes on the economic well being of the worker is not clear. While wage scales have been lowered for some workers, the introduction of production incentive payments and profit sharing have made the task of assessing the total wages of the worker difficult. Likewise, assessment of the variety of strategies to promote "communication," to get workers to buy into the production process, to ease the adjustment of new workers to the work environment, is difficult. Even where there have been changes in the work rules, the impact on the quality of the work environment is not clear. With the exception of a new absentee policy in several mills, few workers complained about these rule changes. Moreover, many took pride in their knowledge of the mill, their willingness and ability to do more than was required, and their flexibility in the work environment.

Another major factor affecting the operation of the mills are the government regulations dealing with health and safety, clear air, and equal opportunity. Changes in mill operations have been made as consequence of the enforcement of these legal mandates over the last two decades.

In an industry in which most workers over 35 have hearing loss, almost all workers can now be seen wearing earplugs issued by the companies. On the other hand, few workers can be seen wearing face masks as a protection from the dust and fumes. Questions persist as to the quality of air emissions into the local environment by the mills. Glues used in the production of plywood (and other pressed boards) worry some of the workers. In addition, workers develop disabilities (e.g., bad backs and carpal tunnel syndrome) which they relate to their work activities. At the same time, the industry complains about the implementation and cost of workmen compensation. And while there are more women working in the mills, some jobs appear to be evolving as "women's work." Such observations suggest that while numerous changes have occurred in the industry, there are issues still to be worked over and efforts to be made in the policy arena.

4.1.3 Labor Representation

The changes that have occurred over the last decade have resulted in a blurring of the distinctions between union and non-union mills in terms of the quality of the work environment, the level of pay and the responsiveness of management to the workers. In two of these areas (responsiveness and quality of the work environment), it is not clear that union mills ever had a distinct advantage, or at least one that was readily apparent to the worker. In our interviews, we encountered small family-run mills whose managements enjoy the respect of employees. We spoke with workers and management in a large union mill in which management was highly respected, but the quality and safety of the work environment was the worst of all the mills visited. We heard rumors of non union mills with supervisors who bullied their employees and of union mills in which the level of conflict was high.

To add to the confusion, over the last decade the distinction between union and non union mills in terms of wages has been largely erased. As noted earlier, profit sharing and production incentive plans make information on real wages more difficult to obtain. From the perspective of the worker, the individual may be as effective as any union representative or contract in redressing the issues of importance to him/her within the mill.

4.2 Firm/Industry Policy Issues

The wood products industry is likely to remain a key employer for the timber dependent regions of Oregon. The industry will continue to be sensitive to the business cycle, and the level of employment is likely to continue to decrease over time. Further, the trend toward fewer mills and greater output per mill is likely to continue. In this context, it is possible to evaluate a number of policy issues which are relevant for firms in the industry.

4.2.1 Technological Innovation

The drop in employment per unit of output which occurred during the early 1980's convinced many that the wood products industry in Oregon was on a track toward extensive automation. The more recent increases in industry employment have reduced the concern somewhat, but have not eliminated it.

Statistical studies of the industry conclude that most of the improvements in output per worker over time have been associated with direct substitution of capital for labor. While there have been improvements in the technology available to the industry, they have been more associated with processing lower quality timber than with generating increases in output per unit of input. These conclusions are largely confirmed by the interviews. Few seem to see major changes in the way individual firms process their output. There are ongoing improvements in the capital stock which allow each mill to produce more output with the same number of workers, but these changes largely represent substitutions of capital for labor rather than a major redefinition of the production process.

To the extent that there are policy concerns with respect to technological change, they are likely to focus on the changes in ability to process lower quality logs. There are likely to be continued substitutions of capital for labor, but this may also reduce the amount of physical labor required in the industry and increase the potential labor pool.

The final factor with respect to technological improvement is the possibility of devoting more resources to training workers with the skills needed to operate and maintain more sophisticated equipment. The interviews indicated that there do not appear to be substantial demands for such workers now, but this may change in the future.

4.2.2 Management Strategies

There are a variety of strategies being followed by the firms in the survey area. Some firms are pushing to maintain a substantial capital investment and "state of the art" technology, while others use older mills and equipment. The older mills have a higher employment per unit of output, but they may not remain viable in the long run. The phase out of such mills is one possible mechanism for future substitution of capital for labor in the industry. However, this is likely to be a relatively gradual process, with the older mills being more vulnerable to closure in cyclical downturns. The older mills are also likely to be more vulnerable if the competition for stumpage increases.

One management strategy which may warrant some concern is the possibility that some firms are attempting to liquidate their marketable timber over short periods of time. This strategy may generate cash flow for the firm, but it may also intensify future competition for stumpage. There is a real possibility that some of the larger firms that have historically relied on their own timber may opt to manage their lands for short-run increases in output, with the intention of then closing processing operations until existing forests mature. This could have a substantial negative impact on employment.

Management strategies dealing with labor do not appear to be of concern. Some of the changes in work rules and labor policies appear to have contributed to a one time increase in labor productivity. Most of these changes cannot be repeated on a regular basis. But the increases in productivity resulting from the changes already introduced may make the industry more competitive in markets for more specialized products.

