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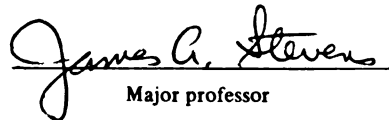
**Production and Trade Flow Estimates
For Sawmills, Pallet and Dimension
Manufacturers in Michigan, 1994**

presented by

John Craig Gregson

has been accepted towards fulfillment
of the requirements for

M.S. degree in Forest Economics


Major professor

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PRODUCTION AND TRADE FLOW ESTIMATES
FOR SAWMILLS, PALLET AND DIMENSION MANUFACTURERS IN
MICHIGAN, 1994

BY

John Craig Gregson

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

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ABSTRACT

PRODUCTION AND TRADE FLOW ESTIMATES FOR SAWMILLS, PALLET AND DIMENSION MANUFACTURERS IN MICHIGAN

By

John Craig Gregson

Sawmills, pallet mills, and dimension mills were surveyed using a telephone questionnaire to determine the source, volume, and origin of inputs and the channels of distribution, volume, and destination of outputs. Michigan sawmills, pallet mills, and dimension mills purchase the majority of their solid-wood inputs in-state. The principle inputs that comes from out-of-state are grade lumber and panel products used in the dimension industry. Sawmills in Michigan sell 53 percent of the high quality grade out-of-state, pallet mills primarily have in-state markets, and dimension mills sell 65 percent of their output out-of-state. Due to increased direct sales, broker's assistance in facilitating sales is less important than in the past for the three industries. Other important findings of the study includes an estimate of sawlog consumption in Michigan and the establishment of complete population of sawmills, pallet mills, and dimension mills in Michigan.

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CHAPTER 1

INTRODUCTION AND OBJECTIVES

INTRODUCTION

The potential for Michigan's forest products industry to expand in-state employment has been a recurring theme in political and academic discussion since the mid-1980's. Conferences and studies during this period identified the forest products industry as one that had great potential for expansion and job creation (see for example, Michigan Technological University 1987 and Michigan State University 1988). Michigan's forest resources continue to hold promise to produce the raw materials for an expanding industry and the need for development in rural areas has only increased in the past decade.

A brief overview of the forest products industry in Michigan will help show its present importance to the state's economy. In 1993, Michigan's forest products industry was responsible for employing 124,000 persons (Stevens 1995). The Michigan Employment Security Commission employment total for the forest products industry in 1993 was 54,000 jobs. An estimated 70,000 additional jobs are dependent upon the forest products industry, assuming a type III employment multiplier of 2.31 (Chappelle and Pederson 1991). Value-

added¹ to Michigan's economy from forest products is more than 5.5 billion dollars (1991 dollars) annually.

The forest products industry is of particular importance to the economy in the Upper Peninsula of Michigan. Approximately one-half of the manufacturing employment in the region is in Standard Industrial Classification (SIC) codes 24 and 26 respectively (Stevens 1995) (see Appendix A for descriptions of SIC codes).

Michigan's forest resources provide an array of raw materials and products. Sawlogs, veneer logs, pulpwood, bolts, poles, fuelwood, chips, and whole trees are the principle raw materials harvested in Michigan. The products manufactured from these raw materials include, but are not limited to: lumber, wood fuel, panel products, pallets, posts, furniture dimension parts, furniture, cabinets, flooring, log homes, Christmas trees, and pulp and paper products.

This study will primarily focus on sawmills, pallet mills, and dimension mills in Michigan for 1994. Within these focus industries the use of sawlogs as a basic raw material/input and the production of lumber, pallets, and dimension will be analyzed. The next sections are a description of the focus industries.

¹Value-added is the net value added to goods at each stage of production. Calculation of value-added avoids double counting of intermediate goods.

THE SAWMILL INDUSTRY

Sawmills (SIC code 2421) process approximately 632 million board feet (MMBF) of sawlogs annually in Michigan (Hackett and Pilon 1992). Some of this lumber, primarily softwoods, is sold as an end use product, while the remainder, hardwoods, is generally processed further into products such as pallets, dimension parts, furniture, cabinets, etc.

All of the regions² in Michigan contribute significantly to lumber production. Proximity to sawlog resources is a factor in the distribution of sawmills across the state, as low value-added industries like sawmills tend to be located near rural forested areas. The NLP produces 55 percent of the state's lumber, while the SLP and UP produce 17 percent and 28 percent respectively (Figure 1) (Hackett and Pilon 1992).

Hardwood lumber makes up seventy-eight percent of the lumber production in Michigan, and softwoods account for the remaining 22 percent (Hackett and Pilon 1992). The NLP's and UP's lumber production is 74 and 77 percent hardwood, respectively. In the SLP, 91 percent of all lumber produced is hardwood lumber.

² Southern Lower Peninsula (SLP), Northern Lower Peninsula (NLP), and Upper Peninsula (UP) (see Appendix B for a geographic description of the regions)

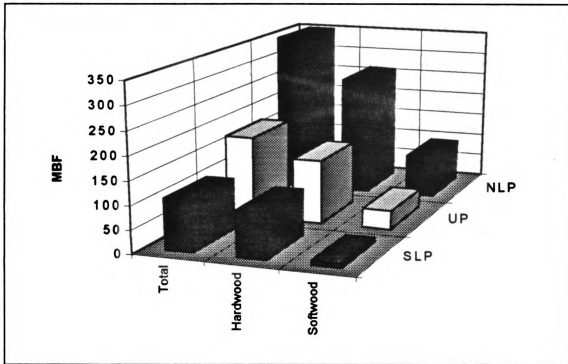


Figure 1. Michigan sawlog production, by region, 1992
(Hackett and Pilon 1992)

THE PALLET INDUSTRY

Pallets (SIC 2448) are classified under "Wood Containers" in the Standard Industrial Classification system. Production volumes and values for other wood containers such as wood boxes (SIC 2441) are included in the analysis of pallets, but pallets are by far the most important product.

The Southern Lower Peninsula of Michigan is an ideal location for a pallet industry. This region has high volumes of low quality hardwoods that are used in the manufacture of pallets. Proximity to wood supplies is of

particular importance to industries like the pallet industry that are characterized by low value-added possibilities (Jones, Bodenman, and Smith 1992). The primary users of pallets, the manufacturing and agriculture sectors, are also concentrated in the SLP. Pallets are used extensively to transport goods from these sectors. In general, the resource used to produce pallets is grown locally and the pallets are consumed locally.

THE DIMENSION INDUSTRY

The dimension industry consists of the manufacture of rough, semi- and fully-machined wood components (Stevens 1995). The current study includes the production of hardwood dimension (SIC 2426) and millwork (SIC 2431) in the dimension industry. The finished products that are manufactured from dimension stock include, but are not limited to: furniture, cabinets, trim, molding, plaques, musical instruments, and hand tools.

In Michigan, the dimension industry is primarily located in the SLP. Much of the state's, manufacturing and labor force is located in this region and markets are in closer proximity to the SLP than the NLP or UP (Stevens 1995).

The dimension industry utilizes both solid-wood³ and panel⁴ inputs. Solid wood inputs are generally hardwood lumber stock that originates in-state, while almost 100% of the panel stock comes from other states.

RESEARCH QUESTIONS AND PROBLEMS

This paper addresses several research questions related to the forest products industry. It also identifies and deals with problems that are associated with finding answers to the research questions. The objectives of this paper are to answer the following research questions:

- 1) What is the complete population of sawmills, pallet mills, and dimension manufacturers in Michigan?,
- 2) What is the annual volume and origin of sawlogs consumed each year in Michigan?,
- 3) What is the annual output per employee for Michigan sawmills?,
- 4) What is the volume, source, and origin of inputs used in the pallet and dimension industry?,
- 5) What is the volume/value, means of distribution, and destination of lumber, pallets, and dimension parts produced each year in Michigan?, and

³ Grade lumber (green or kiln dried), planed lumber, economy grade lumber

⁴ Plywood, particleboard, and medium density fiberboard

6) Should the sawmill, pallet, or dimension industry be targeted for further research to determine if in-state expansion is possible?

Questions 2, 4, and 5 regarding the origin of inputs and the destination of outputs are designed to establish the current trade flows of forest products. "Flow of products" refers to where and through whom manufacturers purchase raw materials and sell their products. "Where" means the geographic location and "through whom" means whether or not companies buy and sell directly or through intermediaries such as brokers and dealers. The reason for interest in the methods of purchasing and selling (direct vs. through brokers) is that less is known about the final destination of products if they are sold through brokers. Information is generally difficult to obtain from brokers.

There are at least three problems in the existing data regarding production and trade flows of forest products in Michigan. The problems are:

- 1) A lack of primary data on trade flows of Michigan forest products,
- 2) Under estimates sawlog use and lumber production, and
- 3) The complete population of sawmills, pallet mills, and dimension mills is not known.

This study utilizes primary data, a need that has been identified by several researchers. Currently, there is no

data to quantify the volume and value of logs and processed products that leave the state for further processing in other states, Canada, Mexico, or overseas. Gray, Ellefson and Lothar (1986) ranked "better information about the markets to which Lake States wood products flow and reasons for the development of such trade patterns..." as a primary research need. Erickson (1989) identified some of the limitations of secondary data, noting the importance of "information which identifies the state/country of origin/destination" of products.

There are several related topics that will not be covered in this paper. Production and trade information on pulp and paper, veneer, panel products, fuelwood, and Christmas trees is not included in the analysis. Due to limited information on loggers, no in-depth discussion will be presented for their activities.

CHAPTER 2

LITERATURE REVIEW

Overview

Literature on trade flows and/or production of wood products can be found on state, regional, and national levels (some example are: Stier 1989, Fraser, Johnson, and Blankenhorn 1990, and Phelps and McCurdy 1993). Related literature is varied but far from complete. Most of the regional and national studies are based on aggregated secondary data; some regional studies and a number of the state-level studies rely on primary research data.

