FINAL REPORT

MICHIGAN TIMBER MARKET ANALYSIS

Prepared For

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

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EXECUTIVE SUMMARY

Introduction

Currently there is very little market analysis that puts into perspective the status and outlook for forest products produced in Michigan. The purpose of this project is to understand how Michigan forest products are currently positioned in the global, domestic and regional markets and to benchmark delivered wood costs against other domestic and international regions. This information will help define where future opportunities and efforts can be focused to improve Michigan's forest sector competitiveness, preserve and create jobs and promote local and state economic activity. The paper and presentation generated from this work is intended to be used by Michigan's Forest Finance Authority (FFA), current forest product businesses and potential investors in new Michigan businesses.

Prentiss & Carlisle Management Company (PCMC) was engaged by the Michigan Department of Natural Resources (DNR) to conduct a descriptive analysis of Michigan's forest products industry. The analysis focuses on two subject areas: (1) the current and near future market outlook and trends for forest products that are manufactured in Michigan, and; (2) benchmarking of Michigan's current delivered wood costs against other domestic and international regions.

The market position occupied by Michigan's current forest products industry was analyzed for the following eight product groups:

- Pulp and Paper
- Lumber
- Oriented Strand Board
- Other Wood Products
- Furniture and Kitchen Cabinets
- Wood-based Biofuels

Michigan's average delivered wood costs were benchmarked against the following domestic and international regions:

- US Northeast
- US South
- US Pacific Northwest

- Brazil
- Russia
- New Zealand
- Finland
- Sweden
- Ontario, Canada

Forest Products in Michigan's Economy

The forest products industry is conventionally described as two sectors: (1) the primary industry, which converts raw wood from the forest into products such as lumber and pulp for paper-making, and; (2) the secondary industry, which converts materials from the primary industry into greater value added products, for example furniture manufacture which uses lumber as an input. This report is more heavily focused on the primary sector, as that is the sector most directly impacted by the policies of the DNR and FFA.

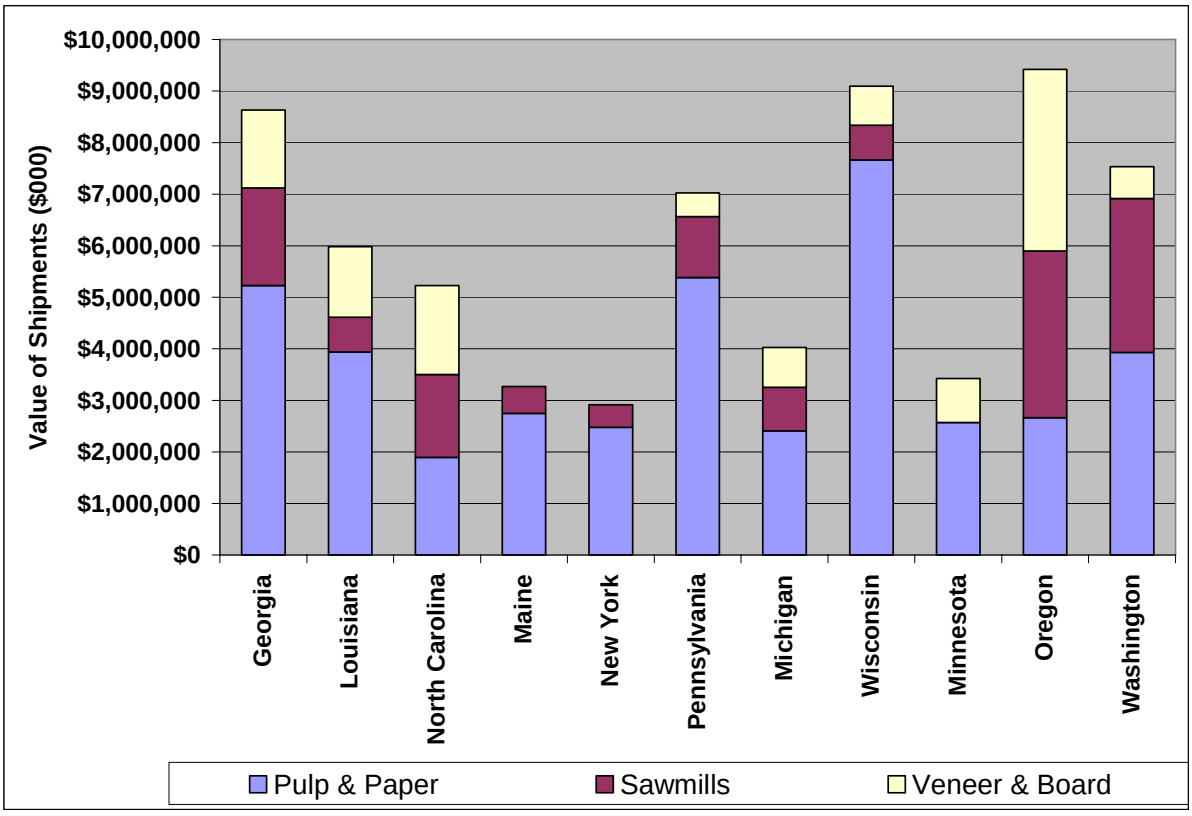
Contrary to popular perceptions of being dominated by the auto industry, almost half of Michigan's economy consists of service industries. Manufacturing represents less than one-fifth of the state's GDP. The wood products, paper products, and furniture industries combined account for 9% of the manufacturing sector, and about 2% of the state economy.

In Michigan's solid wood products sector in 2005, there were 530 establishments with over 12,000 employees. In the pulp and paper sector, there are only a handful of pulp and paper mills in the state, but over 170 paper converting establishments. In both sectors, 30-40% of the establishments account for about 80% of the employees. The integrated pulp and paper mills, although few in number, are among the largest manufacturing establishments in the state.

Of the annual Michigan timber harvest (about 4 million cords), about 40% is sawlogs that are used to manufacture lumber, 35% is pulpwood that is the raw material of the paper industry, and 20% is pulpwood-sized material that goes to the composite board industry. Almost three-fourths of the total harvest is in hardwoods, with a roughly 40/40/20 split among sawlogs, pulpwood, and composite board. In softwoods, a little more than half of the harvest is in sawlogs, and most of the remainder is pulpwood.

Compared to some benchmark states in the major forest regions of the country, Michigan's forest products industry ranks toward the bottom of the spectrum in employment and production. Compared to its Lake States neighbors, Michigan's industry is larger than Minnesota's, but much smaller than Wisconsin's, due to Wisconsin's large pulp and paper sector.

In terms of employees, the size of Michigan's pulp and paper industry is comparable to those in the Pacific Northwest (Oregon and Washington), but the solid wood industries in those states dwarf that of Michigan. In the South, Michigan's overall industry employment is comparable to that of Louisiana, but significantly smaller than the industry in Georgia or North Carolina. In terms of value of shipments, Michigan's overall industry is larger than only three states, and significantly smaller than any state in the South or Pacific Northwest.



Market Profiles

The chart on the following page lists some forest industry characteristics that are germane to an assessment of opportunities for Michigan:

- Primary or secondary product: primary forest industries directly purchase wood from the forest, and therefore are more directly impacted by the State's timber sale policies. For these industries, the cost of delivered wood represents from 25% up to 75% of the costs of production.
- Commodity or specialty product: commodities are products that are undifferentiated with respect to quality, dimensions, and utility, a prime example being a pine 2x4 stud. Commodity producers compete almost entirely on the basis of price, so market advantages are principally obtained through production efficiencies due to scale, materials costs, labor and energy costs, etc. Specialty products can exploit market niches through increased value added in the form of product characteristics or customer services. All primary forest products are commodities; certain secondary products, such as structural engineered products, are commodities by virtue of their standardized performance specifications. However, most secondary products are specialty products, furniture and cabinets being the prime examples.
- Product life cycle: Most forest products would be characterized as mature, i.e. the product characteristics are standardized or well understood by end-users, production techniques are well-known, the industry players are well-established, and there is little ability to increase market share for the product in the end-uses it serves. However, in a growing market with few competing products, mature industries can continue to grow profitably. The only growth industry identified is structural engineered wood products, as they have the ability to take market share from traditional lumber products in residential construction uses. In addition, wood-based biofuels is in a "pilot" stage, where commercial scale production will not be fully operational for several years.
- End uses: Most wood products are dependent to some extent on the housing industry, whether in new home construction or maintenance and remodeling. Producers of softwood lumber and oriented strandboard (OSB) rely on these markets for two-thirds or more of their volume, while by definition kitchen cabinets are entirely consumed in new or remodeled homes. Hardwood lumber probably serves the most diverse set of end uses, ranging from flooring and cabinets that obviously are tied to housing, but also to industrial uses such as shipping and packaging, and railroad ties.
- Overcapacity problems: Several forest products industries are in a state of overcapacity, leading to low prices and poor profitability. Overcapacity is not strictly a supply-side problem – it is always relative to product demand, and in the current housing downturn, it would be surprising if any related industry was right-sized. However, in the industries noted here, overcapacity was recognized prior to the housing downturn. Painful corrections have been underway for a couple of years in the wood products sector, with numerous plant closings in softwood lumber and OSB across North America. In the pulp and paper sector, overcapacity has been a much longer term problem, which has been addressed over the last ten years with shutdown of older capacity and consolidation within the industry.

	Primary/Secondary	Wood % of Cost	Commodity / Specialty	Product Life Cycle	Principal End Uses	Industry Overcapacity Problems	Import Competition	Recent Price Trend	Michigan Rank Among States
Pulp and Paper									
Pulp	Primary	40%	Commodity	Mature	Paper Mills			Flat to Rising	10
Paper	Secondary		Commodity	Mature	Paper Converters	X	X		
Converted Paper Products	Secondary		Both	Mature	Consumer & Industrial			Rising	11
Lumber									
Softwood	Primary	70%	Commodity	Mature	Residential Construction	X	X	Falling	11
Hardwood	Primary	75%	Commodity	Mature	Shipping, DIY, Furniture & Cabinets	X		Flat to Falling	
Oriented Strand Board	Primary	40%	Commodity	Mature	Residential Construction	X	X	Falling	11
Other Wood Products									
Hardwood Plywood And Veneer	Mixed	35%	Both	Mature	Furniture & Cabinets		X	Flat	8
Reconstituted Wood (particleboard, medium density fiberboard, hardboard, insulation board)	Secondary		Commodity	Mature	Furniture, Cabinets, Laminated Flooring	X		Flat to Rising	11
Structural Engineered Products (glulam, structural composite lumber, I-joists)	Secondary		Commodity	Growth	Residential Construction			Falling	23
Specialty Hardwood (millwork, flooring, dimension)	Secondary		Both	Mature	Remodeling, New Construction			Falling	17
Furniture and Kitchen Cabinets									
Wood Furniture	Secondary		Specialty	Mature	Consumer		X	Flat to Rising	5 - 15
Kitchen Cabinets	Secondary		Specialty	Mature	Remodeling, New Construction			Rising	22
Wood-based Biofuels	Mixed	25%	Commodity	Pilot	Industrial, Gasoline Additive			Falling	-

- Import competition: A number of industries face moderate to severe competition from foreign producers. Canada is the source of competition in paper, softwood lumber and OSB. China has all but eliminated the US wood household furniture industry, and has also become the largest source of imports of hardwood plywood. The currently weak US dollar and the US/Canada agreement on softwood lumber have helped to stem the tide of Canadian imports, but Chinese imports are expected to continue to increase.
- Price trends: With the current state of the US economy and housing in particular, recent and expected short term price trends are flat or falling for most forest products. Prices in the pulp and paper sector have held up due to industry focus on the overcapacity problem and the weak US dollar. Price trends in the furniture and cabinet industries were also positive in the last several quarters, although these may very well decline as the full impact of low housing starts mitigates what has been a strong remodeling market.
- Michigan rank among states: How Michigan ranks among the states for a particular industry may be an indication of Michigan's inherent comparative advantages for that industry. At the least, it indicates whether a critical mass exists that may be the starting point for expansion. In most industries, Michigan is the 10th or 11th ranked state in terms of number of establishments which, considering the number of states with significant forest resources, is about the "middle of the pack". Michigan is more highly ranked in the hardwood plywood/veneer and the wood office furniture industries, where it is the 8th and 5th ranked state respectively. The lowest rankings are in structural engineered wood products and kitchen cabinets, unfortunately industries that have somewhat brighter prospects than other forest products.

There is no single comprehensive indicator of the outlook for a given industry and its potential for Michigan. It is important to recognize that there are significant interrelationships among industries, e.g. the hardwood sawmill industry produces lumber which is consumed by wood furniture, cabinet, and specialty product manufacturers, and also wood residues which are consumed by reconstituted wood product manufacturers and could serve as feedstock for biofuels production. So although there is not a direct connection between the forest and secondary industries, the forest is the starting point for much of the total forest products industry, and can therefore provide advantages up the value chain.

In the short term, the state of the general economy and the housing market in particular will dampen the forest products industry throughout North America. In the longer term, product markets are expected to recover with positive projections for the US and global economies. However, survival past the short term woes is not guaranteed, particularly given the overcapacity in industries where the Michigan capacity is somewhat dated, i.e. pulp/paper and OSB. These are critical industries in Michigan as they provide markets for low grade timber that is a necessary by-product in the production of higher quality sawlogs.

Wood Cost Benchmarking

One of the major competitive factors in the forest products industry is the cost of wood. In this analysis, the benchmark is the cost of roundwood delivered to the mill gate. That delivered cost is then broken down into its three principal components:

- stumpage: the cost/price of the right to cut standing
- harvesting: the cost of felling, bucking or slashing, and skidding or forwarding to roadside
- transport: loading the roundwood onto a truck for delivery to the mill gate

Costs were estimated based on a number of published and unpublished sources, and were converted to $US/green ton. Because of the inherent variability in costs over large regions, the lack of comprehensive systematically collected cost data, the use of broad conversion factors, and the fact that a variety of sources were used, the cost estimates presented in this report should be considered only general indicators.

Estimated delivered wood costs are summarized by region in the table below.

Region	Hardwood Pulpwood	Hardwood Sawtimber	Softwood Pulpwood	Softwood Sawtimber
Brazil	$40.00		$37.50	$50.50
Finland	$51.50		$69.00	$123.00
Michigan	$33.00	$97.50	$37.50	$57.50
New Zealand			$33.50	$66.00
Ontario, Canada	$38.00	$40.00	$64.00	$66.00
Russia	$37.50	$46.00	$49.50	$75.00
Sweden	$50.50		$65.00	$91.50
US Northeast	$36.00	$91.50	$50.00	$85.00
US Northwest	$39.00	$90.50	$36.00	$71.50
US South	$29.50	$45.00	$30.00	$55.50

The most variable cost component is stumpage. This variability owes to several factors:

- Principal timber sale methods. In some regions, including Michigan, timber is sold at auction or by negotiation in relatively small lots, on relatively short term contracts. In other regions, timber is sold under long-term leases or licenses, where the lessee or licensee has the responsibility for managing the forest property. In these regions, including Ontario and Russia, stumpage appears to be low, but it is difficult to make apples to apples comparisons because of the significant differences in sale methods.
- Timber quality. In Michigan, the hardwood sawtimber prices reflect the principal species of hard maple and red oak. Most other regions do not have the same high quality resource as Michigan, nor do they reflect the same species.

- Stumpage as a residual. By this perspective, the amount paid for stumpage is the residual of the value of wood delivered to the mill gate, less harvest and transport costs. This partially explains why in regions of high operating costs, stumpage is relatively low.
- Pure supply and demand conditions. Timber supply can be limited by physical scarcity, or by harvest policies of landowners. Typically, where forest ownership is heavily public (Michigan, Pacific Northwest) or heavily small private landowners (Finland, Sweden) stumpage prices tend to be higher because of landowner reluctance to harvest.

Harvest and transport costs are less variable than stumpage. Variability tends to be related to:

- Fuel costs, which depend on regional production capacity, global supply/demand and energy tax levels.
- Labor costs, which obviously vary across the globe. In some regions, logging and transportation functions are integrated with the destination mill, and may be unionized operations, which tends to raise costs. In Michigan, company logging operations are rare, and often harvest and transportation are performed by separate firms.
- Technology in use. More modern technologies such as cut-to-length systems that are commonly used in Michigan can be expensive to employ but are better adapted to certain forest conditions and silvicultural techniques. Manual felling is most expensive, but is necessary in some regions where topography is difficult.
- Silvicultural techniques. Where partial cutting systems predominate, as they do in Michigan, per unit costs tend to be higher than in regions where clearcutting is the dominant production method.
- Transport distances. Average haul distances are difficult to estimate over wide regions with hundreds of destination points, but cost per ton-mile seems to fall within a fairly narrow range of $.13 to $.18/ton/mile across regions. Transport distance can vary widely, with the longest distances in some of the more remote regions such as Ontario and Russia.

Despite the inherent variability and data uncertainties, the analysis suggests some general conclusions:

- Finland, Sweden, Russia, and Ontario have some of the highest wood costs in the world, due to a combination of supply/demand and operating conditions.
- The US South appears to be the lowest cost region in the world, but if Brazil's integrated operations were able to be considered, their costs would likely be lower.
- Michigan's costs appear to be within a reasonable range of most other benchmark regions, and are generally lower than the most comparable region, the US Northeast, although differences are within likely margins of error.

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1 Introduction

Prentiss & Carlisle Management Company (PCMC) was engaged by the Michigan Department of Natural Resources (DNR) to conduct a descriptive analysis of Michigan's forest products industry. The analysis focuses on two subject areas: (1) the current and near future market outlook and trends for forest products that are produced in Michigan, and; (2) benchmarking of Michigan's current delivered wood costs against other domestic and international regions. This report and a companion PowerPoint presentation represent the final project deliverables.

2 Purpose and Scope

2.1 Purpose

Currently there is very little market analysis that puts into perspective the status and outlook for forest products produced in Michigan. The purpose of this project is to understand how Michigan forest products are currently positioned in the global, domestic and regional markets and to benchmark delivered wood costs against other domestic and international regions. This information will help define where future opportunities and efforts can be focused to improve Michigan's forest sector competitiveness, preserve and create jobs and promote local and state economic activity. The paper and presentation generated from this work is intended to be used by Michigan's Forest Finance Authority (FFA), current forest product businesses and potential investors in new Michigan businesses.

2.2 Scope of the Analysis

The scope of research involves two subject areas: (1) the market position of Michigan's forest products industry relative to its counterparts outside of the state, and; (2) the comparative cost of wood in Michigan relative to other major US and global forest regions.

The market position occupied by Michigan's current forest products industry was analyzed for the following eight product groups:

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Michigan's average delivered wood costs were benchmarked against the following domestic and international regions:

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- US South
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- Brazil
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- New Zealand
- Finland
- Sweden
- Ontario, Canada

The market and cost benchmarking analyses relate only to the current and 2-5 year timeframes. The project was intended to be a compilation of factual data and objective estimates, devoid of recommendations for industrial or public policy. These profiles and estimates have been synthesized from existing government and third party data and analyses. Sources of data are identified throughout the report and in Appendix A.

3 Market Profiles

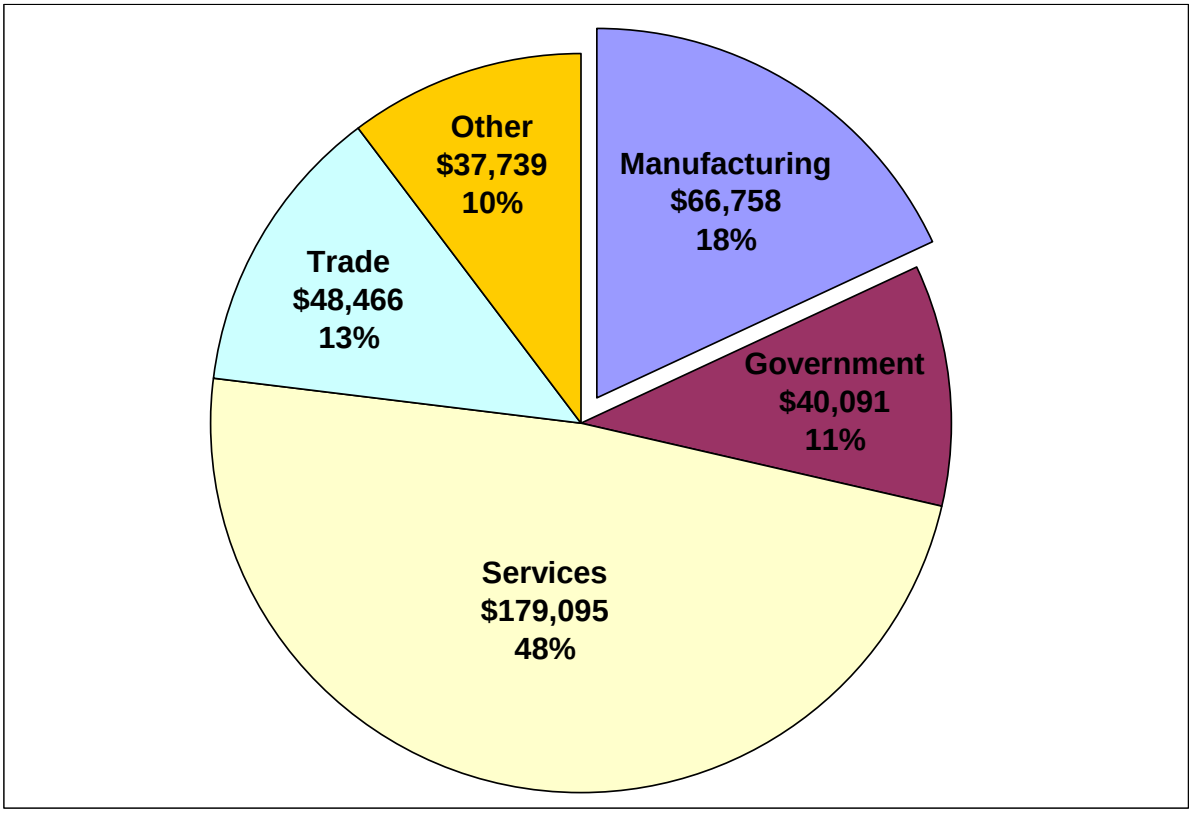
3.1 Overview of Michigan's Forest Products Industry

The forest products industry is conventionally described as two sectors: (1) the primary industry, which converts raw wood from the forest into products such as lumber and pulp for paper-making, and; (2) the secondary industry, which converts materials from the primary industry into greater value added products, for example furniture manufacture which uses lumber as an input. This report is more heavily focused on the primary sector, as that is the sector most directly impacted by the policies of the DNR and FFA. The principal secondary sector that will be analyzed is the wood furniture industry.

Michigan's forest products industry consists of establishments in both primary and secondary sectors. Unfortunately, government statistics on the economic characteristics of industries are often not detailed enough to distinguish between primary and secondary sectors. Nevertheless, such data are utilized here to present a general picture of the size of the Michigan forest products industry relative to other Michigan industries and relative to the forest products industries of other states.

Figure 2 shows the breakdown of state gross domestic product by industry. Contrary to popular perceptions of being dominated by the auto industry, almost half of Michigan's economy consists of service industries. Manufacturing represents less than one-fifth of the state's GDP.

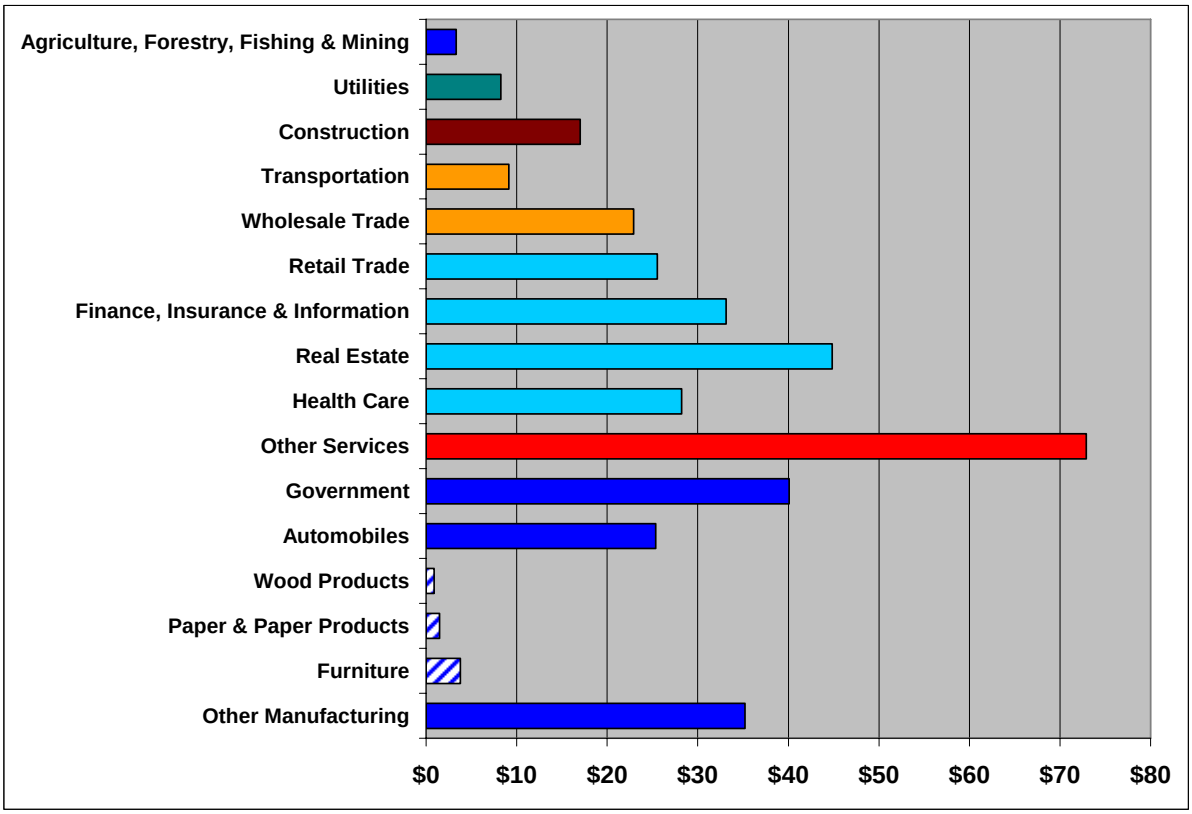
Figure 1. Michigan Gross Domestic Product by Major Industry Sector, 2005 ($ million).



SOURCE: [1]

Figure 2 breaks down GDP by finer categories, and shows that the forest products industry is a fairly small part of the state economy. In this chart, the Wood Products and Paper Products industries include both primary and secondary forest products industries, and the furniture sector includes not only wood, but also metal furniture [2]. Nevertheless, these industries combined account for only 9% of the manufacturing sector, and less than 2% of the state economy.

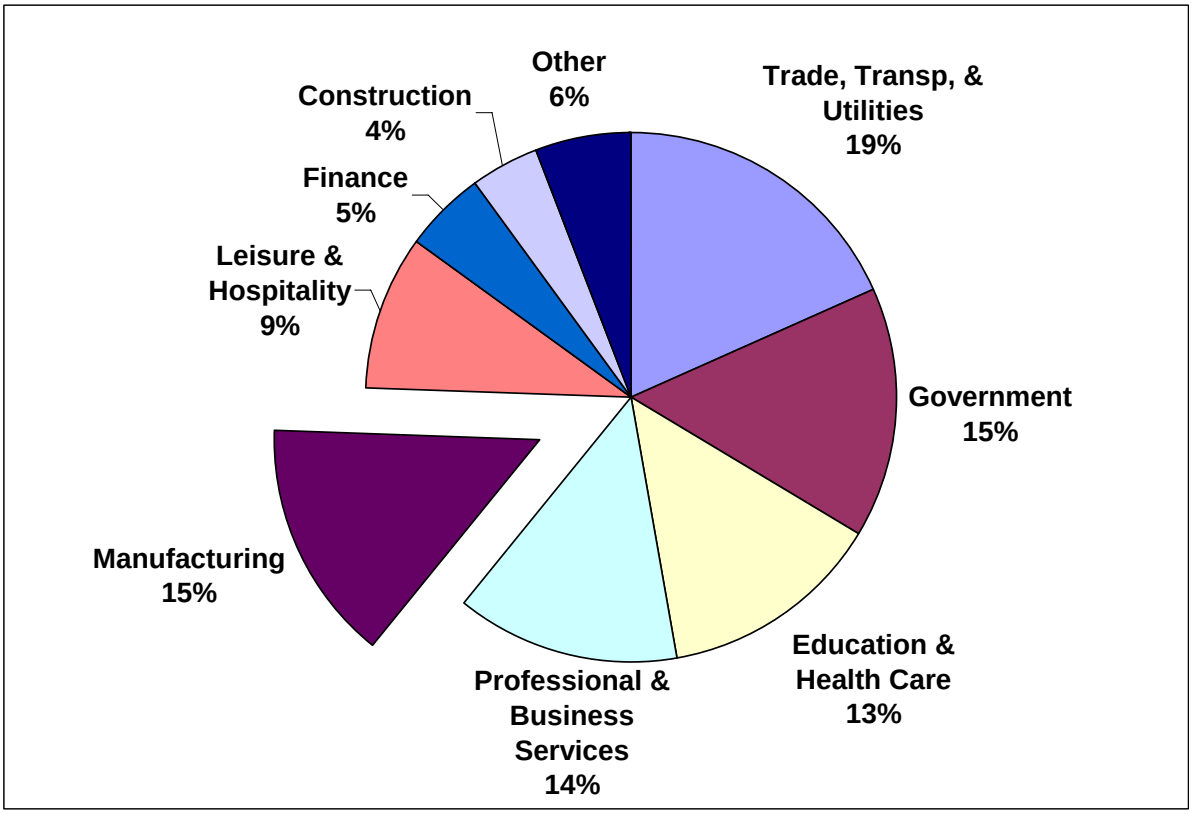
Figure 2. Michigan Gross Domestic Product by Industry Sector, 2005 ($ billion).



SOURCE: [].

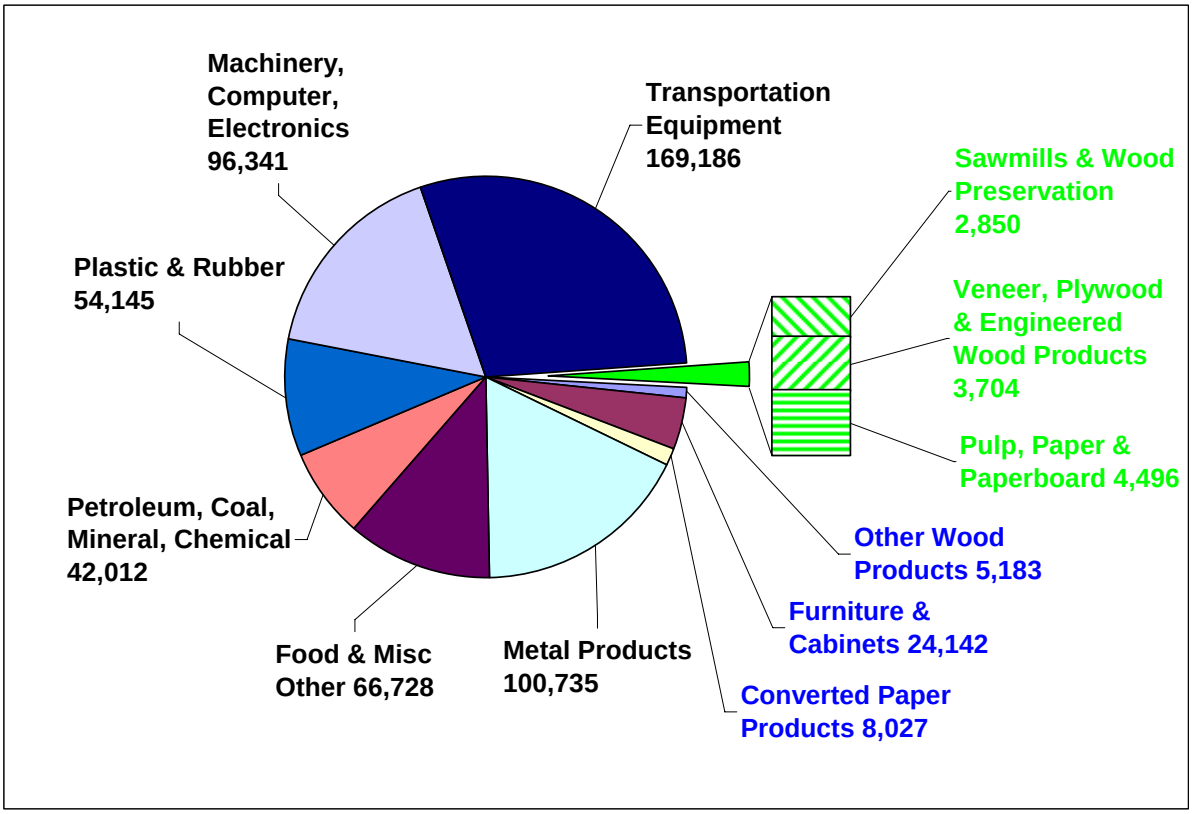
The distribution of employment by industry roughly parallels the GDP breakdown (Figure 3). Manufacturing accounts for about 15% of employees, and Figure 4 shows where the primary and secondary forest products industries rank in the manufacturing sector. The primary industries employ about 11,000 of the approximate 580,000 manufacturing employees in the state. The secondary forest products sector is a larger employer, but the chart overstates that sector, again because the furniture sector includes metal furniture.

Figure 3. Breakdown of Michigan Non-Farm Employment by Industry Sector, 2006 (% of total non-farm employees).



SOURCE: [3]

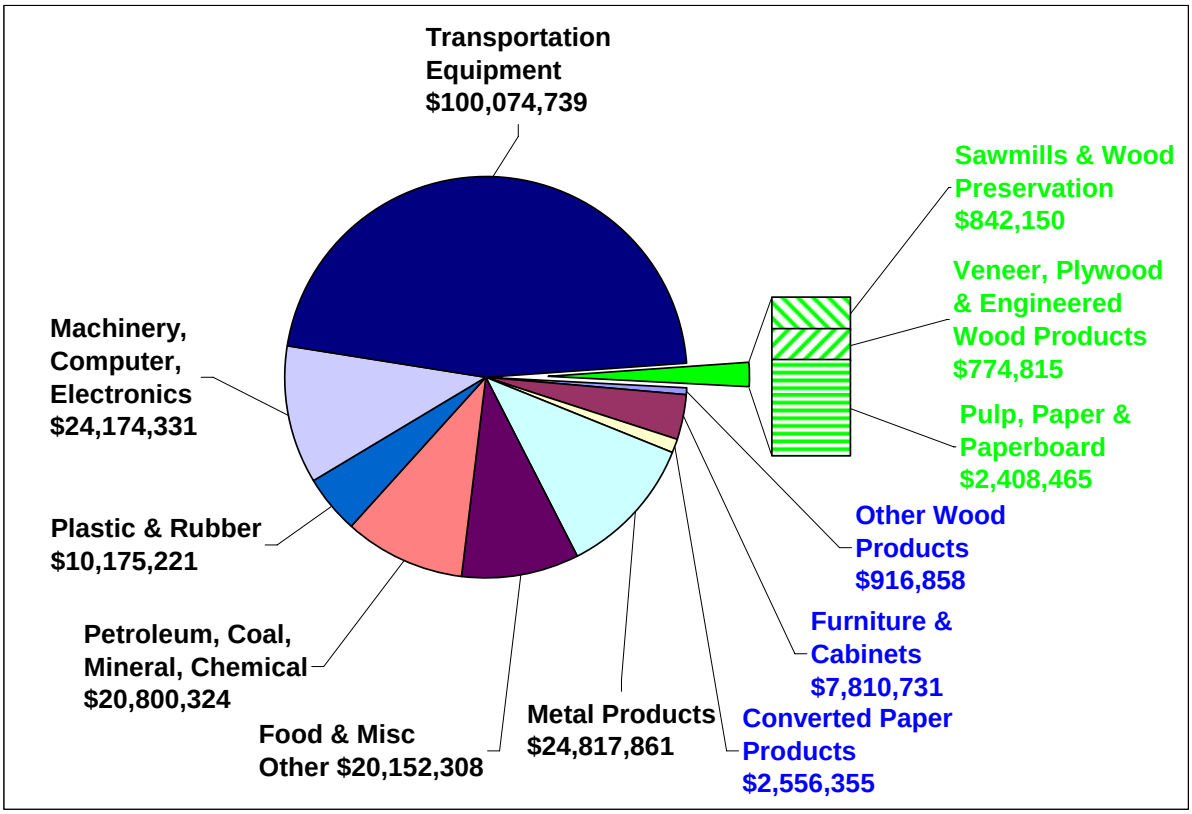
Figure 4. Breakdown of Michigan Manufacturing Employment by Industry Sector, 2006 (number of employees).



SOURCE: [4]

Figure 5 shows the manufacturing sector in a different light, by value of shipments. Comparing Figure 5 and Figure 8, clearly the automobile industry adds much more value per employee than other manufacturing industries. Within the primary forest products industries, the value of shipments from the pulp and paper sector is much higher than the solid wood products sectors, representing not only higher physical quantities shipped, but also higher value-added products.