4.2.3 Product Market Diversification

The output of the wood products industry in Oregon is largely concentrated in lumber and plywood, but there appears to be some potential for increases in the processing of wood products to enter into specialized markets. These markets are potential sources of

employment growth for the region, since the additional processing allows the wood products industry to use more labor per unit of output. The ability to compete in these markets will depend on the cost of labor in the region and the cost of transporting and marketing the more specialized products.

4.2.4 Log Exports

Log exports are currently attractive because the low value of the dollar makes the price of the logs appear relatively low to foreign purchasers. Thus, foreign buyers have increased their purchases. If these exports are restricted, more logs would be processed into other outputs. The increase in processing is expected to cause an increase in employment in the region, although the input-output analysis did not find this to be a significant effect.

However, if log exports are restricted the stumpage price of the timber is likely to decline. Since local governments share in this price, a restriction on exports may also cause the government revenue to decline. This would reduce employment by local government, which would at least partially offset wood products employment gains created by an export limitation measure.

A more appealing resolution of the concerns expressed over the export of raw logs would be to increase the ability to sell finished products. If the lower value of the dollar makes the logs more attractive internationally, it should also make finished products more attractive. Thus, regional producers of finished products should also be willing to pay more for the logs which would otherwise be exported. It may be possible to have both the industry employment gains and additional government related employment created by higher harvest revenue. But this will require that the industry successfully diversifies its output and competes more aggressively in the specialized products market.

4.3 Community Development

Changes in the structure of economic activity in Oregon and the survey area over the past several decades have lessened their dependence on the wood products industry for jobs, income and tax revenue. Nevertheless, the state, and in particular its rural communities, still rely heavily on harvesting and processing timber. The focus of community development planning, as a result, continues to be generally defined by the objective of expanding economic activities that are independent of wood processing. At the very least, the appeal of this objective lies in diversification for the purpose of ensuring greater stability, offsetting the highly cyclical pattern of economic activity that goes with over-reliance on the wood products industry. For a number of smaller communities, economic diversification may well be the only prescription for their preservation, given the general outlook for timber harvests in the coming years.

About half the timber processed in the survey area is harvested from the national forests. Management plans for these forests are currently in preparation. A major feature of the plans involves the determination of the sustainable yield of timber from the forests and the consequent allowable sale quantities to be set by the Forest Service in auctioning timber. The Winema and Rogue River National Forests are the principal sources of Forest Service timber in the survey area. Proposals contained in the draft plans for these two forests call for allowable sale quantities in the first decade of implementation that are 10

percent (Winema) and 32 percent (Rogue River) lower than their average respective yields between 1985 and 1987. These reductions would not likely be significantly offset by increased timber harvests from other sources. As a result, an absolute reduction in wood products output looms large in southwestern Oregon irrespective of market conditions, lending a sense of urgency to community development planning efforts.

Considering the effects of labor productivity improvements alone, Schallau et. al. (1969) in their study of the wood products industry in western Oregon and Washington concluded:

Peripheral communities having weak ties with area and regional centers are likely to become increasingly isolated as total employment declines in response to rising productivity per worker in the timber-dependent industries and relocation of high-order services to larger places (p.104).

The effect of timber harvest reductions combined with labor productivity improvements thus poses a potentially serious threat to the maintenance of economic vitality in the smaller timber dependent communities.

In light of the conditions facing many of Oregon's timber and resource dependent communities, the state has stepped-up its commitment to economic development planning. In 1987, for example, the 64th Oregon Legislative Assembly passed the Regional Economic Development Act (HB-3011), whose purpose was to encourage regional coordination of development planning activity in the state. As administered by the Oregon Economic Development Department, the program authorized by the Act promotes the formulation of "regional strategies" by coalitions of counties linked together by common historical, cultural and economic conditions. Regional strategies are defined to consist of development proposals advanced by the counties, subject to review by the Economic Development Department and final approval by the Governor. Proceeds from the state lottery (\$25 million in the 1987-89 biennium) were earmarked to finance the program and the strategy proposals.

The regional strategies program provides a basis for discussing policy issues associated with community responses to potential economic decline. Two regional strategies were formulated among the three counties in the survey area. The proposals contained in these strategies are addressed in the following section.

4.3.1 Development Strategies

The development proposals advanced by the three counties in the survey area are set forth in two regional strategy documents. Klamath County elected to formulate a regional strategy for itself, while Jackson and Josephine Counties joined with Curry and Douglas Counties in proposing their regional strategy.

The Klamath County strategy consists of a six-pronged program designed to promote the development of light manufacturing and warehousing and distribution activities in Klamath Falls, the county seat and principal city.* The strategy intends to capitalize on

* We note that the Klamath County regional strategy reflected considerable input from several major studies that analyzed development potential in the county. One of these studies was conducted by SRI International following the 1979 closure of Kingsley Field and consequent loss of military jobs. The other, a target industry study, was conducted by Pacific Power & Light Company (who provides electrical services to the

the area's proximity to a large California market. For various economic and noneconomic reasons, it is argued, firms intending to serve this market may find a peripheral location (just beyond California's border) more advantageous. Evaluation of the logic and economic feasibility of this rationale is beyond the scope of the present study. The major California markets are a considerable distance from Klamath County, and an additional trans-shipment point would possibly be introduced in serving this market. Both of these factors would add to the cost picture. Savings in other costs can be expected, however, which could outweigh the economic disadvantages associated with the lack of direct access to final markets.