There is no comprehensive state-wide study in Michigan that addresses the subject of trade flows of forest products, although studies in other states do address the subject for some products. Another obvious shortcoming is the general absence of export and import data in existing analyses. Following is a review of the existing studies related to these subjects.

Regional Surveys

There have been a number of regional studies of the forest products industry in the 1980's. Stier (1989) evaluated product flows in the North Central Region.⁵ While

⁵Including Illinois, Indiana, Iowa, Missouri, Ohio, Minnesota, Wisconsin, and Michigan.

this study is comprehensive in its industry-wide focus, its broad regional focus gives it limited applicability to the situation in Michigan.

Sawlog exports outside the region were found to be minimal, although there is a fair amount of trade among bordering states. Lumber production is known to be underestimated by the U.S. Bureau of the Census for the region. Accordingly, Stier (1989) suggests that more effort be invested to improve production estimates for the North Central Region. Stier's study probably gives better estimates for the region than the U.S. Bureau of the Census, but it does not contain Michigan-specific information. Although some primary production data have been gathered for Michigan, information on trade flows is lacking.

Gray et al. (1986) surveyed the Lake States⁶ to determine production and consumption of wood products. Interest for this study was partially derived from the economic recession of the early 1980's, which adversely effected the manufacturing sectors of all three states. During this time, Michigan's unemployment rate rose to 15.5 percent, while the national unemployment rate was 9.7 percent. With this in mind, the forest products industry was targeted for possible expansion, because it had

⁶Michigan, Minnesota, and Wisconsin

"weathered" the recession better than the automotive and mining industries (Gray et al. 1986). The large forested land base in the region also contributed to interest in the forest products industry.

The principal data sources used for the Gray et al. 1986 study are the U.S. Department of Commerce Bureau of the Census and the USDA Forest Service. Both sources give secondary product information following the guidelines set forth by the Standard Industrial Classification system. These secondary data sources have the potential of having large sampling errors and should be analyzed with great care. For example, in 1977 the North Central Experiment Station estimated Michigan's lumber production at 457 MMBF, while the Bureau of the Census's estimate was only 350 MMBF for the same year (Gray et al. 1986).

Data on sawlog and lumber production in the region are more difficult to obtain than information on other sectors like pulp and paper production. One of the reasons for the lack of information is the large number of small sawmills in the region. Small firms tend to be difficult to contact for several reasons. First, trying to reach small establishments on the telephone is difficult because a business phone numbers seldom exist; telephone numbers are usually home phone numbers. Second, owners of small firms tend to work extended hours which makes reaching them at

home difficult. Finally, responses to mail surveys are difficult because the owner's time constraints and/or lack of interest.

Existing data reveals that Lake States' hardwood consumption is approximately equal to production, suggesting that very little hardwood leaves the region for processing (Gray et al. 1986). Still, little is known about lumber and log flows among states in the region. This information is of particular importance to individual states that may be losing possible opportunities for value-added processing to other states in the region. Gray et al. (1986) also noted that sawlog exports outside of the region account for less than 1 percent of the total sawlog production and that sawlog imports are insignificant.

On a state-level, the Michigan Department of Commerce was interested in expanding the forest products industry in the mid-1980's. Nine forest products industries were reviewed by the Department of Commerce and the hardwood dimension industry was chosen as the industry for further review and possible expansion. The diversity of the dimension industry is one of the reasons it was chosen as the target industry. For example, dimension stock can be an end product; with some processing, it can be transformed into parts to supply furniture and cabinet manufacturers, and with further processing dimension stock "can result in

the production of furniture subassemblies" (Michigan Technological University 1987). Availability of lumber, state programs designed to help new or existing businesses, a strong wood products infrastructure, and competitive capital and operating costs are other reasons investors might choose Michigan for new investments or expansions (Michigan Technological University 1987).

Studies from regions other than the North Central Region have added to the literature on production and trade flows. Jones et al. (1992) surveyed the hardwood manufacturers of the northern and central Appalachian states⁷. The principle emphasis of the study was to determine general characteristics of the hardwood industry in order to identify potential opportunities to expand the industry. Firms were segregated as either having resource orientation or market orientation. Firms purchasing 50 percent or more of their raw materials in-state were considered "local resource oriented", while firms purchasing 50 percent or more of their raw materials from out-of-state were considered, "importers". Firms selling 50 percent or more of their products in-state were considered "local market oriented", while firms selling 50 percent or more of their products out-of-state were considered, "exporter".

⁷Connecticut, Maryland, Massachusetts, New Hampshire, New York, Ohio, Pennsylvania, Vermont, Virginia, and West Virginia

In the northern and central Appalachian region, 41 percent of the companies that were surveyed are considered exporters. The sectors most likely to export are dimension and flooring, with 62 percent of these firms selling 50% or more out-of-state. The level of exporting was found to be related to company size, with larger firms being more likely to export products. Jones et al. (1992) concluded that the dimension and flooring industry was the most beneficial to the local economy because "these plants employ more workers, purchase more raw materials locally, and export more than plants in other industries."

State Surveys

Hackett and Pilon (1992) assessed the Michigan timber industry following the format of earlier surveys (e.g., Smith, Weatherspoon and Pilon 1990). These studies concentrate on the production of industrial roundwood: pulpwood, sawlogs, veneer logs, fuelwood, posts, poles, and cabin logs (Table 1). This study also provide information on the origin of materials, including the counties and region of Michigan from which logs originate. According to the study, loggers delivered an estimated 632 million board feet (MMBF) of sawlogs to mills in 1992.

Although this study is specific to Michigan and gives needed information on sawlog use, its applicability is

limited. No information on the source of input purchases (through brokers or direct), the type of products produced, including volumes and values, destination, or the means of distributing these products is included.

Table 1. Industrial roundwood use in Michigan (Hackett and Pilon 1992)

Industry Type	Volume
Pulpwood	2.65 million cords Approximately 1,325 MMBF
Sawlogs	632 MMBF
Veneer Logs	38 MMBF
Other Products Industrial Fuelwood Commercial Posts Cabin Logs Shingle and Shaving Bolts	Approximately 130 MMBF

Michigan has both direct and indirect users of sawlogs. Sawmills are the most common direct user of sawlogs. They generally convert the sawlogs into lumber, then market the lumber. Some pallet mills are also direct users of sawlogs. The pallet mills that use sawlogs convert the sawlogs to lumber, then convert the lumber into pallets. Most pallet mills and almost all dimension mills are indirect users of sawlogs, i.e. they usually purchase the lumber from sawmills, then convert the lumber into various products.

Studies by McCurdy, Ewers, Kung, and McKeever (1988), Ostermeier, Watson, and Winistorfer (1989), Fraser et al. (1990), Jones et al. (1992) and Smith (1991), also address questions concerning input volume and origin. The distinction between these studies and others is that they addressed the question concerning the distribution and flow of products. Of these four studies, three are state level studies, two of which specifically deal with the pallet industry. The fourth is also a study of the pallet industry, but on the national level. The results indicate that solid wood inputs and distribution patterns tended to vary from state to state and nationally. Some states rely more heavily on brokers to distribute products than other states and the use of pallet cut stock, cants, and logs as inputs were different among the different studies (see Tables 2 and 3). This gives rise to the following general question: "What are the wood product use and flow trends in Michigan?".

Table 2. Distribution of pallets from studies in Pennsylvania, Washington, and the U.S.

Location	Direct	Broker	Other
Pennsylvania (Fraser et al. 1990)	54%	45%	1%
Washington (Smith 1991)	74%	25%	1%
USA (McCurdy et al. 1988)	87%	12%	1%

Table 3. Percentages of solid wood inputs used in pallet manufacturing from studies in Pennsylvania and the U.S.

Location	Lumber	Cants	Logs
Pennsylvania (Fraser et al. 1990)	34%	53%	13%
USA (McCurdy et al. 1988)	39%	37%	24%

The following is a discussion of studies related to the sawmill industry. The importance of sawmills is derived from the role they play in the chain of events that leads to the manufacture of secondary wood products (Phelps and McCurdy 1993). Hardwood sawmills cutting at least 10 MMBF of lumber per year distributed 71 percent of their lumber directly to the end user, while mills cutting less than 5 MMBF of lumber per year sell 33 percent of their lumber directly to the end user (Cassens 1989). Part-time operation, mixed truckloads of lumber, and the lack of a dry kiln are some of the reasons smaller companies sell less to

end users. The distinction between how small versus large companies distribute lumber was not made. In other words, the role of brokers in getting lumber from sawmills to wholesalers, distribution/concentration yards, processing facilities or end users was not examined.

Non-response bias

Non-respondents were often unaccounted for in the survey studies that were reviewed. When non-respondents were accounted for, one primary method was used - late respondents are assumed to resemble non-respondents (Meyer, Michael, and Sinclair 1992, and Ifju and Bush 1993). In neither of the previous studies was non-respondent bias detected. Meyer et al. (1992) used a Chi-squared test to compare relationships between late and non-respondents. Another method used to account for non-respondents was simple extrapolation (Fraser et al., 1990).

A review of the literature showed a trend concerning the response rates related to the size of companies. Small companies tended to be harder to receive responses from than large companies (Smith 1991 and Gray et al. 1986).

When one sector of the population is underrepresented, the likelihood of non-response bias toward that sector increases. Although this may be the case for that particular sector, the industry as a whole still may be well

represented. For example, Hyldahl (1993) only surveyed 21% of the forest products companies in Michigan, but that 21% accounted for 65% of forest industry employment.

Exports

Exports of wood raw materials and products, especially hardwoods, to Canada and other countries from the U.S. have drastically increased since 1978. Since that time, hardwood exports have risen by 300 percent to over 800 MMBF in 1990 (Nolly 1992).

The Lake States have actively encouraged wood products exports. Beier and Bertsch (1989) developed a hardwood marketing report based on the Interzum International Trade Fair, 1989. The purpose of the report is to help the hardwood industry develop interest in pursuing markets in Europe. The products of significance that are discussed in the report are graded lumber and hardwood dimension.