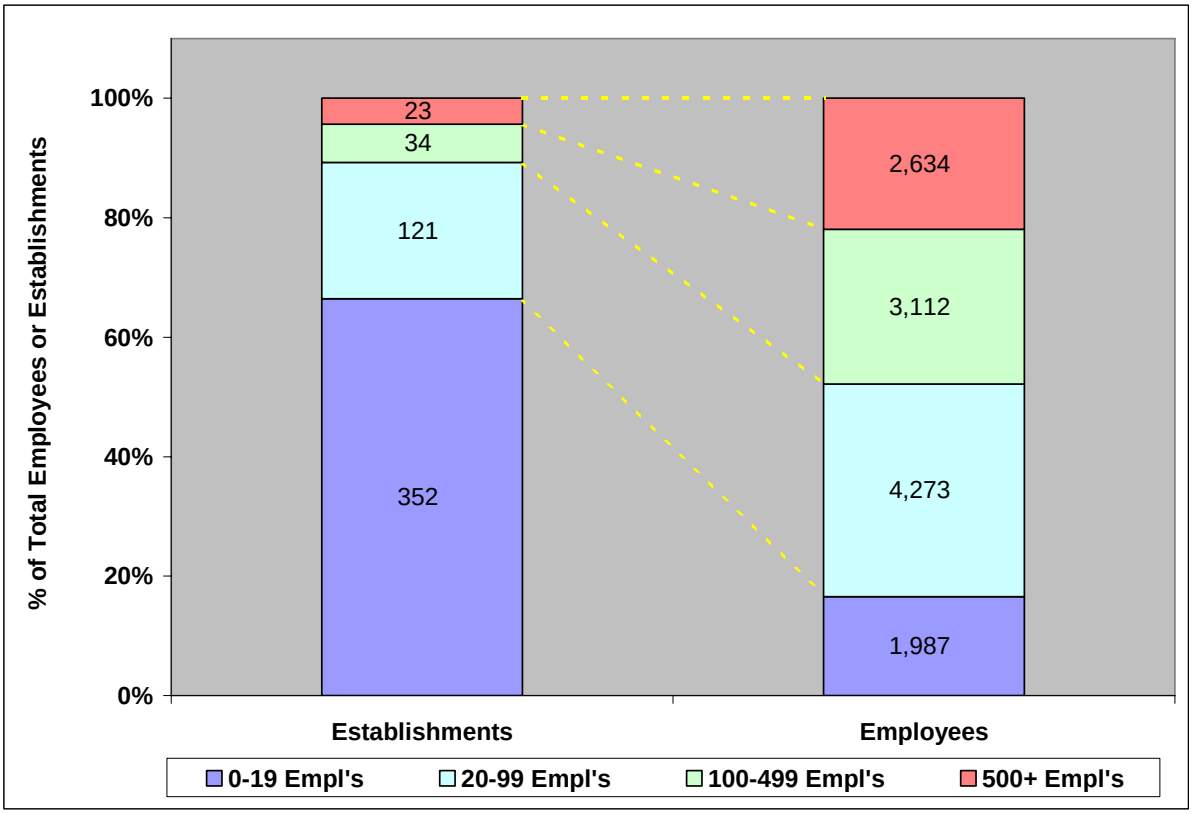
Figure 5. Value of Shipments by Michigan Manufacturing Sector, 2006 ($000).



SOURCE: []

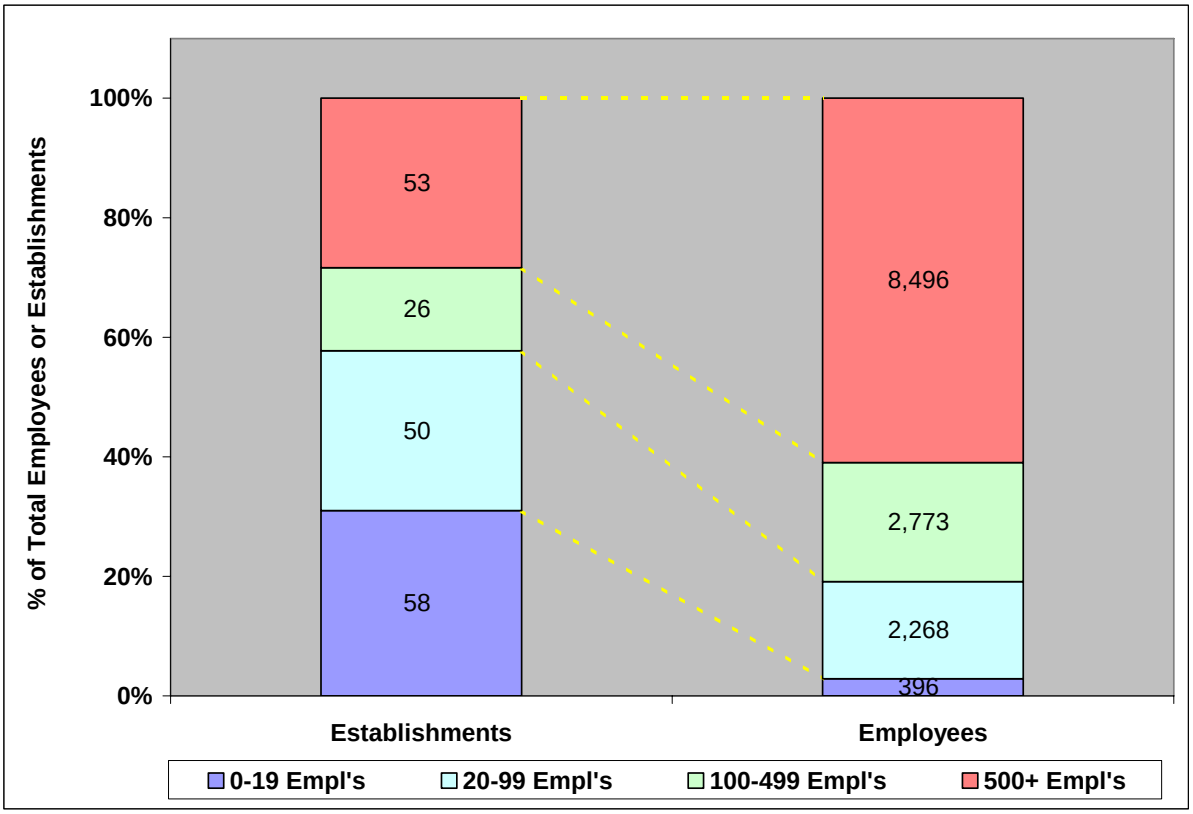
Figure 6 shows that in the solid wood products sector in 2005, there were 530 establishments with 12,006 employees, and that about 30% of the establishments account for about 80% of the employees. This sector includes some secondary industry establishments, but the majority are thought to be primary. Such is not the case in Figure 7, which shows the same breakdown for the paper products sector. Within this sector, there are only a handful of pulp and paper mills in the state, so the great majority of the 187 establishments indicated in the chart are secondary industries. Throughout this sector, the average scale of operations tends to be larger than in the wood products sector – here about 40% of the establishments account for about 80% of the employees. The integrated pulp and paper mills, although few in number, are among the largest manufacturing establishments in the state.

Figure 6. Establishments and Employees in the Wood Products Sector, by Enterprise Size Class, 2005.



SOURCE: [5]

Figure 7. Establishments and Employees in the Paper Products Sector, by Enterprise Size Class, 2005.

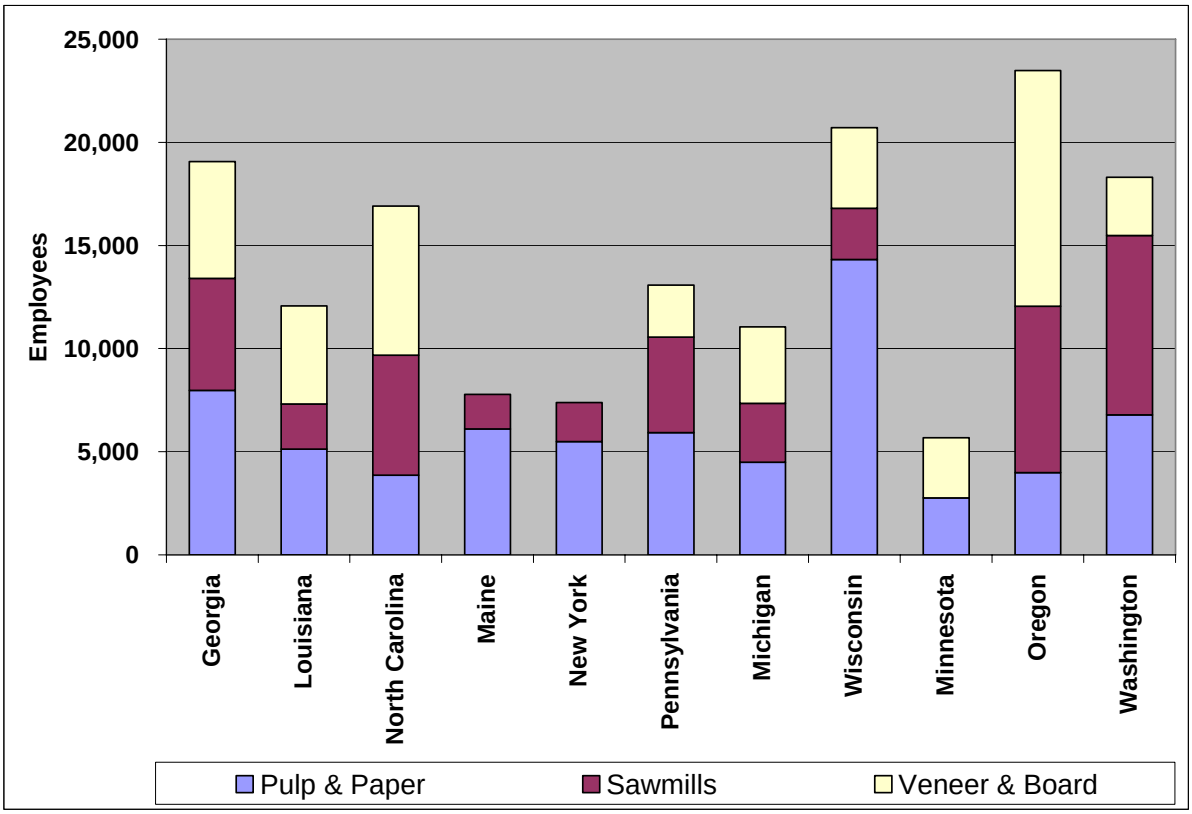


SOURCE: [5]

Figure 8 and Figure 9 compare Michigan's forest products industry to some benchmark states in the major forest regions of the country. In both employment and value of shipments, Michigan ranks toward the bottom of the spectrum. Compared to its Lake States neighbors, Michigan's industry is larger than Minnesota's, but much smaller than Wisconsin's, due to Wisconsin's large pulp and paper sector.

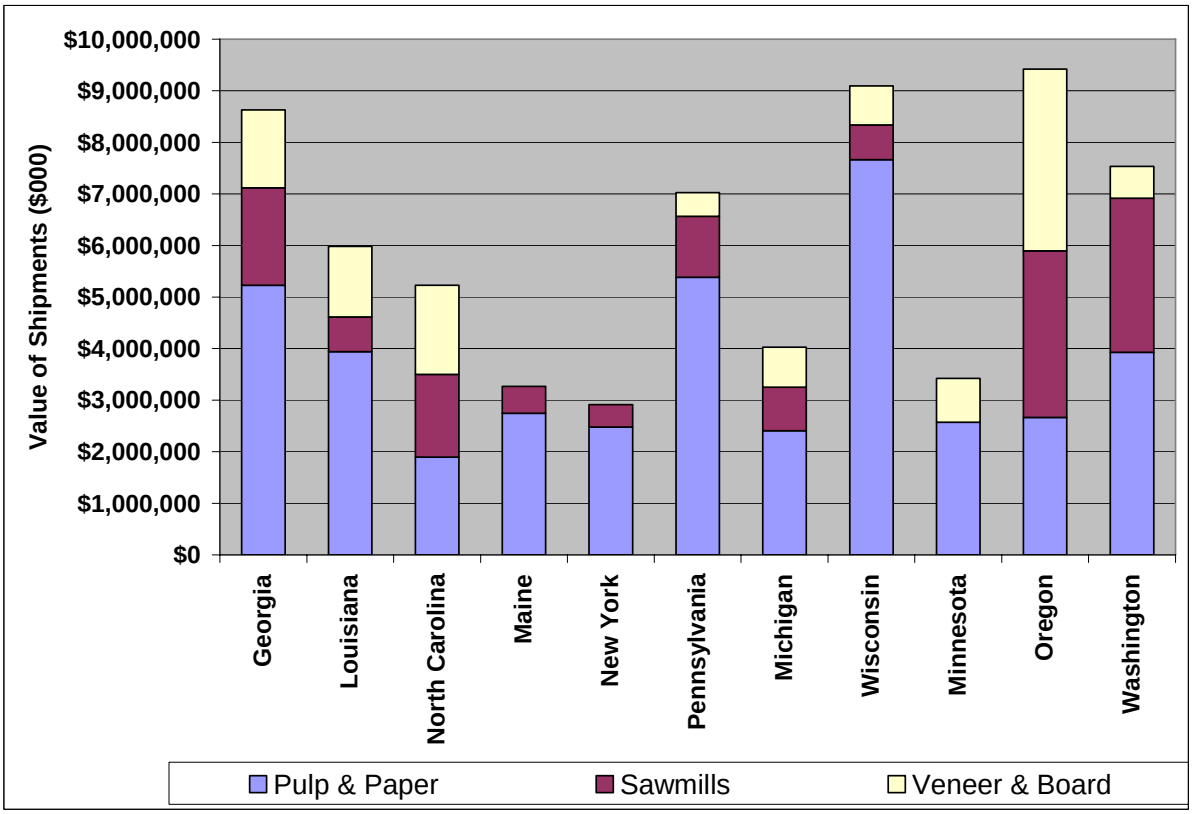
In terms of employees, the size of Michigan's pulp and paper industry is comparable to those in the Pacific Northwest (Oregon and Washington), but the solid wood industries in those states dwarf that of Michigan. In the South, Michigan's overall industry employment is comparable to that of Louisiana, but significantly smaller than the industry in Georgia or North Carolina. In terms of value of shipments, Michigan's overall industry is larger than only three states, but significantly smaller than any state in the South or Pacific Northwest.

Figure 8. Forest Products Industry Employment Among Comparable States, 2006.



SOURCE: [4]

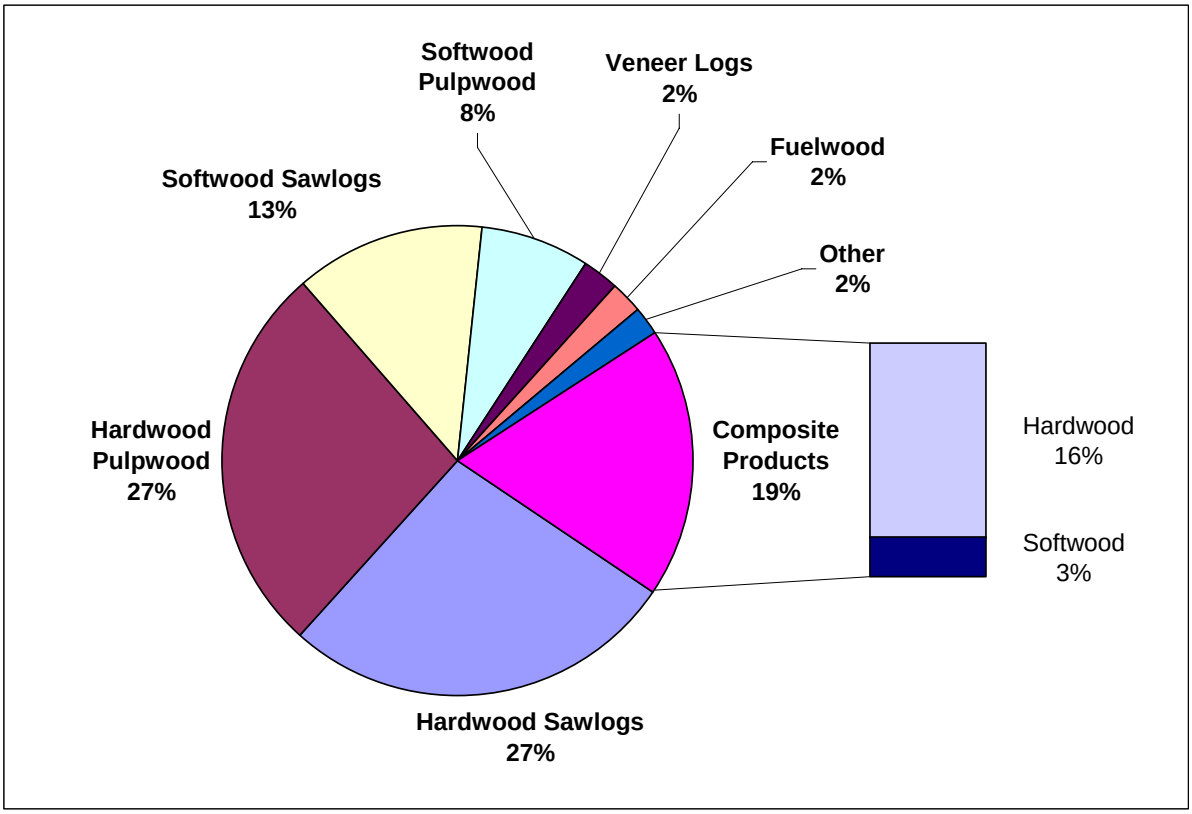
Figure 9. Forest Products Industry Value of Shipments Among Comparable States, 2006.



SOURCE: [4]

Figure 10 shows the species/product breakdown of the timber harvest that fuels Michigan's primary forest products industry. About 40% of the harvest is sawlogs that are used to manufacture lumber, 35% is pulpwood that is the raw material of the paper industry, and 20% is pulpwood-sized material that goes to the composite board industry. Almost three-fourths of the total harvest is in hardwoods, with a roughly 40/40/20 split among sawlogs, pulpwood, and composite board. In softwoods, a little more than half of the harvest is in sawlogs, and most of the remainder is pulpwood.

Figure 10. Michigan Timber Harvest From Growing Stock by Product, 2007 (% of 3.9 million cords).



SOURCE: [6]

3.2 Pulp and Paper

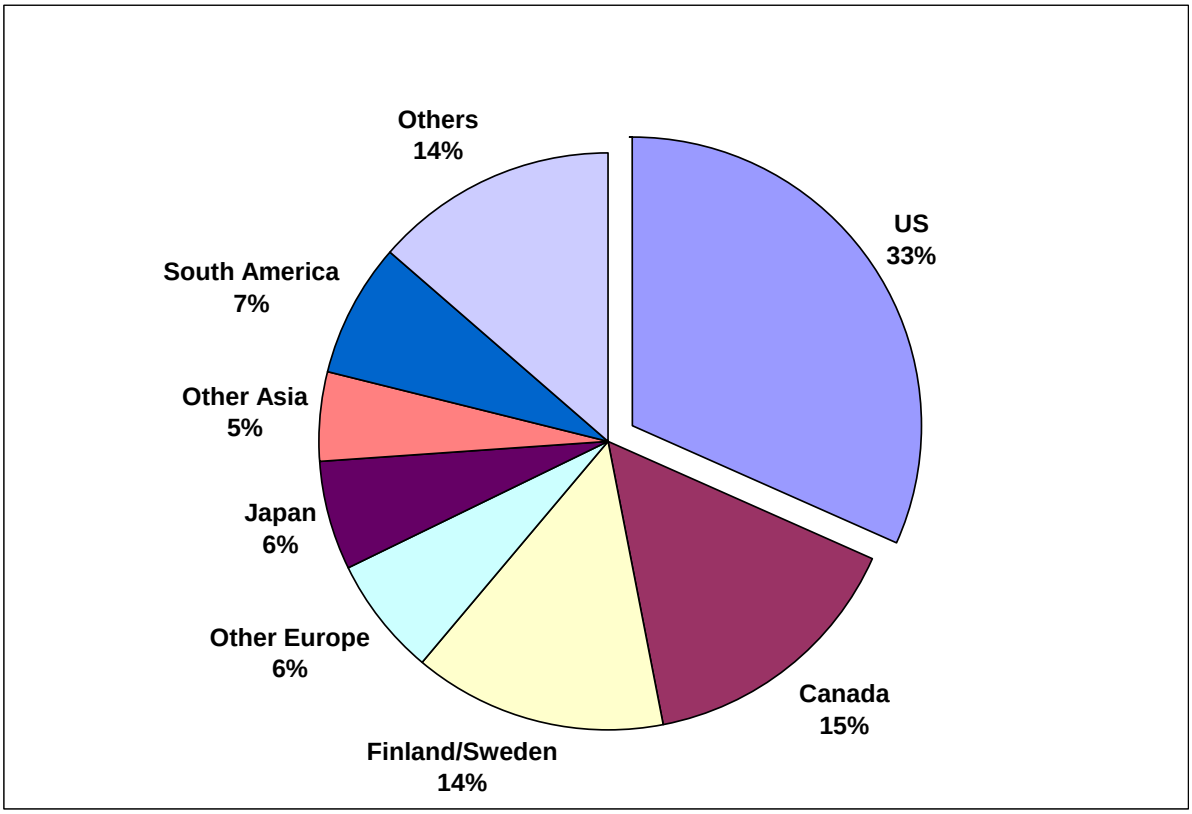
The pulp and paper industry manufactures primary products – commodity grades of wood pulp, printing and writing papers, sanitary tissue, industrial-type papers, containerboard and boxboard – using cellulose fiber from timber or purchased or recycled fibers. Customers of the pulp and paper industry convert the paper into specialized secondary products such as paperboard boxes, writing paper, envelopes, and sanitary paper.

The two macro processes in the industry are pulping and paper or paperboard manufacturing. There are stand-alone pulp mills that produce pulp for sale ("market pulp") to paper mills, stand-alone paper mills that operate on purchased pulp, and integrated mills where the pulp and paper are produced at the same location. Most paper mills are not integrated with a pulp mill, but the largest producers of both pulp and paper are integrated mills. Of the United States' total production of wood pulp, less than 15% is market pulp [7].

3.2.1 Industry Overview

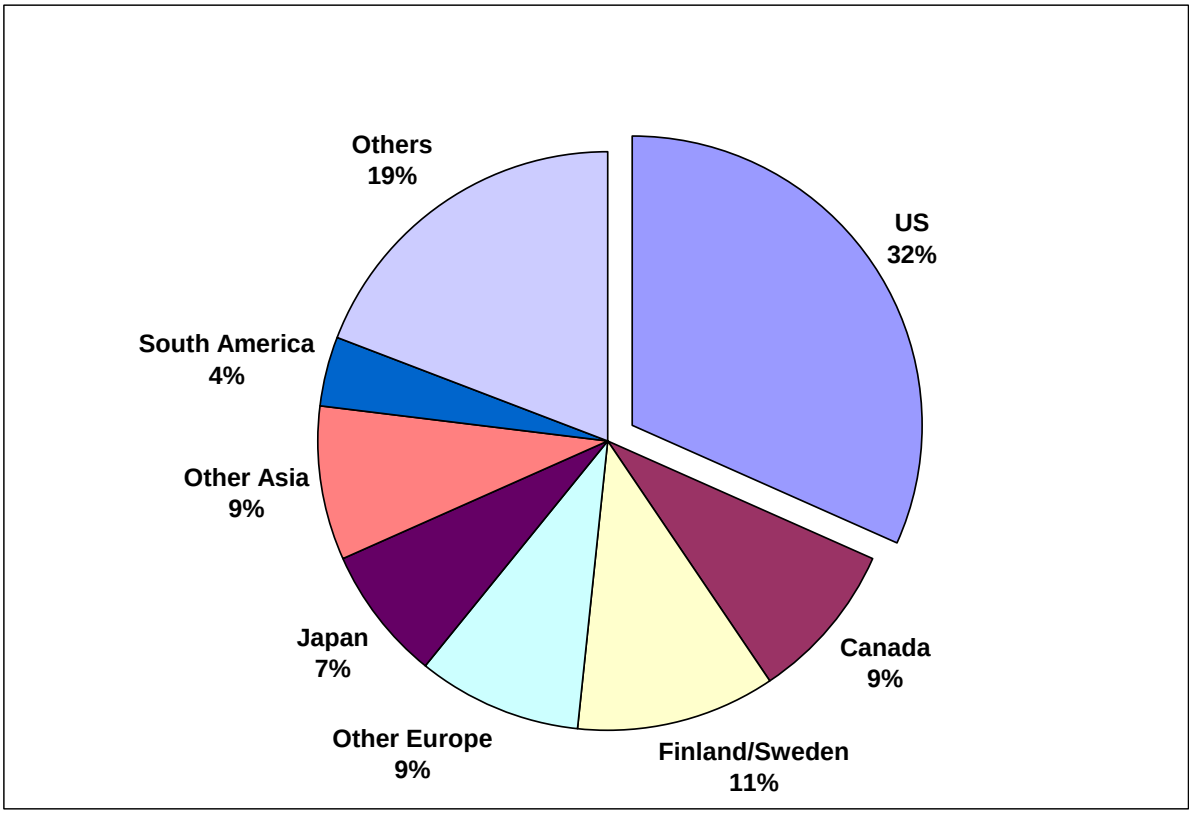
More than any other forest products sector, the pulp and paper industry operates within an integrated global marketplace. Figure 11 shows that the United States is by far the largest single producer of wood pulp, and North America produces almost half of the global output. The US is also the world's largest consumer (Figure 12).

Figure 11. Distribution of Global Production of Wood Pulp, 2004 (% of 173 million metric tons).



SOURCE: [8]

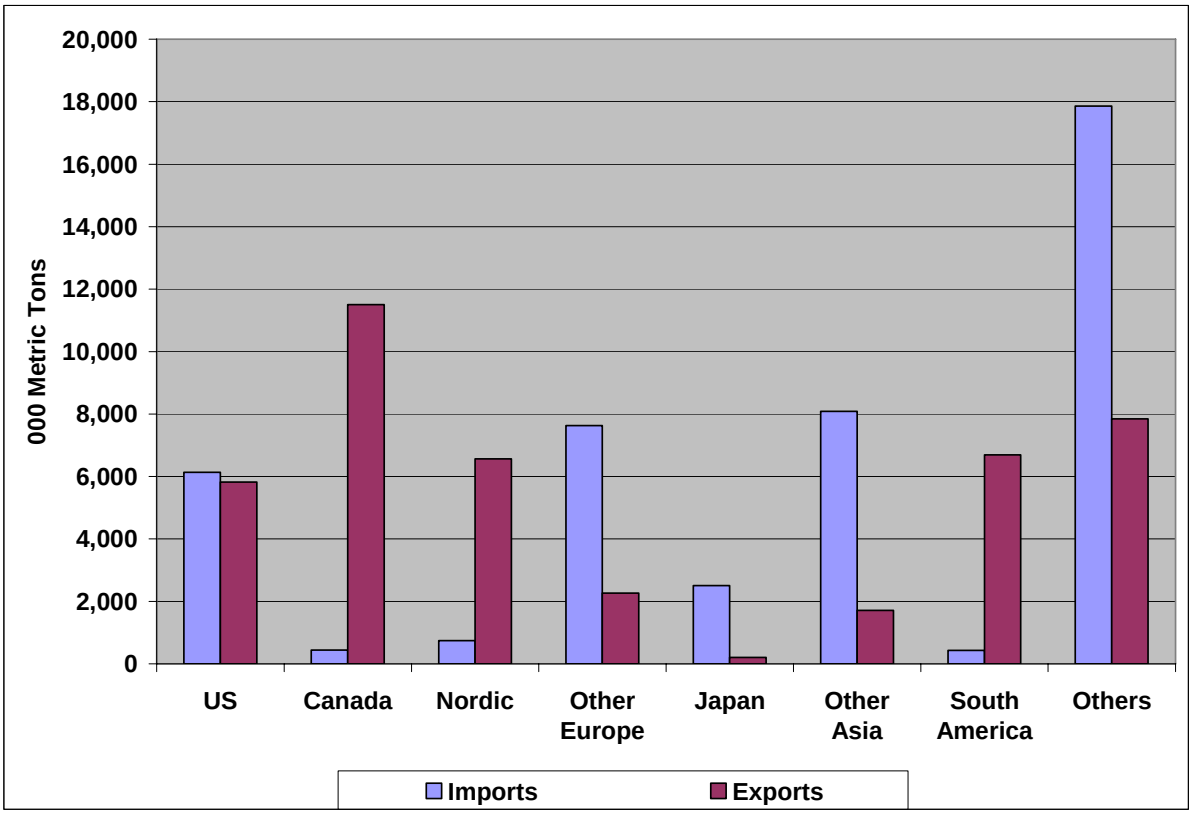
Figure 12. Distribution of Global Consumption of Wood Pulp, 2004 (% of 174 million metric tons).



SOURCE: [8]

Comparison of Figure 11 and Figure 12 suggests that certain countries are significant net exporters or importers. Figure 13 shows that the US is a slight net importer, but imports do account for about 10% of consumption, while exports account for an equivalent amount of production. Canada, South America (Brazil and Chile) and the Nordic countries (Norway, Finland and Sweden) are large net exporters, together exporting nearly 40% of their production. Outside of these countries and the US, the rest of the world in aggregate imports nearly half of its consumption.

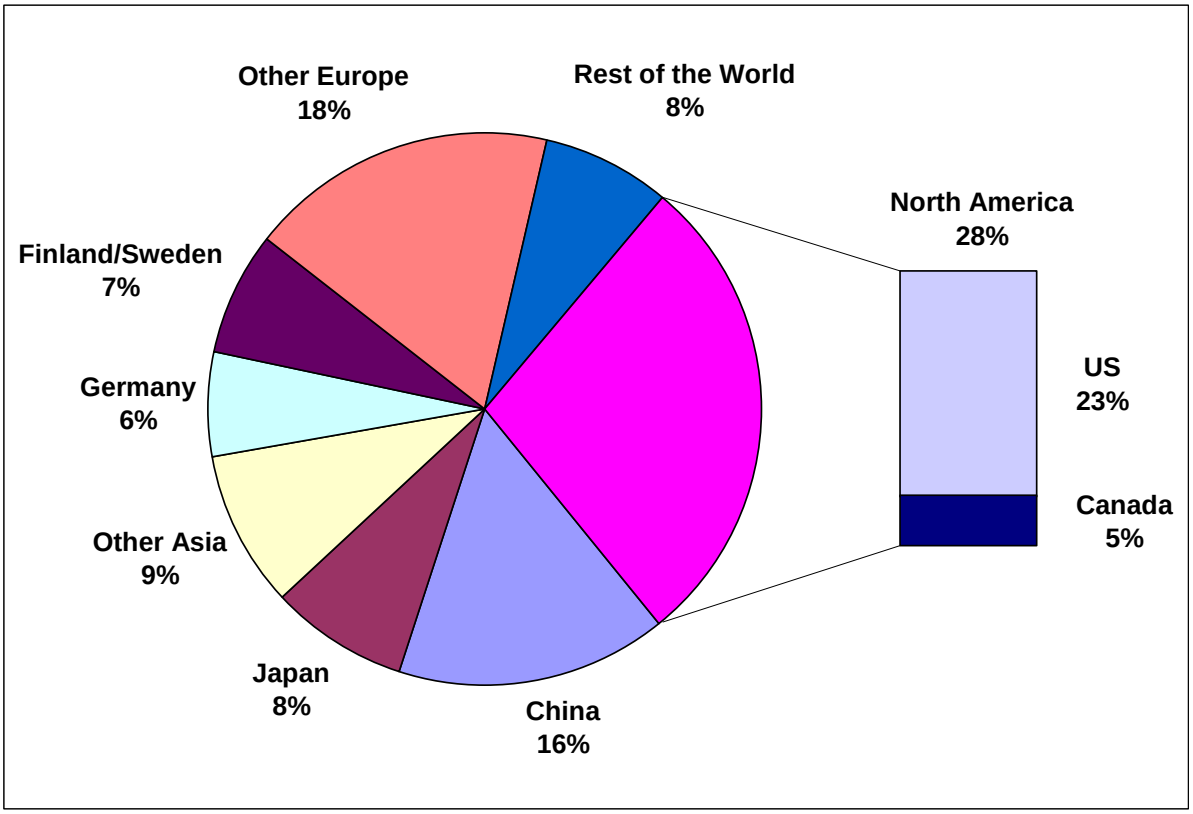
Figure 13. Global Trade of Wood Pulp, 2004.



SOURCE: [8]

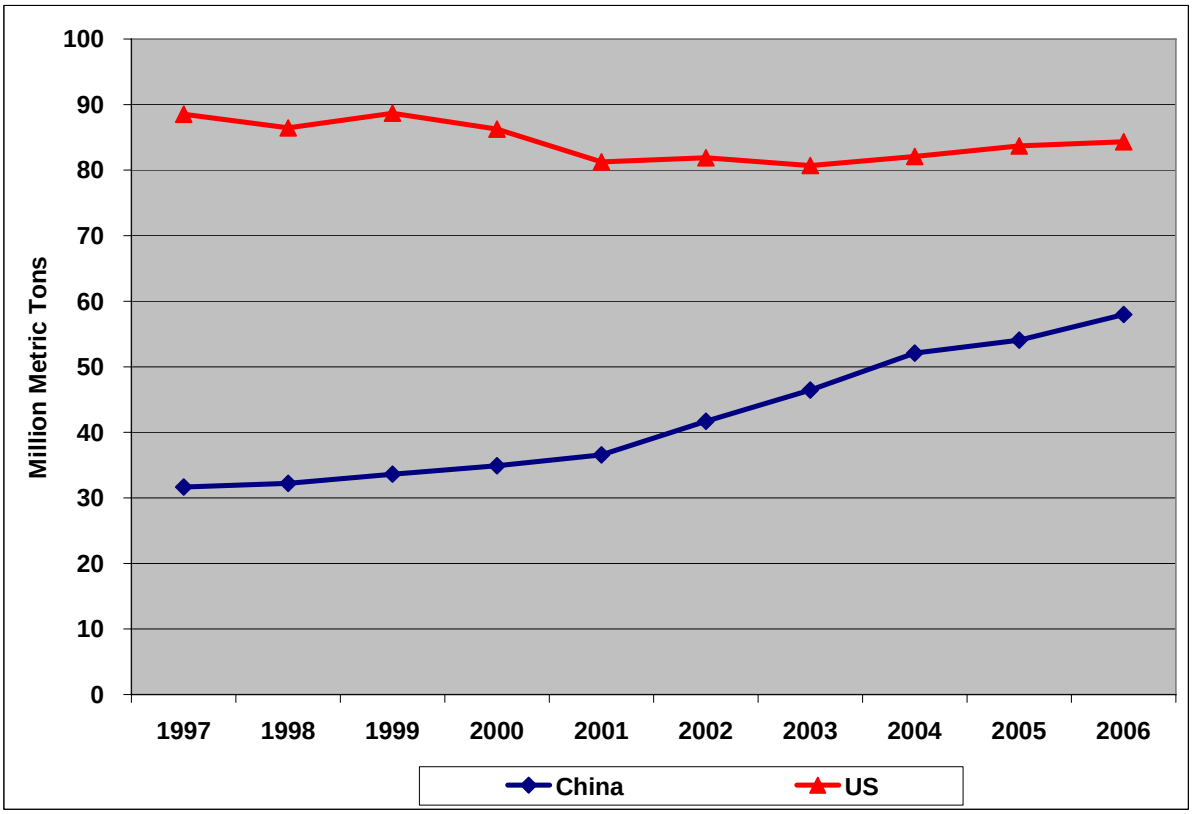
Global production of paper and paperboard essentially breaks down as one-third of the total in each of Europe, Asia, and North America (Figure 11). The US is the largest single country producer, with about one-quarter of the global total. China is the second largest country, and has been rapidly growing as the US has declined over the last ten years (Figure 15).

Figure 14. Distribution of Global Production of Paper & Paperboard, 2006 (% of 365 million metric tons).