Klamath County evaluated the potential for further diversification within the wood products sector, but chose not to select this option for its development strategy. The reasons offered included:

- diversification in the wood products industry is likely to proceed without the support of the regional strategies program, given ongoing marketing efforts;
- some secondary wood products sectors have experienced negative growth rates in recent years;
- the cyclical nature of the industry makes it less desirable as a development objective.

The strategy articulated for the four county region including Jackson and Josephine Counties differs from that of Klamath County in a number of respects. In substance, the strategy endorses services (tourism) rather than goods production and distribution. In scale, the proposals are dispersed geographically rather than concentrated in the regional center. The strategy elements include enhancement of visitor services and attractions, initiation of a regional tourism marketing campaign, and improvements in the regional transportation infrastructure. Each of these elements, in turn, is comprised of an extensive set of project proposals.

The regional strategy for Jackson and Josephine Counties intends to capitalize on the area's "location as the southern gateway to Oregon" and its existing tourism attractions, including the Oregon coast, Crater Lake National Park and the Ashland Shakespearean Festival (all ranked among the top 10 attractions in the state). In addition, the strategy is expected to have positive consequences for growth of the already substantial retirement population in the area, recognizing that the tourists of the present are also the retirees who may relocate to the area in the future.

The emphasis on further development of tourism activity in Jackson and Josephine Counties raises several questions from a development planning standpoint. First, tourism, like wood products, is a cyclical industry. They both tend to follow the same business cycle, in fact, and thus the stability of economic activity in the area may not be enhanced. In addition, tourism activity exhibits significant seasonal variation. Second, the Regional Economic Development Act emphasized that strategies should seek to create "family wage" jobs. While the tourism industry is labor-intensive and thus a good job creator, the jobs generated in the industry reflect a considerably higher proportion of lower-skill/lower-wage

county) and involved analysis by Wharton Economic Forecasting Associates, among others. We note these studies because it is unusual to find community development planning efforts in rural areas bolstered by extensive background analysis. Typically, planning at this level involves a trade-off between the benefits of greater sensitivity to local conditions, goals and objectives, and limitations associated with the scarcity of institutional, monetary and analytical resources. In this case, no such trade-off is in evidence.

characteristics than is reflected overall in the regional economy. Nevertheless, this strategy may well represent the only viable opportunity for development in the region to offset potential declines in the wood products industry. Whatever the structural shortcomings one might note, in the absence of identifiable alternative development proposals the tourism strategy may advance the overall economic prospects of the region. Had the strategy proposals developed the linkages between the tourism industry and the enhancement of the region as a retirement location more comprehensively, moreover, it may well be that the overall long run effect could have been shown to result in more positive gains to the region from a structural perspective.

The development of the secondary wood products industry was also considered as an alternative strategy in the four-county proposal. This strategy was not selected given that ongoing programs in the counties were promoting development of this sector. Prospects for future development of secondary wood products activity were also clouded by a concern about the availability of timber in the region.

The consensus view of the local officials we interviewed who commented on the strategies program was that the major benefits derived from the respective strategies were tied to the planning process as much as the proposals. The strategies program, in their view, provided a vital basis for coordination of planning objectives among a very diverse collection of institutions and individuals whose views and agendas had previously not been inclined toward reconciliation. The fact that some reconciliation of this diversity had been achieved in the preparation of the strategies was seen as an important accomplishment, as well as a necessary precondition for future advances in the planning process. This is not to say that all parties in the strategy development process fully endorsed the end product, but that there was general acknowledgement that the strategies proposed represented an enhancement of the region's development prospects over what would have been achieved in the absence of the state program.

It was also clear to most that the economic growth anticipated from implementation of the strategy proposals would not be sufficient to offset the declines foreseen in the wood products industry. The strategy proposals were seen to be initiatives that could be implemented in the near term having good potential for furthering economic development in the region, which is consistent with our assessment of the intent of the program. A question that surfaces, as a result, is whether program commitments with a longer term focus would hold the promise of building on the accomplishments of the Regional Strategies Program. If so, then what type of commitment and organization would best serve longer term community development objectives? Short of a general assessment of the Regional Strategies Program, recommendations along these lines cannot be made (strategy proposals for a number of Oregon counties have not yet been reviewed by the Economic Development Department and endorsed by the Governor). If further commitments were to be made to longer term development objectives, the role played by the state would probably need to be reconsidered. Its role in the Regional Strategies Program, beyond providing the necessary funding, has been to ensure the logic of the proposals, to coordinate the strategies among regions in order to avoid competition for similar activities, and to integrate the strategies with other economic development initiatives underway at various levels in Oregon. Programmatic commitments to longer term development objectives would likely require, in addition to these responsibilities, provision of technical, logistical and administrative support of the regional planning process.