This study notes that grade hardwood lumber from the Lake States is generally more expensive for the European market because shipping cost are higher. Appalachian and Southeastern states can usually receive \$25-\$50 more per one-thousand board feet because they do not face the higher shipping cost. Another important finding of the Beier and Bertsch (1989) study is that there is potential for increased exports of hardwood dimension to Europe.

Erickson and Vincent (1989) and Erickson (1989) did some preliminary work on Michigan forest products exports. Following are some of the conclusions of their work. First, secondary trade data sources have serious shortcomings when used for state-level analysis. Second, before an accurate description of the Michigan forest products trade profile can be reached, more trade information including methods and routes of exports are needed. Finally, an assessment of the volumes and values of exports are needed.

Some improvement has been made in trade data sources in the past five years that could shed more light on Michigan export/import patterns. One of these improvements is a new method of recording data. Currently, U.S. hardwood export reports are based on Canadian import reports, as opposed to only using U.S. export figures. This change was made because U.S. exports to Canada were being underreported (Luppold 1992). Since Canada is the largest export market for hardwood lumber from the U.S. in both volume and value, the information is important. Canada plays a major role in facilitating trade between the United States and Europe; ten to 20 percent of the US's hardwood lumber exports to Europe go through Canadian ports (Luppold 1992). These numbers do not include the amount that is exported to Canada, then re-exported to Europe.

CHAPTER 3

RESEARCH METHODS

SURVEY DESIGN

The study utilizes a cross-sectional survey design which was administered over the telephone using a structured questionnaire and covers information for 1994. The variables and measures used to answer the research questions in this study are presented in Table 4. The discussions that follow summarize the participants, the instrument used in gathering the information, and the procedures for carrying out the study.

PARTICIPANTS

The Forest Management Division of the Michigan Department of Natural Resources (MDNR) compiles a directory of wood products mills and manufacturers (Forest Management Division, Michigan Department of Natural Resources 1994). This directory is the primary source of information on companies in Michigan involved in wood products production and serves as the sampling frame from which the sample was taken. The unit of analysis in this study is individual companies listed in the directory.

Table 4. Variables and Measures

Variable	Measure
Sawmills, Pallet mills, and Dimension Mills	Count
Sawlog Production	MMBF/year by region and company size
Sawlog Origin	% from Michigan or elsewhere
Lumber Production	
Output/employee	MMBF/year
Grade Lumber	MMBF/year by company size
Destination	% sold to MI, other states, Canada, or elsewhere
Distribution	% sold direct or through a broker
Economy Grade Lumber	MMBF/year by company size
Destination	% sold to MI, other states, Canada, or elsewhere
Distribution	% sold direct or through a broker
Pallet Production	\$/year by company size
Origin of input	% purchased in MI, other states, Canada, or elsewhere
Source of input	% purchased direct or through a broker
Destination of output	% sold in MI, other states, Canada, or elsewhere
Distribution of output	% sold direct or through a broker

Table 4 (cont'd)

Dimension Production	\$/year by company size
Origin of input	% purchased in MI, other states, Canada, or elsewhere
Source of input	% purchased direct or through a broker
Destination of output	% sold in MI, other states, Canada, or elsewhere
Distribution of output	% sold direct or through a broker

The MDNR directory is a state-wide listing of primary and secondary wood products manufacturers in Michigan. Primary manufacturers include mills engaged in the processing of raw materials, generally sawlogs and bolts, into such products as rough lumber or cants. Secondary manufacturers include mills engaged in the processing of semi-finished wood products, such as rough lumber into pallets, furniture, furniture components, and millwork (Forest Management Division, Michigan Department of Natural Resources 1994).

Although the MDNR wood products directory is extensive in its coverage of mills and manufacturers, it is not complete (Table 5). Listings in the MDNR directory are totally voluntary and some companies choose not to be included. The MDNR directory does, however, contain listings for sole proprietors which are not found in the

Michigan Employment Security Commission (MESC) records. MESC records have company listings by SIC code and number of employees. In order to arrive at a more complete population, MESC records were reviewed to determine if records existed in it that are not in the MDNR database (Table 6). The records unique to the MESC database were added to the MDNR records to arrive at the population (Table 7). Cross referencing for individual companies by company name and address was done to avoid double counting those companies that may be listed differently in the two databases. Seventy-six out of 119 firms that are unique to the MESC 1994 database are small companies with 1-5 employees.

SIC codes were utilized to determine which companies in the MDNR directory to survey. Companies with SIC code 2421 are categorized as sawmills; SIC codes 2441, 2448, and 2449 are categorized as pallet mills, and SIC codes 2426 and 2431 are categorized as dimension mills.

Table 5. Firms in the MDNR database by type and # of employees, 1994

	0-5	6-15	16-30	31-50	51+	Total
Sawmills	170	74	28	14	12	298
Pallets	61	62	39	13	13	188
Dimension	76	58	32	20	31	217
Total	307	194	99	47	56	703

Table 6. Firms in the MESC 1994 database that are not in the MDNR database, 1994

	0-5	6-15	16-30	31-50	51+	Total
Sawmills	25	7	3	3	0	38
Pallets	29	7	1	2	1	40
Dimension	22	12	5	1	1	41
Total	76	26	9	6	2	119

Table 7. Total firms by type and # of employees

	0-5	6-15	16-30	31-50	51+	Total
Sawmills	195	81	31	17	12	336
Pallets	90	69	40	15	14	228
Dimension	98	70	37	21	32	258
Total	383	220	108	53	58	822

The difficulty in categorizing a particular firm is that many companies produce multiple products. MESC data is categorized with the SIC code of the product that makes up the largest part of the companies income. This method is also used for categorizing the companies who responded to the survey. Companies not responding to the survey that are in the MDNR database are also categorized by SIC code.

Beyond classifying firms on the basis of products (SIC codes), companies were also aggregated by location and size. Geographically, firms are aggregated into three regions (UP, NLP, and SLP). Company size is based upon the number of employees per firm. The size categories used by the MDNR are: 1-5, 6-15, 16-30, 31-50, 51-100, 101-200, 201-500, 501-1000, and 1000+ employees. Not all of these size categories are used for the current study. Because so few sawmills, pallet mills, or dimension mills employ over 100 employees, the largest size category used for this study is 51+ employees.

A high response rate was needed for this study to get information on certain low frequency categories, primarily exports. Exports of raw wood materials and wood products from Michigan tend to be a small portion of the total wood products industry. This being the case, a high response rate from the industry was needed to procure enough information on exports to be able to make legitimate

inferences to the population. Efforts were made to obtain as many responses as possible given time and budget constraints.

RESEARCH INSTRUMENT

The research instrument used for this survey is a questionnaire that was administered over the telephone (Appendix C). Before the survey began, expert opinion was solicited from knowledgeable forestry professionals across Michigan. This group included foresters from private industry, private forestry consulting firms, government agencies and universities. The purposes of contacting these individuals was to obtain feedback on the survey design and instrument.

The decision to administer the questionnaire on the telephone was made after considering the feedback and reviewing response rates from similar studies that used mail or telephone questionnaires (Ostermeier et al. 1989 and Fraser et al. 1990). The primary concern expressed by the group of forestry professionals was that the survey would not be effective if it were self-administered. The ability to handle complex information on the telephone and the personal touch which accompanies telephone surveys compared with mail surveys were also factors in choosing the telephone survey. Time and budget constraints of the

researcher excluded personal face-to-face interviews as a consideration.

PROCEDURES

Sample groups received a pre-contact letter and a copy of the questionnaire a week prior to receiving the telephone call for the survey (Appendix D). The pre-contact letter served several purposes; first, it briefly described the study and the need for their cooperation and participation. Second, it informed the companies that the information they disclosed would be kept confidential on the individual company level. Third, it let the companies know when to expect the phone call. Finally, the letter informed the companies that they could receive a copy of the survey results if they participated in the study. This was done to help relieve any suspicions the respondents may have had concerning the use of the data. The purpose of the questionnaire was to familiarize the contact people with the questions and allow them time to find the answers if they did not know them.

Phone contacts began a week after the companies received the pre-contact letter. From this point, it often took two to four weeks to complete the calls, depending on the number of companies in the sample group. During these two to four weeks, if the initial attempt to contact a

particular company failed, follow up calls were made until the company responded or until it was judged impractical to continue with that company. These procedures for collecting data began in March of 1994 and were completed in September of 1994.

CHAPTER 4

RESULTS

SURVEY RESPONSE

Overall response rates for the study are judged acceptable for each population sub-category with the possible exception of dimension mills (Tables 8, 9, and 10). Responses were received from 59% of the sawmills, 56% of pallet mills, and 26% of dimension mills with greater than five employees in the sampling frame. Responses from the larger firms are important because they produce a very high percentage of the overall volume/sales. Eighty-six percent of all sawmill production, 96% of all pallet production, and 87% of all dimension production is attributed to firms with greater than 5 employees.

There are two primary categories of non-respondents: companies who refused to answer the survey and companies who could not be contacted. Only 7 (1%) of the 703 companies contacted explicitly refused to answer the survey. The companies refusing to respond to the survey do not represent any particular industry sector or category. In other words, the companies refusing to respond were not all in the same size category and did not all produce the same products. Therefore, refusals were not judged to be a problem.