SOURCE: [9]

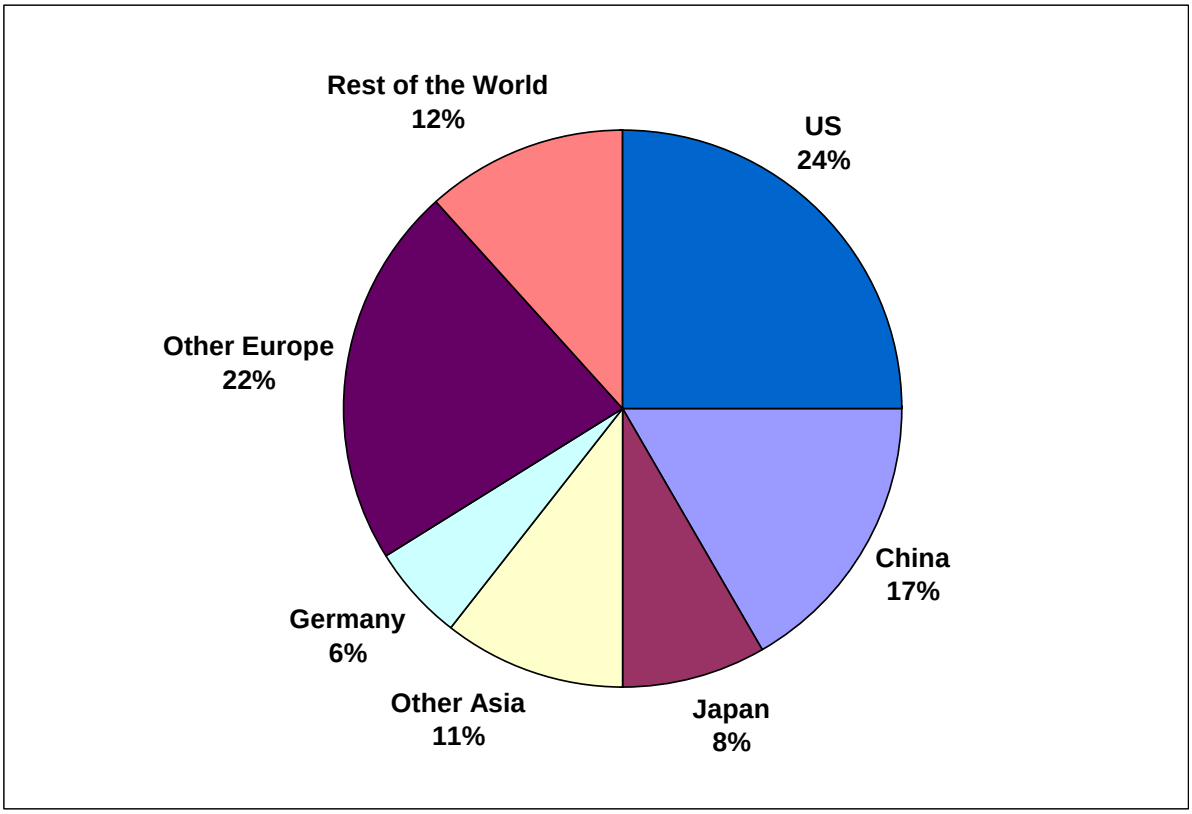
Figure 15. Production of Paper & Paperboard in the US and China, 1997-2006.



SOURCE: [9]

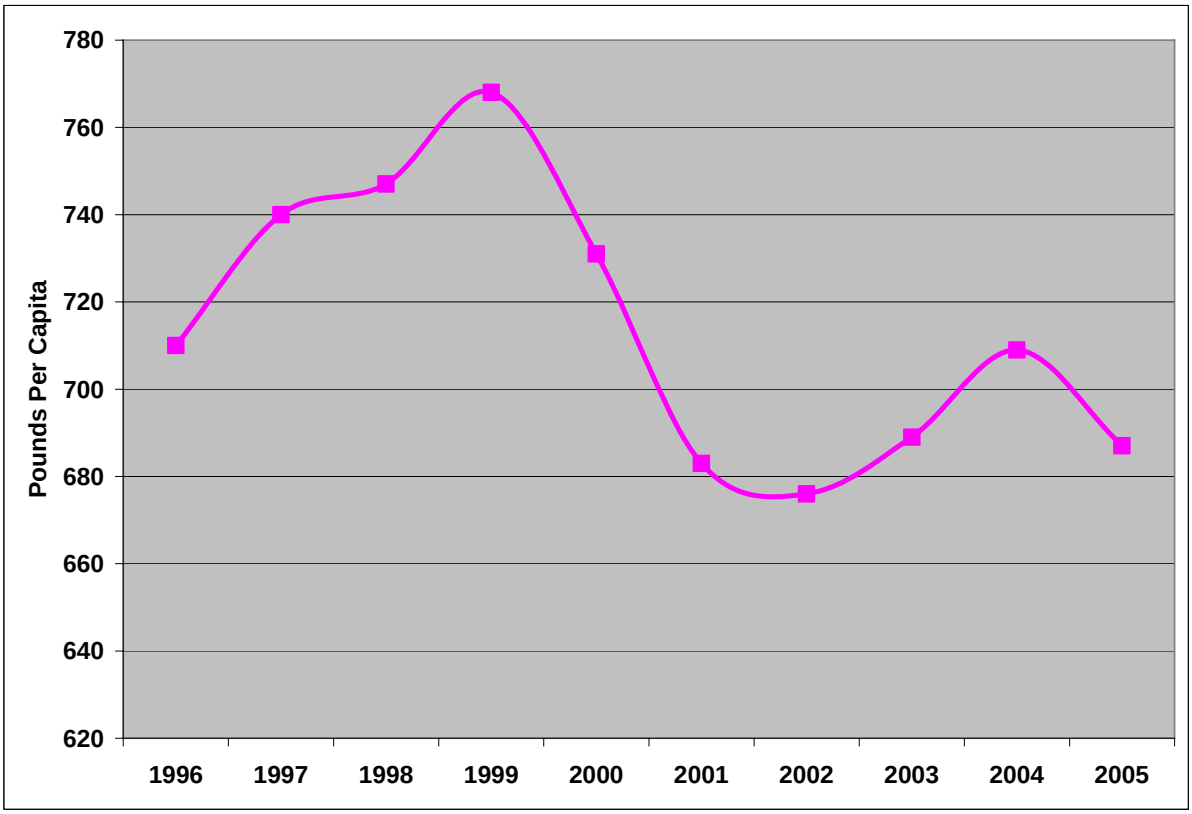
The breakdown of global paper and paperboard consumption (Figure 16) roughly mirrors that of production, with Asia taking a slightly larger share. The US remains the world's leader by virtue of having the highest per capita consumption rate in the world, although that rate is declining (Figure 17).

Figure 16. Distribution of Global Consumption of Paper & Paperboard, 2006 (% of 363 million metric tons).



SOURCE: [9]

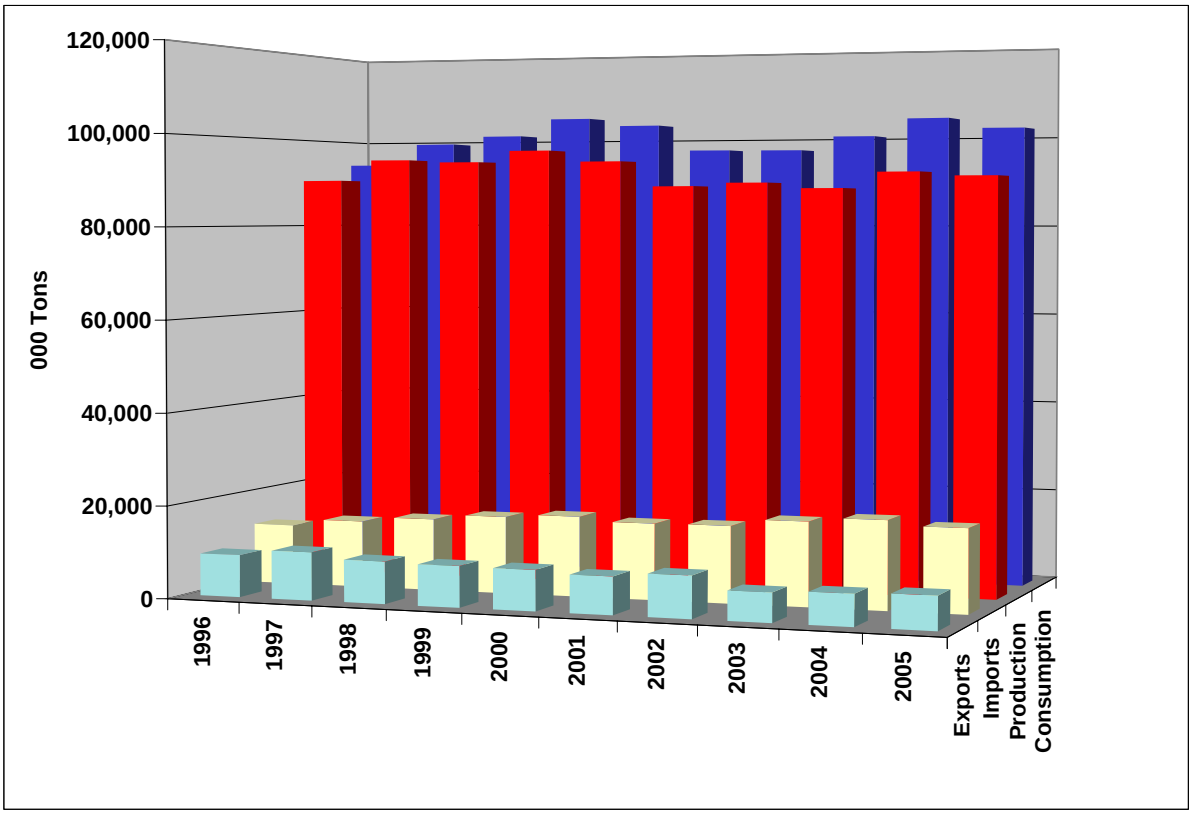
Figure 17. US Per Capita Consumption of Paper & Paperboard, 1996-2005.



SOURCE: [10]

US consumption of paper and paperboard is cyclical, generally following the fortunes of the general economy. Figure 18 shows that consumption has increased faster than production since 1996, and exports have fallen. As a result, the US is a significant net importer, and imports nearly 20% of consumption.

Figure 18. US Paper & Paperboard Production, Consumption, and Trade, 1996-2005.

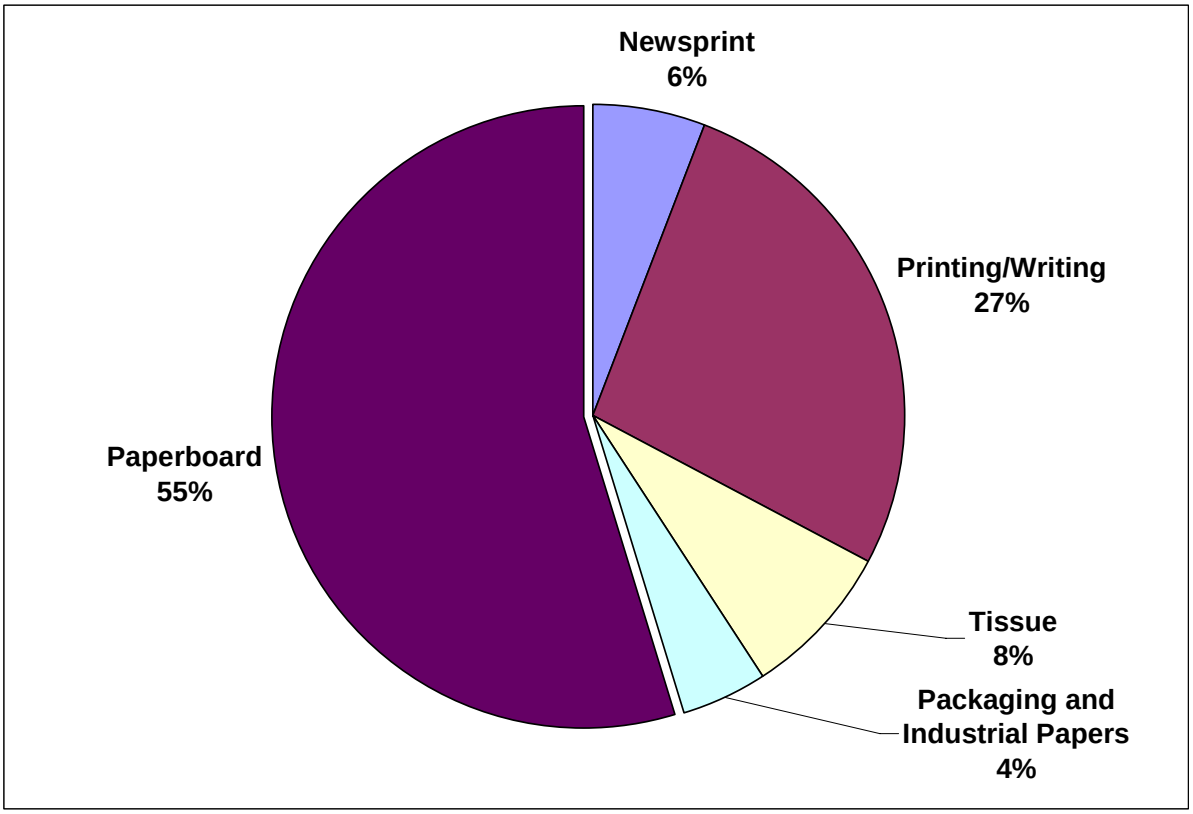


SOURCE: [10]

Figure 19 shows the breakdown of US paper and paperboard production by type:

- Paperboard accounts for more than half of the total. Paperboard is a general term describing heavyweight paper used for a variety of containers and packaging materials, including linerboard which makes up the faces of corrugated board.
- Printing and writing papers are the second largest category and account for about one-quarter of the total. Included within this category are papers used for brochures, business forms, envelopes, magazines, directories, etc. as well as copy and other office papers.
- Tissue paper production accounts for less than 10% of total production and is used for toilet and facial tissues, napkins, and toweling.
- Newsprint represents about 5% of production, but imports from Canada represent a substantial share of US consumption.
- The smallest category of paper production is packaging and industrial papers, which includes not only unbleached packaging papers that go into grocery and retail shopping bags and other shipping sacks, but also a wide variety of specialty papers.

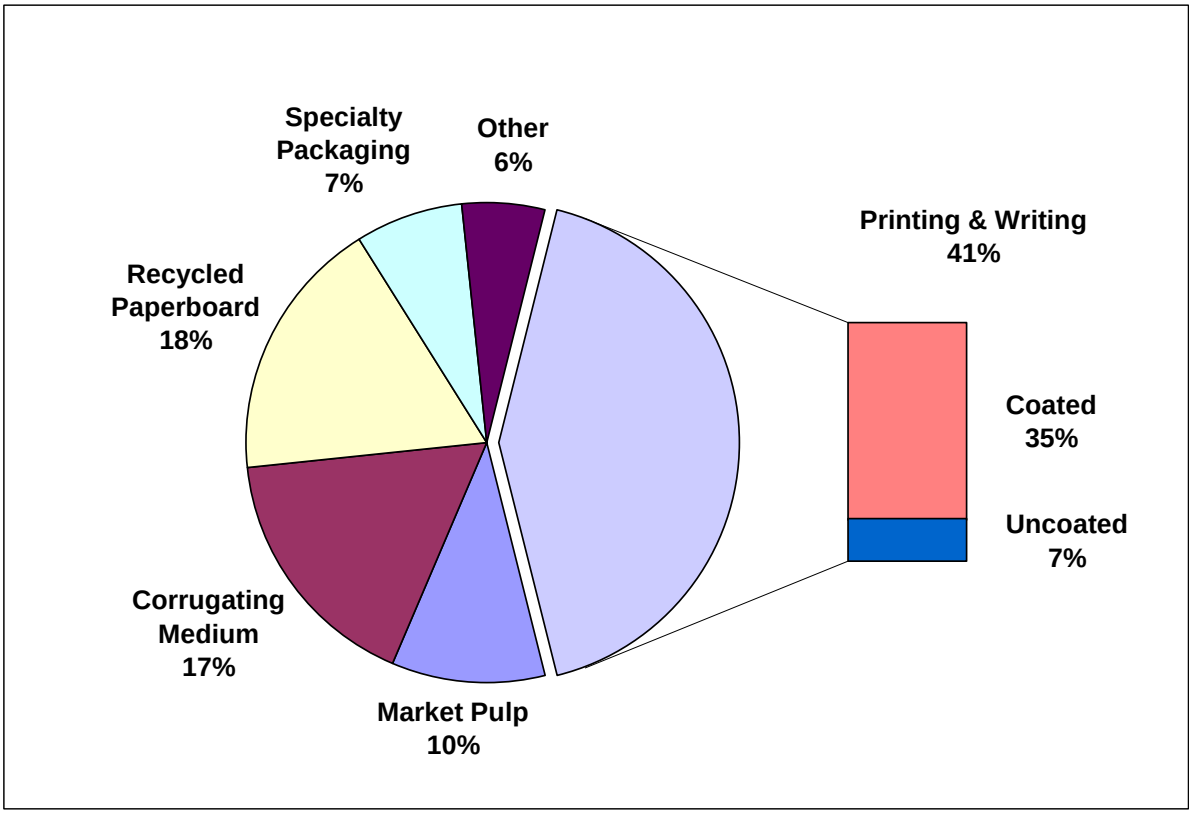
Figure 19. Breakdown of US Paper and Paperboard Production by Product Type, 2006 (% of 91 million tons).



SOURCE: [11]

Michigan's paper industry consists of 22 pulp, paper and paperboard mills and 171 paper product converters [12]. Only four of these facilities are integrated virgin pulp and paper manufacturers; the other mills manufacture or operate with recycled paper and/or market pulp. The integrated mills account for about half of the state's total market pulp, paper and paperboard production, and are concentrated in coated printing/writing papers and corrugating medium.

Figure 20. Breakdown of Michigan Pulp, Paper and Paperboard Capacity by Product Type (% of 3.6 million tons).



SOURCE: [13]

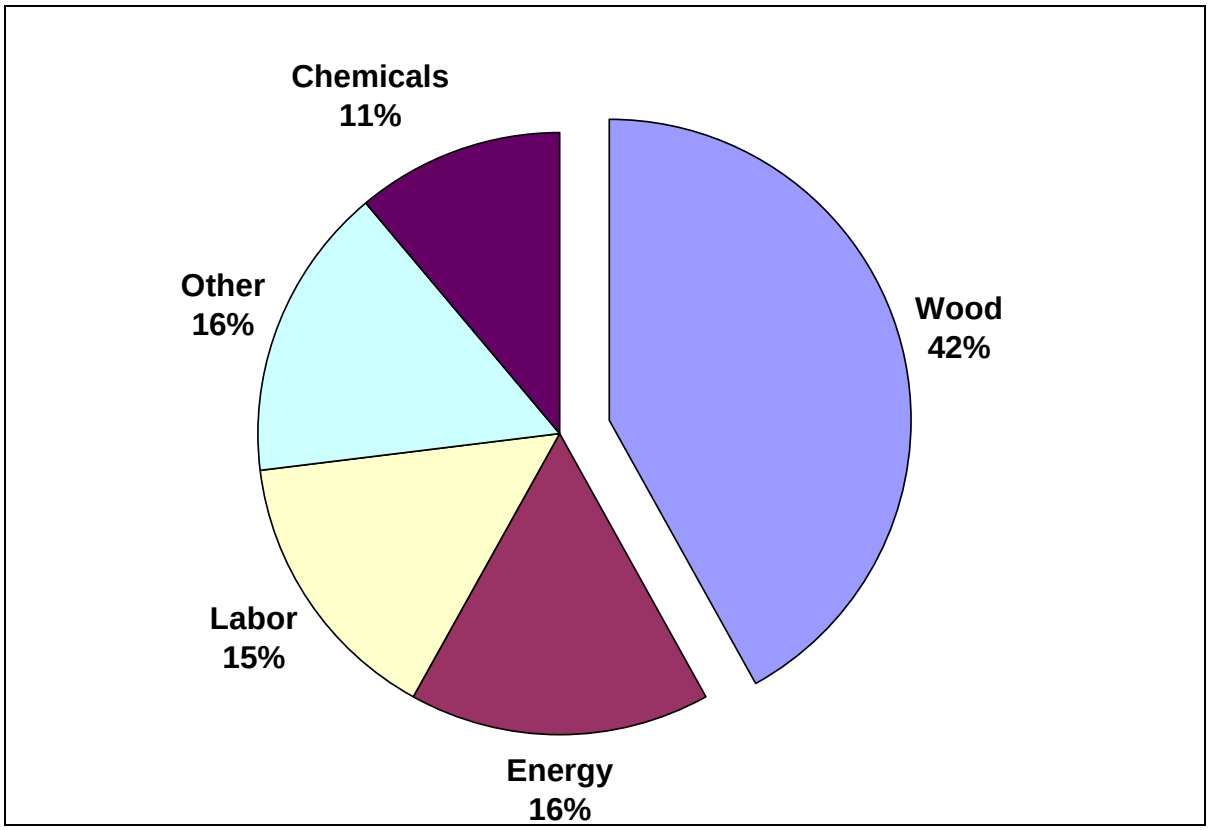
3.2.2 Factors of Production

Wood constitutes about 40% of the total variable cost of manufacturing pulp (Figure 21). Energy, labor, and chemicals each account for about 15% of the total cost. In turn, wood pulp is a significant cost in the manufacture of paper, as materials represent about one-third of the value of shipments of paper mill products [14].

In Michigan, the pulp and paper industry consumes about one-third of the total harvest, and nearly 40% of the total hardwood harvest [6].

A large portion of the energy used by pulp mills is generated by burning spent pulping liquors and wood and bark residues for heat, process steam, and cogeneration of electricity. Pulping liquors accounted for about 75% of self-generated energy in the paper industry in 2002 [15]. A modern chemical pulp mill is essentially self-sufficient in energy [16].

Figure 21. Average Cost Structure, Kraft Pulp Manufacturing.



SOURCE: [17]

3.2.3 Markets

Paper and paperboard are commodities that are intermediate inputs to converting processes prior to reaching the final consumer. As such, demand for paper and paperboard is derived from the demand for the final consumer products.

In the case of coated printing and writing papers, demand is driven by printers and publishers of magazines, catalogs, brochures, etc. Uncoated paper demand is a function of the amount of paper used in offices, as magazine inserts and for direct mailings. The demand for both coated and uncoated paper is therefore is directly related to overall economic activity and health. As economic activity contracts, so does the advertising spending which creates much of the demand for printing papers. Higher postal rates also dampen paper demand as printers and publishers reduce paper use to cut mailing costs.

Paper and paperboard used in packaging are also directly tied to the overall economy – the better the economy, the more goods get packaged and shipped. Two grades of paperboard -- corrugating medium and linerboard -- account for the majority of paperboard produced in the United States. Converting plants glue together corrugating medium and linerboard to make boxes. These converting plants are typically located near the end-users of the containers and are often owned by the company that manufactured the linerboard and medium.

3.2.4 Outlook

On the demand side, the current economic climate is causing consumers to reign in spending, which dampens both advertising and packaging. Aside from economic conditions, paper is increasingly facing competition from electronic media, especially for newsprint and magazines. The hours spent by consumers with printed media is continually falling, while time spent with electronic media is rising steadily. Although predictions of the “paperless office” have been made for some 30 years, only recently has the growth in office paper consumption slowed.

On the supply side, the global paper industry has long suffered from over-capacity, which has kept prices and profitability low. In the last decade, focused attention on this issue has led to consolidation within the industry and retirement of older capacity, to a point where increasing global demand has begun to prop up prices, even in the face of a slow global economy (Table 1). Some of the price growth can also be attributed to cost-push factors, as energy and chemical prices continue to rise.

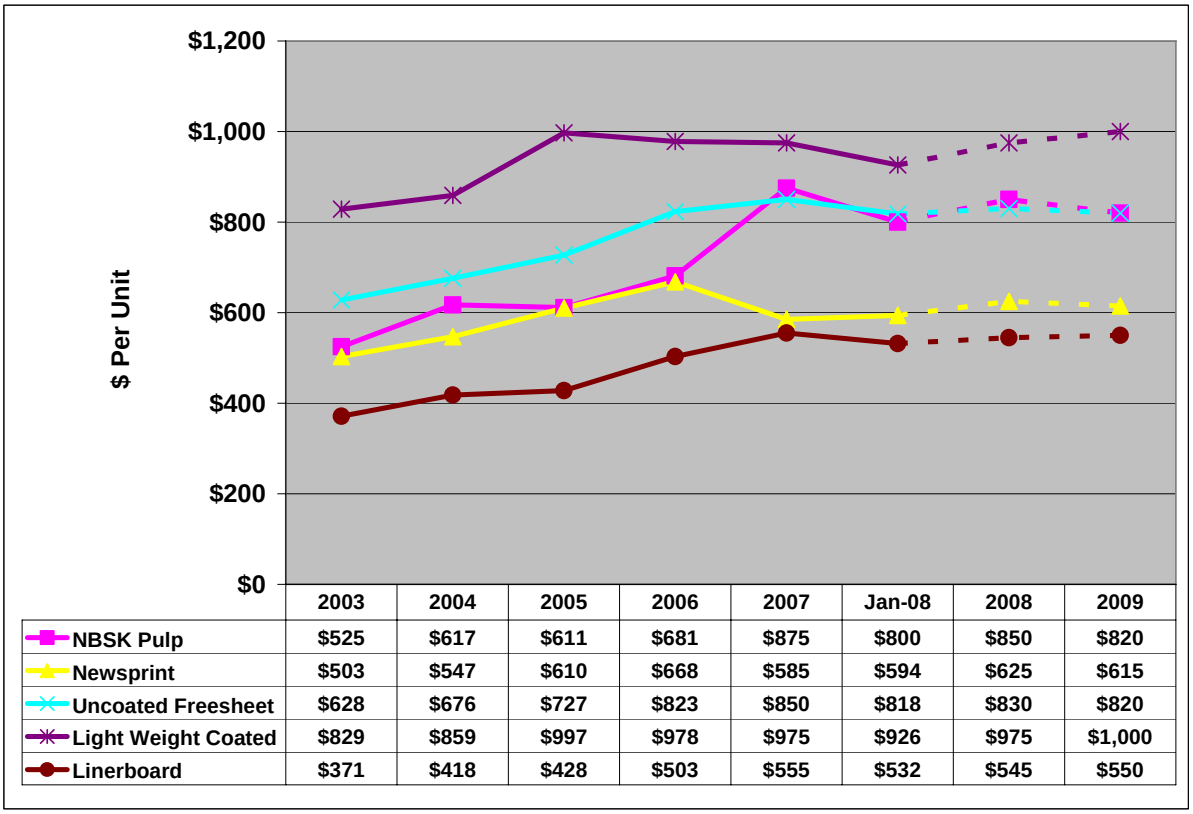
Table 1. Change in North American Prices of Pulp and Paper 2007-08.

	Feb-08	Feb-07	% Change
Uncoated Printing Paper	$1,045	$937	12%
Coated Printing Paper	$1,000	$925	8%
Kraft Liner	$550	$490	12%
Newsprint	$588	$650	-10%
Pulp	$778	$564	38%

SOURCE: [18]

Until the US economy recovers, growth in the US pulp and paper sector is unlikely. However, the weak US dollar may both dampen imports and create export markets to partially take up the slack in domestic demand, and profitability may not suffer, as near-term price forecasts are generally positive (Figure 22). In the longer term, the US industry will have to contend with pricing pressures created by the growing base of more efficient plants in Europe, Asia, and South America.

Figure 22. Historic and Short-term Price Projections for Benchmark Paper and Paperboard Products.



	2003	2004	2005	2006	2007	Jan-08	2008	2009
NBSK Pulp	$525	$617	$611	$681	$875	$800	$850	$820
Newsprint	$503	$547	$610	$668	$585	$594	$625	$615
Uncoated Freesheet	$628	$676	$727	$823	$850	$818	$830	$820
Light Weight Coated	$829	$859	$997	$978	$975	$926	$975	$1,000
Linerboard	$371	$418	$428	$503	$555	$532	$545	$550

SOURCE: [19]

3.3 Lumber

Lumber is manufactured by sawing logs or bolts to produce a variety of sizes and grades for multiple end uses. The lumber industry consists of softwood and hardwood segments, which are distinctly different in terms of resources used, manufacturing technologies, products, and end-markets. Softwood lumber is the most widely used structural component in single family home construction. Hardwood lumber is more decorative, and is used in flooring, cabinetry, and furniture.

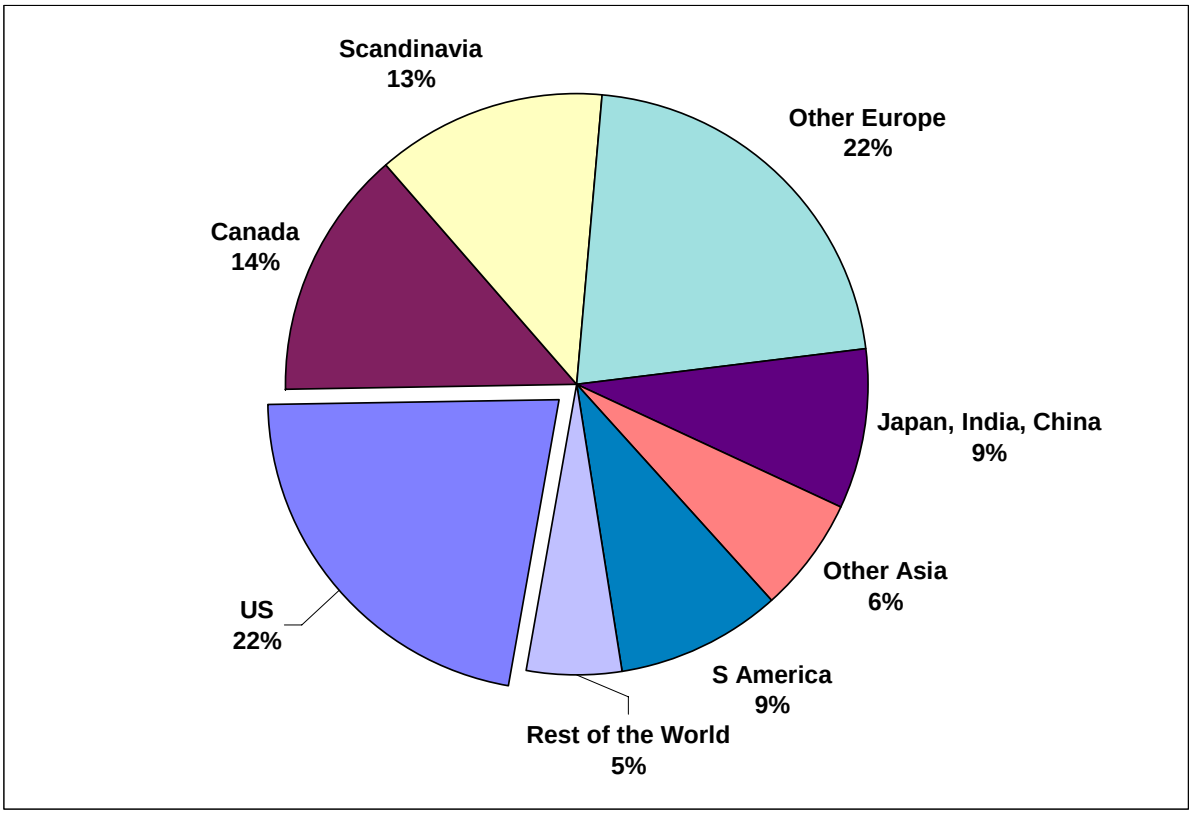
3.3.1 Industry Overview

Lumber is produced in every corner of the world, but nearly three-fourths of total production is concentrated in North America and Europe (Figure 23). The US itself produces about 20% of the world's lumber.

About three-fourths of global lumber production is in softwood species, which is principally a northern hemisphere resource. The US, Canada, Scandinavia, and Russia are responsible for over half of the global softwood production (Figure 24).

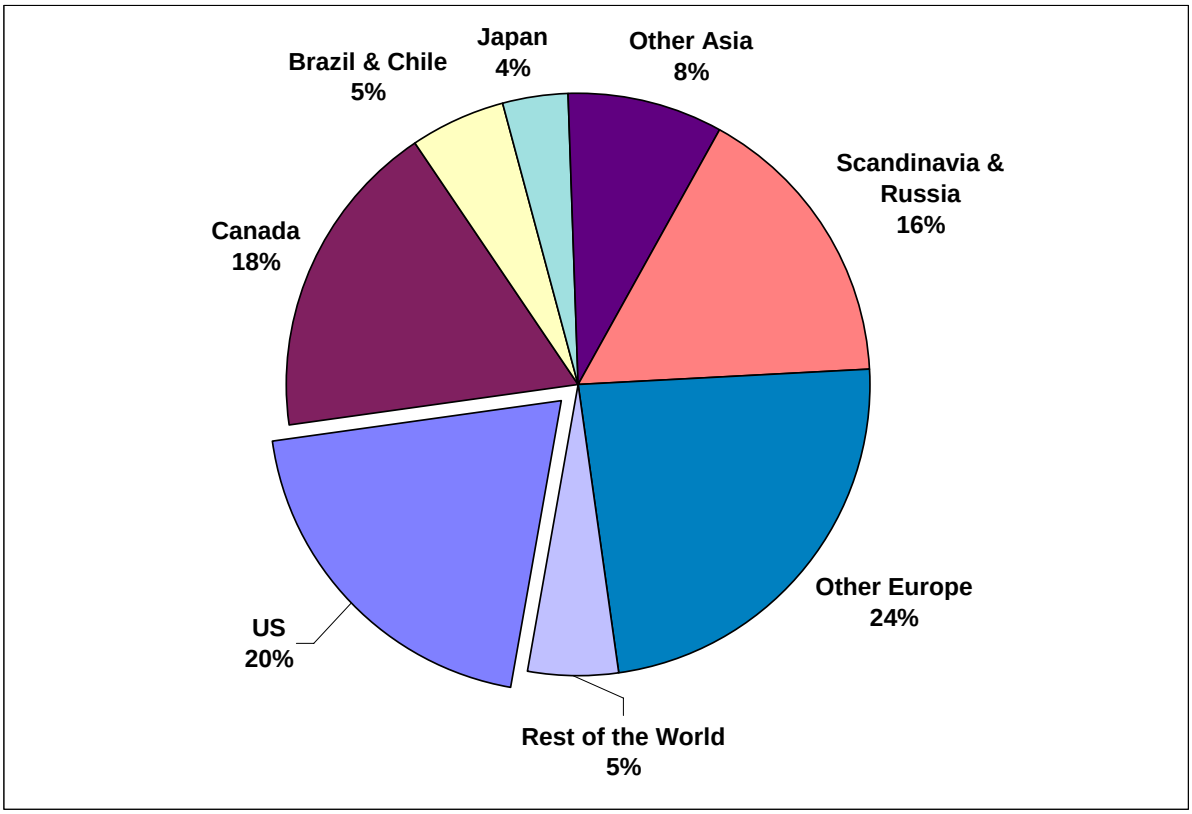
Hardwood lumber production is more equitably spread around the globe, but in this sector the US is most dominant, manufacturing nearly 30% of world production(Figure 25). Brazil is the second largest producer, and both South America and Asia produce more hardwood than Europe.

Figure 23. Global Production of Lumber, 2006 (% of 424.5 million m^3).



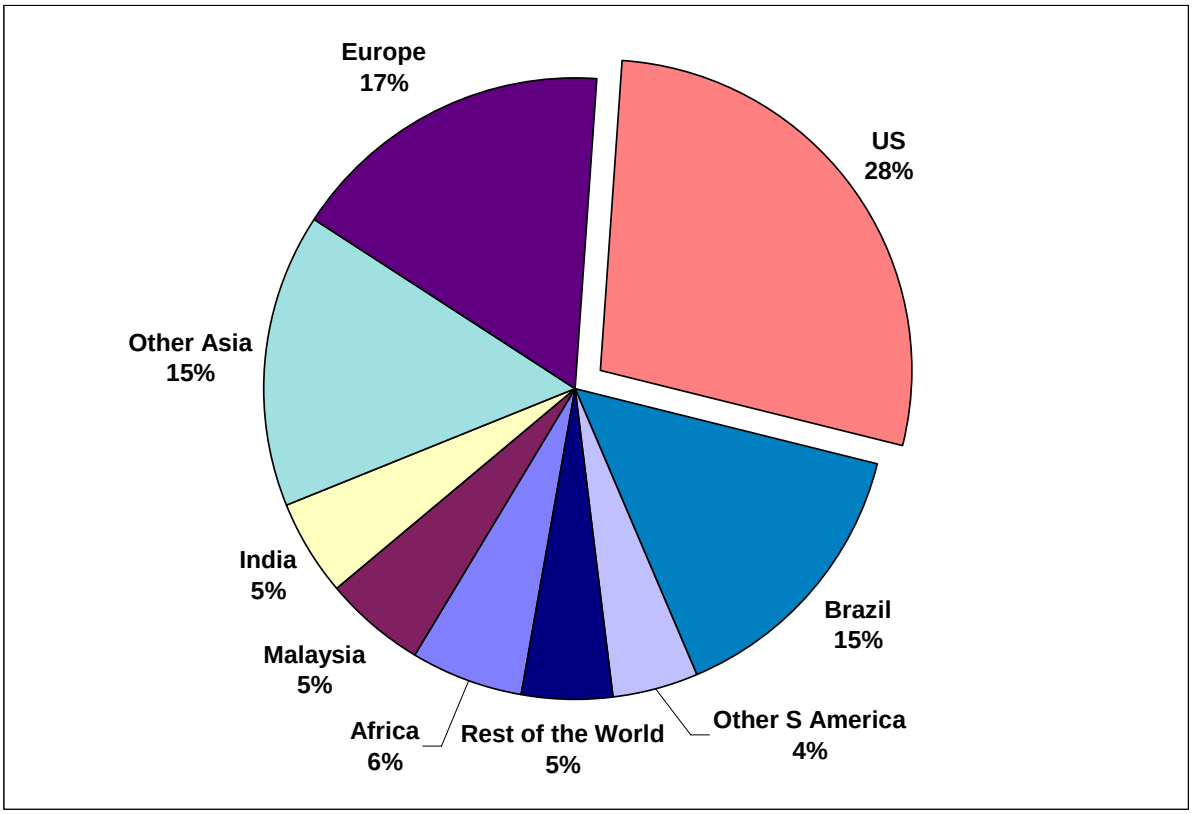
SOURCE: [9]

Figure 24. Global Production of Softwood Lumber, 2006 (% of 325.5 million m^3).