The evolution of economic conditions in Oregon's non-metropolitan areas over the coming years will in large part dictate the need for regional development initiatives. Given the worst case outlook held by some, a concerted effort may be required to maintain the economic vitality of the smaller rural communities in timber-dependent regions. More

favorable conditions, which would be characterized by more liberal timber harvests than what is now projected in the national forest draft management plans, lower rates of labor productivity growth than what has been experienced in the 1980's, and further diversification of the rural economic base would leave these communities in a much better development position.

5. Conclusion

This study has addressed concerns about recent changes in the wood products industry in Oregon and the effects of these changes on timber dependent rural communities. The most significant change observed in the 1980's has been a rapid increase in labor productivity. While labor productivity gains reinforce the industry's ability to compete with producers in other regions, they also raise questions about the future role of wood products activities in regard to 1) providing jobs in rural Oregon; 2) the direct and indirect linkages between the industry, local governments and other sectors of the rural economy; 3) the acquisition of occupational skills to meet the demands of new production technologies; 4) the possible emergence of a pool of structurally unemployed workers displaced by technological change and precluded from moving to other areas for employment. The prospect of additional job losses resulting from proposed reductions in timber harvests from the national forests also adds to the concerns about the employment implications of structural change in the industry.

This study has found that the wood products industry witnessed two distinct productivity phases associated with the timber harvesting and processing cycle between 1975 and 1985. In the first half of this period, the demand for wood products surged. Given limitations on the supply of timber, stumpage prices rose much more rapidly than the prices of the other inputs. Changes in the relative input prices led to more labor-intensive processing between 1975 and 1980. Strong earnings also provided for heavy investment in new plant and equipment. The increases in labor intensity and investment were both targeted to obtaining higher recovery of end products from a given amount of timber.

The conditions in the industry changed considerably during and following the recession of the early 1980's. First, stumpage prices plummeted relative to wages, reversing the changes observed between 1975 and 1980. With the post recession recovery also came the full utilization of new plant and equipment financed during the previous boom. Both of these changes underscored the rapid labor productivity increases observed from 1982 onward. The changes in labor productivity observed over the past decade can thus be described as the result of one of the most severe cycles the industry has experienced in this region. Thus, changes normally experienced in the cyclical history of the industry were much more pronounced during the 1975-85 period. In terms of isolating the various causes of labor productivity improvements, statistical studies of the industry indicate that the substitution of capital for labor predominates over the other conventional alternatives (i.e., technical change and the substitution of other inputs for labor). Productivity improvements may, in fact, have been constrained over the past several decades by reported declines in the quality of timber in the region.

Labor productivity improvements in the industry were also found to result from changes in the mix of products processed from timber. Over the last decade, the industry has increased lumber production and log exports relative to plywood production. Given that plywood production is the most labor-intensive form of timber processing, this shift reduced wood products employment in relation to the amount of timber harvested.

Labor productivity gains from the substitution of capital for labor and from product mix changes can be expected to continue, though probably not at the rate observed in recent years. These changes reflect long run forces that have been operating nationally and in the Pacific Northwest.

A survey of mill workers and government officials in Jackson, Josephine and Klamath Counties revealed that structural unemployment does not exist in the current boom period. Job reductions during the earlier recession were achieved by reductions in hours/days worked, early retirements and, in the case of mill closures, layoffs. Skilled workers were observed to be the most mobile in terms of their search for new employment. Both in the recession and the more recent recovery, the industry has not been a productive source of employment for younger unskilled workers just entering the labor force. This may change, however, with future retirements. Employment skills have traditionally been acquired on the job. Even with the newer more advanced production technologies, occupational skills are still being developed in the mills. There was only slight evidence of an increase in the amount of prior education and training required for entry in the industry's work force.

Local governments are highly dependent fiscally on the wood products industry, both in terms of receipts from timber harvests and property taxes directly and indirectly linked to wood processing activities. Cyclical instability in the revenue streams from wood products production remains a major concern of local governments, although improvements in economic diversification in the survey area have lessened the fiscal dependence of local governments on the industry over time. Local officials are actively engaged in programs to further diversify the economic bases of their communities. These efforts have been facilitated in part by the state-funded Regional Strategies program.

Local economic diversification efforts have been largely focused outside the wood products industry, although there appears to be some potential in promoting secondary processing activities that deserves closer attention. Also, the focus of some diversification efforts has been on tourism, which is at least as cyclical as wood processing. While possibly easier said than done, community development efforts would be best served by concentrating on activities that can mitigate the cyclical impacts of the wood products industry, not exacerbate them.

Smaller communities in timber dependent regions will continue to face economic pressures associated with trends in the industry toward larger mills. The closure of older, smaller, and less efficient mills can be expected to continue, considering that timber supply constraints will most likely tighten over the next decade. In some cases, community assistance programs can effectively mitigate the effects of mill closure. In other communities, however, the loss of mills will represent the elimination of the community economic base, and assistance would not likely alter their ultimate fate.

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APPENDICES

APPENDIX A

Decomposition of the Decline in Wood Products Employment

The methodology used to decompose the decline in wood products employment that occurred between 1977 and 1986 is similar to that used in shift - share analysis (Ashby, 1965). Given the various end products processed from timber, the procedure identifies changes in employment attributable to three factors: (1) the change in the amount of timber available to all types of processors, (2) the change in the mix of end products processed by the industry, and (3) the differential changes in the rates of labor utilization among the various processing sectors. The explicit representation of these three factors is presented below.