Table 8. Study population and response rates for sawmills in Michigan, 1994

Number of Employees	Population (Firms)	Sampling Frame	Respondents	Response Rate	Non-respondents	
					Refusals	No Contact
0-5	195	170	21	12%	0	115
6-15	81	74	33	45%	0	35
16-30	31	28	20	71%	0	4
31-50	17	14	13	93%	0	1
51+	12	12	10	83%	0	2
Total	N = 336	298	n = 97	33%	0	157

Table 9. Study population and response rates for pallet manufacturers in Michigan, 1994

Number of Employees	Population (Firms)	Sampling Frame	Respondents	Response Rate	Non-respondents	
					Refusals	No Contact
0-5	90	61	5	8%	0	1
6-15	69	62	40	65%	2	9
16-30	40	39	20	51%	1	16
31-50	15	13	5	38%	1	6
51+	14	13	6	46%	0	7
Total	N = 228	188	n = 76	40%	4	39

Table 10. Study population and response rates for dimension manufacturers in Michigan,
1994

Number of Employees	Population (Firms)	Sampling Frame	Respondents	Response Rate	Non-respondents	
					Refusals	No Contact
0-5	98	76	5	7%	0	0
6-15	70	58	17	29%	0	17
16-30	37	32	11	34%	1	10
31-50	21	20	6	30%	1	9
51+	32	31	7	22%	1	18
Total	N = 258	217	n = 46	21%	3	54

Companies unable to be contacted pose a potential problem to bias caused by non-respondents. The companies with less than six employees constitute the majority of this group of non-respondents. The difficulty in obtaining responses from this group of companies is related to the nature of small companies. As was mentioned earlier, in most instances, the phone numbers listed for the small companies are the home phone number of the owner and not an actual business number. Thus, when contacts were made, it was often with an individual who did not know or have the answers to the survey. This observation is true for most small firms in all of the major sectors surveyed (sawmills, pallet mills, and dimension mills). Some effort was made to contact loggers (producers) but the same conditions prevail making it difficult to get responses. Most of the phone calls in which responses were received from companies with 1-5 employees were made in the evening between 8:00 PM and 10:00 PM.

SAWLOG INPUTS INTO SAWMILLS AND PALLET MILLS

Non-respondents

Sawlog consumption data exists for many of the non-respondents, especially for the companies with 1-5 employees, who were under sampled in the current survey.

This consumption data is found in "Michigan Timber Industry- An Assessment of Timber Product Output and Use, 1992" (TPO) (Hackett and Pilon, 1992). The publication is a Michigan specific report based on responses from firms found in the MDNR wood products directory. The TPO also analyses the use of roundwood raw materials other than sawlogs such as pulpwood, veneer logs, cabin logs, poles, posts, and industrial fuelwood. The only roundwood input of interest in this study is sawlogs.

The TPO publication is only concerned with roundwood inputs/raw materials. Information on outputs (products, volumes, or values) produced from sawlogs is not listed. Potential non-response bias will not be analyzed for outputs such as lumber, pallets, and dimension because limited additional information exist for these products.

Individual company-level TPO records were acquired for sawlog volumes for 1992 and were entered into a database to make comparisons between the current survey and TPO data on sawlog use. Comparisons are made on the basis of mean annual sawlog use for sawmills and pallet mills by employee size class (Tables 11 and 12).

Sawmills are the primary sawlog consumers. All of the firms categorized as sawmills use sawlogs as their main input. The 1992 TPO publication is based on responses from 256 sawmills, and the current survey is based on responses

from 96 sawmills. The main difference is that the TPO data includes responses from 151 sawmills with 1-5 employees, while the current study only surveyed 23 firms in this class (Table 11).

Some pallet manufacturers also consume sawlogs. Sawlog use by pallet manufacturers in both the TPO data and the current survey was limited to small and medium sized firms (1-5, 6-15, and 16-30 employees). Only one pallet manufacturer in both data sets with greater than 30 employees reported using sawlogs as an input. Mean annual sawlog use tended to be lower for pallet manufacturers who used sawlogs than for sawmills of the same size (Table 12).

One tailed, two sample t-tests were used to test for differences in the means of non-respondents and respondents of the same employee size class. TPO data has larger sample sizes of sawmills with 1-5 and 6-15 employees, and similar sample sizes for large sawmills. Statistical tests were made assuming the following: 1) $\alpha = .05$, 2) variances between the two data sets are different, 3) the company-level 1992 TPO means are not adjusted for increases in sawlog use between 1992 and 1994, and 4) the null hypothesis is that in the population, the two means (TPO and current survey) are statistically equal.

Given the previous assumptions, no statistically significant differences were detected between the TPO and

the current study's mean annual sawlog consumption for sawmills or pallet mills. P-values are the probability of obtaining a mean significantly different from the population mean at a .05 significance level (Table 11 and 12). All P-values were larger than .05, therefore the null hypothesis can not be rejected and the difference in sample means is not significant. This does not imply that the 1992 and 1994 averages are exactly the same. Actually, mean annual sawlog use increased for all employee size categories by at least 13% with the exception of companies with 1-5 employees, which decreased 21%.

Analysis of sawmills shows the most convincing evidence that there are not statistically significant differences in mean annual sawlog use. Each of the three smallest employee classes have at least 20 samples. Sawmills with 31-50 and 51+ employees have between 8 and 13 samples, which may seem low, but this is only because the population of sawmills in these employment classes is small. For example, the response rates for sawmills with 31-50 and 51+ in the current survey are 93% and 83% respectively.

Although pallet mill sawlog consumption is less extensive than sawmill sawlog consumption, comparisons are still needed. No statistically significant differences in means were observed for pallet mills, but the tests for pallet mills with 1-5 and 16-30 employees should be reviewed

with caution because the current survey contains small sample sizes for these employee classes, 3 and 7 samples respectively.

Table 11. Sawlog use by sawmills surveyed in 1994 compared to sawlog use by sawmills in the 1992 TPO publication

Employees	TPO n (1992)	TPO mean (MBF)	Survey n (1994)	Survey mean (MBF)	P-value ⁸
1-5	151	583	23	461	0.3025
6-15	58	1,874	32	2,354	0.1524
16-30	26	3,853	20	5,166	0.1140
31-50	13	7,599	11	8,568	0.2608
51+	8	13,196	10	14,955	0.3231
Total	256		96		

⁸All P-values are acceptable at the 95% significance level

Table 12. Sawlog use by pallet mills surveyed in 1994 compared to sawlog use from the 1992 TPO publication

Employees	TPO n (1992)	TPO mean (MBF)	Survey n (1994)	Survey mean (MBF)	P-value ⁹
1-5	16	636	3	312	0.2433
6-15	15	1,357	15	1,314	0.4660
16-30	9	1,348	7	2,127	0.4013
31-50	0	N/A	0	N/A	N/A
51+	1	N/A	0	N/A	N/A
Total	41		25		

Sawlogs: Expanded Volumes for 1994

Three methods are used for calculating sawlog use in Michigan for 1994. First, the data obtained during the current study is expanded to the population. Second, data from the 1994 survey and the 1992 TPO study are combined to increase the sample size then expanded to the population. Finally, the 1992 TPO results will be expanded on the basis of percent changes in usage between 1992 and 1994 and new information concerning the population.

⁹All P-values are acceptable at the 95% significance level

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Method 1

Sawlog consumption estimates in this section are based on data obtained during the current survey. Sawlog usage is analyzed for sawmills and pallet separately in Methods 1 and 2. The discussion in this section on the technique in which pallet mill sawlog usage is derived is also applicable for Method 2, therefore the discussion will not be repeated in the Method 2 section.

Companies in this section are grouped by the number of employees. Groupings by location would have also been made for more in-depth comparisons with the results using *Method 2*, but this would have left sample sizes using the current survey too small in each sub-group.

An estimated 742 MMBF of sawlogs was consumed by sawmills and an estimated 51 MMBF was consumed by pallet mills in 1994 (Tables 13 and 14). The total estimate of sawlogs consumed in Michigan in 1994 using method 1 is 793 MMBF. Estimates for each employee size class are derived by multiplying the number of firms in each employee class by the mean annual sawlog use for that employee class. Mean annual sawlog use was calculated by summing the volumes of the sampled firms in each size class and dividing the sum by the number of firms sampled in that size class.

Table 13. Summary of sawlog use by sawmills in Michigan by size, 1994 (1994 survey data only)

# of Employees	Population	Mean Volume/ firm (MBF)	Total Volume (MBF)	Percent Contribution
0-5	195	497	96,831	13%
6-15	81	2,281	184,776	25%
16-30	31	5,096	157,981	21%
31-50	17	7,250	123,250	17%
51+	12	14,955	179,460	24%
Total	336		742,297	100%

Pallet mill sawlog use

Although most pallet mills primarily purchase economy grade lumber and convert it into pallets, some process the lumber directly from sawlogs, then manufacture the lumber into pallets. Estimating sawlog use by pallet manufacturers is therefore necessary to estimate the total sawlog consumption in Michigan. As previously mentioned, the total estimated sawlogs used by pallet mills is 51 MMBF using Method 1 (Table 13).

Significant amounts of sawlogs are used by pallet manufacturers in the Northern Lower and Southern Lower Peninsulas. In the NLP, only firms with 30 or less employees use significant amounts of sawlogs and in the SLP,

only small firms with 15 or less employees use significant amounts of sawlogs (Table 13). Pallet mills in the UP are not considered because only 3 firms reported using sawlogs.

Since all pallet manufacturers do not use sawlogs, averages used to expand sawlog use is adjusted to estimate the sawlog use of all pallet mills, as opposed to only those that use sawlogs. Adjustments are made to the mean by summing the amounts of sawlogs used by pallet mills and dividing the sum by the total number of pallet mills instead of only the ones that are using sawlogs. The adjusted mean is reported as "Adjusted mean/firm (MBF)". (Table 14 and 16).

Table 14. Summary of sawlog use by pallet mills in Michigan by size, 1994 (1994 survey data only)

# of Employees	Population	Adjusted mean/firm (MBF)	Total Volume (MBF)	Percent Contribution
0-5	90	187	16,866	33%
6-15	69	493	33,990	67%
16-30	40	0	0	0
31-50	15	0	0	0%
51+	14	0	0	0%
Total	228		50,856	100%

Method 2

Sawlog consumption estimations in this section are based on combined 1992 TPO data and 1994 survey data. Combining these two data sets increases the sample size from 96 to 238 sawmills and 25 to 48 pallet mills that use sawlogs (Tables 15 and 16). The major contribution obtained by adding the TPO responses to the survey responses is the addition of 113 responses from companies classified as sawmills with 1-5 employees. The major disadvantage is that the 1992 company-level volumes are not adjusted to 1994 volumes, thus a slight under estimate is expected since overall sawlog use increased during this period.