SOURCE: [9]

Figure 25. Global Production of Hardwood Lumber, 2006 (% of 99.0 million m^3).

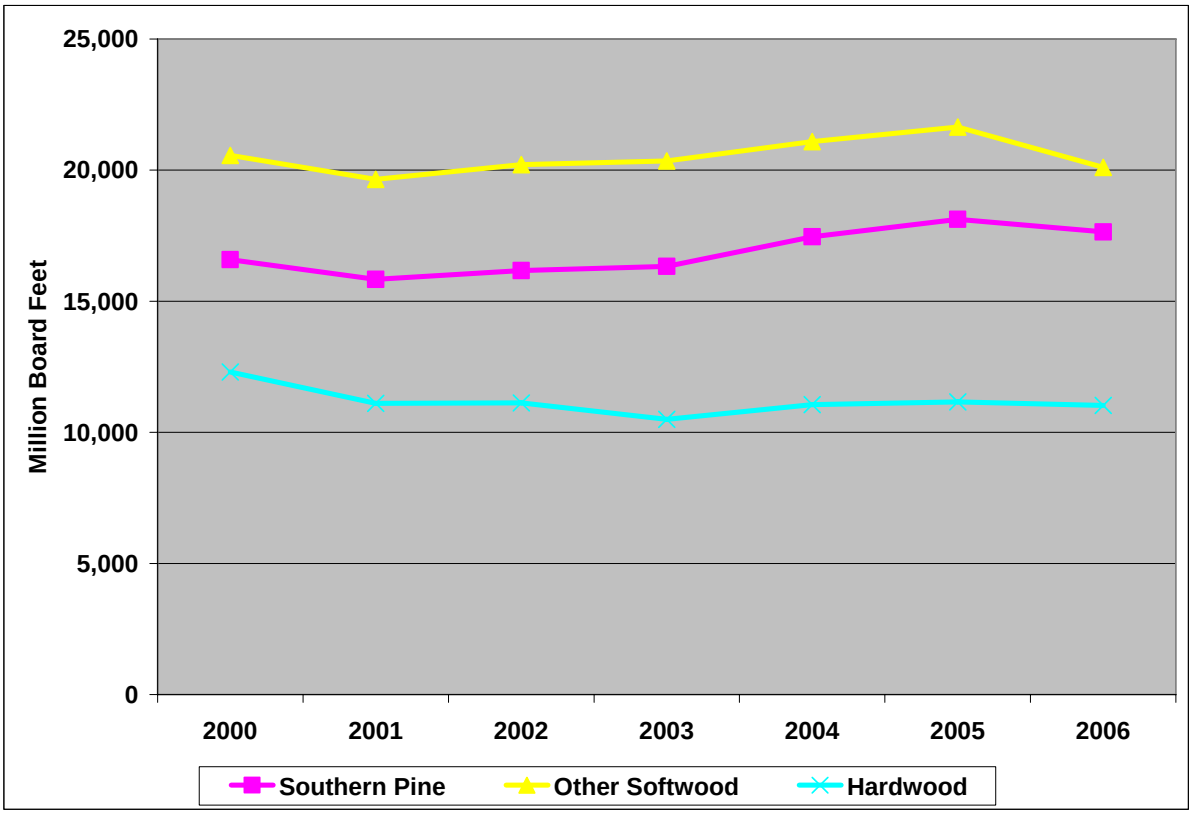


SOURCE: [9]

Despite being the largest hardwood lumber producer in the world, the US is predominantly a softwood lumber producer (Figure 26). Softwood production in the US is concentrated in the southern pine belt and the Pacific northwest, while hardwood production takes place almost exclusively in the eastern half of the country.

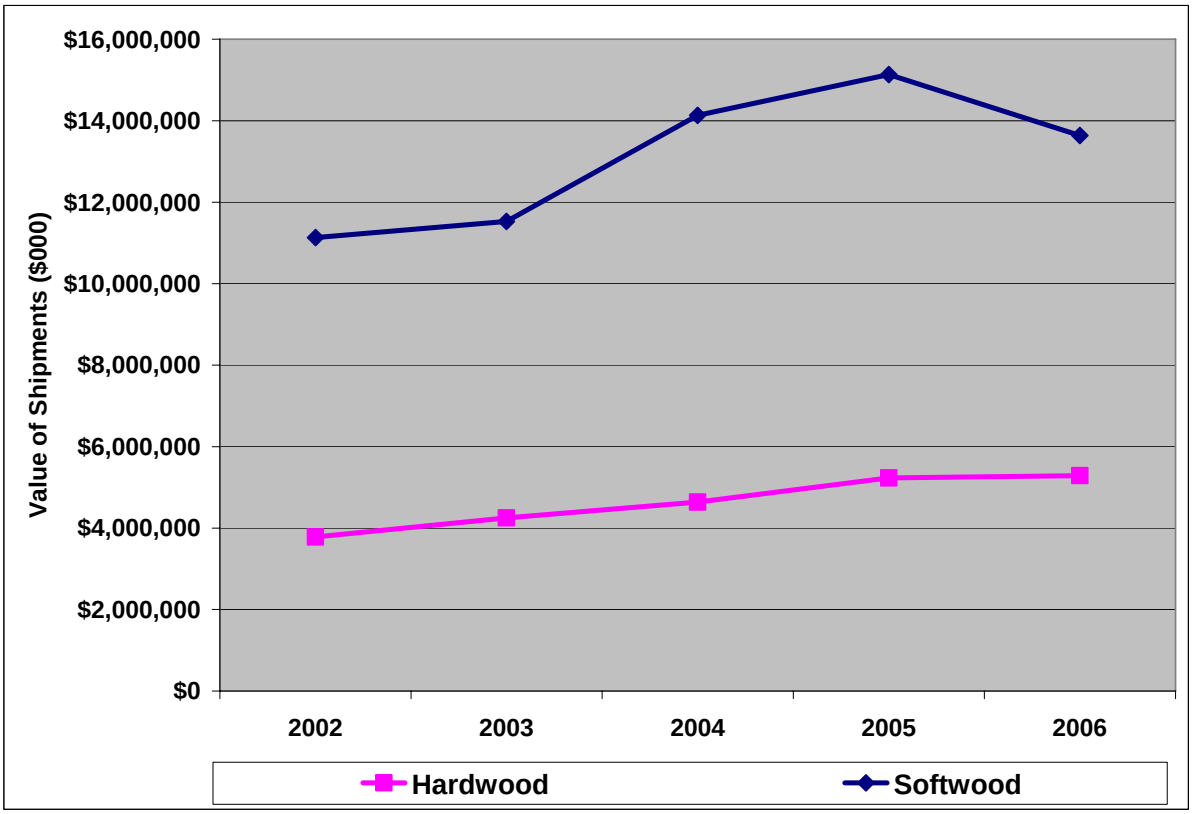
For the period 2000-2005, softwood lumber production was steadily rising in the face of strong housing markets, but dropped off in 2006 as housing slowed. Hardwood lumber production was slightly declining during this entire period, as the strength of housing could not mitigate the loss of furniture markets to overseas manufacturers. However, despite declining volumes of hardwood lumber production, the value of shipments rose (Figure 27), indicating rising unit prices.

Figure 26. US Production of Lumber, 2000-2006.



SOURCE: [20]

Figure 27. Value of US Shipments of Lumber, 2002-06 ($000).

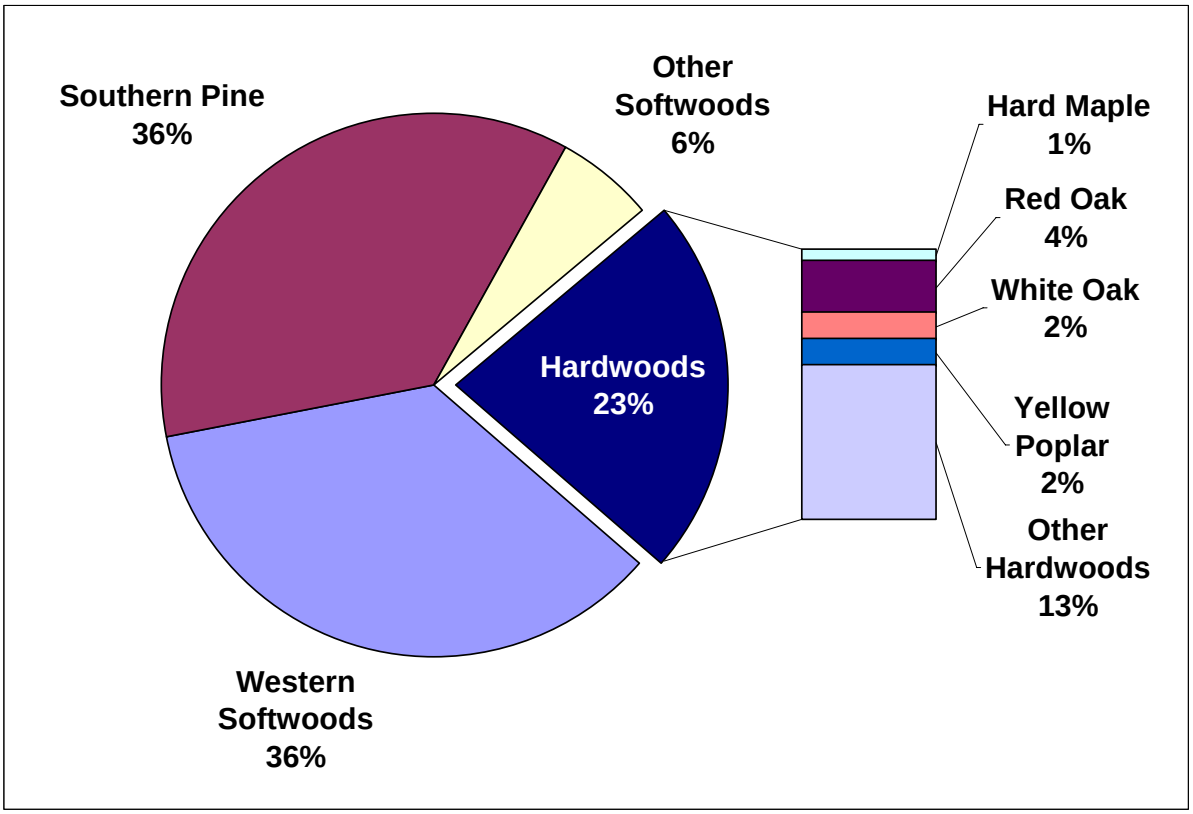


SOURCE: [21]

Figure 28 shows that almost 80% of US lumber production is in softwoods, with southern pine and western softwoods having equal shares. Other softwoods are those produced in Michigan and other northern states from Minnesota to West Virginia and north. These species are primarily red, white and jack pines, spruce, and balsam fir.

Hardwood lumber production is spread over a large number of species; the largest species by volume is red oak, which has both northern and southern species and therefore a wide geographic range. However, red oak still accounts for only about 15% of total hardwood production. No other single species accounts for more than 10% of total hardwood production. Red oak and hard maple are Michigan's most important sawtimber species.

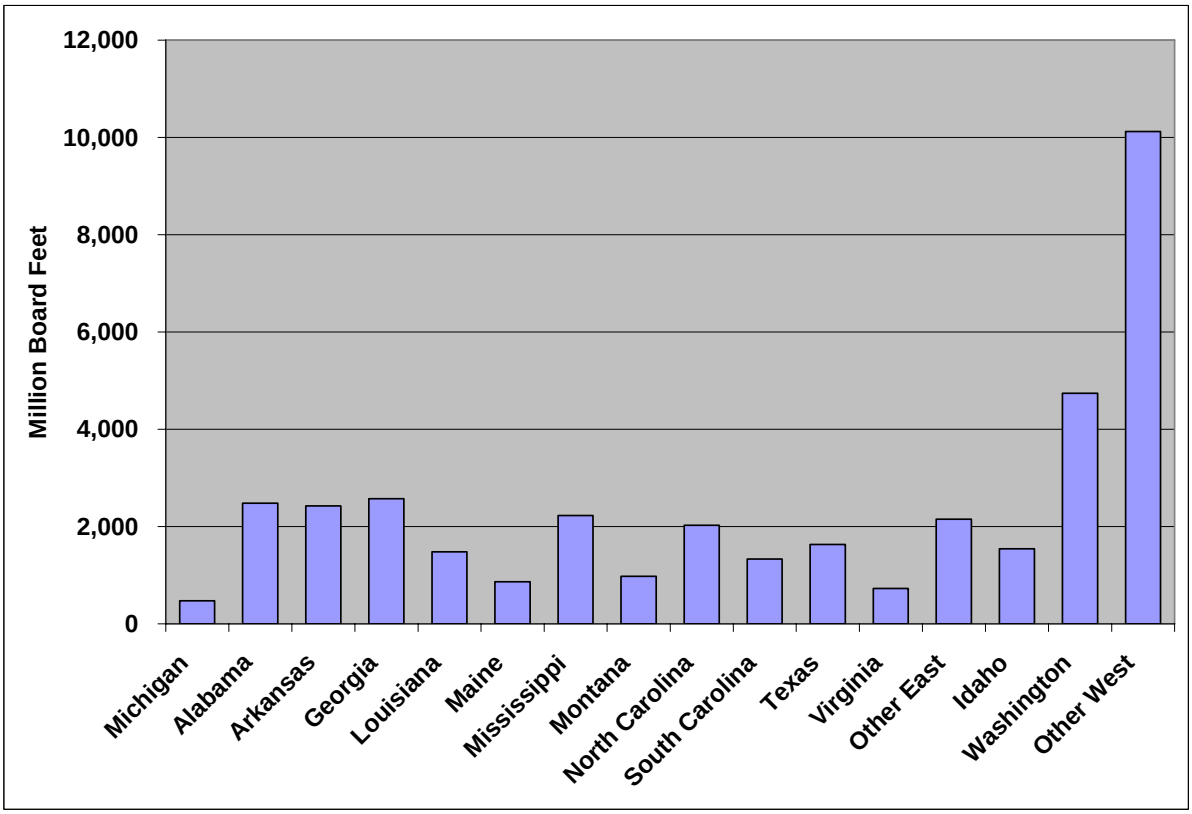
Figure 28. US Production of Lumber by Species, 2006 (% of 48.7 billion board feet).



SOURCE: [20]

The largest lumber producing states by far are Washington, Oregon, and California, due to their sheer forest areas and the larger average tree sizes (Figure 29). The large southern resource is spread over about 15 states, with the greatest concentration in the region from Georgia west to Mississippi and Arkansas. Michigan is the 16th largest softwood producing state, and just ahead of it is the only other northern state, Maine.

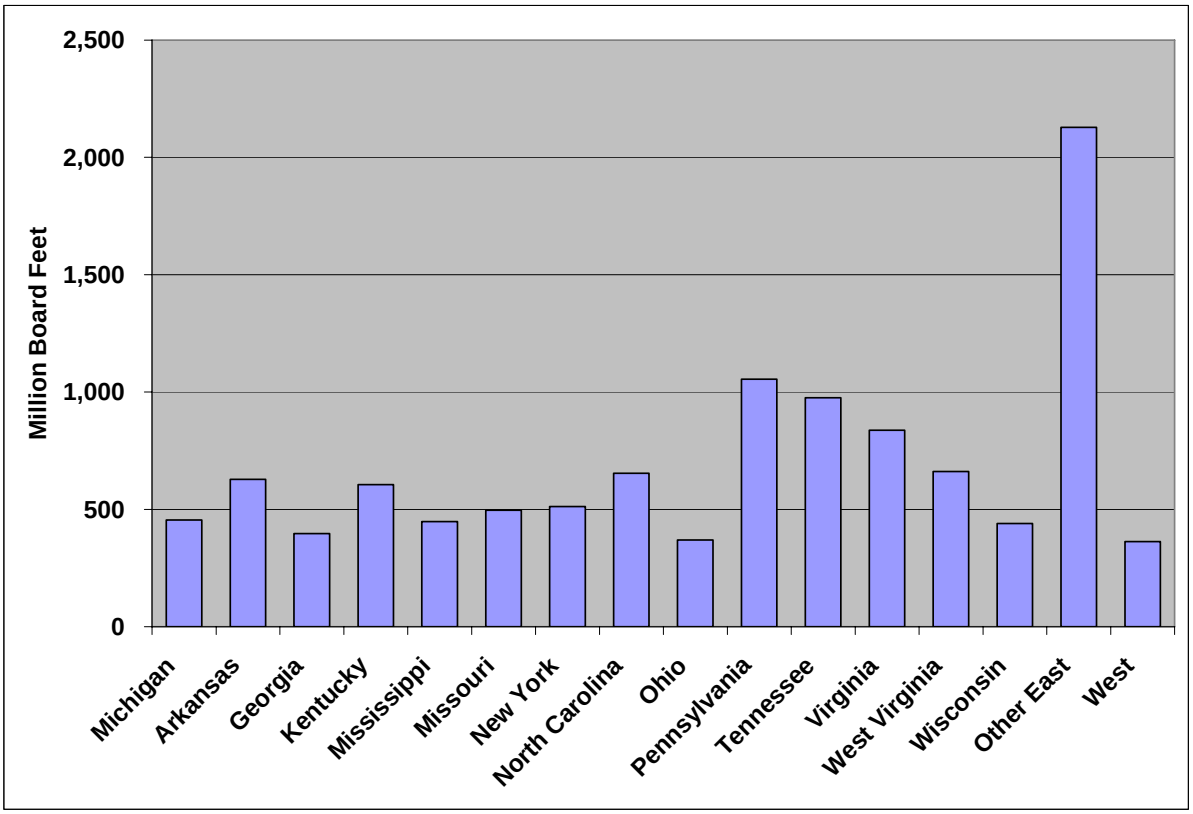
Figure 29. US Production of Softwood Lumber by State, 2006.



SOURCE: [20]

By contrast, the western states hardly show up on Figure 30, which shows hardwood lumber production by state. The largest concentration of hardwood lumber production is in the central Appalachian region from Pennsylvania south to North Carolina and west to Tennessee. Michigan is the 11th ranked state, and produces about the same volume as Wisconsin, and less than half of the volume of each of the leading states of Pennsylvania and Tennessee.

Figure 30. US Production of Hardwood Lumber by State, 2006.

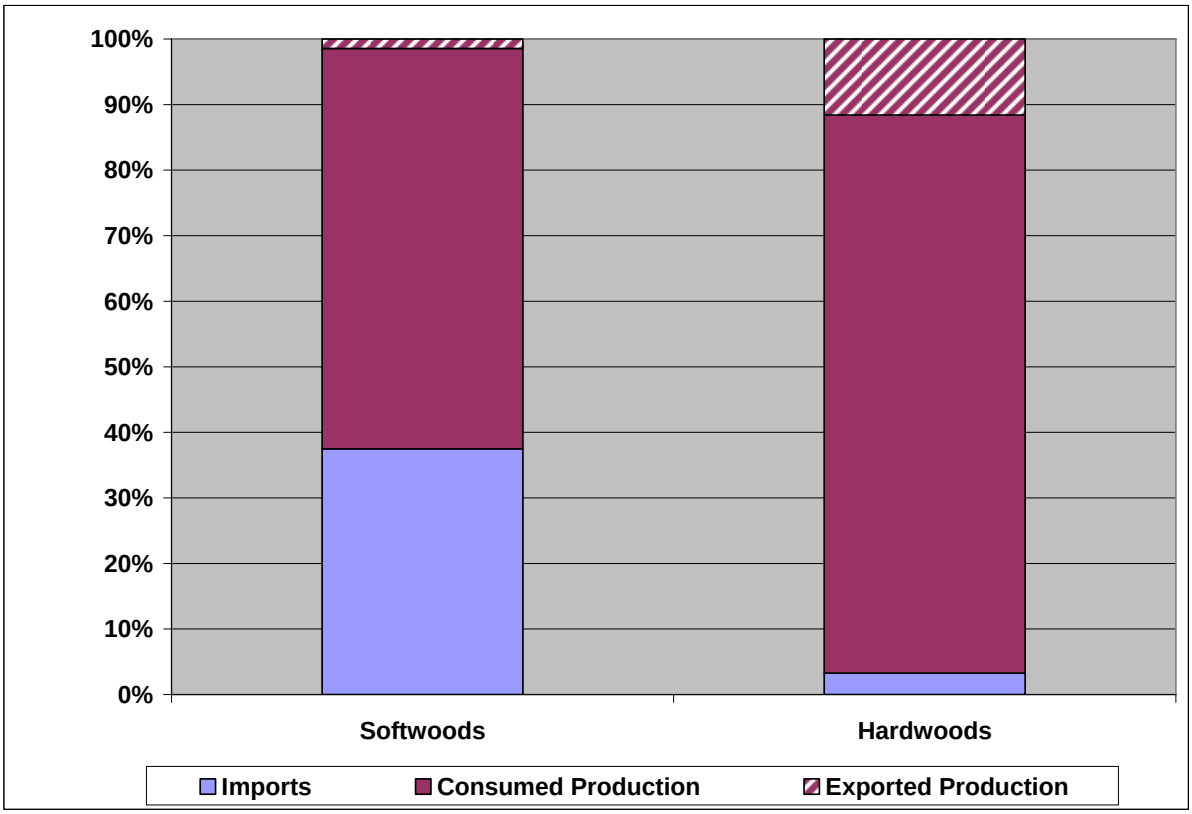


SOURCE: [20]

For both softwoods and hardwoods, a large portion of US lumber production is consumed domestically (Figure 31). In addition, nearly 40% of softwood consumption is imported, almost entirely from Canada. A negligible portion of softwood lumber is exported, although the absolute volume is four times the total annual production of Michigan.

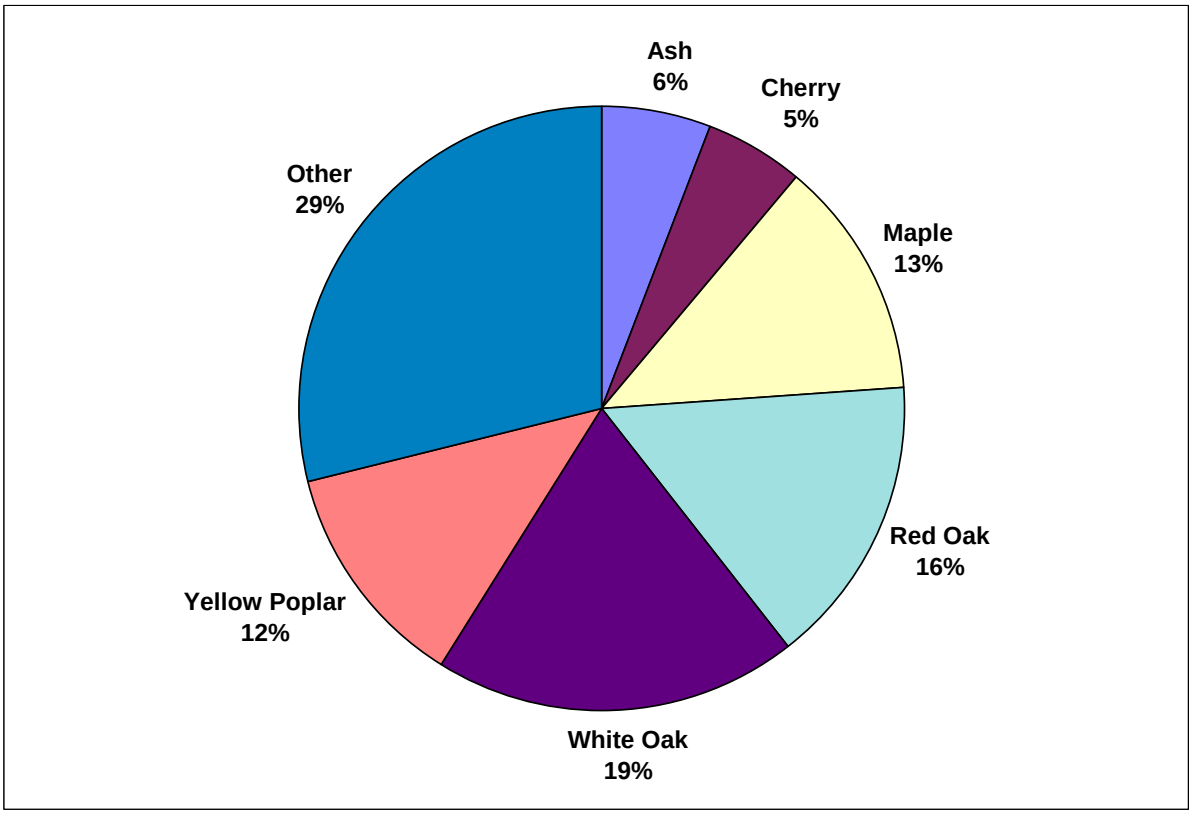
In hardwoods, imports are less significant and exports more significant relative to production. Imports are a relatively small percentage of consumption, less than 5% in 2006, and about 7.5% in 2005 [20]. Exports represented about 12 percent of production in 2006. White oak, red oak and maple together comprised about half of the total volume exported (Figure 32). For both maple and white oak, more than 20% of production was exported.

Figure 31. Lumber Production and Trade Breakdown, 2006.



SOURCE: [20]

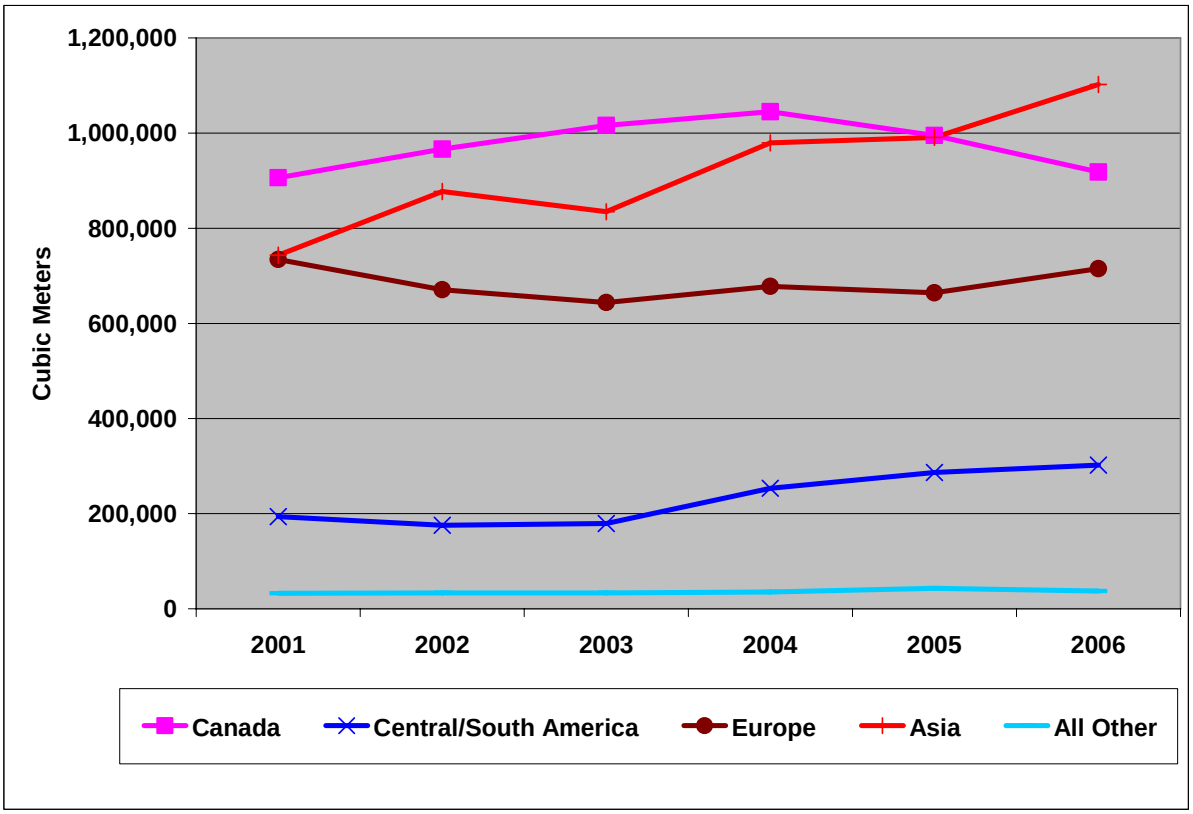
Figure 32. US Hardwood Lumber Exports by Species, 2006 (% of 3.1 million m^3)



SOURCE: [20]

Canada was the principal destination of US hardwood lumber exports until 2006, when exports to Asia, particularly China, rose above exports to Canada (Figure 33). During the period 2001-2006, exports to Asia rose by 48%, while exports to all other countries in aggregate rose by only 6%.

Figure 33. US Hardwood Lumber Exports by Country of Destination, 2001-2006.

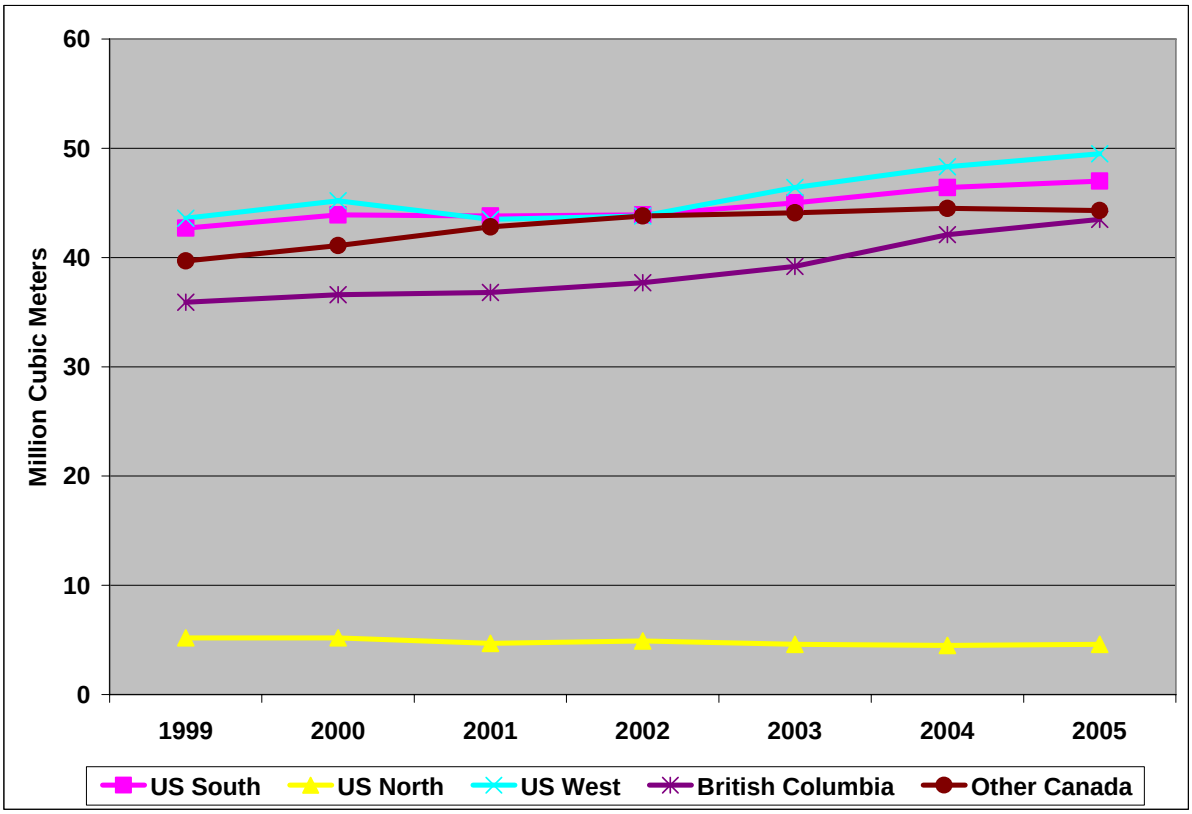


SOURCE: [22]

During 1999-2005, North American softwood manufacturing capacity grew by an average of 14% in all regions but the US North (including Michigan), where capacity declined by 12% (Figure 34). The decline in the North was due to several large mill closures in Maine, where the cost of timber became excessive [23].

Michigan softwood capacity in 2005 was estimated to be 841,000 m^3 in nine softwood sawmills [23]. The largest mill accounted for half of the state's total production, and the largest three mills accounted for 80% of the state's total production. Over the period 2000-2005, statewide capacity increased by 34%, not due to any new mills, but rather to "capacity creep" at the three largest mills.

Figure 34. North American Softwood Lumber Capacity by Region, 1999-2005.



SOURCE: [23]

The structure of the hardwood lumber sector is significantly different than the softwood sector. The softwood industry is composed of large automated mills that produce standardized high volume commodities. The hardwood industry is composed of a large number of smaller mills which tend to be more labor intensive operations that produce a great variety of dimensions, species and grades. Profitability in the hardwood sector is more a function of marketing expertise than in the softwood sector, which is driven largely by manufacturing efficiency.

There are few estimates of the number of mills or productive capacity in the hardwood industry. While there are an estimated 1,067 North American softwood mills [23], one author [24]estimated 2,349 US hardwood mills – more than twice as many mills and less than one-third the volume produced by softwood mills.

Even though there is a large number of hardwood sawmills, that number has been declining for decades as smaller operations are retired. Table 2 shows that in Michigan in the 1990's, the number of mills was reduced by one-fourth, and the average mill capacity increased by 37%. The net change in total production was negligible, but undoubtedly production was more efficient. Table 2 shows a similar experience across other major hardwood producing states.

Table 2. Estimates of Circa 1990-2000Change in the Number of Hardwood Sawmills and Production Capacities for Various States (for mills producing more than one million board feet per year).

	Number of Mills			Annual Production Per Mill (mmbf)			Implied Total Production (mmbf)		
State	Early 1990's	Early 2000's	Chg	Early 1990's	Early 2000's	Chg	Early 1990's	Early 2000's	Chg
New York	113	110	-3%	4.040	4.620	14%	457	508	11%
Pennsylvania	276	285	3%	3.150	3.960	26%	869	1,129	30%
West Virginia	118	101	-14%	4.520	6.900	53%	533	697	31%
Kentucky	204	189	-7%	4.280	4.940	15%	873	934	7%
Missouri	203	213	5%	2.790	3.040	9%	566	648	14%
Indiana	127	100	-21%	2.890	3.790	31%	367	379	3%
Michigan	131	96	-27%	3.890	5.330	37%	510	512	0%

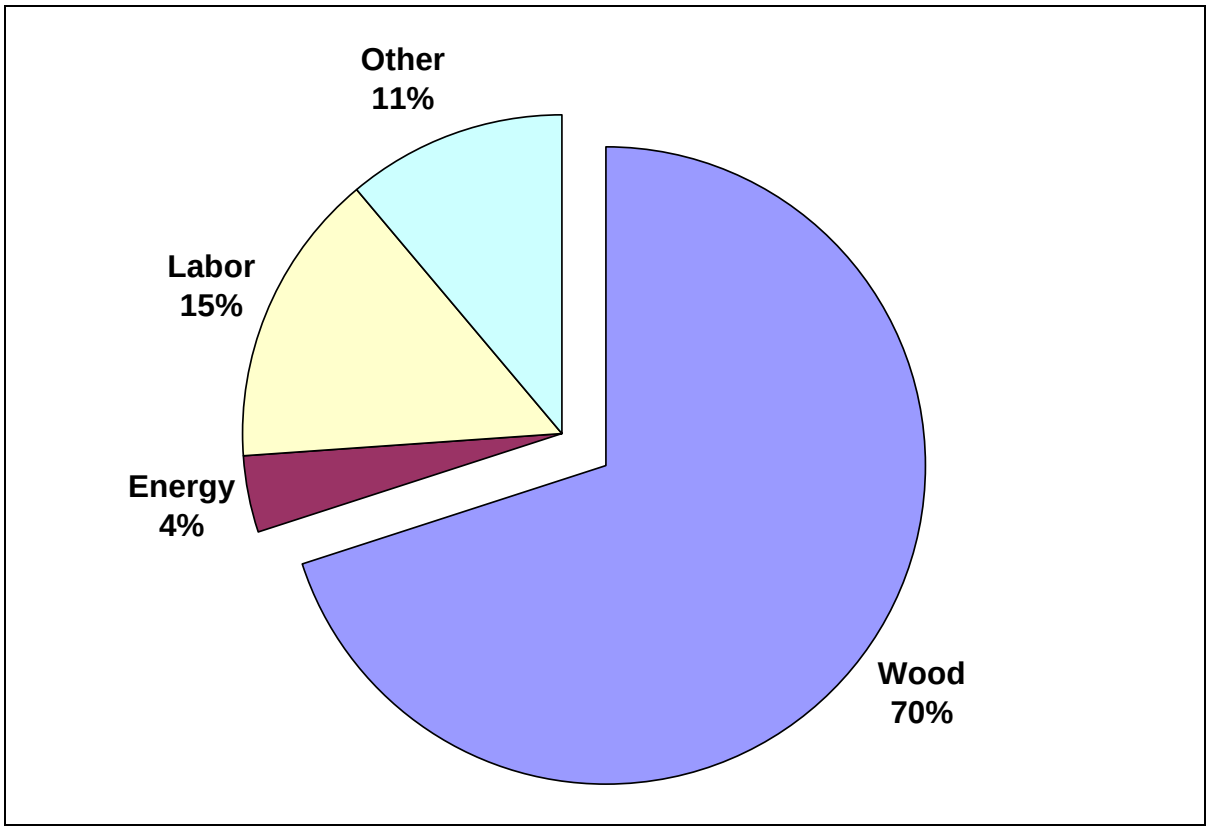
SOURCE: [25]

3.3.2 Factors of Production

Wood is by far the largest cost of manufacturing lumber, slightly more so for hardwood lumber (Figure 35) than for softwood lumber (Figure 36). Labor is the second largest cost component, at 15% of variable costs. Energy costs are relatively low because mills self-generate heat and electricity through burning of bark and wood residuals.