A. Change in Timber Consumption

The change in employment resulting from a change in the total amount of timber processed by the industry is represented as follows:

$$E_c = (C_{86} / C_{77} - 1) \times E_{77}, \text{ where}$$

E_c = the change in employment due to the change in the amount of timber processed;

C_{86} = the amount of timber processed in 1986;

C_{77} = the amount of timber processed in 1977;

E_{77} = total wood products employment in 1977.

Given the data for these symbols, we have

$$-.01785 \times 71,434 = -1,275$$

B. Change in Product Mix

The change in employment resulting from a change in the mix of timber dedicated to plywood and lumber production is represented as follows:

$$E_{i m} = (iS_{86} - iS_{77}) \times C_{86} \times iI_{77}, \text{ where}$$

$E_{i m}$ = the change in employment in sector i (sawmills, plywood mills) due to the change in that sector's share of the total amount of timber processed by the wood products industry;

iS_{86} = the proportion of total timber consumption in the wood products industry in 1986 that was processed by sector i ;

iS_{77} = sector i 's proportion of total timber consumption in 1977;

C_{86} = the total amount of timber processed by the wood products industry in 1986;

iI_{77} = the number of employees required to process a given amount of timber in sector i in 1977.

The values applicable to the lumber and plywood sectors are as follows:

$$\text{Lumber:} \quad .02696 \times 9302 \times 4.2624 = 1069$$

$$\text{Plywood:} \quad -.05307 \times 9302 \times 5.7633 = -2845$$

The partial effects of the change in the lumber/plywood mix resulted in a gain of 1,069 employees in the lumber sector and a loss of 2,845 employees in the plywood sector. The net effect of these two changes is a reduction of 1,776 jobs.

C. Change in Labor Utilization

The change in employment resulting from the change in the number of workers required to process a given amount of timber into lumber and plywood is represented as follows:

$$E_i L = (iI_{86} - iI_{77}) \times iC_{86}, \text{ where}$$

$E_i L$ = the change in employment in sector i (lumber, plywood) due to changes in labor intensity in that sector;

iI_{86} = the number of workers required to process a given amount of timber into sector i 's product in 1986 (labor intensity);

iI_{77} = labor intensity in 1977;

iC_{86} = the amount of timber processed by sector i in 1986.

Inserting the appropriate values in the equations for lumber and plywood gives the following:

Lumber: $-.5191 \times 5,636 = -2,926$

Plywood: $-.2952 \times 2,880 = -850$

The combined effects of the changes in labor utilization rates in lumber and plywood production result in a loss of 3,776 jobs.

The effects of changes in labor utilization for wood products sectors other than lumber and plywood are derived in the following way:

$$E_r = (rI_{86} - rI_{77}) \times C_{86}, \text{ where}$$

E_r = the change in wood products employment in sectors other than lumber and plywood due to changes in labor intensity for those activities;

rI_{86} = the collective employment requirements in sectors other than lumber and plywood associated with processing a given amount of timber in 1986 (labor intensity);

rI_{77} = labor intensity in 1977;

C_{86} = the total amount of timber processed by the wood products industry in 1986.

For both 1977 and 1986, the labor intensity values were obtained as follows:

$$rI = (E_T - E_L - E_P) / C, \text{ where}$$

rI = labor intensity;

E_T = total employment in the wood products sector;

E_L = employment in the lumber sector;

E_P = employment in the plywood sector;

C = the total amount of timber processed by the wood products industry.

Inserting the appropriate values, the change in employment due to the change in labor intensity in activities other than lumber and plywood production is:

$$.0198 \times 9203 = 184$$

As a final check, we know that the observed change in employment in the wood products industry between 1977 and 1986 must equal the sum of the employment changes attributable to the changes in timber consumption, product mix and labor utilization. That is,

$$DE = EC + EM + EL + ER$$

The values obtained are:

$$-6643 = -1275 - 1776 - 3776 + 184$$

APPENDIX B

Derivation of the Alternative Input - Output Scenarios

This appendix explains the procedure used in defining the four input - output scenarios dealing with changes in product mix in the industry. The products included in the analysis are lumber, plywood, and log exports. The steps involved in deriving the scenarios were described in Section 3.2, and are reiterated below.

Step 1: The Shift in Timber Consumption

In the "1976 Mix" scenario, we determine the change in sectoral timber consumption in 1986 associated with the change from 1976 in the proportionate share of consumption for each product. The trade-off scenarios examine the effects of shifting one percent of total timber consumption - 94 million board feet - from the production of one product to another.

The following equation demonstrates the approach used to determine the shifts in timber consumption for the "1976 Mix" scenario:

$$C_i = (iS_{1976} - iS_{1986}) \times C_{1986}, \text{ where}$$

C_i = the change in the amount of timber processed into product i (lumber, plywood, log exports) due to the change in that product's share of total timber consumption between 1976 and 1986;
 iS_{1976} = product i 's proportion of total timber consumption in 1976;
 iS_{1986} = product i 's proportion in 1986;
 C_{1986} = the total amount of timber processed by the industry in 1986.