The combined sample size is represented as "n+TPO" in Tables 15 and 16. When combining the data sets, in cases where individual company data exists for both years, the 1994 volumes were used. Of the 336 firms listed as sawmills, sawlog input volumes are known for 71% of all firms or for at least 82% of the total sawlog use.

Using method 2, sawmills in Michigan in 1994 are estimated to consume approximately 713 MMBF of sawlogs, and pallet mills consume approximately 43 MMBF of sawlogs (Tables 15 and 16). This totals to an estimate of 756 MMBF of sawlogs consumed in Michigan for 1994. This estimate is 4.7% lower than the estimate obtained using method 1.

Table 15. Summary of sawlog use in sawmills in Michigan by region and size, 1994 (Combined data)

Region	employees	N	n+TPO	Mean annual sawlog use (MBF)	Total Sawlog use (MBF)
UP	0-5	46	29	223	10,259
UP	6-15	24	17	1,879	45,096
UP	16-30	4	2	5,750	23,000
UP	31-50	7	5	7,050	49,350
UP	51+	8	6	12,592	100,733
sub-total		89	59		228,438
NLP	0-5	97	77	809	78,478
NLP	6-15	34	26	2,416	82,152
NLP	16-30	19	17	5,019	95,370
NLP	31-50	6	5	10,200	61,200
NLP	51+	2	2	21,333	42,667
sub-total		158	127		359,866
SLP	0-5	52	28	258	13,392
SLP	6-15	23	13	1,457	33,511
SLP	16-30	8	7	4,179	33,429
SLP	31-50	4	3	6,145	24,581
SLP	51+	2	1	10,000	20,000
sub-total		89	52		124,913
TOTAL		N=336	238		713,217

Table 16. Summary of sawlog use in pallet mills in Michigan by region and size, 1994 (Combined data)

Region	employees	N	n+TPO	Mean annual sawlog use (MBF)	Adjusted mean/firm (MBF)	Total Sawlog use (MBF)
UP	0-5	3	1	N/A	N/A	N/A
UP	6-15	4	1	N/A	N/A	N/A
UP	16-30	1	1	N/A	N/A	N/A
UP	31-50	0	0	0	0	0
UP	51+	2	0	N/A	N/A	N/A
sub-total		10	3			
NLP	0-5	27	10	886	328	8,856
NLP	6-15	17	13	1,092	835	14,195
NLP	16-30	10	6	1,493	896	8,960
NLP	31-50	2	1	N/A	N/A	N/A
NLP	51+	3	0	N/A	N/A	N/A
sub-total		59	30			32,011
SLP	0-5	60	7	267	31	1,860
SLP	6-15	48	6	1,256	183	8,784
SLP	16-30	29	1	0	0	0
SLP	31-50	13	1	0	0	0
SLP	51+	9	0	0	0	0
sub-total		159	15			10,644
TOTAL		N=228	48			42,655

Method 3

The 1992 TPO publication reported that mills in Michigan used 632 MMBF of sawlogs annually. This estimation is 161 MMBF lower than the method 1 1994 total and 124 MMBF lower than the method 2 1994 total.

There are two legitimate reasons for the discrepancy. First, the TPO 1992 data only contains information on the companies found in the MDNR wood products directory; companies in the MESC 1994 database that are not also in the MDNR directory are excluded. This accounts for 38 sawmills and 40 pallet manufacturers or an additional annual consumption of 78 MMBF of sawlogs.

The second explanation is that overall mean annual sawlog use is higher in 1994 than in 1992. The 1992 TPO total of 632 MMBF is now be expanded by the percent increases in usage for 1993 and 1994 to estimate 1994 sawlog use.

Adjustments for increases in sawlog usage between 1992 and 1994 for the 1992 TPO data are based on Bureau of the Census data for 1993 and expert opinion for 1994. The Bureau of Census estimates that Michigan lumber volumes increased 7.8% from 1992 to 1993 (United States Department of Commerce 1994). Although lumber volumes do not correspond directly with sawlog volumes, the percent change is estimated to be the same and is used for this analysis.

Sawlog use in Michigan in 1994 rose an estimated 10 and 20 percent above 1993 usage (Personal communication, Jack Pilon¹⁰). A conservative increase in sawlog usage of 8% is used to make adjustments for 1993-1994. The 1994 volume adjusted for increases in sawlog usage is calculated as follows.

1993: $632 \times 1.078 = 681$ MMBF

1994: $681 \times 1.080 = 736$ MMBF

Combining adjusted volumes caused by increases in sawlog usage (736 MMBF) between 1992 and 1994 and adding volumes that are not accounted for in the 1992 due to an incomplete population (78 MMBF) gives an estimated 1994 sawlog use of 814 MMBF (Method 3).

Table 17. Estimated sawlog usage in Michigan, 1994 (3 methods)

	Volume (MMBF)
Method 1	793
Method 2	756
Method 3	814

¹⁰ Mr. Pilon works for the Michigan Department of Natural Resources and is responsible for gathering information on sawlog usage in Michigan. He is currently gathering 1994 data.

Sawlogs: Origin and Purchasing Methods

Michigan sawmills and pallet mills purchased 95 percent of their sawlogs in-state (Figure 2). Almost all of the sawlogs not originating in Michigan were used by companies located in close proximity to Wisconsin and Indiana. Purchases of sawlogs were distributed between direct purchases and purchases from loggers, 53 percent and 45 percent respectively (Figure 3). A direct purchase in this case is the purchase of stumpage or the use of timber from company owned land. "Purchases from loggers" are the purchases that mills make from loggers who have purchased and produced stumpage. Only 2 percent of the sawlog inputs were purchased through brokers.

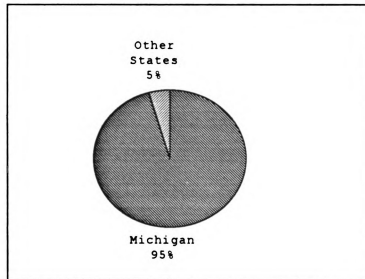


Figure 2. Origin of logs used by Michigan mills

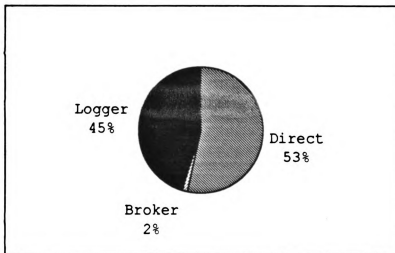


Figure 3. Source of logs for Michigan sawmills

Sawlogs: Region and Firm Size

All of Michigan's regions contribute significantly to sawlog use. Fifty-two percent of Michigan's sawlogs were consumed in the NLP (Figure 4). This region contains 127 sawmills, compared to 59 in the UP and 52 in the SLP. The UP and SLP account for 30% and 18% of the sawlog consumption, respectively. The 1992 TPO estimates are similar with the NLP estimated using 55%, and the UP and SLP using 28% and 17% of all sawlogs in Michigan, respectively.

Company size is determined by the number of employees. Overall sawlog consumption is similar for all employee classes, especially the classes with 6 or more employees (Figure 5). Although overall sawlog consumption is similar

for all employee classes, consumption relative to the number of firms in the classes is heavily weighted toward the larger companies. The twenty-nine sawmills (9% of all sawmills) that employ over 30 workers account for 42% of all sawlog use by sawmills. As expected, mean annual sawlog consumption by sawmills increases as the number of employees increase (Figure 6).

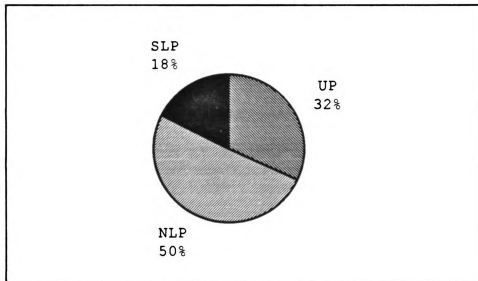


Figure 4. Regional consumption of sawlogs by Michigan sawmills, 1994

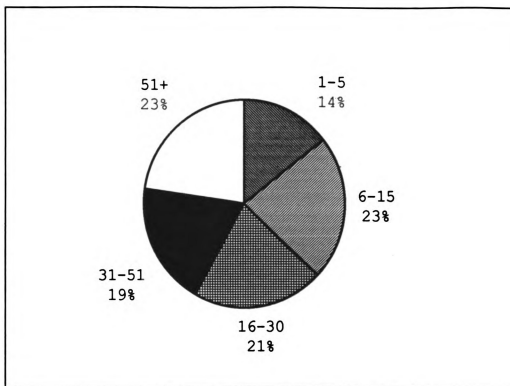


Figure 5. Consumption of sawlogs by Michigan sawmills by the number of employees per firm, 1994

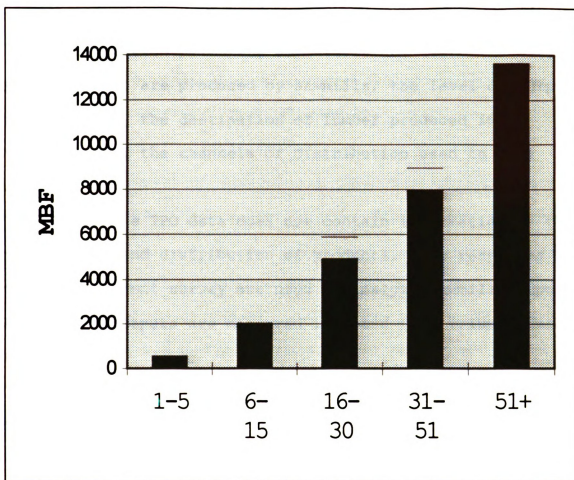


Figure 6. Mean annual sawlog consumption by Michigan sawmills by # of employees, 1994

SAWMILL OUTPUTS

This section primarily emphasizes the various lumber products that are produced by sawmills, the level of output per employee, the destination of lumber produced in Michigan, and the channels of distribution used to sell lumber.