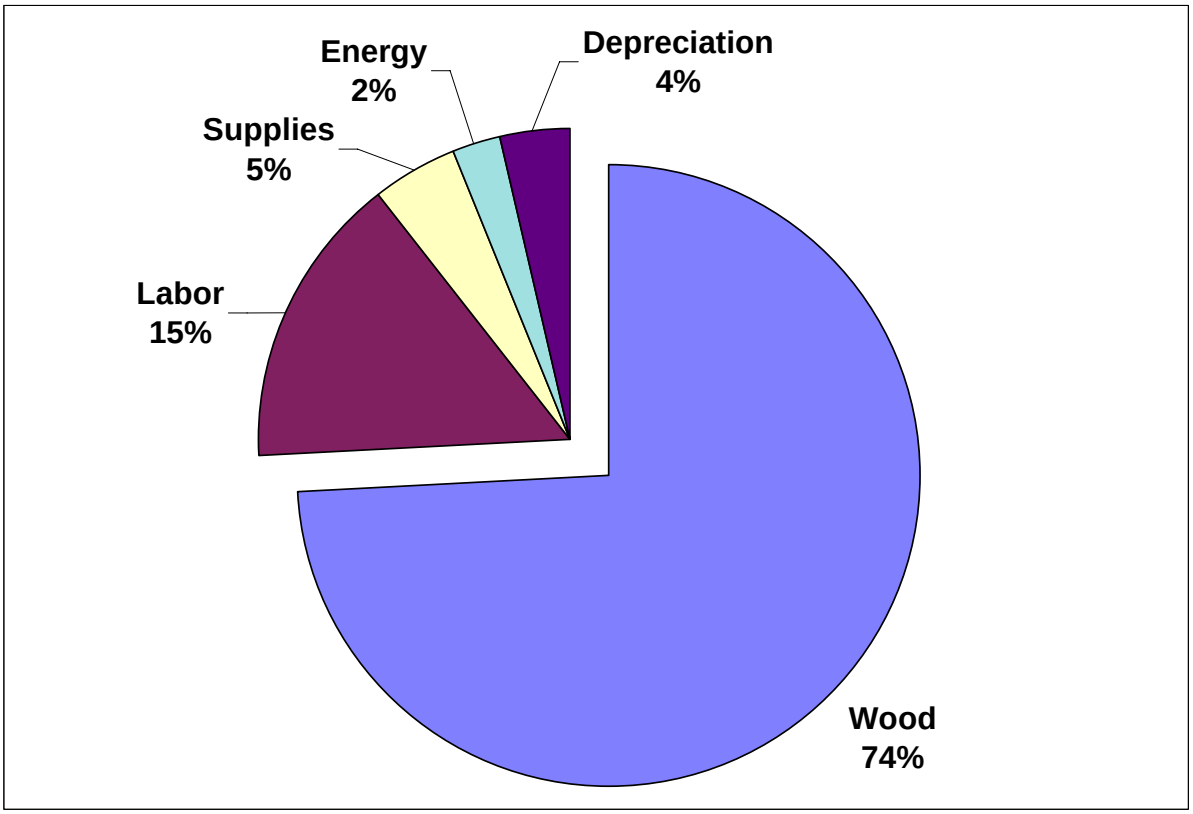
In Michigan, sawlogs constitute about 40% of the total state timber harvest, with hardwoods comprising about two-thirds of the sawlog production [26].As shown, in Figure 37, the sawlog harvest volume is distributed among a wide variety of species, with maples, oaks, and aspen together accounting for about half of the total, while softwoods account for about a third of the total. However, the stumpage value [27] of the sawlog harvest (Figure 38) is much more concentrated, with hard maple representing over 40% of the total. The maples and oaks together account for about 40% of the volume but 70% of the value.

Figure 35. Typical Cost Structure, Softwood Lumber Manufacturing.



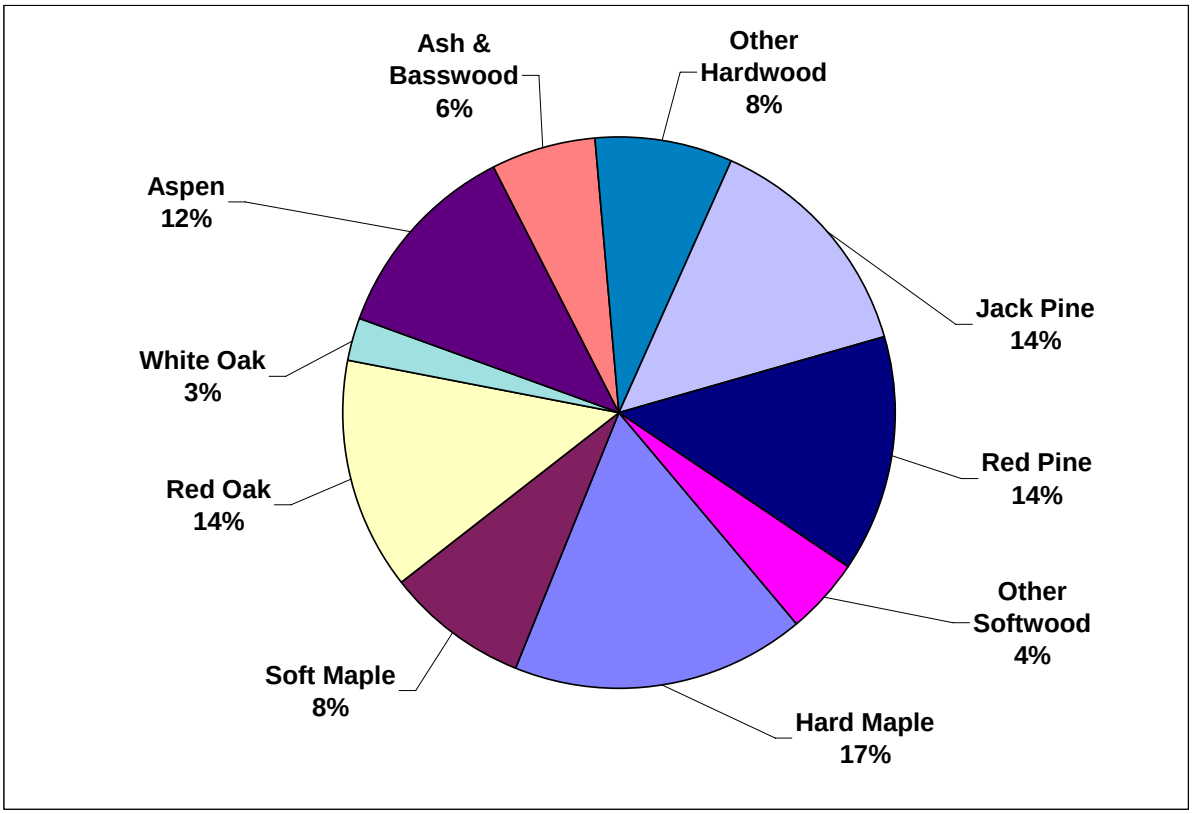
SOURCE: []

Figure 36. Typical Cost Structure, Hardwood Lumber Manufacturing.



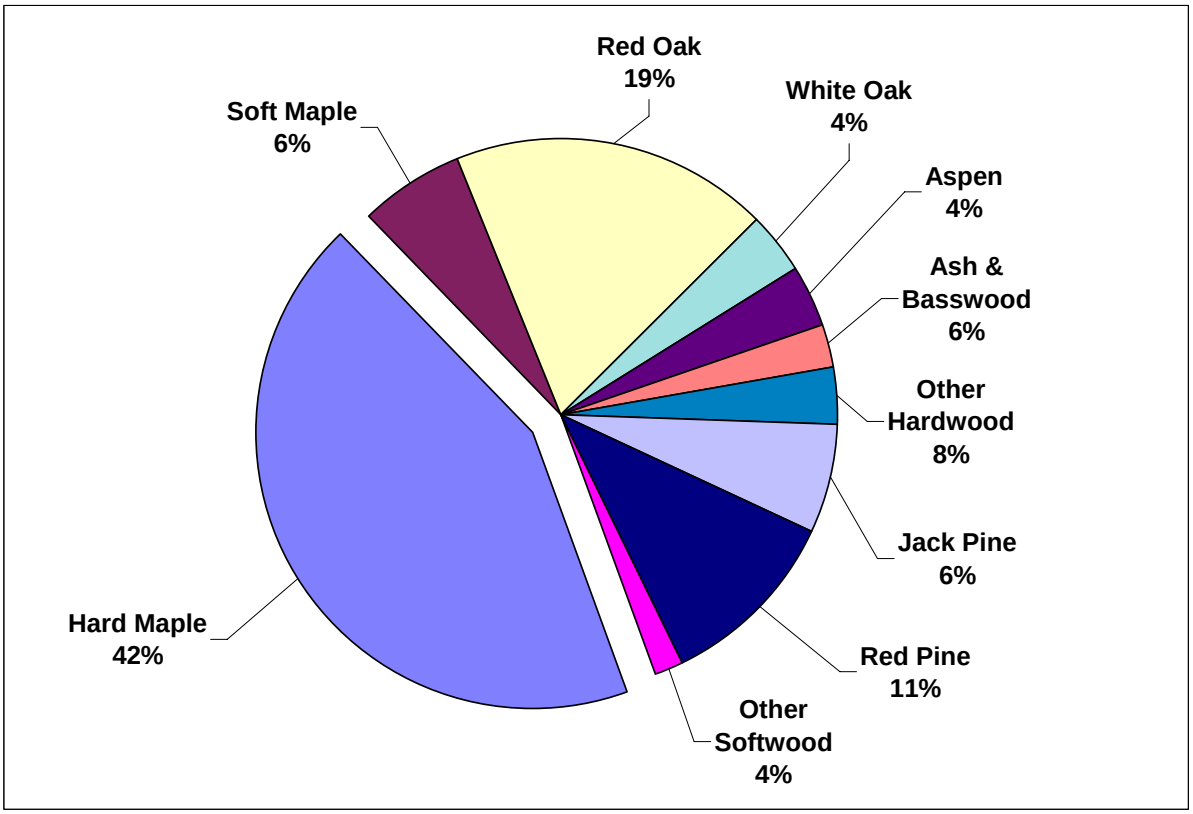
SOURCE: [28]

Figure 37. Michigan Sawlog Harvest Volume by Species (% of 749 million board feet).



SOURCE: [6]

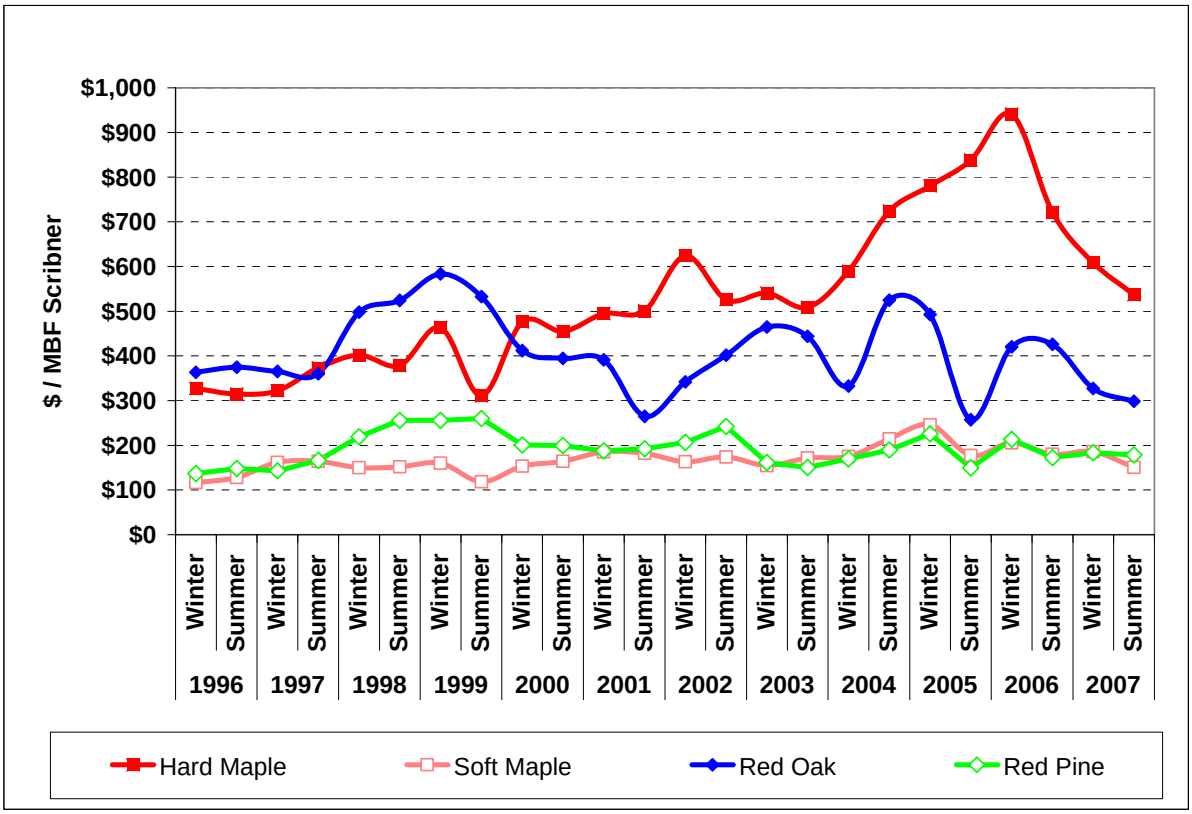
Figure 38. Michigan Sawlog Harvest Value by Species (% of $171.7 million).



SOURCE: [6] and [27]

Raw material costs are obviously critical for the lumber industry. As shown in Figure 39, hard maple prices exploded in the last decade, peaking in 2005-06 after tripling in about ten years. Hard maple prices have since dramatically receded in response to the slowdown in housing, but at current levels still represent a 5% annual compound rate of increase over a ten-year period. During that same period, hard maple prices overtook red oak prices, which despite some periods of increase, have now dropped below their 1996 level. Red oak fell out of favor with designers during this period, and has not returned. The high cost of maple has also led it to be less favored by designers, but its price is still substantially below that of cherry, which is the “hot” species for high end applications.

Figure 39. Michigan Sawtimber Stumpage Trends, 1996-2007.



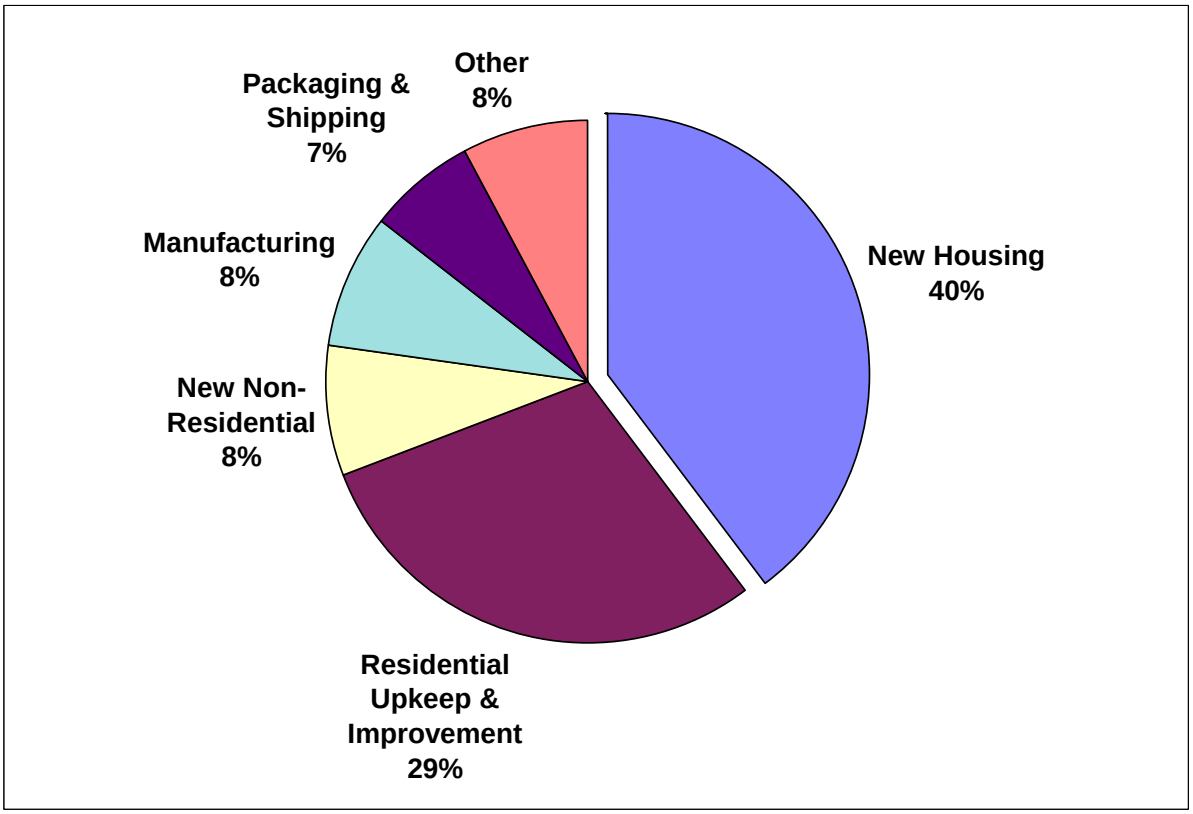
SOURCE: [29]

3.3.3 Markets

Softwood lumber is heavily tied to the residential housing market, whether in new house construction or maintenance and remodeling. These two uses account for about 70% of all softwood lumber consumption (Figure 40).

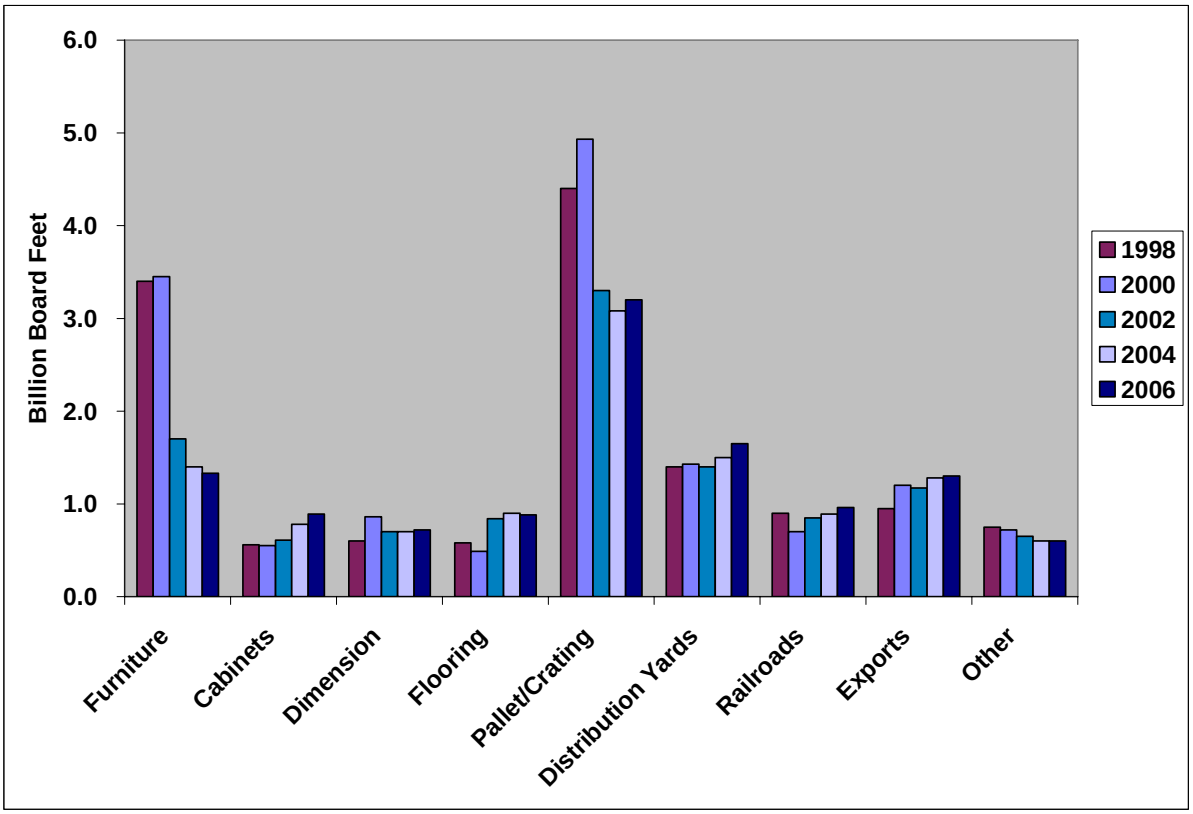
Hardwood lumber serves a more diverse set of end uses, and the mix has undergone some significant changes in the last decade (Figure 41). In 1998 the furniture industry consumed 25% of total hardwood production; by 2006 that share was down to 12%, as much of the US domestic furniture industry fell victim to imports from lower wage countries, especially China. The largest use of hardwood lumber is in shipping pallets and crating, but that share also dropped significantly during this period, as shippers have improved pallet and other material recycling. Uses related to residential construction and upkeep, i.e. flooring and cabinets, both increased, and exports increased, partially to serve the offshore furniture manufacturers.

Figure 40. US Softwood Lumber End Uses, 2002 (% of 56.6 billion board feet).



SOURCE: [30]

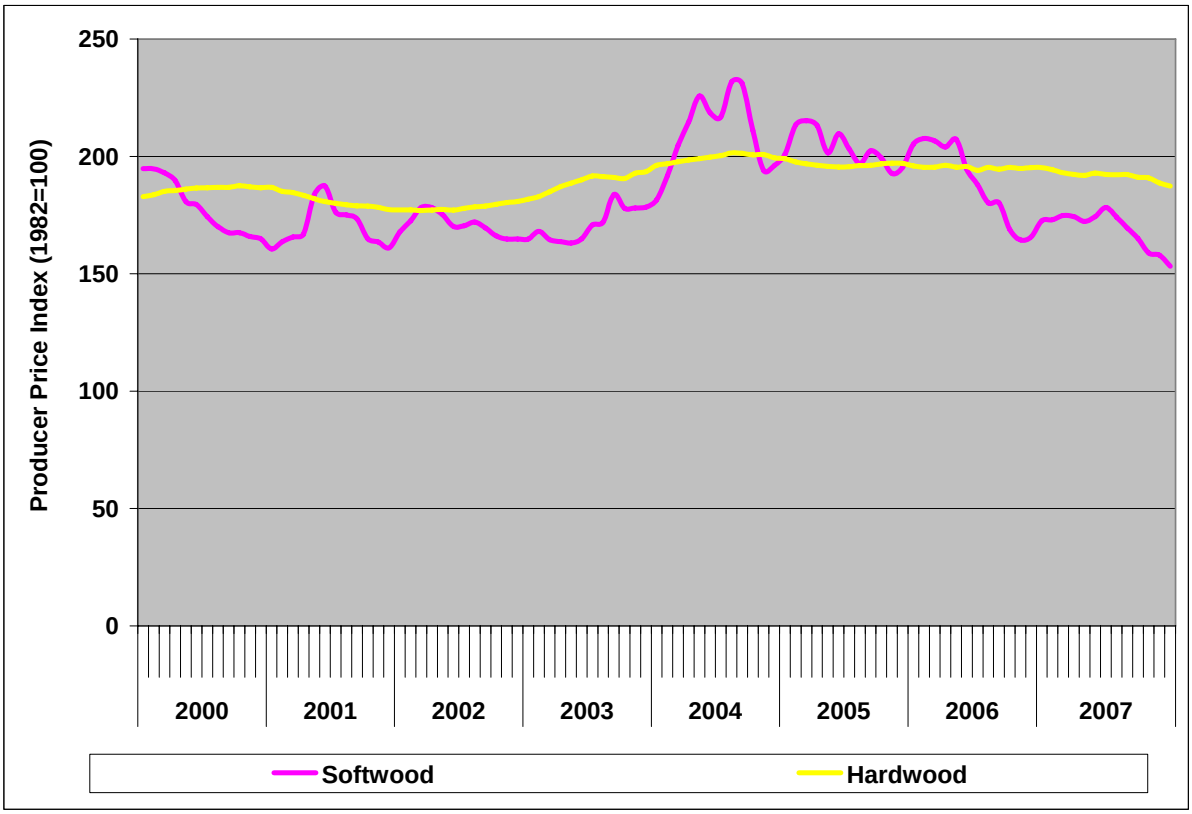
Figure 41. US Hardwood Lumber End Uses, 1998-2006.



SOURCE: [31]

Price trends for the two lumber sectors reflect the end use demands (Figure 42). Softwood prices tend to be more volatile, responding to the housing market swings. As the chart shows, softwood prices peaked during the 2004-2006 period when housing starts were high, and have fallen off dramatically since then. Hardwood prices are somewhat correlated, as they are tied to the fortunes of the general; economy, of which housing is a large part.

Figure 42. Softwood and Hardwood Lumber Price Trends, 2000-2007.



SOURCE: [32]

3.3.4 Outlook

The outlook for softwood lumber is directly dependent on the outlook for housing. Most analysts expect the housing market not to recover until 2009-2010, but the long term prospect is for steady growth [30]. The industry in Michigan is essentially tied to the fate of the three large mills, the largest of which is owned by a major forest products corporation that has been restructuring over the last several years.

The prospects for the Michigan hardwood lumber industry depend not only on the larger economic trends for hardwood in general, but more particularly on the demand for hard maple and red oak. Lower quality species and low grade lumber will generally find outlets, but at prices and volumes that aren't enough to support a healthy industry. The industry needs robust markets for its higher quality species that go into cabinets, flooring, furniture and fixtures. The demands for these species are dictated by designer trends, which have been down on red oak for some time, and have recently been turning negative on hard maple. These negatives are the target of industry marketing efforts such as The New Oak Partnership, an alliance of companies aimed to promote oak to the designers and specifiers.

In addition to the designer issues, the higher quality end uses have been subject to growing import pressures. However, the weak US dollar may help to mitigate import growth and at the same time stimulate hardwood lumber exports.

3.4 Oriented Strand Board

Oriented strand board (OSB) is a structural panel made from wood strands, flakes or wafers bonded with exterior-grade adhesives under high heat and pressure. It is widely used in residential construction and its use is growing in the commercial construction industry. Traditional applications include sub-flooring, underlayment, roof sheathing, wall sheathing and exterior siding, but OSB is increasingly used in engineered products such as I-beams, floor trusses, and structural foam core panels.

3.4.1 Industry Overview

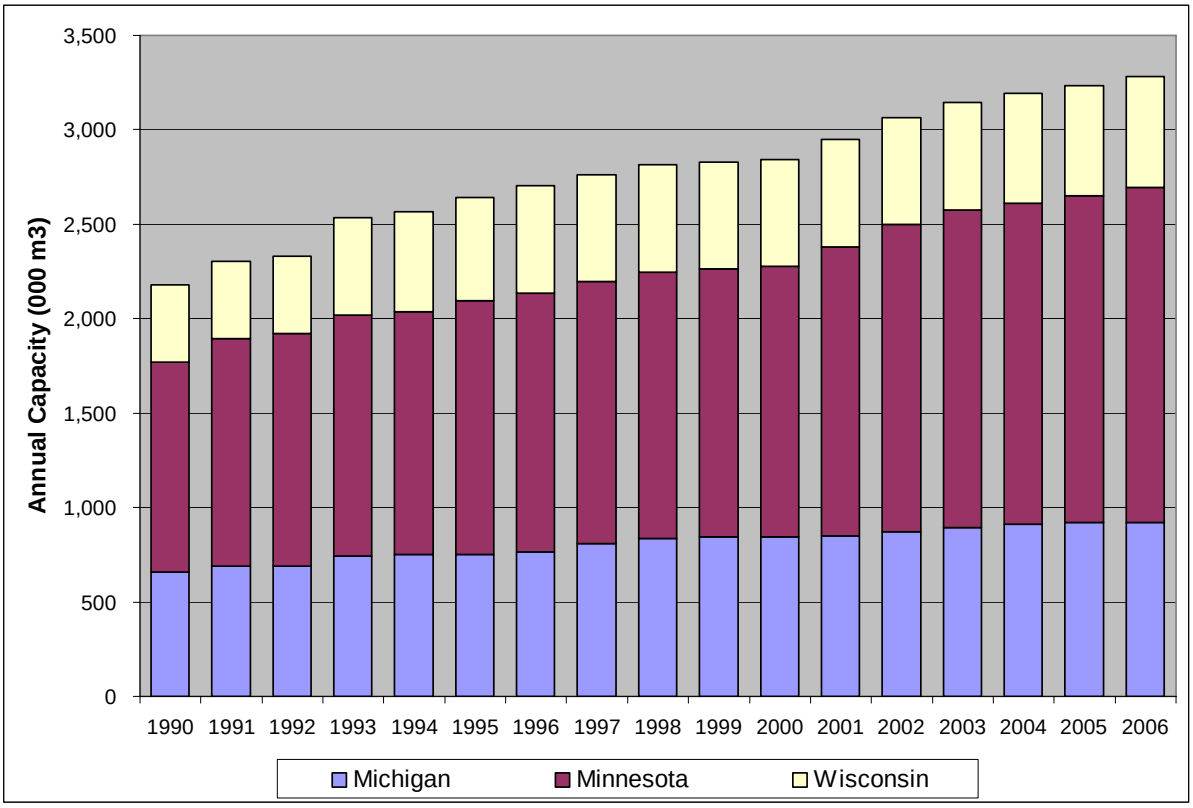
The OSB industry evolved from waferboard in the 1970's and early 1980's. It has been primarily a North American industry; of the approximate 80 OSB mills worldwide, about 80% are in the US and Canada [33]. While Canada accounts for about 40% of North American production, about three-fourths of that production is exported to the United States [34]. OSB production is increasing in Europe and South America, limiting the potential for offshore exports from North America.

The surplus aspen resource in the Lake States, and particularly in Minnesota, attracted significant OSB investment in the early to mid-1980's. Capacity in the Lake States has grown at about a 2.5% compound annual rate over the last 15 or so years, but growth is slowing. During that period, Minnesota capacity grew faster than Michigan or Wisconsin, and consequently increased its share of the Lake States capacity (Figure 43). Michigan currently has three OSB plants, one owned by

Weyerhaeuser Corporation in the Lower Peninsula and two owned by Louisiana Pacific Corporation in the Upper Peninsula. Annual OSB capacity at Weyerhaeuser is approximately 450,000 cubic meters, roughly equal to the combined capacity of the two Upper Peninsula mills [35].

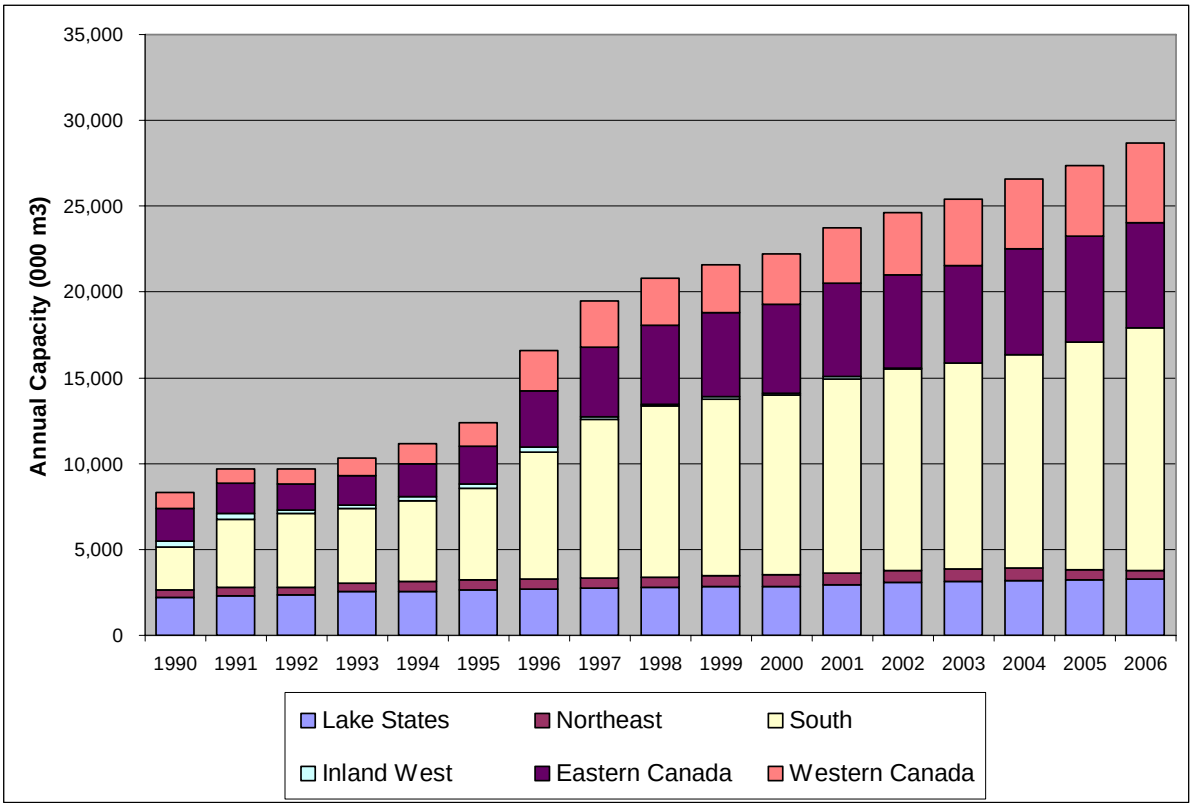
Just as Michigan lost a share of the Lake States OSB capacity, from a North American perspective the Lake States lost ground to the South and to western Canada during the last two decades. In 1990, the Lake States was home to about a quarter of North American OSB capacity; by 2006, that share was down to about 10% (Figure 44).

Figure 43. OSB Capacity in the Lake States, 1990-2006.



SOURCE: []

Figure 44. North American OSB Capacity, 1990-2006.



SOURCE: []

The US South, where OSB is manufactured primarily from southern pine, has clearly become the region of choice for capacity expansion. Southern capacity grew at a compound annual rate of over 11% during 1990-2006. By 2006, the South was the home to nearly half of North American capacity. Southern capacity has expanded since then, with even more plants announced for startup in 2008-09. The new plants, coming on line in the midst of a housing and general economic downturn, are expected to force older plants to be shuttered. Indeed, from late 2006 to the present, production was curtailed temporarily or permanently at several plants in Minnesota and Wisconsin.

The OSB industry is fairly concentrated, with the top 6 firms accounting for nearly 80% of capacity (Table 3). The top two firms are those with mills in Michigan. Industry concentration has increased over the last ten years due to mergers and exit from the industry by some firms.

Table 3. North American OSB Capacity by Firm, 1995-2006 (000 m^3).