Inserting the relevant values into the above equation gives the following changes in timber consumption:

$$\begin{aligned} \text{Plywood:} & \quad .0473 \times 9302 = 440 \text{ MBF} \\ \text{Lumber:} & \quad -.0219 \times 9302 = -204 \text{ MBF} \\ \text{Log Exports:} & \quad -.0254 \times 9302 = -236 \text{ MBF} \end{aligned}$$

The shifts in product mix must, of course, sum to zero. Table B1 presents the alternative input - output scenarios as measured by changes in timber consumption.

TABLE B1
Changes in Timber Consumption For Alternative Scenarios
(million board feet)

<u>Scenario</u>	<u>Lumber</u>	<u>Plywood</u>	<u>Log Export</u>
1. "1976 Mix"	-204	440	-236
2. "Plywood to Lumber"	94	-94	0
3. "Export to Lumber"	94	0	-94
4. "Export to Plywood"	0	94	-94

Step 2: Converting the change in timber consumption to the change in sectoral employment.

The IMPLAN model reflects the 1982 structure of interindustry relations in Oregon. Thus, such factors as the value of output, final demand, income and the value of output per employee are measured in constant 1982 dollars. The underlying level of labor productivity reflects 1982 conditions as well. Also, as mentioned in the text, the IMPLAN model does not contain a "log export" sector. Log export activity in the analysis was thus defined to reside within the logging sector. The text discusses the implications of this.

In order to convert changes in timber consumption to changes in employment, the labor utilization rate for each product must be determined. Using sector employment data from IMPLAN and timber consumption data from U.S. Forest Service mill surveys (U.S. Forest Service, 1982), labor utilization rates for each product were derived. The relevant information is presented in Table B2.

TABLE B2
Labor Utilization Rates

<u>Sector</u>	<u>Employment</u>	<u>Timber Consumption (MBF)</u>	<u>Employees Per MBF Timber</u>
Sawmills	16,582	3,411	4.86
Plywood Mills	15,761	2,035	7.74
Logging	8,566	5,758	1.49

Source: U.S. Forest Service

The changes in sectoral employment associated with the alternative scenarios are then recovered by multiplying the timber consumption values in Table B1 by the labor utilization rates in Table B2. The resulting changes in sectoral employment are presented in Table B3.

TABLE B3
Changes in Sectoral Employment for Alternative Scenarios

<u>Scenario</u>	<u>Sawmills</u>	<u>Plywood Mills</u>	<u>Log Export</u>
1. "1976 Mix"	-991	3,406	-352
2. "Plywood to Lumber"	457	-728	0
3. "Export to Lumber"	457	0	-140
4. "Export to Plywood"	0	728	-140

Step 3: Converting the changes in employment to changes in sectoral gross output.

The IMPLAN model provides the value of gross output per employee in each sector. These values are reported in Table B4. Multiplying the changes in sectoral employment by their respective values of output per employee produces the changes in sectoral gross outputs, reported in Table B5

TABLE B4
Value of Output Per Employee, 1982

<u>Sector</u>	<u>Value of Output Per Employee</u>
Logging	\$258,940
Sawmills	98,671
Plywood Mills	91,642

Source: U.S. Forest Service

TABLE B5
Changes in Gross Output For Alternative Scenarios
(millions, 1982 dollars)

<u>Scenario</u>	<u>Sawmills</u>	<u>Plywood Mills</u>	<u>Log Exports</u>
1. "1976 Mix"	-97.783	312.133	-91.147
2. "Plywood to Lumber"	45.093	-66.716	0
3. "Export to Lumber"	45.093	0	-36.252
4. "Export to Plywood"	0	66.716	-36.252

Step 4: Converting changes in gross output to changes in final demand.

In order to determine the changes in economic activity of other input - output sectors associated with the changes in gross output in the logging, sawmill and plywood mill sectors, we must derive the changes in final demand underlying the observed changes in gross output in those three sectors. This derivation is a straightforward process involving the basic input - output identity. In matrix notation,

$$(I - A)^{-1} \times Y = X$$

$$Y = (I - A) \times X$$

$$= X - AX, \text{ where}$$

X = the 3 x 1 vector of changes in the sectoral gross outputs of logging, sawmills and plywood mills;

A = the 3 x 3 matrix of technical coefficients covering the three sectors;

I = a 3 x 3 identity matrix;

Y = the 3 x 1 vector of changes in final demand for the three sectors.