Since the TPO data does not contain information on the destination and distribution of products, only responses from the current survey are used to analyze sawmill outputs. All lumber outputs are measured in board foot volumes (mill tally).

Productivity

Lumber output per employee (productivity) is measured to determine if there are economies or dis-economies of scale as the number of employees per firm increases. Lumber output in this section includes the total amount of lumber per sawmill, regardless of quality. The companies analyzed in this section are sawmills that are listed in the MDNR and MESC databases who responded to the current survey, since only the MESC database lists the exact number of employees per firm.

Lumber output per employee for sawmills in Michigan does not show a consistent increasing or decreasing trend between employee classes. Productivity decreases for

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sawmills with 6-15 employees relative to those with 1-5 employees, then gradually increase for sawmills with 16-30 and 31-50 employees, then decreases substantially for sawmills with 51+ employees (Figure 7).

Sawmills with 1-5 employees are shown as having a productivity level of 260 MBF per employee, the highest of all size classes (Figure 7). Several factors may account for this. First, output per employee may be less for larger firms because all employees, including those who are not directly involved in the milling process, are reported. Sawmills with 1-5 employees have fewer "over-head" employees. Second, the MESC database may underestimate the number of employees per firm, especially for small firms. For example, there are 16 sawmills in the MESC database listed as having 1-5 employees that responded to the current survey; eight of the 16 are listed in the MDNR database as having 6 or more employees. These factors combined help to explain why small sawmills show higher outputs per employee.

Productivity does increase from 185 MBF to 194 MBF per employee for sawmills with 16-30 employees, and from 194 MBF to 203 MBF per employee for sawmills with 31-50 employees. A surprising result is that companies with 51+ employees have a relatively low output per employee compared to the smaller mills (Table 7). Annual output for companies with 31-50 employees (the size class closest to 51+ employees) is 230

MBF/employee, while companies with 51+ employees exhibit a productivity level of 153 MBF/employee. One possible explanation is that the MESC data reports fewer employees than is actually employed in companies with 31-50 employees, therefore over estimating their productivity. Second, sawmills with 51+ employees may be producing products other than lumber. Finally, productivity may be actually lower for sawmills with 51+ employees, otherwise more large sawmills would exist.

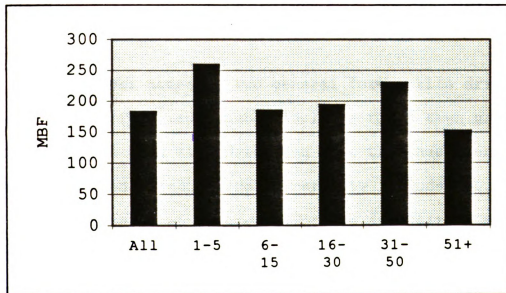


Figure 7. Annual lumber output per employee by company size, 1994

Grade Lumber

Lumber in this study is divided into two categories, "grade lumber" and "economy grade" lumber (Smith 1991). Grade lumber consists of all boards graded as 3A or better. All other boards are considered economy grade lumber. This study does not differentiate between hardwood and softwood lumber; information on hardwood and softwood volumes can be found in Hackett and Pilon 1992 (Figure 1, Chapter 1).

An important use of grade lumber is in the dimension and millwork industry. Over 80% of all solid wood inputs into the dimension and millwork industry in 1994 was grade lumber.

Grade lumber comes in two general forms: kiln dried and green. Kiln dried grade lumber includes rough sawn grade lumber that has been kiln dried and some that has been kiln dried and planed. Green grade lumber only includes rough sawn grade lumber that is green. For the analysis in this section, green grade lumber and kiln dried grade lumber will be aggregated and reported as "grade lumber" to avoid possible double counting. In the "Dimension Mill" section, they will be separated to analyze the various production levels and/or possible trends.

Michigan sawmills produced an estimated 342 MMBF of grade lumber in 1994 (Table 18). The 12 firms with 51 or more employees (3.6% of all sawmills) produced 33% of all

grade lumber. All other employee classes contribute significantly to overall grade lumber production.

Table 18. Annual production of grade lumber by Michigan sawmills, 1994

Employees	Number of sawmills	TOTAL VOLUME (MBF)	Percent contribution
0-5	195	47,494	14%
6-15	81	77,875	23%
16-30	31	42,143	12%
31-50	17	62,693	18%
51+	12	111,958	33%
TOTAL	336	342,163	100%

Destinations of Grade Lumber

Michigan sawmills sold forty-five percent of the grade lumber they produced to out-of-state buyers, but this does not account for all of grade lumber that leaves Michigan (Table 19). Some of the in-state sales were to kiln drying operations that dried the lumber then re-sold it, often to out-of-state buyers. Combining the amount of grade lumber that sawmills and kiln dry operations sell to out-of-state buyers adjust the amount of out-of-state sales to 53% of all grade lumber produced in Michigan (Figure 8 and Table 20).

The majority of all grade lumber sales, whether in-state or out-of-state are to dimension mills.

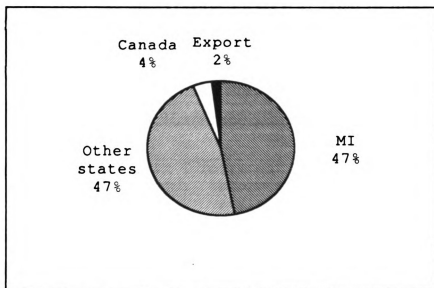


Figure 8. Destination of grade lumber produced in Michigan, 1994

It is significant that 53% of grade lumber is sold outside of Michigan. Grade lumber has the potential of having a high degree of value-added processing, i.e. conversion into dimension parts and/or furniture. If it leaves the state as lumber, increases in value-added will not be realized in Michigan. Jones et al. (1992) concluded that the best opportunities for increasing processing in a region/state is with resources that are locally grown and processed then sold out-of-state. The reasoning associated with this conclusion is that local purchases of resources keep funds in a region or state and selling products out-of-

state brings new funds into the region. This is the case with grade lumber in Michigan. A high percent the resource is purchased locally and a high percent of the products made from grade lumber are sold out-of-state (see the discussion on dimension products).

Table 19. Destination grade lumber sawn in Michigan, 1994

Employees	Total sold in Michigan (MBF)	Total sold in other states (MBF)	Total sold in Canada (MBF)	Total exported (MBF)
0-5	40,784	5,597	1,113	0
6-15	44,082	28,401	5,392	0
16-30	28,016	11,399	2,728	0
31-50	28,282	28,873	3,454	2,084
51+	46,744	59,935	1,510	3,768
TOTAL	187,908	134,204	14,198	5,852
Percent Contribution	55%	39%	4%	2%

Larger firms are more likely to export grade lumber and economy grade lumber than smaller companies. This result supports the findings of Jones et al. (1992) and Cassens (1989) (Table 20). Personal contacts with sawmill representatives lead the researcher to believe that one reason for this trend is that large companies have more

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networking and communication capabilities that small companies.

Table 20. Percent of grade lumber and economy grade lumber sold out-of-state, 1994

Employees	Percent Grade Lumber sold out-of-state	Percent Economy Grade lumber sold out-of-state
1-5	14%	>.05%
6-15	43%	8%
16-30	33%	24%
31-50	55%	29%
51+	58%	42%
Total	53%	18%

Distribution of Grade Lumber

Knowing the channels of distribution in which products are sold and the amounts sold through these channels is important in analyzing the amount of products that are sold out-of-state. Participants in this study were asked the percentages of each product that was sold directly and the percent sold through brokers.

Direct sales included all sales to end-users, including retailers, and sales to firms that processed the product further. Sales through brokers primarily included sales to firms that did no further processing to the product:

brokers, dealers, agents, and some wholesalers. It is important to know how much is sold through brokers because little is known about the final destination of products that are sold through brokers. Thus, if high percentages are sold through brokers, the amount being sold to out-of-state buyers is harder to determine. This discussion applies to the distribution of all products¹¹ under consideration.

Respondents to the survey often knew when the brokers whom they were selling to were selling to out-of-state buyers. Thus, sales were recorded as out-of-state sales, although the transaction was to a Michigan broker, as long as the respondents knew the final destination of the product.

Michigan sawmills overall sell 22% of their grade lumber through brokers; the remainder is sold directly (Table 21). There is a distinct trend in how companies in various size classes sell grade lumber. As company size increases, less and less grade lumber is sold through brokers relative to total production for that size class (Figure 9). One explanation is that large companies tend to have more drying and planing capabilities on site, thus preparing the raw material for end use processing. Another reason mentioned by some of the respondents relates back to the reason given

¹¹ Grade lumber, economy grade lumber, pallets, and dimension parts

why larger companies sell more out-of-state: they have more networking and communication capabilities than small companies, thus creating opportunities to sell more directly.

Table 21. Distribution of grade lumber produced in Michigan, 1994

Employees	Total volume sold directly (MBF)	Total volume sold through a broker (MBF)
0-5	22,973	24,523
6-15	54,064	23,811
16-30	31,618	10,525
31-50	56,129	6,564
51+	102,242	9,716
TOTAL	267,026	75,139
Percent Contribution	78%	22%

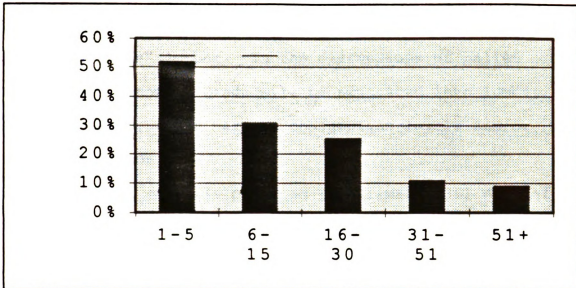


Figure 9. Percentage of grade lumber sold through brokers by firm size, 1994

Economy Grade Lumber

Economy grade lumber is the poorest quality lumber that is manufactured and is primarily utilized in the pallet industry. Economy grade comes in two forms: rough sawn lumber and cants. The primary distinction between the two is that the rough sawn lumber comes in various thicknesses, generally 1 or 2 inches, while cants are quarter sawn. In other words, cants come in dimensions such as 4" x 4", 5" x 5", or 6" x 6". Because of these distinctions, rough sawn lumber is more easily manufactured into pallets than cants. Rough sawn lumber only needs to be cut to length and notched before nailing, while cants must be sawn into lumber, then

cut to length and notched. In the following discussions, the two types will be aggregated and will be referred to as "economy grade" lumber. In the discussions of pallet production, economy grade will be separated into lumber and cants to analyze the various consumption levels and/or possible trends.