Firm	1995	2000	2006
Louisiana Paciic	3,915	6,440	6,505
Weyerhaeuser	1,503	3,553	4,130
Georgia Pacific	1,196	1,845	2,695
Potlatch	1,082	1,115	0
Norbord	815	1,590	3,743
Huber	721	1,250	2,120
Grant	570	1,220	1,280
International Paper	545	955	0
McMillan Bloedel	370	0	0
Ainsworth	350	935	2,925
Forex	305	0	0
Martco	260	300	453
Langboard	215	211	450
Malette	200	0	0
Longlac	160	0	0
Tolko	0	545	1520
Slocan	0	470	0
Canfor	0	0	635
Peace Valley	0	0	620
Voyageur	0	400	0
Willamette	0	350	0
Tembec	0	200	0
Kruger	0	160	170
Footnerb	0	30	810
Jolina Capital	0	0	270
Total	**12,367**	**21,569**	**28,276**
Top 6 Share	**75%**	**74%**	**78%**

SOURCE: []

3.4.2 Factors of Production

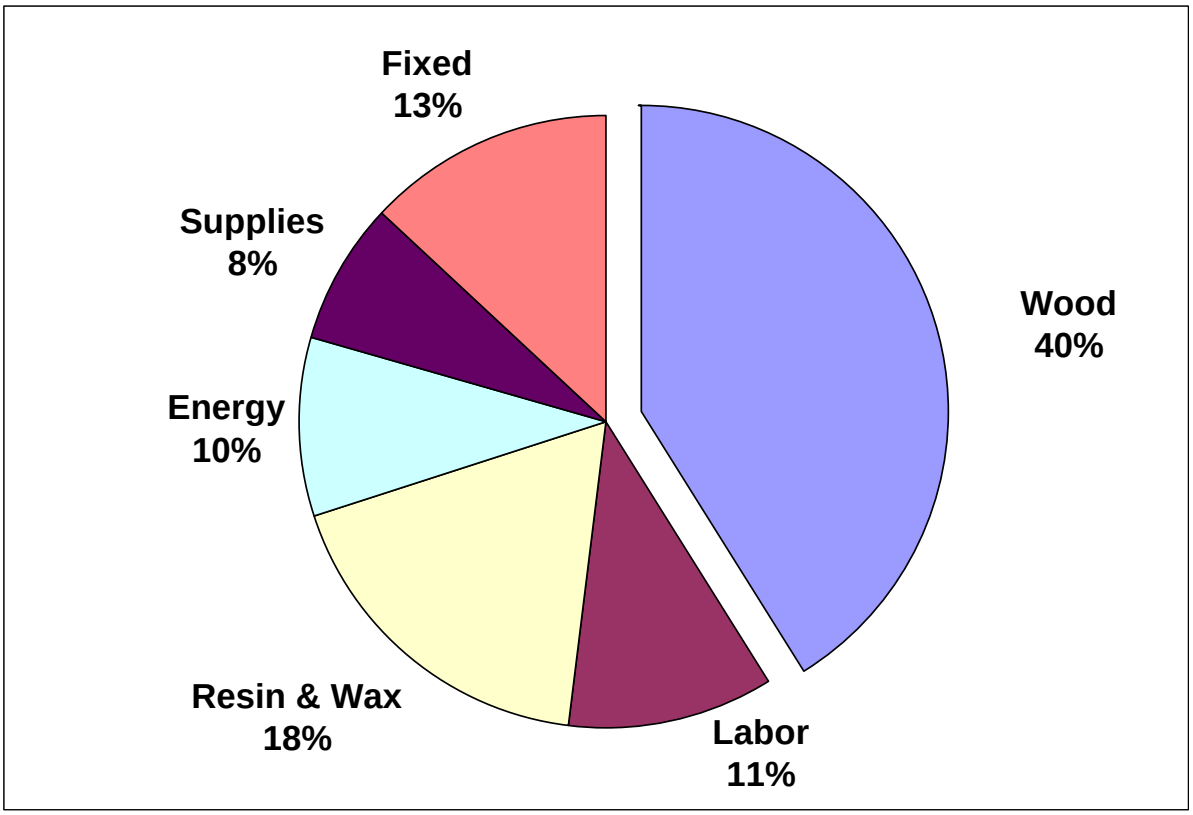
As shown in Figure 45, wood represents the largest cost in OSB manufacture. A standard conversion ratio is 1.7 m^3 of wood input per m^3 of board output [36]. In Michigan, all three OSB mills use predominantly aspen, in total approximately 650,000 cords per year, about half of the state's annual aspen harvest.

The other principal factors of production include:

- Resin and wax. Although these are applied in concentrations of about 5% of the oven-dried weight of wood, they account for nearly 20% of the cost. Resin costs jumped significantly in 2003 and have remained high.

- Energy. The OSB process generates significant volumes of bark and wood residues, which are used as a source of energy for heating and drying, either by direct combustion or by conversion to synthetic gas. Electricity and liquid fuels are purchased to power machinery and fuel vehicles.
- Labor. The typical OSB plant employs 125-150 people, but the labor/output rate has been declining due to annual productivity gains of about 2.3% [35]. In 2006, the average annual output per employee rose to 3 million square feet, which explains why the cost of labor per unit of output is relatively low.
- Fixed costs. These consist of depreciation and general administrative costs. When market conditions are favorable, OSB plants will generally operate 24 hours a day and 7 days a week. Therefore, despite the high capital cost of an OSB plant (in excess of $100 million), fixed costs per unit of output are a relatively low percent of total cost.
- Other supplies account for 8% of total costs.

Figure 45. Average Cost Structure, North Central OSB Manufacturing, 2006.

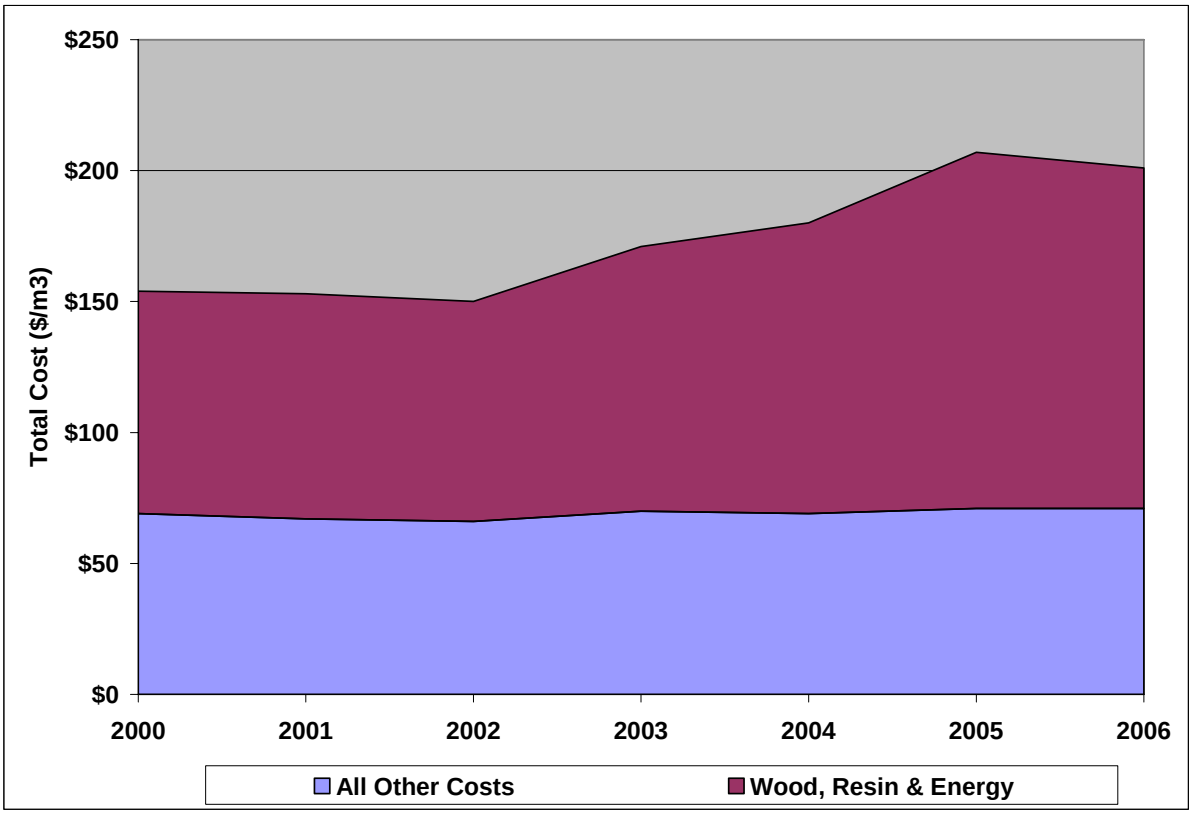


SOURCE: []

OSB production costs rose significantly since 2002 (Figure 46), driven by increases in the cost of wood, energy, and resins. Wood costs were particularly explosive in the Lake States, as the OSB plants were running at full capacity to take advantage of record high OSB prices, driven by a booming

housing market, Iraq war needs, and hurricane reconstruction. As that demand subsided from mid-2006 and into 2007, Lake States aspen prices recede back to more “normal” levels.

Figure 46. Cost Trends in North Central OSB Manufacturing, 2000-06.



SOURCE: []

OSB profitability tends to be highly volatile. Plants typically run at close to full capacity on a 7-day 3-shift schedule, so supply is fairly constant. Demand, however, is cyclical due to the nature of the housing industry and subject to surge events, e.g. the hurricanes and wartime needs of 2002-2005. When capacity could not expand fast enough to meet rising demand, prices skyrocketed and OSB profitability soared. During that period, it was reported that OSB producers’ earnings before interest, taxes, depreciation and amortization (EBITDA) represented a margin on sales of about 35%, a payback period of less than three years on a modern mill [37]. As that demand dissipated in 2006-07, plants had to be curtailed or closed to stem the losses. Ironically, some new plants will be coming on line, having been planned and broken ground as profitability was rising.

3.4.3 Markets

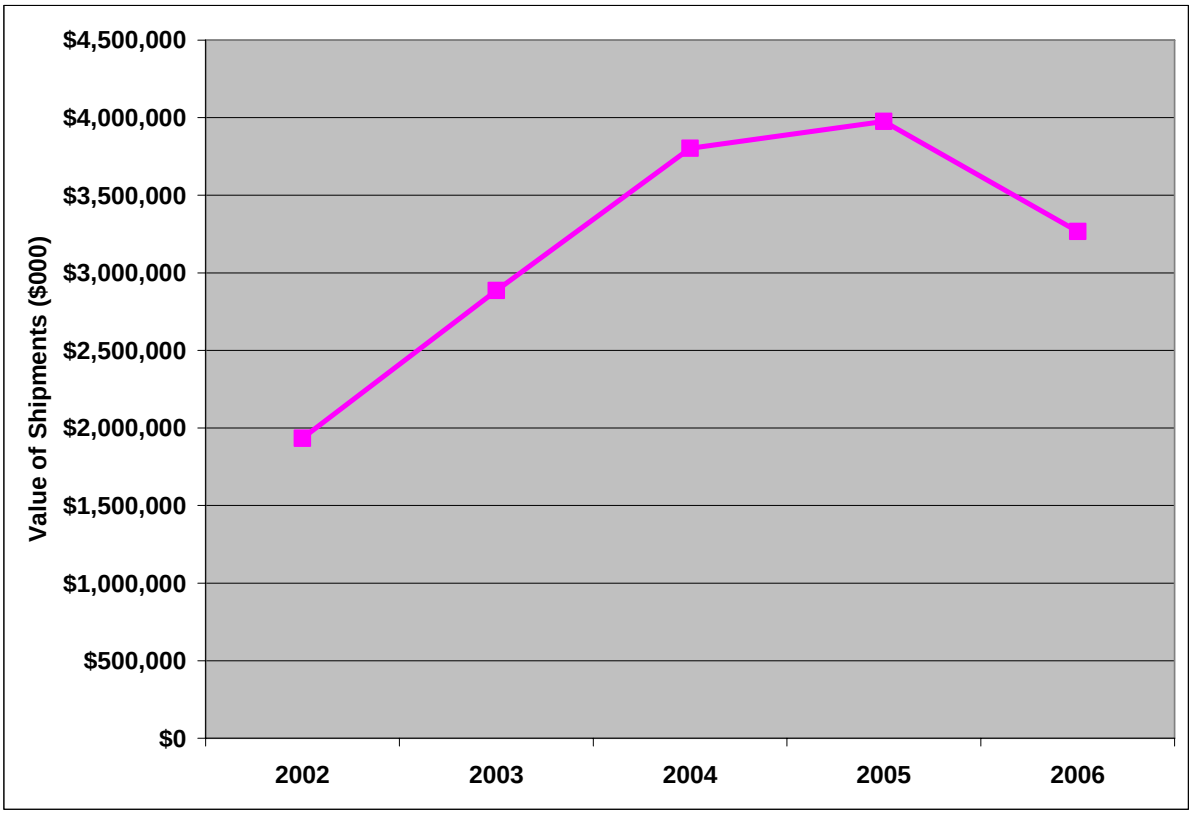
OSB markets are dominated by demand for construction applications, falling into three classes: new residential buildings; residential repair and remodel, and; low-rise non-residential buildings. Together, these three segments account for about two-thirds of OSB demand [35]. The remaining one-third goes to miscellaneous industrial, packaging, and shipping applications.

Being so closely tied to construction, OSB is subject to the same cyclical ups and downs as the construction industry, particularly single family home construction. During the period 2003-05, US housing starts were in the 2 million units range, there were several major hurricanes, OSB capacity utilization rates were about 95%, and OSB prices were about twice their variable production costs. By December 2007, housing starts had fallen to about 1 million and OSB production was down by about 10%. OSB prices in October 2007 were only about 1/3 of the peak price reached in early 2004. Declining prices and production volumes led to a substantial decline in the value of shipments (Figure 47).

Going forward, the key drivers of OSB demand include:

- new residential construction, driven by a growing US population, a trend toward larger homes, and a continuing demand for second homes
- repair/remodeling of the aging existing home inventory
- increasing substitution of OSB for softwood plywood in construction applications
- increasing use in non-residential construction

Figure 47. Value of US Shipments of OSB, 2002-06 ($000).



SOURCE: []

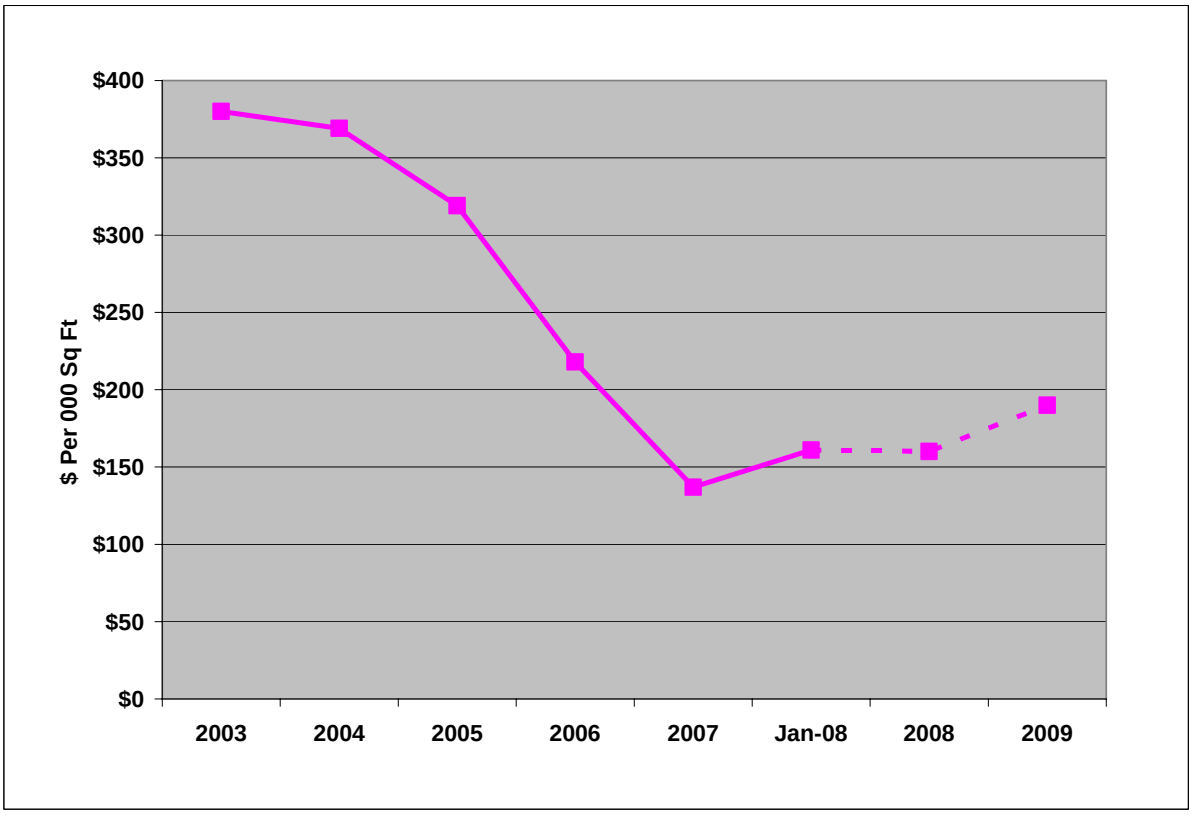
3.4.4 Outlook

Demand for OSB is highly dependent on the strength of the housing markets, which in turn is dependent on general economic conditions, interest rates, and changes in lending standards. There is no consensus on exactly how long the current downturn will last, but most economists believe that housing will not pick up until at least 2009, and possibly into 2010. Freddie Mac's current forecast for housing starts in 2008 is 1.1 million units, down by more than 50% from 2005's peak of 2.1 million units [38]. The forecast for 2009 is 1.3 million units, about equal to the 2007 level.

OSB demand might benefit from reduced demand for softwood plywood, OSB's principal substitute but a higher cost material whose manufacture has been in decline. This is in fact the rationale for one analyst's projection of slightly rising prices in the face of a continued weak housing market in 2008-09 (Figure 48).

On the supply side, excess capacity will continue to be a problem, as about 5.75 million to 7.6 million m3 of new OSB capacity in the South and in Canada was expected to come on line during 2006-09 [35]. Supply/demand conditions suggest that to make room for this new capacity, some existing capacity be forced to retire. Unfortunately, the Lake States OSB mills, including the three Michigan plants, are some of the oldest in the country.

Figure 48. Price Trend and Projection for OSB Prices.



SOURCE: [19]

One of the strategies companies can adapt to deal with the excess capacity issue is to convert from manufacture of commodity sheathing to more specialty products such as Oriented Strand Lumber (OSL), or specialized construction components such as rim boards, flooring panels, I-joists, stair systems, and siding products. While this strategy essentially expands the market for OSB by taking market share from other products such as softwood lumber, it is still dependent on the housing market.

Expansion into export markets is unfortunately not a very likely possibility. Although OSB is the fastest growing panel in Europe, it is currently being produced in at least ten countries, with plans for

expansion in eastern Europe and Russia [39]. Indeed, in the arena of international trade, the North American strategy will more likely be to try to protect existing domestic market share, as new capacity in South America, Australia, and other eucalyptus forest areas seeks to export to North America, Asia and Europe.

3.5 Other Wood Products

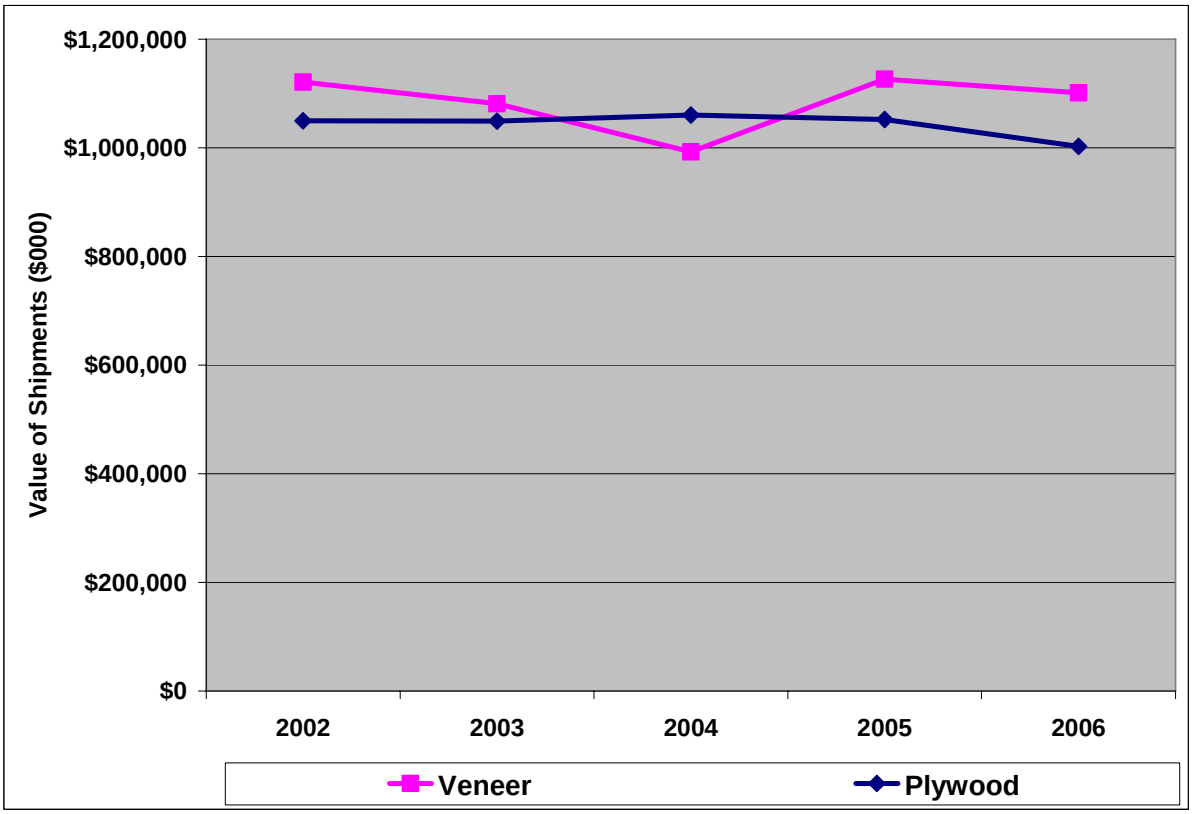
Other wood products include hardwood plywood and veneer, reconstituted wood products, structural engineered wood products, and specialty hardwood products.

3.5.1 Hardwood Plywood and Veneer

Hardwood plywood products include panels constructed with core material made from: veneer (softwood or hardwood), lumber, medium density fiberboard, particleboard, other composite panels, or any combination of these core materials.

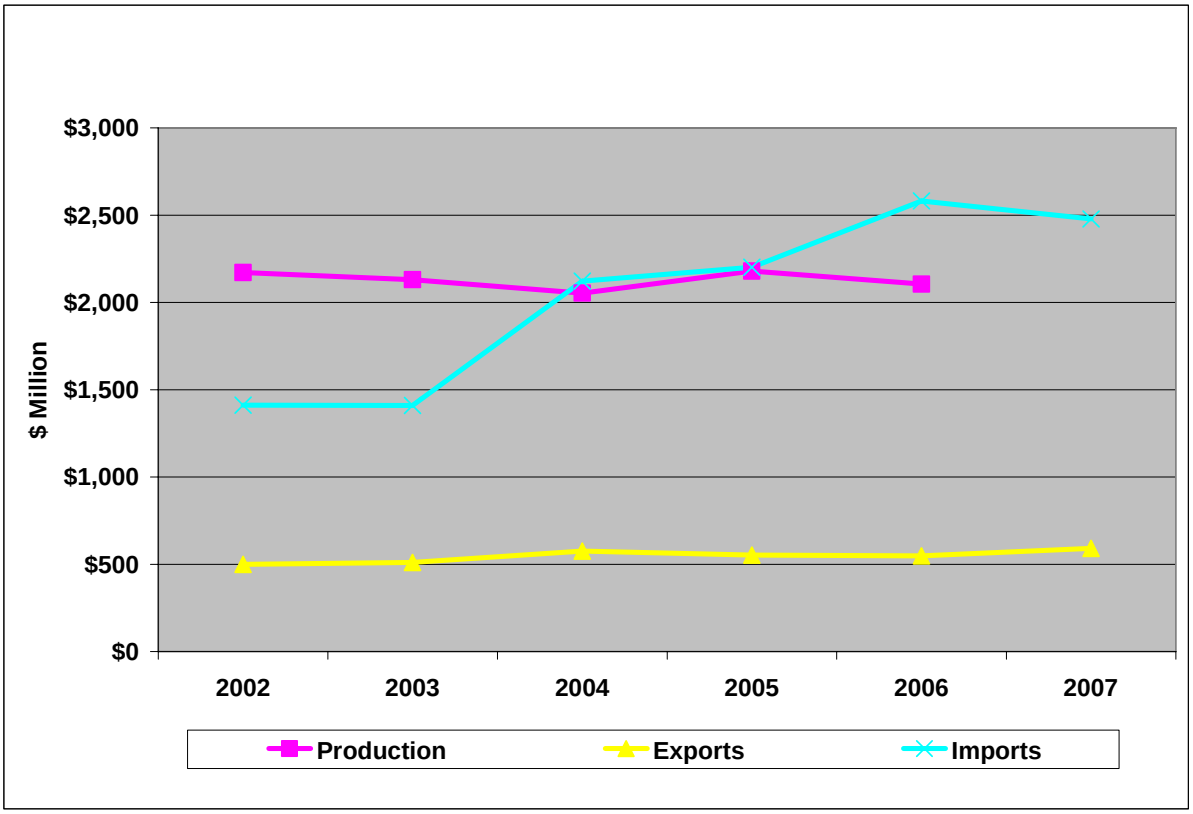
Production of hardwood plywood and veneer has been relatively stable over the last few years (Figure 49), but has been overcome by the level of imports, primarily from low cost regions such as China (Figure 50). Exports have been stable, and represent about one-quarter of production.

Figure 49. Value of Shipments of Hardwood Plywood and Veneer, 2002-06.



SOURCE: [4]

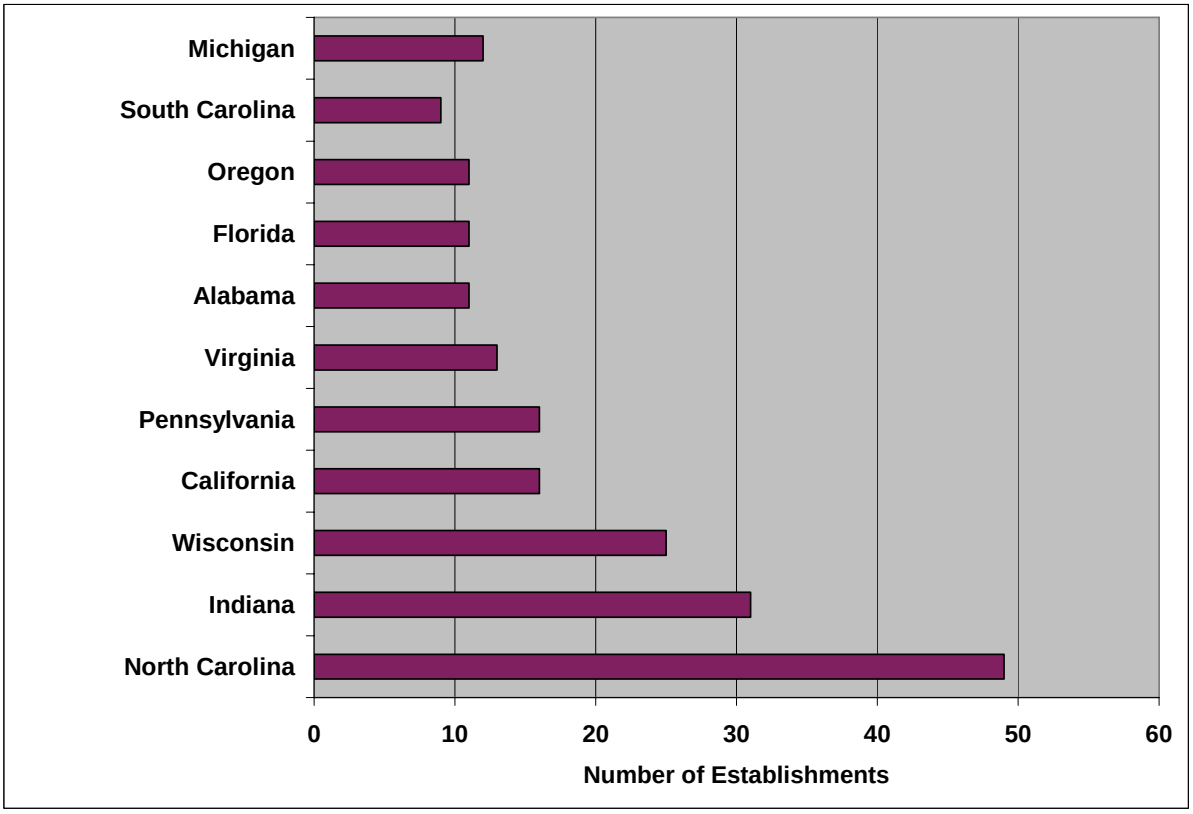
Figure 50. Production (Value of Shipments), Imports and Exports of Hardwood Plywood and Veneer, 2002-06.



SOURCE: [4] and [42]

Michigan is the seventh largest state in hardwood plywood and veneer production (Figure 51). Two neighbors, Wisconsin and Indiana, are larger so there is significant competition for hardwood veneer logs in the region.

Figure 51. Number of Hardwood and Veneer Establishments by State, 2005.



SOURCE: [40]

Hardwood plywood and veneer are largely used by the furniture and cabinet industries, and as such demand is subject to supply/demand conditions in those industries.

3.5.2 Reconstituted Wood Products

There are several types of reconstituted panel products:

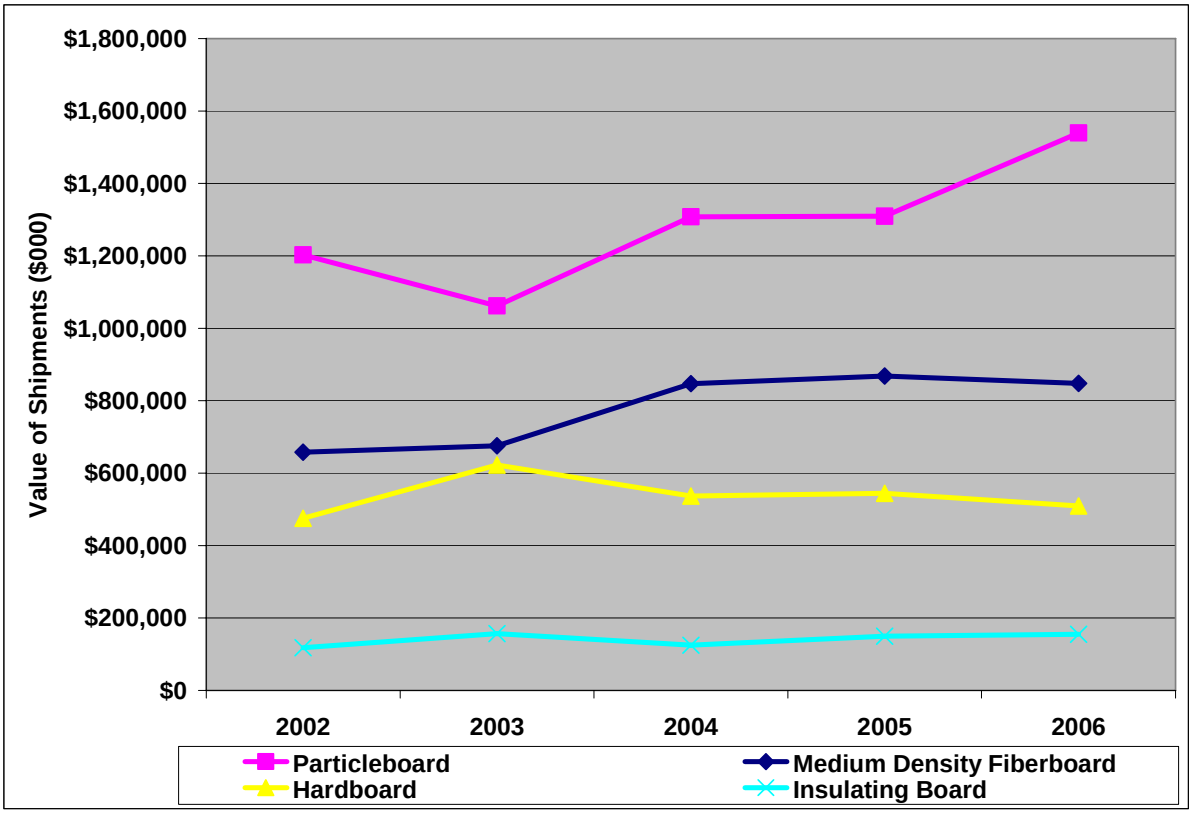
- Particleboard is consists of wood particles bonded together with a synthetic resin or binder under heat and pressure. Particle geometry, resin levels, board density and manufacturing processes may be modified to produce products suitable for specific end uses. Particleboard is commonly used in countertops, door cores, floor underlayment, kitchen cabinets, manufactured homes, shelving, and office and household furniture.
- Medium density fiberboard (MDF) is produced by combining cellulosic fibers with a synthetic resin or other suitable bonding system and formed heat and pressure. The surface of MDF is flat, smooth, uniform, dense and free of knots and grain patterns. MDF is widely used in the manufacturing of furniture, kitchen cabinets, door parts, moldings, millwork and laminate flooring
- Hardboard is manufactured by consolidating wood fibers under heat and pressure. The familiar “brown board” has a uniform thickness, density and appearance and has no

grain. Panels are also available with wood grains and embossed surfaces, paper overlays, plastic laminates and veneers. Hardboard is used in a variety of applications including furniture components, wall paneling, exterior siding and trim, underlayment, interior trim and perforated boards.

- Insulation board is a category that consists of a wide variety of fiberboard products that are used in thermal and acoustical insulation applications. These include applications with decorative qualities such as acoustical ceiling tile.

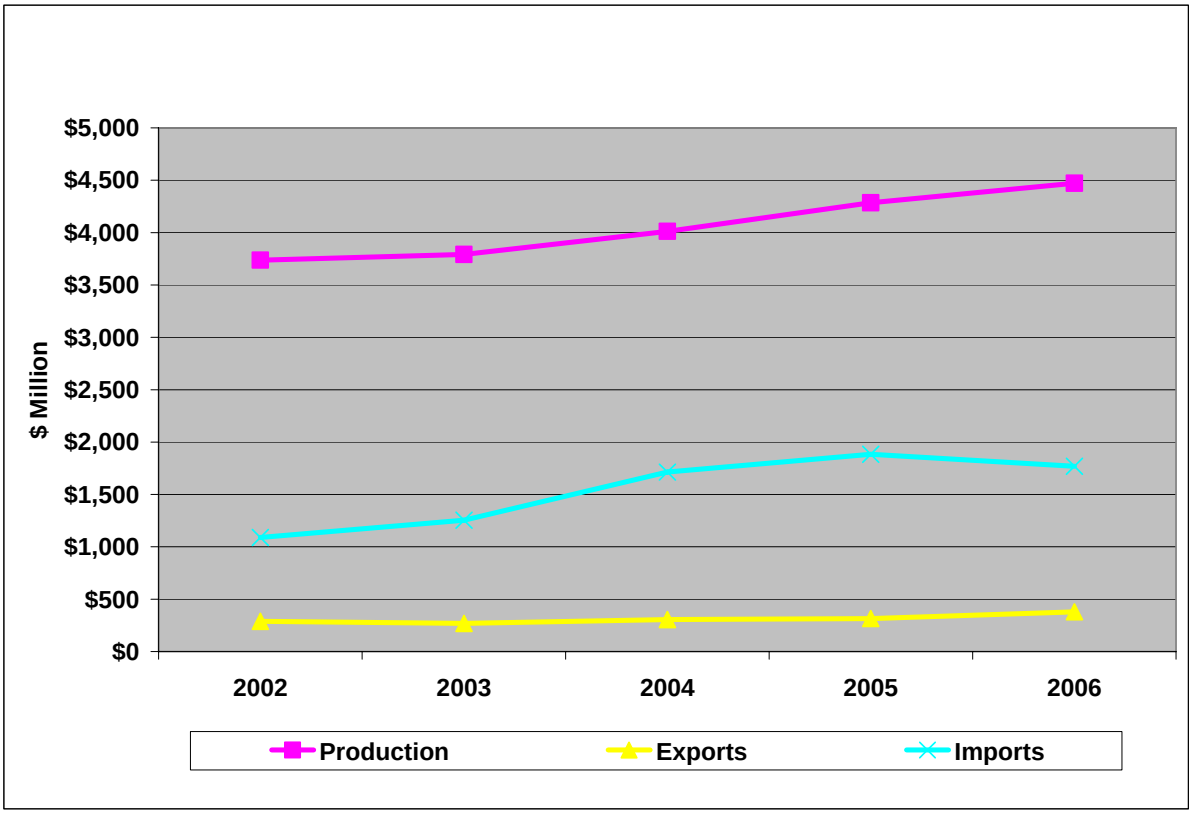
Particleboard and MDF are the leading products in this category, and both experienced significant growth in the last few years (Figure 52). These production increases occurred even in the face of steadily rising imports (Figure 53), principally from Canada.

Figure 52. Value of Shipments of Reconstituted Board, 2002-06.