The changes in sectoral final demands derived from the changes in gross outputs are reported in Table B6

TABLE B6
Changes in Final Demand For the Alternative Scenarios
(millions, 1982 dollars)

<u>Scenario</u>	<u>Sawmills</u>	<u>Plywood Mills</u>	<u>Log Exports</u>
1. "1976 Mix"	-98.535	283.478	-142.48
2. "Plywood to Lumber"	44.571	-60.698	0
3. "Export to Lumber"	43.821	0	-54.563
4. "Export to Plywood"	0	60.499	-55.713

APPENDIX C

Mills Identified in the Survey area

<u>Sawmills</u>	<u>County</u>	<u>Interview</u>	<u>Union</u>	<u>Size*</u>
Idaho Forest Industries				
Double Dee Lumber	Jackson	XX		S
Croman Corp. Lumber	Jackson	XX		S
Modoc Lumber Co.	Jackson	XX		S
Rough & Ready Lumber Co.	Josephine	XX		S
Gilchrist Lumber	Klamath	XX		S
Eugene F. Burrill Co.	Jackson	XX		S
Medford Corporation				L
Delah Lumber	Jackson	XX	XX	
Pine Mill	Jackson	XX	XX	
Weyerhaeuser	Klamath	XX	XX	L
Boise Cascade				L
White City Lumber	Jackson	XX		
Medford	Jackson	XX		
<u>Plywood Mills</u>	<u>County</u>	<u>Interview</u>	<u>Union</u>	<u>Size*</u>
Medford Corporation				L
Southern Oregon Plywood	Josephine	XX	XX	
Medford (site)	Jackson	XX	XX	
Rogue River	Josephine	XX	XX	
Gregory Forest Products	Klamath	XX		S
Croman	Jackson	XX		S
Stone Container	Josephine	XX		S
Kogap Manufacturing Co.	Jackson	XX		S
Weyerhaeuser	Jackson	XX	XX	L
Timber Products				
Grants Pass	Josephine	XX		L
White City	Jackson	XX		S
Boise Cascade				L
Rogue Valley	Jackson	XX		
Medford	Jackson	XX		
Murphy Creek Lumber	Josephine			S
Spalding and Sons, Inc.	Josephine			S
WTD Industries				L
Crater Lake Lumber	Klamath			

* S = less than 500 employees

L = more than 500 employees

APPENDIX D
Interview Protocols

Local Government Interview

Name Interviewee:
Address:
Name Interviewer:
Date & Time:

- 1) **The economy of your county is has been classified as highly dependent on the wood products industry. How would you describe this dependency?**

---employment
---public finance
---retail sales
---other

- 2) **Has the nature of this county's dependency on the wood products industry changed in the last decade?**

Define the change.

- 3) **What factors have brought about this change?**

- 4) **Do you expect this dependency to change in the next 5-10 years?**

Define the change.

- 5) **What factors will bring about the change in the next 5-10 years?**

- 6) **How is your county (city) government dependent on the wood products industry?**

---public finance
---types of issues on the political agenda
---public leadership changes

- 7) **Please be specific with respect to the nature of county revenues received from the wood products industry?**
Percentages and numbers.
- 8) **Which percentage of total county (city) revenues comes from: (If he/she doesn't know, ask who could answer, follow up, go to 12)**
- sale of lumber
 - property taxes on wood products firms
 - property taxes paid by workers
 - other
- Are forest sales revenues assigned for specific uses? Which?
- 9) **Have these figures changed in the last decade?**
(If he/she doesn't know, ask who could answer follow up.and go to 12)
- Please be specific.
- 10) **Why did these figures change?**
- 11) **Do you expect these figures to change in the future?**
- If yes, why?
- 12) **How do you budget considering the uncertainty of your revenues associated with the wood products industry?**
- 13) **What were the socioeconomic consequences in general for this county (city) of the downturn in the wood products industry in the early 80s?**
- change in population (ask to explain change, probe who is leaving, who is coming, and characteristics of those people)
 - out-migration
 - in-migration
 - reduced sales
 - reduced revenues
- 14) **Has this resulted in any change in the demand for services? (explain)**
- 15) **Has this been the result of changes in the wood products industry or changes in the population composition or other reason?**

16) What specific consequences did the early 1980s downturn of the wood products industry have for your county (city) government?

- loss of workers
- change in the provision of services
- change in the demand for services
- change in political leadership
- new policies for economic development
- other new policies

17) How has the recent upturn in the wood products industry (since 1985) affected your county (city)?

18) How has it affected your county (city) government?

19) What do you think the future is going to be for the wood products industry in your county (city)?

20) What will happen to your government if there are further cutbacks in employment in the wood products industry?

21) Did you or a representative from your government participate in planning a regional strategy for economic development?

22) Was this in response to changes in the wood products industry?

With whom did you work?

23) Did anything come of your efforts?

If yes, where are you now in the planning efforts?

Have there been any problems with this planning effort/

If yes, what are (were) the problems?

25) What recommendations do you have for developing better planning procedures?

26) What strategies would you like to see implemented to help your county (city) and your government deal with problems which result from the dependency of your region on the wood products industry?

* Let's shift our attention to the people in your county who work or have worked for the wood products industry.

27) Would you describe: Who are they?

---age
---time of residence in the county (or city
---skilled/unskilled workers

28) Are these people typical of the workers for the industry in the past? If no, how are they different?

29) During the downturn of the 80s, what happened to the wood products industry workers in your county (city), who became unemployed?

30) What kind of people left the region? (age, skills, etc.)

Those who left were unemployed wood products workers or were also others affected?

Where did they go?
Will they come back?
If yes, why and under what conditions:

31) What kind of people stayed in the region?

Of those unemployed who stayed, how did they survive economically?

32) Are some of these people still unemployed?

How do they survive now economically?

33) Do the people who stayed raise any particular problems for your government to deal with?

34) If there is another downturn, what will the current workers do if they become unemployed?