Michigan sawmills produced an estimated 361 MMBF of economy grade lumber in 1994 (Table 22). Firms with 6-15 employees produced 31% of all the economy grade lumber, which is more than any other size category.

Table 22. Annual production of economy grade lumber by Michigan sawmills, 1994

Employees	Number of sawmills	TOTAL VOLUME (MBF)	Percent contribution
0-5	195	57,774	16%
6-15	81	113,076	31%
16-30	31	80,631	23%
31-50	17	57,596	16%
51+	12	51,588	14%
TOTAL	336	360,665	100%

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Destinations of Economy Grade Lumber

As previously mentioned, economy grade lumber is a low value product and is used extensively in the pallet industry. It is no surprise that 82% of the economy grade lumber manufactured in Michigan is also sold in Michigan (Table 23). The other 18% is sold in other states.

Company size seems to be a factor in determining whether economy grade lumber is sold outside of Michigan. As firm size increases, the amount of out-of-state sales increases relative to total production for that employee size class (Table 20). This trend corresponds to the trend observed for grade lumber sales in this study and in the Jones et al. (1992) and Cassens (1989) study.

Table 23. Destination of economy grade lumber sawn in Michigan, 1994

Employees	Sold in Michigan (MBF)	Sold in other states (MBF)	Sold in Canada (MBF)
0-5	57,720	54	0
6-15	104,085	8,829	162
16-30	61,380	19,251	0
31-50	40,698	16,626	272
51+	30,000	21,588	0
TOTAL	293,883	66,348	434
Percent Contribution	82%	18%	.12%

Distribution of Economy Grade Lumber

Brokers are used very little to facilitate the sale of economy grade lumber in Michigan. Only eleven percent of all economy grade lumber is sold through brokers (Table 24). Only the smallest companies (1-5 employees) sell significant amounts through brokers (40%). Sawmills with greater than 5 employees only sell 5% through brokers.

Table 24. Distribution of economy grade lumber produced in Michigan, 1994

Employees	Total volume sold directly (MBF)	Total volume sold through a broker (MBF)
0-5	34,320	23,400
6-15	108,540	4,617
16-30	7,601	4,030
31-50	48,773	8,823
51+	51,300	300
TOTAL	319,534	41,170
Percent contribution	89%	11%

PALLET MILLS

This section deals with the production of pallets and other closely related products. Although wood boxes and baskets are included in the pallet category, pallets and skids are by far the major product in this category. All products in the pallets section are measured in 1994 dollar values.

Approximately 71% of all pallet production takes place in the Southern Lower Peninsula. This region is heavily populated and the major manufacturing and agricultural sectors are located here. The stability of the pallet industry is directly related to the stability of the manufacturing and agricultural sectors (Stevens 1995).

Inputs into Pallet Production

Pallet manufacturers are both direct and indirect users of sawlogs. The distinctions between direct and indirect use of sawlogs are discussed in the "Methods" chapter.

Twenty-one percent of the solid wood inputs into Michigan pallet manufacturing is logs (Table 25). Cants and low quality lumber (including pallet cut stock) make up the remainder of the solid wood inputs, 37 and 42% respectively.

Table 25. Solid wood inputs into pallet mills
(Results of 3 studies)

Location of study	Sawlogs	Cants	Lumber and pallet cut stock
National (McCurdy et al. 1988)	24%	37%	39%
Michigan (Current study)	21%	37%	42%
Pennsylvania (Fraser et al. 1990)	12%	50%	34%

Based on previous studies, the mix of raw materials that pallet manufacturers use in Michigan is similar to the nationwide mix, but different from raw material use in Pennsylvania. Nationally and in Michigan, pallet manufacturers tend to rely more on sawlog inputs, while Pennsylvania uses more cant inputs (Table 25).

Annual Sales, Destination, and Distribution

Michigan pallet manufacturers sold approximately 219 million dollars worth of pallets in 1994 (Table 26). The pallet manufacturers that employ 1-5 workers only contribute 4% of all pallet sale although they make up 39% of all pallet manufacturers. The employee size classes contributing the most to pallet production are 6-15 and 16-30, which contribute 29 and 30 percent respectively.

Eighty-seven percent of pallets produced in Michigan are sold in-state (Table 27). Pallet manufacturers in the UP sell the majority of their pallet to Wisconsin, but the overall amount is very small. Most of the 11% that is sold to other states is sold in Indiana.

Eighty-six percent of pallets produced in Michigan are sold directly to end-users (Table 28). The remaining 14% is sold through brokers. It is no coincidence that the amount of pallets sold out-of-state and the amount sold through brokers is similar. There is no way to quantify the exact amount of pallets that are sold out-of-state which are also sold through brokers, but through the telephone survey discussions, it is noted that most out-of-state pallet sales were through brokers.

Table 26. Annual pallet production in Michigan by # of employees, 1994

Employees	Number of pallet mills	TOTAL SALES (\$ million)	Percent contribution
0-5	90	8.68	4%
6-15	69	64.21	29%
16-30	40	66.60	30%
31-50	15	38.70	18%
51+	14	40.97	19%
TOTAL	228	219.16	100%

Table 27. Destination of pallets manufactured in Michigan,
1994

Employees	Sales to Michigan (mill \$)	Sales to other states (mill \$)	Sales to Canada (mill \$)	Export sales (mill \$)
0-5	8.37	0.00	0.00	0.31
6-15	62.72	1.39	0.11	0.00
16-30	58.43	5.84	2.33	0.00
31-50	31.88	6.07	0.75	0.00
51+	29.32	11.07	0.00	0.58
TOTAL	190.71	24.37	3.19	0.89
Percent contribution	87%	11%	1.4%	0.6%

Table 28. Distribution of pallets manufactured in Michigan,
1994

Employees	Direct sales (million \$)	Brokered sales (million \$)
0-5	8.62	0.00
6-15	56.66	8.61
16-30	56.17	11.31
31-50	36.23	2.72
51+	33.79	7.18
TOTAL	189.35	29.81
Percent contribution	86%	14%

DIMENSION MILLS

Dimension parts consists of rough, semi- and fully-machined wood components that are used in the manufacture of furniture, cabinets, construction, millwork, and specialty items (Stevens 1995 and Michigan Technological University 1987). Dimension mills are listed as secondary manufacturers in the MDNR directory. All dimension products are measured in 1994 dollar values.

Response rates from dimension mills are lower than for sawmills and pallets mills (see Table 10). Obtaining responses tended to be more difficult because the person who answered the phone was usually not the contact person. The low responses have the potential of creating sampling errors that could bias the results.

Raw Materials

The principal solid wood input into dimension mills in Michigan is kiln dried grade lumber, accounting for 72% of the solid wood inputs (Figure 10). The dimension industry also uses panel products¹² in the manufacture of dimension (Figure 11). Most firms primarily using panels manufacture millwork (SIC 2431) and most firms primarily using solid wood inputs manufacture hardwood dimension (SIC 2426).

¹² Plywood, Particleboard (P-board), and Medium Density Fiberboard (MDF)

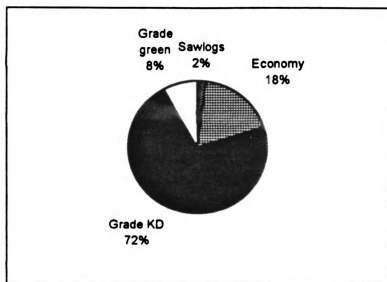


Figure 10. Solid wood inputs into dimension manufacturers in Michigan

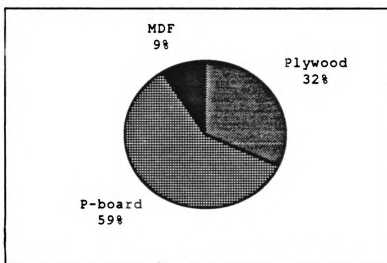


Figure 11. Panel inputs into the dimension manufacturers in Michigan

Annual Sales, Destination, and Distribution

Dimension mills in Michigan sell an estimated \$651.7 million dollars worth of dimension parts annually (1994 dollars) (Table 29). Production of dimension parts is heavily weighted to firms with 51+ employees. The study results indicate that firms with 51+ employees produce 59% of all dimension parts. One of the reasons why this class of dimension mills produces such a high percent of the overall production compared to sawmills and pallet mills of the same size is because there are more dimension mills with 51+ employees relative to the overall number of dimension mills. For example, sawmills with 51+ employees make up 3.5% of all sawmills; pallet mills with 51+ employees make up 6% of all pallet mills. Dimension mills with 51+ employees make up 12% of all dimension mills.

Seventy-one percent of Michigan's dimension parts are sold outside of Michigan, 65 percent to other states and 6 percent is exported to Canada or other countries (Table 27). Most of the dimension sales to other states is being sold in Kentucky, Tennessee, West Virginia where labor cost is generally lower than in Michigan.

Michigan dimension mills sell 93% of their products directly and 7% through brokers (Table 28). There are similarities between dimension mills and sawmills related to distribution of products. Recall that as sawmill size

increased, the amount of direct sales increased. Direct sales for dimension mills with 51+ employee is 96%. Thus, it is easy to see why direct methods dominate dimension sales, since firms with 51+ employees produce such a high percent of overall dimension production.