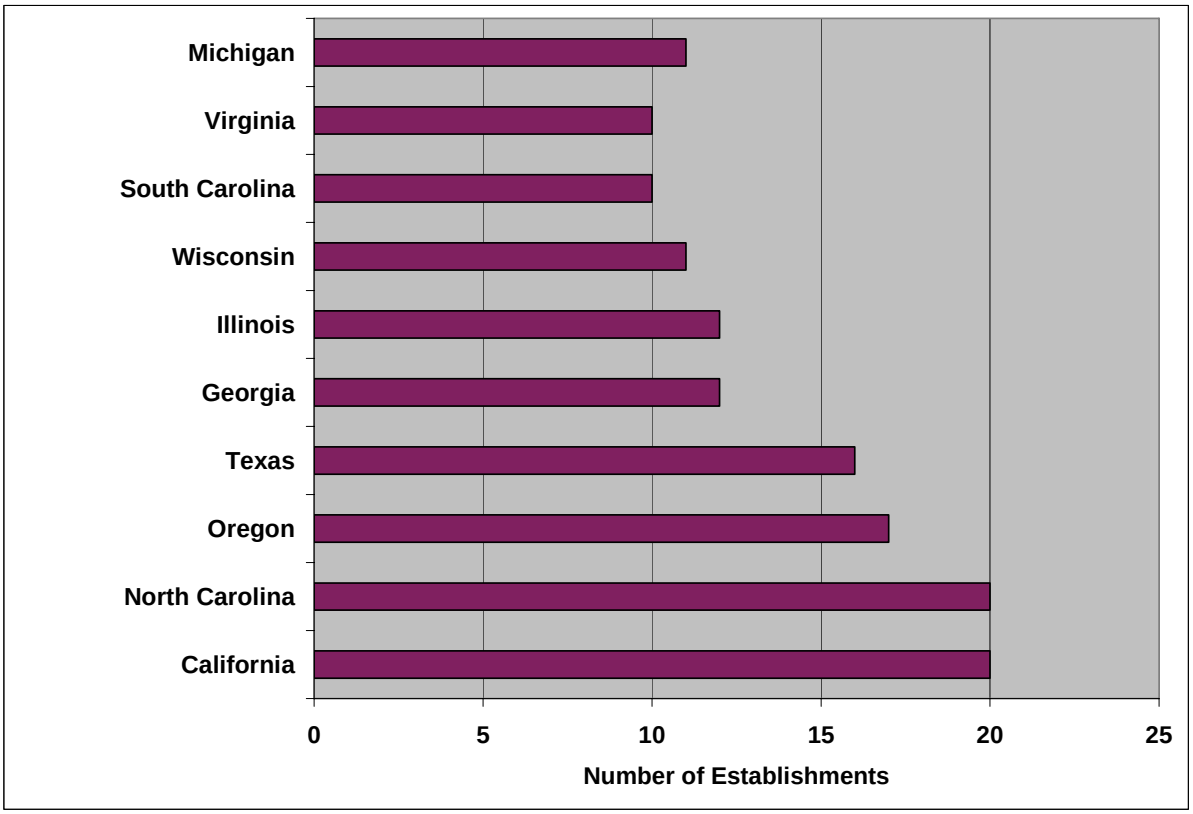
SOURCE: [4]

Figure 53. Production (Value of Shipments), Imports and Exports of Reconstituted Wood Products (except OSB), 2002-06.



SOURCE: [4] and [42]

Figure 54. Number of Reconstituted Wood (including OSB) Establishments by State, 2005.



SOURCE: [40]

Because reconstituted wood manufacturers are dependent on other forest products industries (e.g. sawmills) for the wood residues that represent their raw materials, when the general forest products economy is down, raw materials for reconstituted products can become scarce, raising costs even in the face of lower demand for the final product.

3.5.3 Structural Engineered Wood Products

Structural engineered wood products (SEWP) are building materials or components that are designed to have structural performance characteristics that surpass traditional solid wood products such as lumber and timber beams. SEWP include the following categories:

- Glulam is a stress-rated product that consists of wood laminations, or "lams," that are bonded together with waterproof adhesives. Glulam components can be a variety of species, and individual "lams" are typically two inches or less in thickness. It can be shaped into forms ranging from straight beams to complex curved members, and is used in a wide variety of residential and nonresidential building construction applications.

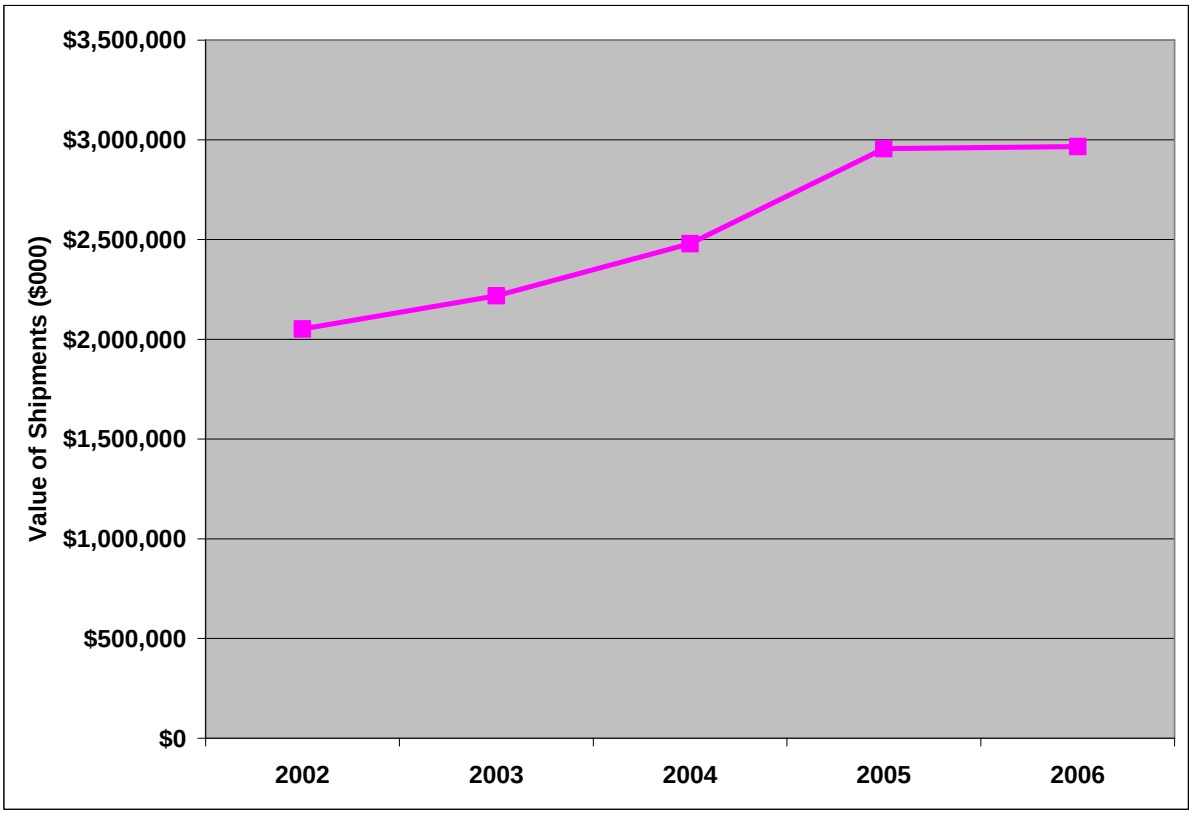
Some of the largest wood structures in the world have been framed using glulam components.

- Structural composite lumber, which includes laminated veneer lumber (LVL), parallel strand lumber (PSL) and oriented strand lumber (OSL), is manufactured by layering dried and graded wood veneers or flakes with waterproof adhesive into blocks of material known as billets. Structural composite lumber is available in various thicknesses and widths. LVL and OSL are typically used in beam and header applications, while PSL can substitute for lumber in a wide range of applications, including studs for framing or millwork products.
- Wood I-joists are structural, load-carrying engineered wood products designed for long span applications. The I-shape mimics commonly seen steel girders, and is designed to take advantage of the fact that most of a beam's stress is along the top and bottom edges. The flange material for I-joists is typically dimension lumber or LVL while the web material is OSB or plywood. This construction means that I-joists contain 50 percent less wood than a solid wood beam of the same strength. I-joists are most commonly utilized in floor and roof applications.

Production of SWEP increased substantially in the last few years, before leveling off as the housing market softened (Figure 55). SWEP are expected to continue to increase market share in the residential construction industry, as the trend toward factory-built components continues.

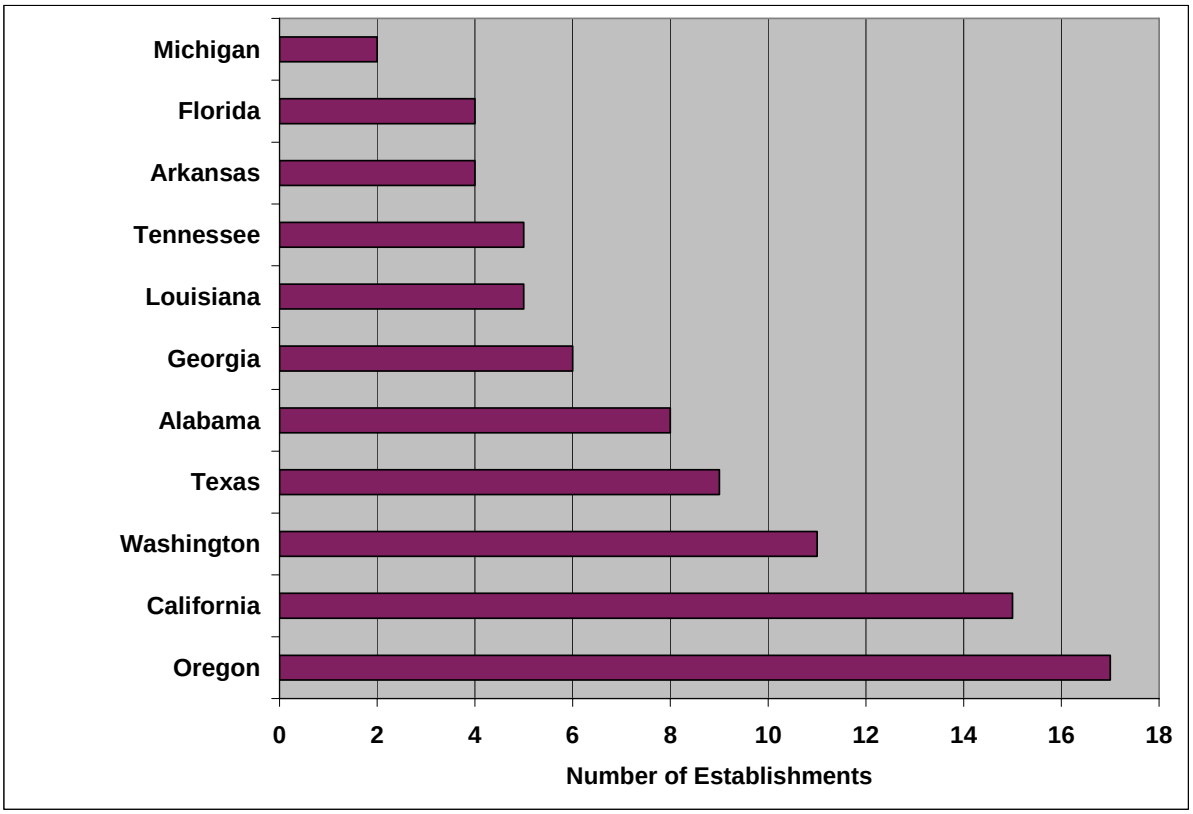
Only two Michigan firms manufacture SWEP, and Michigan lags most large forest industry states in SWEP production (Figure 56). While it would appear that the three west coast states dominate the industry, in fact the southern states when aggregated have a larger share of US establishments and employment. The South and west coast together account for over 60% of the US industry, while the Lake States account for about 5%.

Figure 55. Value of Shipments of Structural Engineered Wood Products, 2002-06.



SOURCE: [4]

Figure 56. Number of Structural Engineered Wood Product Establishments by State, 2005.



SOURCE: [40]

3.5.4 Specialty Hardwood Products

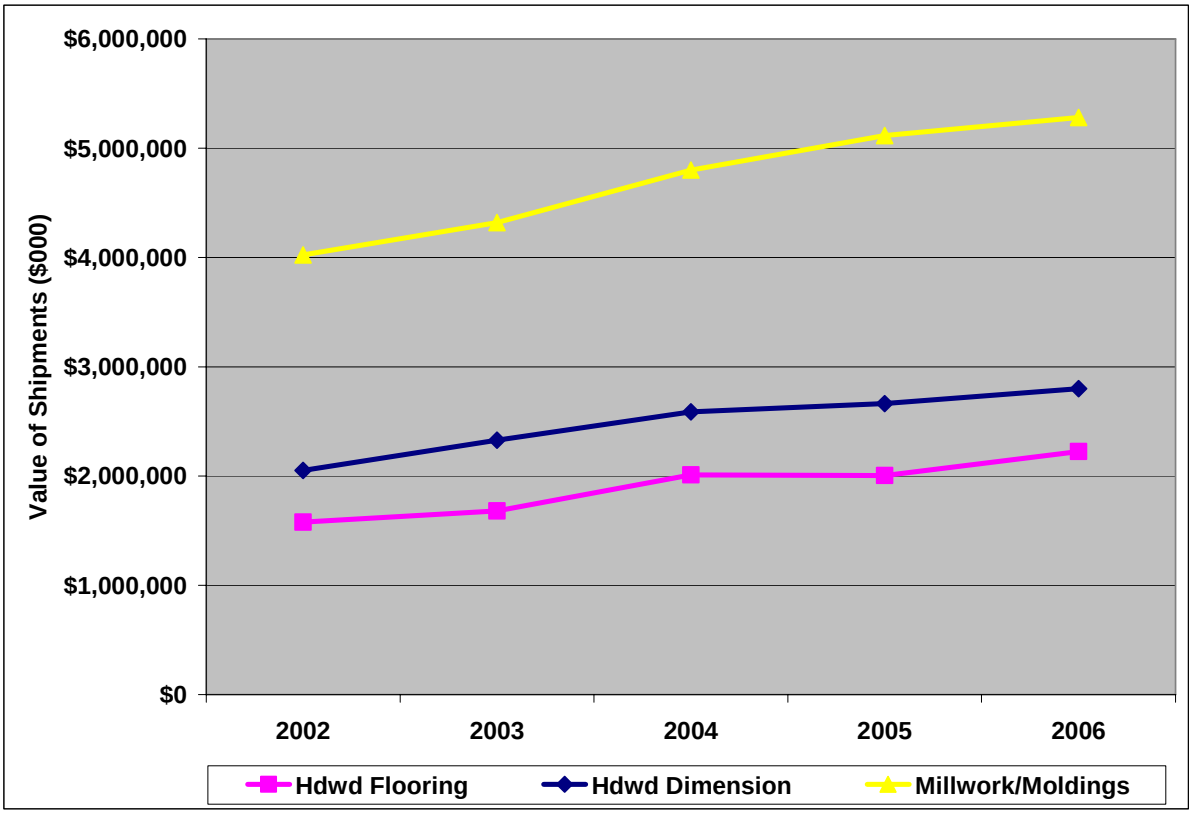
Specialty hardwood products including millwork, flooring and hardwood dimension are products that have been remanufactured from lumber, typically purchased from a sawmill rather than sawn from logs onsite:

- Millwork includes blinds, mantels, panel work, stairway components (balusters, rail, etc.), moldings, interior trim, etc.
- Flooring includes both solid wood and laminated wood flooring strips, panels and tiles.
- Hardwood dimension is a broad category that refers to kiln-dried lumber that has been re-processed for use as a component in furniture, cabinets, millwork, toys, novelties, and other similar woodworking operations. The material is produced in specified thicknesses, widths, and lengths; it may be solid or glued up, including panels, and it may be rough or semi-finished.

The strong housing market led to rising production in all three categories during 2002-2006, particularly in moldings (Figure 57). Imports and exports are relatively small percentages of production (Figure 58).

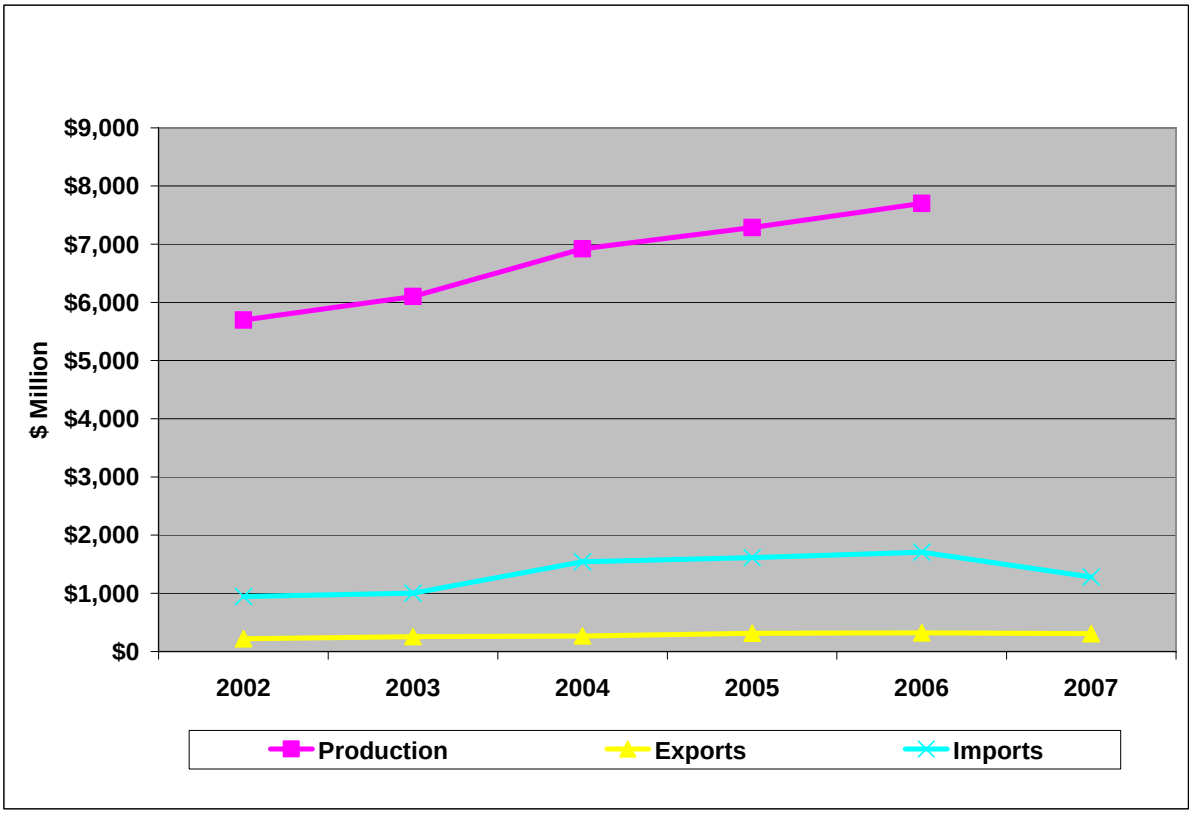
Michigan had 105 specialty hardwood manufacturing establishments in 2005, ranking it 12th among states (Figure 59). While all such businesses are small, Michigan establishments on average had 14 employees, compared to a national average of 24.

Figure 57. Value of Shipments of Hardwood Flooring, Hardwood Dimension, and Millwork/ Moldings, 2002-06.



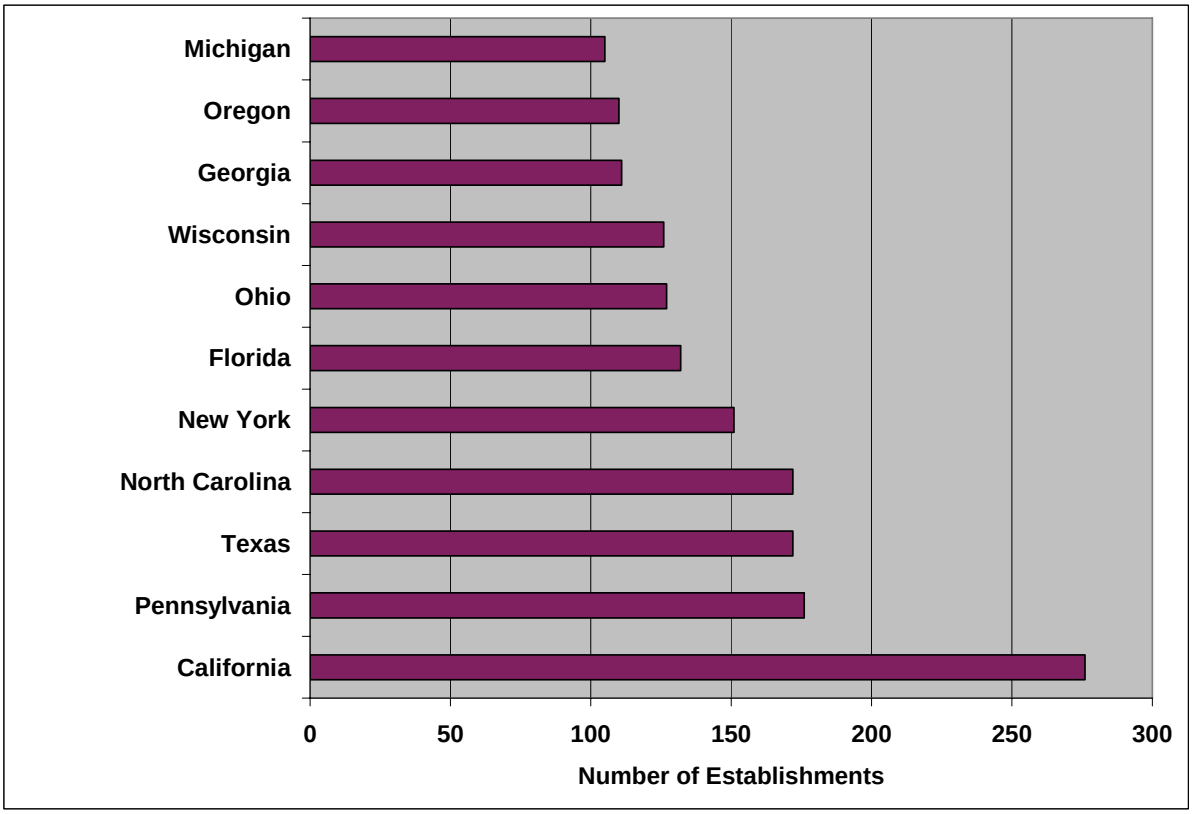
SOURCE: [4]

Figure 58. Production (Value of Shipments), Imports and Exports of Millwork (including flooring), 2002-06.



SOURCE: [4] and [42]

Figure 59. Number of Cut Stock and Other Millwork (including flooring) Establishments by State, 2005.



SOURCE: [40]

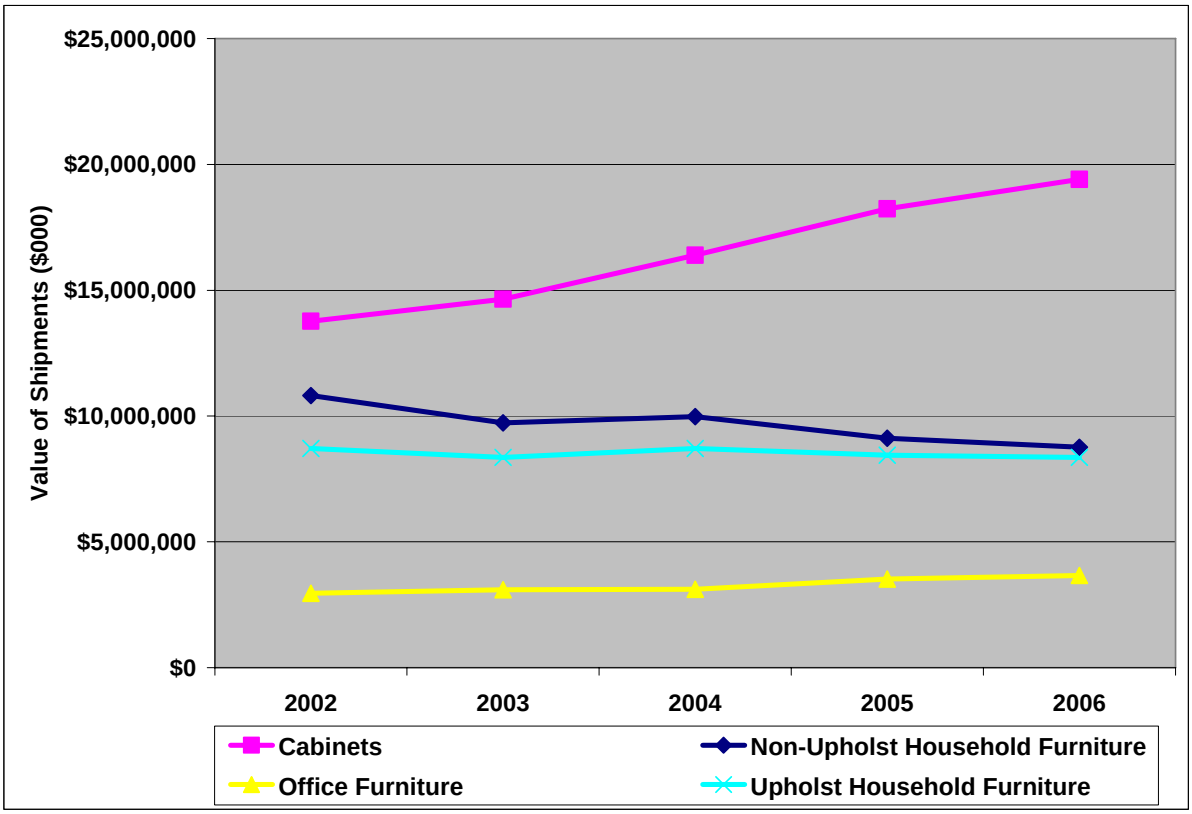
3.6 Wood Furniture and Kitchen Cabinets

The residential furniture and kitchen cabinet industries consume significant volumes of hardwood lumber, particleboard, plywood, veneer and medium density fiberboard.

3.6.1 Industry Overview

The US wood furniture industry consists of firms that manufacture office furniture, non-upholstered household furniture, and upholstered household furniture. Total production in all three categories was about $22 billion in 2006 a decline of 7% since 2002, a period when the general economy and housing were strong. Production of wood kitchen cabinets was nearly a$20 billion industry in 2006, up by more than 40% during that same period (Figure 60).

Figure 60. Value of Shipments of Wood Cabinets and Furniture, 2002-06.

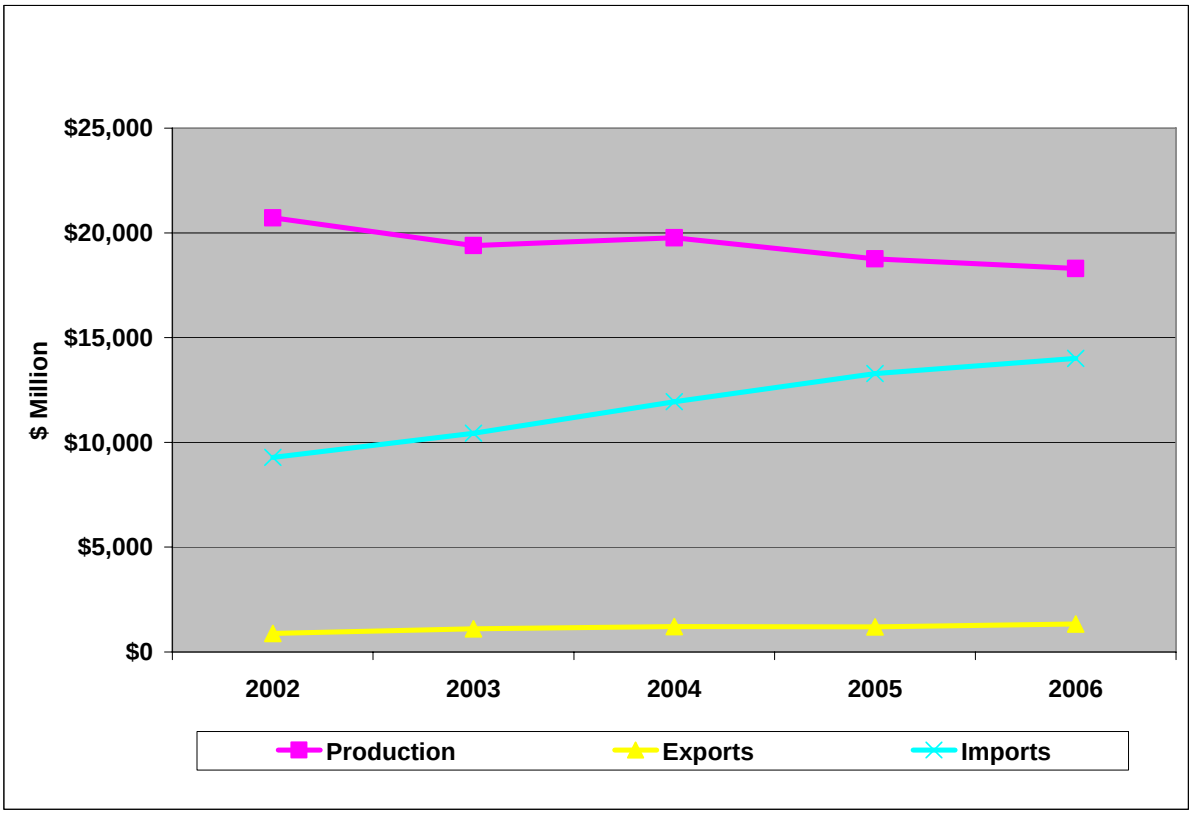


SOURCE: [4]

The disparity in the fortunes of the furniture and cabinet industries can be explained by the rising tide of furniture imports, particularly household furniture (Figure 61), where imports rose by 50% during 2002-06. China accounts for over half of US imports of furniture.

During this period of rapidly escalating imports, the domestic furniture industry has contracted production and remade itself into marketers of Chinese made furniture. In 2007, more than 30 furniture plants in the US and 10 in Canada closed [41]. Although the early Chinese imports were simple and lower quality items, the low labor cost advantage in China has now been bolstered with the establishment of some of the largest and most high-tech furniture manufacturing facilities in the world, due in part to technology transfer from former US manufacturers. China retained its competitive edge despite an anti-dumping action by the US.

Figure 61. Shipments, Imports and Exports of Wood Household Furniture, 2002-06.

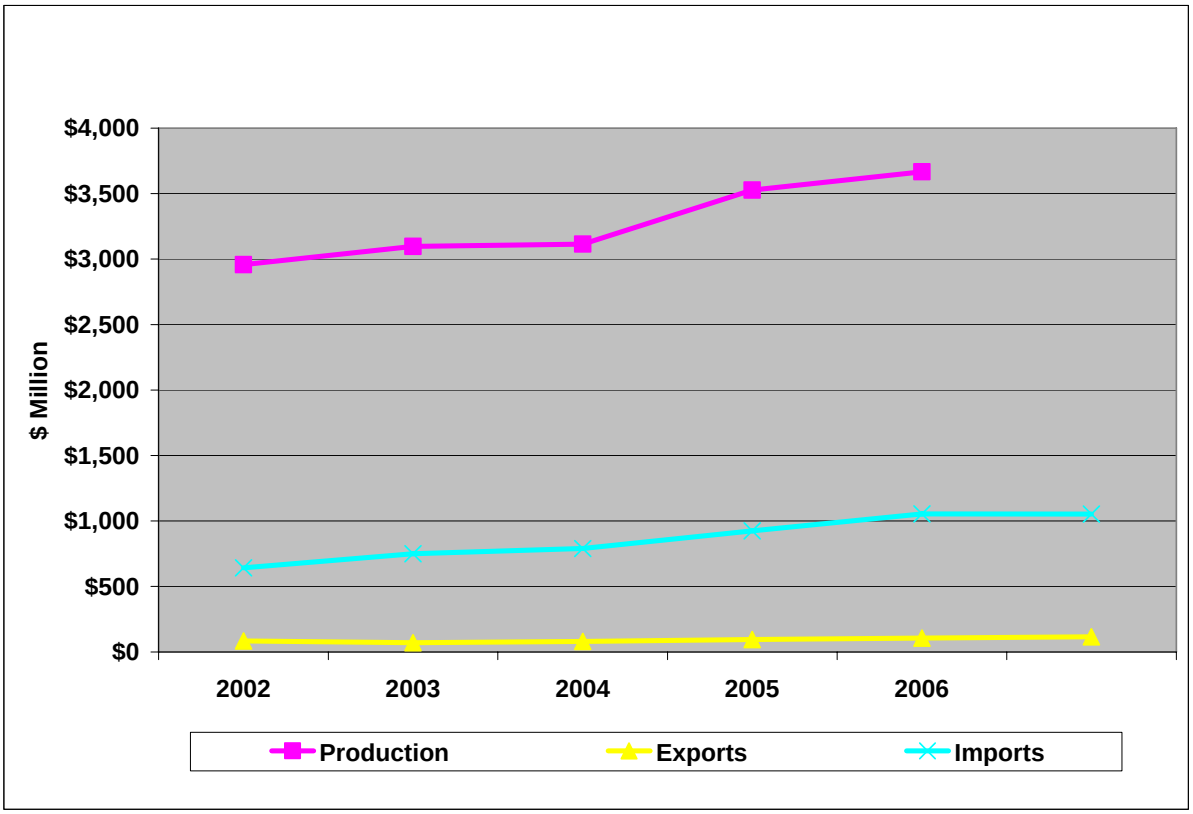


SOURCE: [4] and [42]

Wood office furniture has not fared nearly as badly as household furniture. Imports of wood office furniture represented 29% of domestic production in 2006, up from 22% in 2002 (Figure 62). Canada provides about 45% of all office furniture imported by the US. That percentage was closer to 60% in the late 1990's but imports from other countries, particularly China, have gradually been increasing their share of the US market.

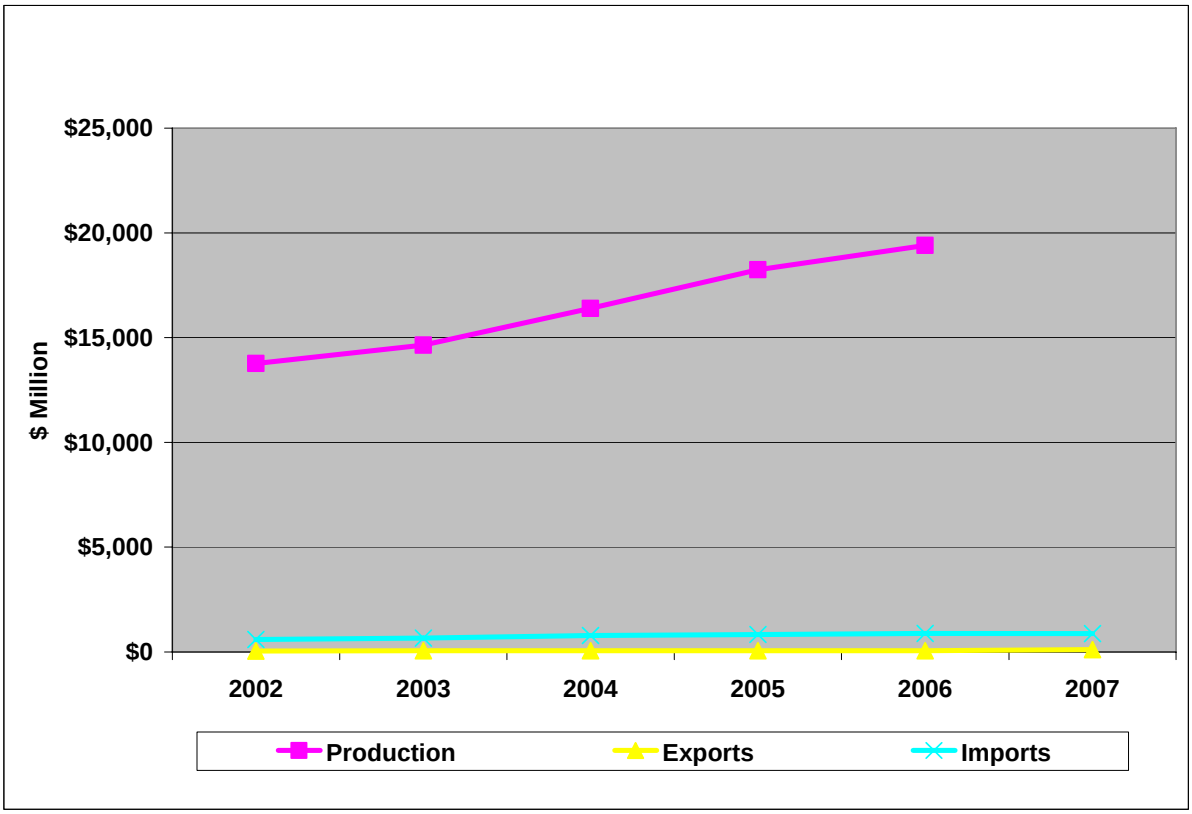
Kitchen cabinets have not faced the import competition seen by the furniture industry. Domestic production of kitchen cabinets increased by about 40% during 2002-06. Imports increased by nearly 50% during that time period, but remained less than 5% of domestic production (Figure 63). A principal barrier to imports has been the domestic industry's ability to provide customized products with short delivery times [43].