Interview Protocols: Managers

Background

How long has this mill been in operation?

Has management or ownership of the mill change during this time?

Do you know the reasons for choosing this location for the mill?
If yes, what are they?

When was the last capital upgrade undertaken?

What was the nature of this upgrade?

The product which you produce is _____. Are there any unique characteristics of this product which distinguish it from other similar products produced by the industry?

Input - Stumpage

What is the source of your stumpage?

Forest service _____ From which forest? _____ Why this forest? _____
Other public _____ Name and location _____
Private industrial forest _____ Location _____
Other private _____ Location _____

Has there been a shift in the source of stumpage in the last 10 years?

Shift in source? _____
Shift in location? _____
If so, why?

Do you rely on old growth or second growth timber? _____

Estimate the mix of old growth and second growth _____

Has there been a shift in this mix in the last decade?
If yes, please explain.

Do you expect a change in the mix in the future? If yes, what will be the change?

Why will there be a change?

Do you anticipate a change in the source of stumpage in the next 5 years?

Source?
Location?
If so, why?

Employment

Relative to the experience of the wood products industry in the Northwest, how has your mill fared?

In terms of sales?

In terms of employment?

Has the mill and its production activities undergone any specific changes in response to the changing economic conditions over the last decade? (e.g., change in ownership, automation, etc.)

You have stated that employment has _____ (summarize comments of interviewee). Do you have any numbers which we could look at?

Has the composition of your work force changed in the last decade? If yes, what are the changes? Probe.

skilled vs unskilled _____

age _____

experience in the wood products industry _____

permanent vs temporary or contract employees _____

sex composition _____

What factors have brought about this change?

If labor requirements have changed, what changes in production activities have permitted this change?

_____ new technology which makes it cheaper to use machinery rather than workers

_____ changes in work rules have allowed more output per worker

_____ new technology which requires a different mix of workers (e.g., more skilled workers vs unskilled)

_____ changes in inputs (type of lumber) have allowed for more mechanized

_____ treatment which has altered the mix of workers necessary to get the job done

_____ change in the type of employee we hire

_____ change in management techniques

_____ other

Do you anticipate any major changes in the number and/or composition of the work force in the next 5 years?

If so, what will these changes be?

Why will change occur?

Productivity

What has been the trend in productivity over the last 10 years?

If productivity has changed, has the change occurred across the board or in specific phases of production (be specific)?

Why has productivity changed?

What factors have facilitated change in productivity?

How does this company try to get the most out of the mill?

For example, what's your strategy for getting the most out of the machinery?

What's your strategy for getting the most out of your employees?

Are there tradeoffs between the two strategies of which you are aware?

Inputs from Local Economy

To what extent do you depend on the local economy to provide you with equipment and raw materials for production?

Specifically, what kind of things do you purchase?

How important to these businesses is the economic well being of your mill?

Public Policies

What public policies benefit your industry?

What policies impede the activities of your industry?

Other than the forest service policies, what policies are a problem?

Discuss the form and frequency of interaction with local government.

State Government?

Federal Government?

Interview Protocol: Employees

Name _____
Employer _____
Union _____ Non Union _____
Age _____
Level of Education _____
Specialized Training _____

Work Experience

How long have you worked for the wood products industry? _____ At what age did you start working for the industry? _____ What year? _____
What was your first type of job in this industry?

How long have you worked for this mill? _____ Years? _____ What was your first job at this mill? What is it now?

What kind of employment have you had other than in the wood products industry?

Describe your work experience over the last year in terms of stability of employment and the type of work which you did and for whom.

Was this typical of your work experience? Explain answer?

For most employees in the industry is work pretty stable or do you get laid off quite frequently?

When you get laid off or fired, what is the cause?

When you get laid off, how do you survive economically?

Work Expectations

What kind of work do you plan to be doing in 5 years? In 10 years?

Where (employer/location) do you plan to be working in 5 years? In 10 years?

If you do not continue to hold work in this mill, where will you look for work? What kind of work will you look for?

If you cannot find work in the wood products industry in Oregon, where would you look for work and what kind of work would you look for?

What would it take to get you to take a job outside of the wood products industry?

Money _____
Better working conditions _____

Training _____
A job _____
Other _____

Explain to me why people choose to work for the wood products industry.

You started out as a _____. Is this the typical first job?

Where (in terms of type of work) do you go from there?

After 5 years working for the industry, what kind of job can a person expect to have? In 10 years?

Types of Employers

Are there "good" and "bad" mills to work for?

Can you give me some examples?
What makes a mill employer good?
What makes a mill employer bad?
How would you rate your current employer?

Perspective on Industry

What comments would you make to a person who is deciding to look for work in the wood products industry?

What advice would you give them about "making their way" in the industry. I mean if they're interested in having a job and making money.

What kind of production work have you done? What are you doing now?

Has the production of these products changed for these products over the last decade? (Probe for specifics)

New technology introduced _____
Change in work rules _____
Raw materials are different _____
Product is different _____
Management's approach to labor is different _____

Do you expect production to change in the future?

Are you doing more work for less pay or benefits now than in the past? Explain your answer.

Union/Non Union

You are (not) a member of a union?