Table 29. Annual dimension production in Michigan by # of employees, 1994

Employees	Number of dimension mills	TOTAL SALES (\$ million)	Percent contribution
0-5	98	87.37	13%
6-15	70	63.17	10%
16-30	37	83.76	13%
31-50	21	35.14	5%
51+	32	382.26	59%
TOTAL	258	651.69	100%

Table 30. Destination of dimension parts manufactured in Michigan, 1994

Employees	Sales to Michigan (mill \$)	Sales to other states (mill \$)	Sales to Canada (mill \$)	Export sales (mill \$)
0-5	26.85	48.71	11.76	0.04
6-15	25.53	22.82	0.38	14.45
16-30	44.49	37.43	0.00	1.84
31-50	8.31	26.46	0.37	0.00
51+	85.03	288.54	4.29	4.40
TOTAL	190.20	423.95	16.80	20.74
Percent Contribution	29%	65%	3%	3%

Table 31. Distribution of dimension parts manufactured in Michigan, 1994

Employees	Direct sales (million \$)	Brokered sales (million \$)
0-5	85.16	2.21
6-15	45.59	16.4
16-30	73.93	6.35
31-50	32.63	1.49
51+	368.69	16.00
TOTAL	606.00	42.45
Percent contribution	93%	7%

CHAPTER 5

DISCUSSION

This section summarizes the major findings of the study, identifies limitations of the study and identifies potential research topics that may further the literature regarding production and trade flows of forest products. Following is a list of the research questions that are answered in the "Results" section. The conclusions are derived from the answers to these questions.

Research Questions:

- 1) What is the complete population of sawmills, pallet mills, and dimension manufacturers in Michigan?,
- 2) What is the annual volume and origin of sawlogs consumed each year in Michigan?,
- 3) What is the annual output per employee for Michigan sawmills?,
- 4) What is the volume, source, and origin of inputs used in the pallet and dimension industry?,
- 5) What is the volume/value, means of distribution, and destination of lumber, pallets, and dimension parts produced each year in Michigan?, and
- 6) Should the sawmill, pallet, or dimension industry be targeted for further research to determine if in-state expansion is possible?

THE POPULATION

One of the most important accomplishments of this study is the establishment of a more complete database of companies who manufacture lumber, pallets, and dimension parts. One-hundred nineteen firms not present in the Michigan Department of Natural Resources directory of mills and manufacturers were identified by cross referencing the MDNR directory with the Michigan Employment Security Commission database. The 119 firms consists of, 38 sawmills, 40 pallet mills, and 41 dimension mills. These firms consume 78 MMBF of sawlogs annually, or approximately 10% of all sawlog consumption in Michigan.

The identification of forest products firms not in the MDNR directory has several benefits. First, researchers may use this information to adjust previous estimates for sawmills, pallet mills, and dimension mills. Second, researchers can use the information to obtain better estimates in future research. Third, this study identifies the need to examine the databases (MDNR and MESC) in more detail. For example, the number of firms producing products other than lumber, pallets and dimension may also be underestimated and a comparison of the databases revealed that the MESC database often listed companies as having fewer employees than the MDNR database listed (for the same company). Finally, the manner in which firms are classified

needs examining. For example, some firms are classified as sawmills in one database and loggers in the other. These factors should all be considered when using data from the MDNR database and/or the MESC database to do research.

FOCUS INDUSTRIES

In the following discussions on "Sawmills", "Pallet Mills", and "Dimension Mills", the following criterion used by Jones et al. (1992) will be used for a portion of the analysis. Firms purchasing 50 percent or more of their raw materials in-state are considered "local resource oriented"; firms purchasing 50 percent or more of their raw materials from out-of-state are considered, "importers". Firms selling 50 percent or more of their products in-state are considered "local market oriented"; firms selling 50 percent or more of their products out-of-state are considered, "exporters".

Sawmills

Production (output per employee) varied for sawmills as the number of employees per firm changed. Economies of scale are present for sawmills with 16-30 and 31-50 employees relative to sawmills with 6-15, however sawmills with 51+ employees are shown to have much lower productivity levels than those with 31-50 employees.

Sawmills are local (in-state) resource oriented. Market orientation for lumber varies by lumber grade. Sawmills are local (in-state) market oriented for economy grade lumber, and export (out-of-state) oriented for grade lumber.

The amount of rough (unplaned) grade lumber that is sold outside of Michigan is probably the most important finding in the sawmill sector. Fifty-three percent of Michigan's grade lumber leaves the state for processing elsewhere. Many survey respondents stated that out-of-state sales had risen over the last three years.

Recall that the primary use of grade lumber is in the dimension industry. An interesting point is that 50% of the grade lumber that dimension mills purchase comes from outside of Michigan and the other 50% is purchased in-state. One possible explanation for this out-flow and in-flow of grade lumber is that species mix is different (Personal communication, Dr. Otto Suchsland, Michigan State

University). Species was not a variable in this study, therefore it can not be determined, with the current data, if the reason for grade lumber out-flows and in-flows is species related.

The results identify grade lumber producers and the dimension industry as targets for further research. Further research may be aimed at determining the reasons for the various in-flows and out-flows of grade lumber and if more in-state processing is possible. Grade lumber producers will need to be consulted for grade lumber out-flows and dimension producers will need to be consulted for grade lumber in-flows.

Other important findings in the sawmill sector are trends related to company size. As the number of employees increased, sawmills tended to sell more lumber, especially grade lumber, to out-of-state buyers. This result substantiates the findings of Jones et al. (1992) who made the same conclusions for hardwood sawmills in the northern and central Appalachian states and Cassens (1989).

As the number of employees per firm increased, brokers were used less to facilitate lumber sales; in other words, more sales were made to end-users by large mills than small mills. Many of the firms surveyed also noted that they were using brokers less in the past three years to sell their products than previously. This finding and trend is

significant because as more sales are made directly, the more information about the final destination of products is known. Thus, sampling errors related to under estimations of out-of-states sale is not as critical because less is sold through brokers.

Pallet Mills

Pallet mills are local (in-state) resource oriented, and local (in-state) market oriented. Local resource orientation is attributed to the availability of low value lumber. Local market orientation is attributed to local markets, primarily the manufacturing and agricultural sectors.

Dimension Mills

Dimension mills rely equally on solid wood inputs purchased in-state and out-of-state. Panel inputs are primarily purchased from other states. Dimension mills sell 65% of their sales outside of Michigan, thus are export (out-of-state) market oriented. The production of dimension parts is dominated by firms with 51+. These large dimension mills sold higher percentages of their sales out-of-state, relative to the industry average of 65%.

Summary

Of the three groups surveyed (sawmills, pallet mills, and dimension mills), the most complete information was obtained for sawmills, followed by pallet mills and dimension mills, consecutively. The primary accomplishments of the study are the establishment of a more comprehensive population of sawmills, pallet mills, and dimension mills, the estimation of sawlog consumption in Michigan, the identification of large amounts of grade lumber out-flows from Michigan, and the identification of high percentages of dimension parts that are sold outside of Michigan.

APPENDICES

APPENDIX A. STANDARD INDUSTRIAL CLASSIFICATION

Table A.1. Description of SIC Codes

Industry Group Number	Description	Industry Number	Description
242	Sawmills and planing mills	2421	Sawmills and planing mills, general
		2426	Hardwood dimension and flooring mills
243	Millwork, veneer, plywood, and structural wood members	2431	Millwork
244	Wood Containers	2441	Nailed and lock corner wood boxes and shook
		2448	Wood pallets and skids
		2449	Wood containers, not elsewhere classified

APPENDIX B. REGIONS IN MICHIGAN

Figure B.1. Description of the regions in Michigan

APPENDIX C. PRE-CONTACT LETTER

Date:

Dear Forest Products Producer:

The Michigan State University Department of Forestry is conducting research to determine the flow of logs, lumber and other wood products from the stump to their point of final processing. Knowledge of these flows will be useful in determining the potential for increased value-added processing in the state. The information will also be helpful in projecting future changes in timber availability and prices. Your cooperation in this project would be greatly appreciated and is vital for its success.

In the next few weeks Craig Gregson, a research assistant in the Department of Forestry, will be calling to ask for your participation in this short phone survey. The questions are shown on the enclosed sheet. Your answers will be kept confidential and the results will be tallied in aggregate form with no individual company data disclosed. The results of the study will be made available to you upon completion.

We appreciate your help in this project. If you have any questions or concerns, please call me.

Sincerely,

Jim Stevens
Michigan State University
126 Natural Resources Building
East Lansing, Michigan 48824-1222
Telephone: (517)432-3353
Fax: (517)432-1143

APPENDIX D. SAMPLE QUESTIONNAIRE

Remember, Craig Gregson will call you for the answers.

This is strictly a Michigan study. The following questions will be asked during the survey. Thanks for you help in this study.

Inputs/Raw Materials

1. What raw materials/inputs (rough grade lumber, rough low quality lumber (kiln dried or green), round logs, pallet cut stock etc.)does your company use in production?
2. What is the approximate annual volume of each raw material?
3. What percent of each input comes from Michigan?
Other states? Primary states?
Canada? Primary provinces?
Other Countries?
4. What percent of each input do you purchase:
Directly (e.g., lumber from a sawmill or dry kiln operation, stumpage, etc.)?
Through a broker ?
Through a logger?
Through other sources?

Outputs/Products

**** We are not interested in mill residues that you may sell. ****

5. What is the approximate annual volume or value of each product.
6. What products does your company produce or resale? (e.g., pallets, furniture, dimension parts, green or dried lumber, finished lumber, etc.)
7. What percent of each product do you sell in Michigan?
Other States? Primary states?
Canada? Primary provinces?
Other countries?
8. What percent of each product do you sell:
Directly to an intermediate or end user?
Through a broker?
Through other outlets?
9. How have these patterns changed over the last three years?
10. Would you like a copy of the survey results? (y / n)

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