Figure 62. Shipments, Imports and Exports of Wood Office Furniture, 2002-06.



SOURCE: [4] and [42]

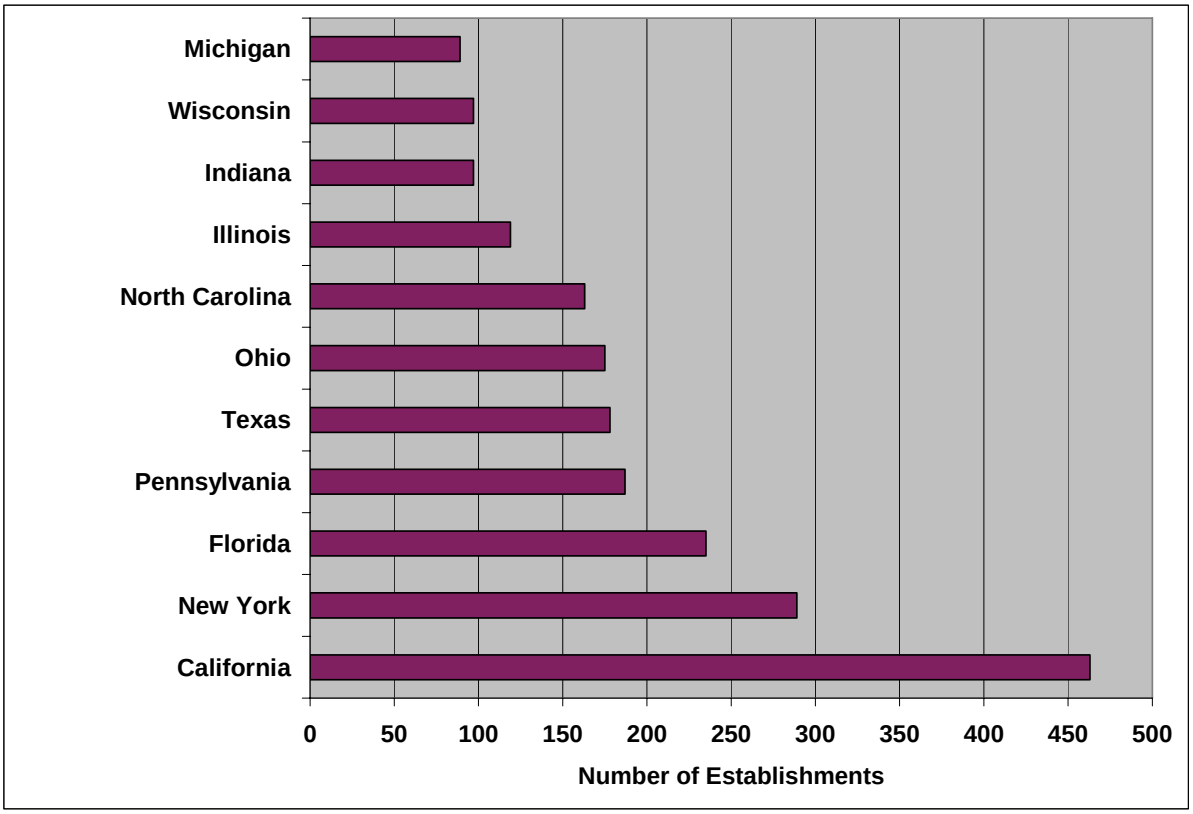
Figure 63. Shipments, Imports and Exports of Wood Kitchen Cabinets, 2002-06.



SOURCE: [4] and [42]

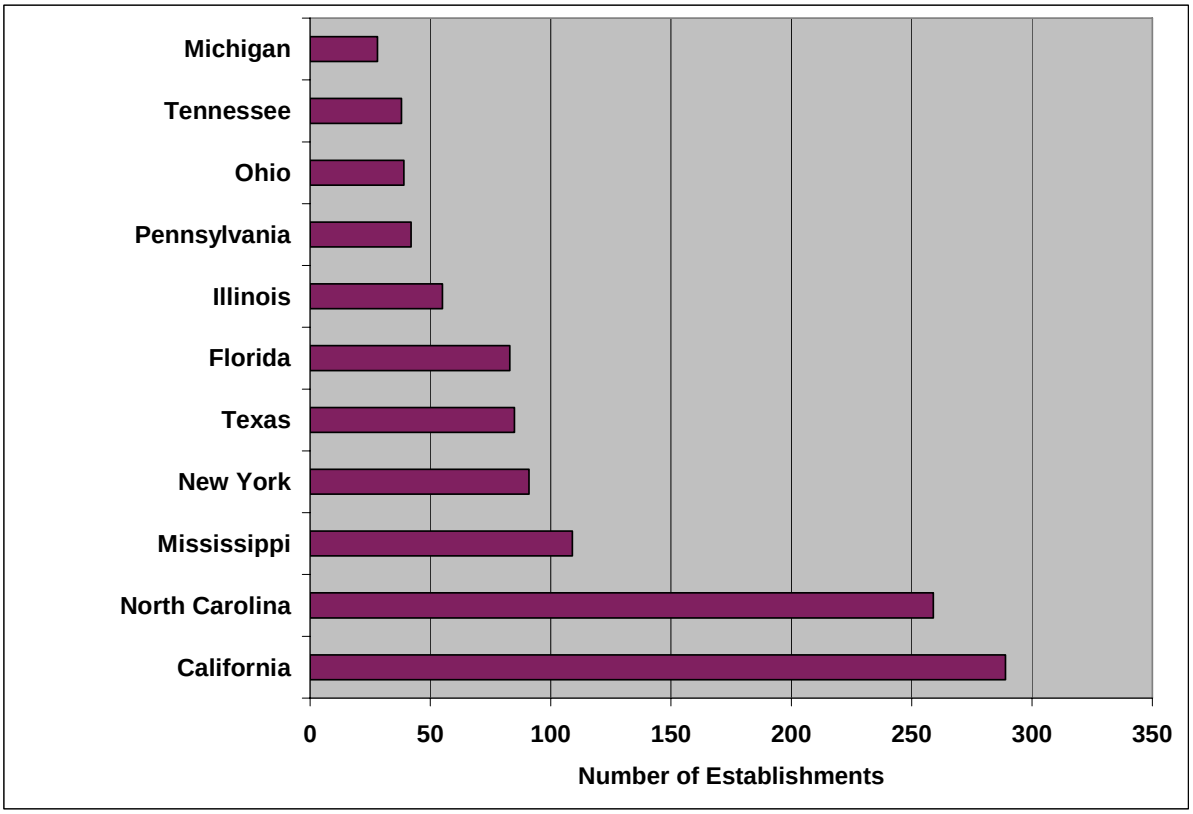
Michigan is not a leading manufacturer of household furniture (Figure 64 and Figure 65), but is the fifth leading state in terms of number of wood office furniture establishments (Figure 66). Michigan's 30 establishments (2005) had an average of 61 employees, well above the national average of 43.

Figure 64. Number of Wood Household Non-Upholstered Furniture Manufacturing Establishments by State, 2005.



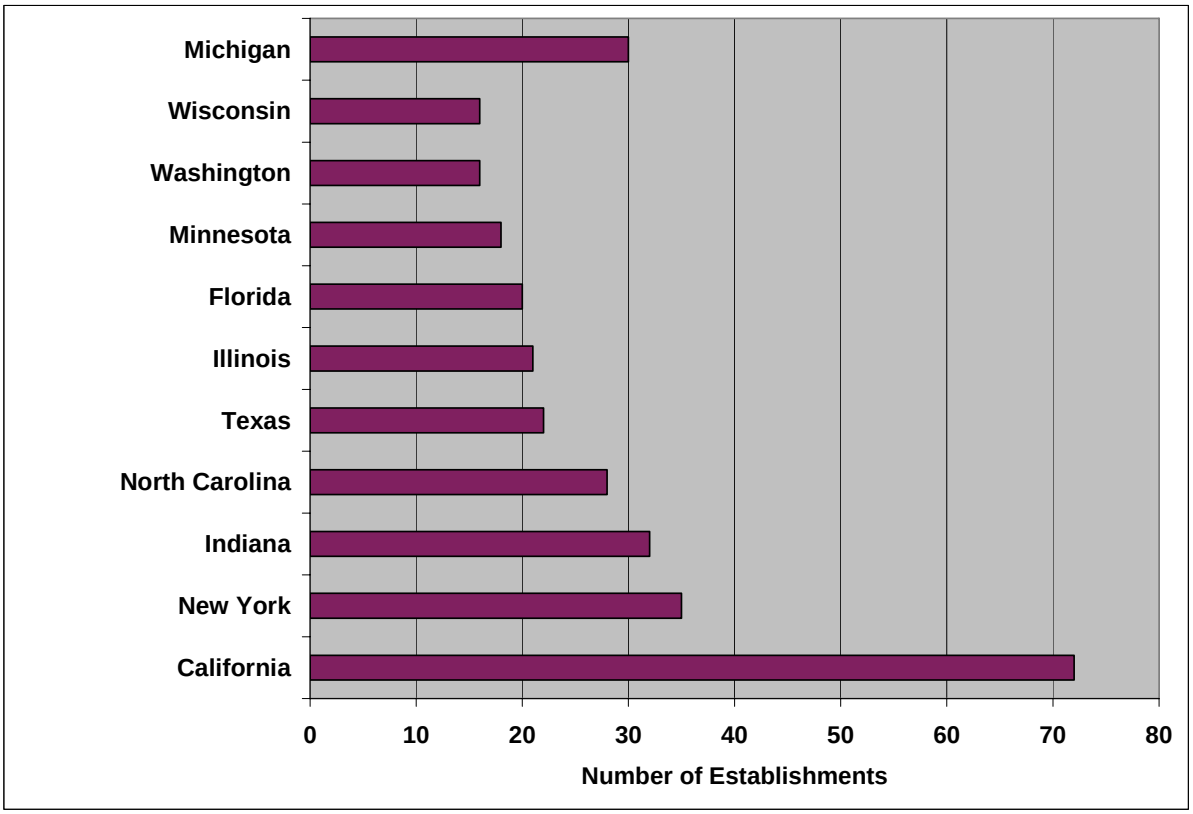
SOURCE: [40]

Figure 65. Number of Wood Household Upholstered Furniture Manufacturing Establishments by State, 2005.



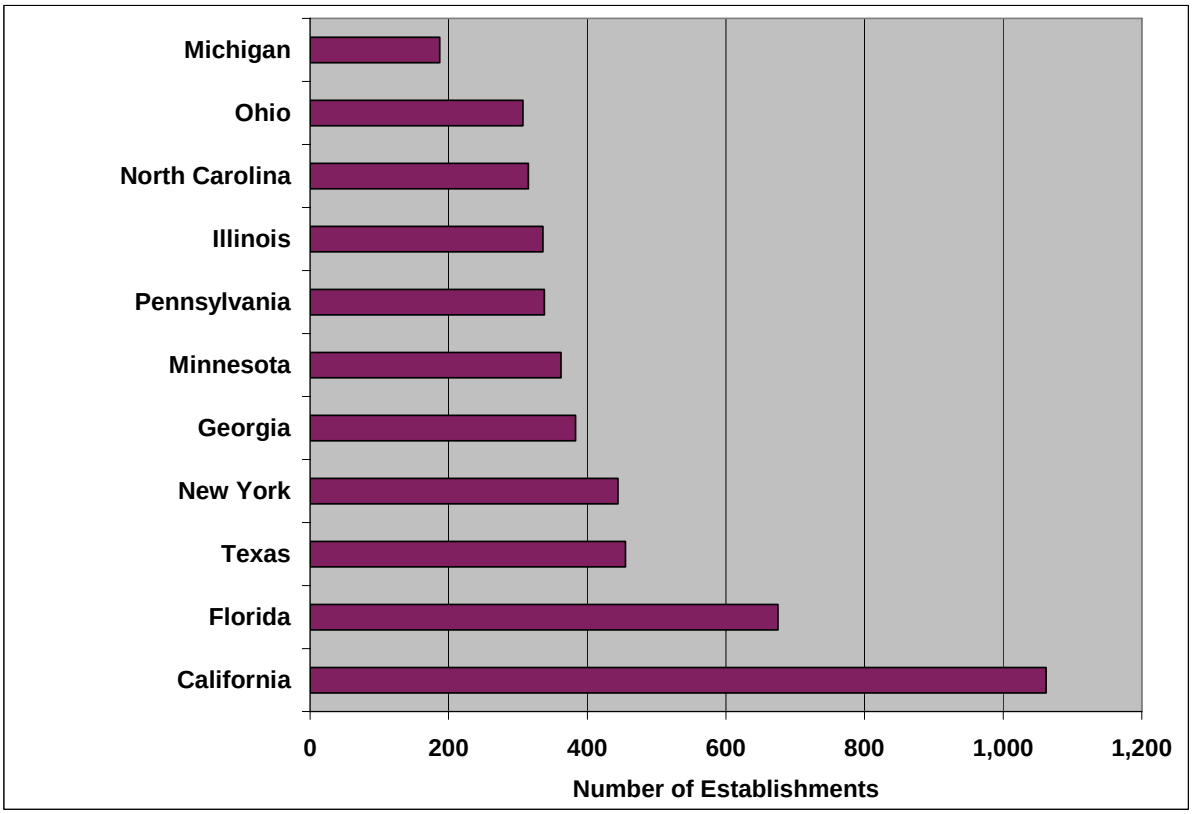
SOURCE: [40]

Figure 66. Number of Wood Office Furniture Manufacturing Establishments by State, 2005.



SOURCE: [40]

Figure 67. Number of Wood Kitchen Cabinet Manufacturing Establishments by State, 2005.

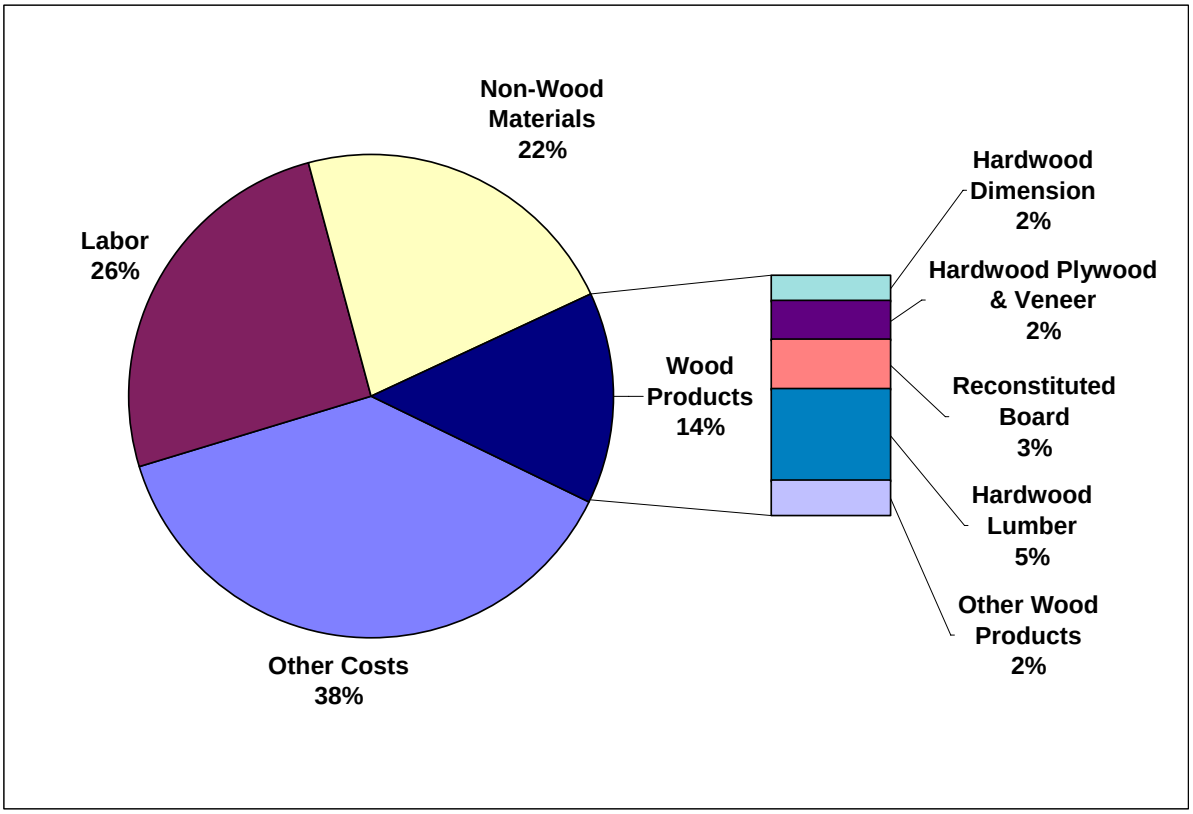


SOURCE: [40]

3.6.2 Factors of Production

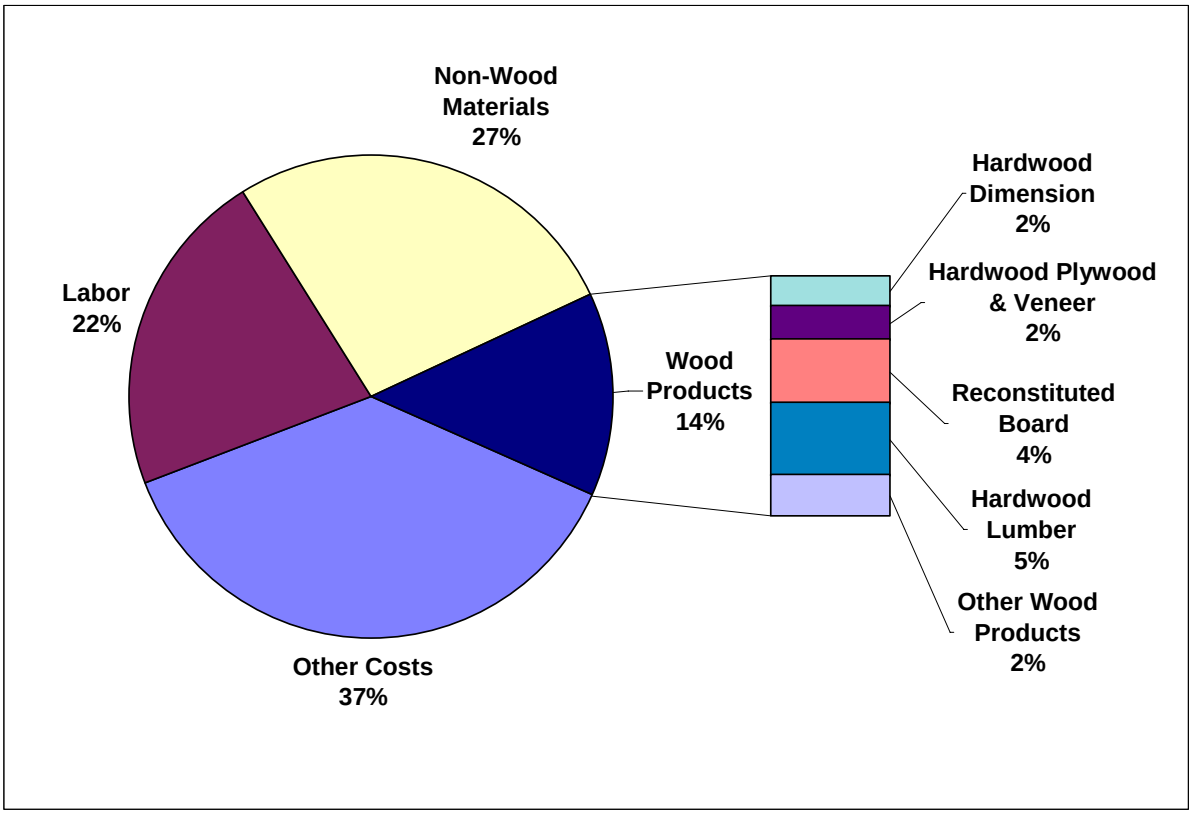
The breakdown of costs of production are remarkably similar for the wood furniture and kitchen cabinet industries (Figure 68 and Figure 69). Wood products represent about 15% of manufacturing costs, with hardwood lumber accounting for about a third of the total. Non-wood materials are a larger component of costs at about 20%, and labor accounts for about one-quarter of total costs.

Figure 68. Estimated Breakdown of Wood Costs in the Manufacture of Wood Kitchen Cabinets.



SOURCE: [44]

Figure 69. Estimated Breakdown of Wood Costs in the Manufacture of Wood Furniture.



SOURCE: [45]

3.6.3 Markets

Household furniture demand is a function of housing activity and general economic conditions. Apparent consumption of wood household furniture increased by about 6% during 2002-06, and industry reports suggest that entire gain was given back in 2007 [41].

Office furniture demand is driven by a nonresidential construction, office vacancy rates and corporate spending, which in turn depend on general economic conditions, but the industry grew 5.5 percent in 2007, although the fourth quarter was the weakest [46].

The cabinet industry is of course tied to housing, but only 30% of cabinets manufactured in the US are for new homes, with the remainder sold for remodeling [43]. Nevertheless, remodeling activity normally moves in tandem with housing starts, which may explain why industry sources think cabinet production dropped by 20%-30% in 2007 [47].

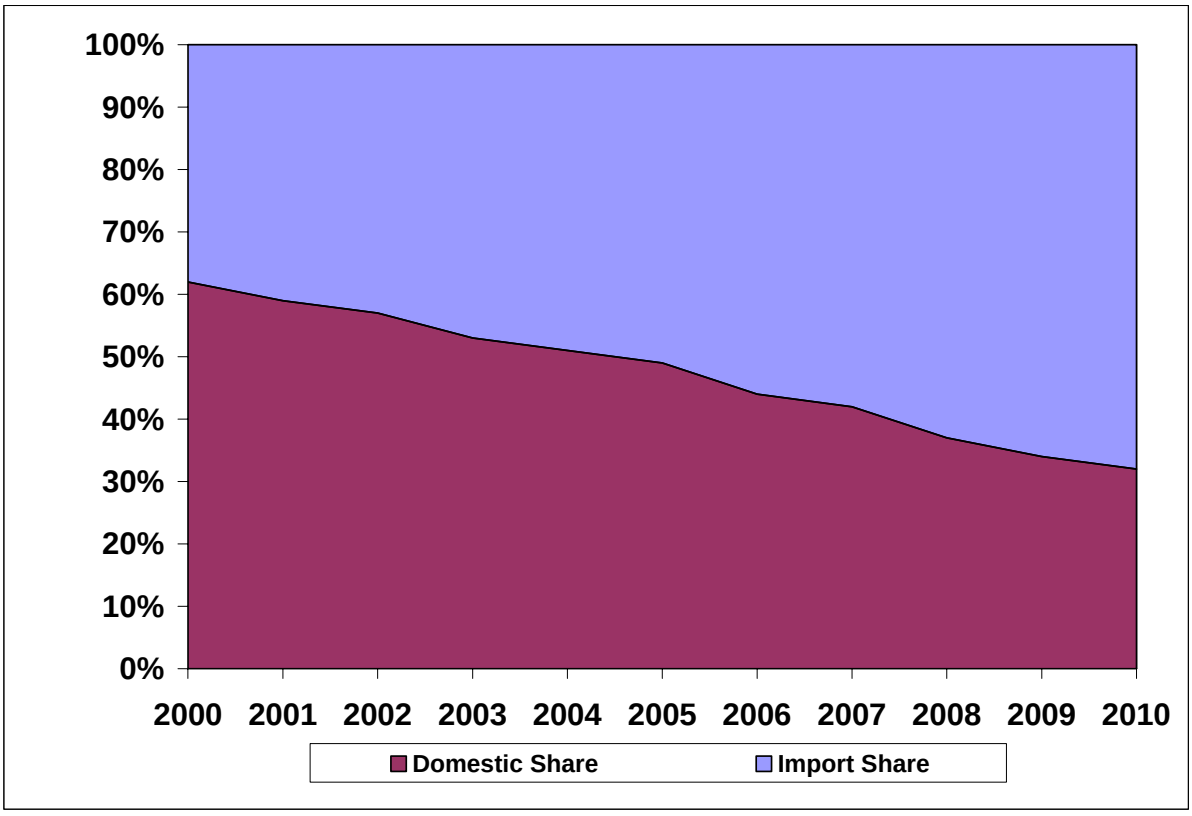
3.6.4 Outlook

The household furniture market is expected to decline modestly in 2008, and not rebound until housing picks up in 2009 [41]. To add further pain to the domestic industry, market share of imports of wood household furniture is expected to continue to grow through 2010, reaching nearly 70% of the total market (Figure 70).

Despite reported growth in 2007, the principal industry association forecasts consumption of office furniture to be down .6% in 2008 and 2.6% in 2009 [48]. Longer term, office-related employment is expected to increase at a 1.2% annual compound rate through 2016 [49].

The kitchen cabinet industry expects a slowdown in 2008, picking back up in 2009, and then steady growth [47]. Current overcapacity may lead shuttering of older capacity during the slowdown, improving results for newer plants.

Figure 70. Historic and Projected Market Share of Imports of Wood Household Furniture.



SOURCE: [43]

3.7 Wood-based Biofuels

It is technically feasible, although not yet commercially proven, to produce liquid fuels from wood and bark. Ethanol production holds the most immediate promise; in the longer term, it may be possible to produce a form of biodiesel.

3.7.1 Industry Overview

Sugar cane and sugar beets are most frequently used in producing ethanol around the world. Brazil, the world's largest producer of ethanol, makes most of its ethanol from sugar crops, which are the easiest to convert into alcohol since alcohol is created by fermenting sugar. US commercial biofuels consist mainly of ethanol made from corn, and to a lesser extent, biodiesel made primarily from soybeans.

Although there does not yet exist a commercial plant using cellulosic biomass, interest is expanding in the use of agricultural, forestry or municipal wastes as a feedstock. The process for producing ethanol from cellulose is complex and costly and is still currently in the research and development stage, although the process has been proven to be technically feasible.

There are two types of processes currently being considered for cellulosic ethanol production: (1) a biological approach called cellulolysis, and ; (2) a thermochemical approach called gasification.

The biological approach consists of five steps:

- Pretreatment to make the lignocellulosic material such as wood or straw amenable to hydrolysis,
- Cellulose hydrolysis (cellulolysis), in which water is used to break down the molecules into sugars;
- Separation of the sugar solution from the residual lignin;
- Microbial fermentation of the sugar solution;
- Distillation to produce 99.5% pure alcohol.

The economics of ethanol production form any feedstock are partially dependent on the value of byproducts. With cellulolysis, the principal byproduct, lignin, can be burned for steam or power generation.

The thermochemical approach involves three principal steps:

- Gasification, in which carbon based molecules are broken down to carbon monoxide, carbon dioxide and hydrogen using what amounts to partial combustion;
- Fermentation in a special kind of fermenter in which a microorganism ingests the carbon monoxide, carbon dioxide and hydrogen to produce ethanol and water;
- Distillation or separation of the ethanol water.

In February 2007 the US Department of Energy (DOE) announced it will provide partial financing totaling $385 million for six biorefinery projects over the 2007-2011 period. When fully operational, the biorefineries are expected to produce more than 130 million gallons of cellulosic ethanol per year [50].

Of the six projects, three have a wood component in the feedstock, but only one is really tied to forest-based wood residues. Range Fuels, Inc. has broken ground on a plant in Georgia that will use 1,200 tons/day of currently unmerchantable timber, forest residues and wood waste as its feedstock. The plant will have the capacity to produce about 50 million gallons of ethanol and methanol per year using a thermochemical process, and is permitted for up to 100 million gallons. Construction of the first 20 million-gallon-per-year phase is expected to be completed in 2008. The total cost is projected to be in excess of $150 million [51] of which DOE is providing up to $76 million. The plant will employ about 70 people.

Unrelated to the DOE projects, in July 2007 Mascoma Corporation announced its intention to build a cellulosic ethanol plant in Michigan, utilizing mainly wood chips and other non-food agricultural crops. Supporting research on production processes, feedstock availability and logistics, and forestry impacts are underway at both Michigan State University [52] and Michigan Technological University [53].

A related biofuel technology involves the use of black liquor, a byproduct of the kraft (brown paper) processing system. In August 2007 Chemrec AB, a Swedish company, and NewPage Corp. announced a project to explore production of fuels from black liquor at NewPage's Escanaba paper mill. Using Chemrec's black liquor gasification (BLG) technology, the Escanaba mill could produce up to 13 million gallons per year of liquid biofuels such as dimethyl ether, methanol, or hydrogen. The plant would be closely integrated with the paper mill to provide energy efficiency and optimize pulp production at the mill.

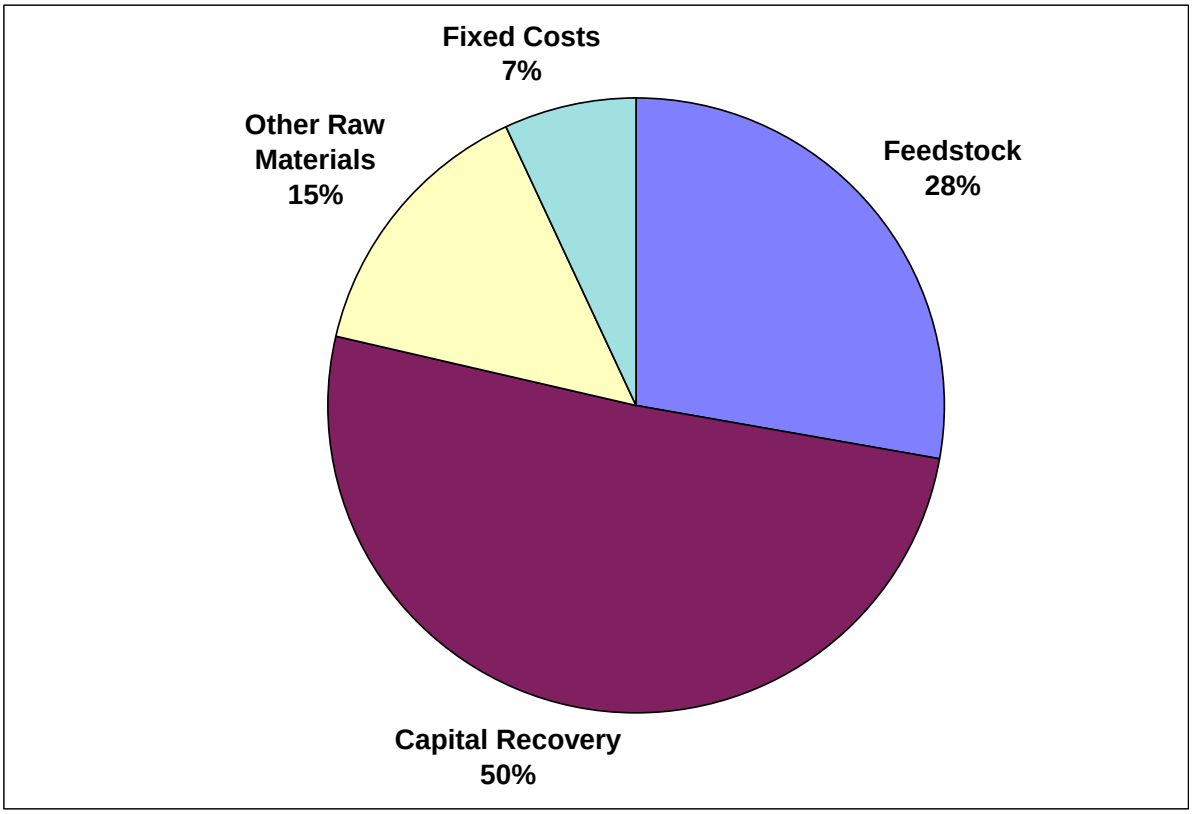
Technologies are also being developed to produce forms of biodiesel. A liquid called BioOil can be produced via gasification of wood and condensation into a free-flowing liquid that can be stored, pumped and transported like petroleum products and can be combusted directly in boilers, gas turbines and slow to medium speed diesel engines [54]. In Norway, an oil company and paper company have announced plans to jointly pursue research aimed at production of biodiesel from wood. Norske Skog aims to establish full-scale biodiesel production requiring 1 to1.5 million cubic meters of wood to produce 65,000 – 100,000 tonnes of biodiesel per year, equivalent to 4-6% of Norway's overall consumption of diesel in transportation [55].

3.7.2 Factors of Production

Cost estimates for cellulosic ethanol production are not widely available, but the largest item is the initial capital cost. Somewhat dated studies suggest that today's cost for a cellulosic ethanol plant would be in the range of $200-$400 million, on the order of three times the cost of a corn-based plant [56]. One study estimates that for a plant with $25/dry ton feedstock cost (1996 dollars), capital recovery charges represent about half of the total production cost (Figure 71).

Perhaps the most uncertain cost item in cellulosic ethanol production is the cost of feedstock, because of the unknown resource availability and logistics. Nevertheless, lower feedstock costs are thought to be the advantage cellulosic ethanol will have over agricultural crop based biofuels. Corn feedstock made up nearly 57 percent of the total production cost of ethanol 2002. Soybean oil represents 70 to 78 percent of the total production cost of biodiesel [56].

Figure 71. Estimated Breakdown of Cellulosic Ethanol Production Costs (% of $1.44 per gallon in 1996 dollars).



SOURCE: [57]

3.7.3 Markets

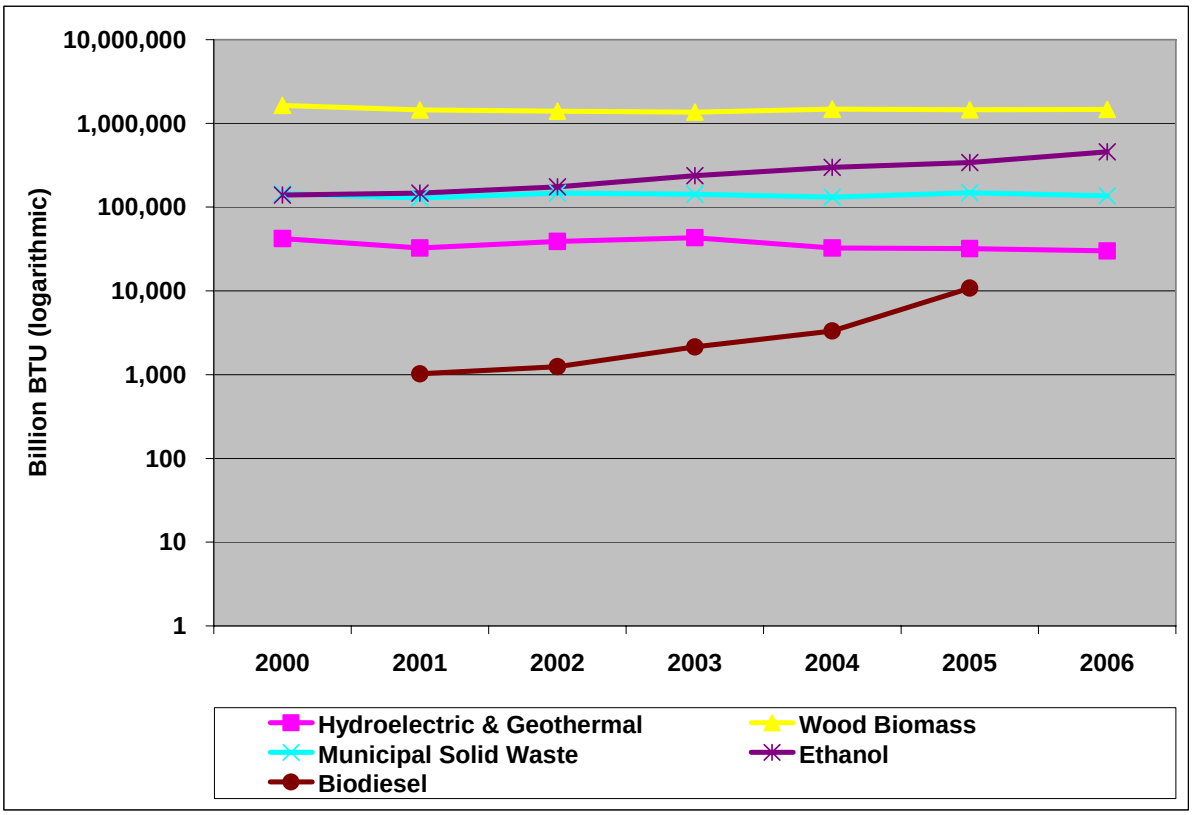
The markets for wood-based biofuels fall into two categories: (1) substitution for fossil fuels currently used by forest products industries, where a biorefinery is co-located with a forest products manufacturing plant, and; (2) existing markets for corn-based ethanol and biodiesel.

The forest products industry has long been the largest producer of renewable energy, primarily by direct combustion of black liquor and wood residues for process steam, heat, and electricity cogeneration (Figure 72). Production of liquid fuels as an alternative could enable the plant to reduce its use of fossil fuels and create useable energy more efficiently than direct combustion in today's aging boilers.

The ability to serve the demand for ethanol as a gasoline additive depends on the relative costs and prices of gasoline, corn-based ethanol, and wood-based ethanol. As indicated above, some of these

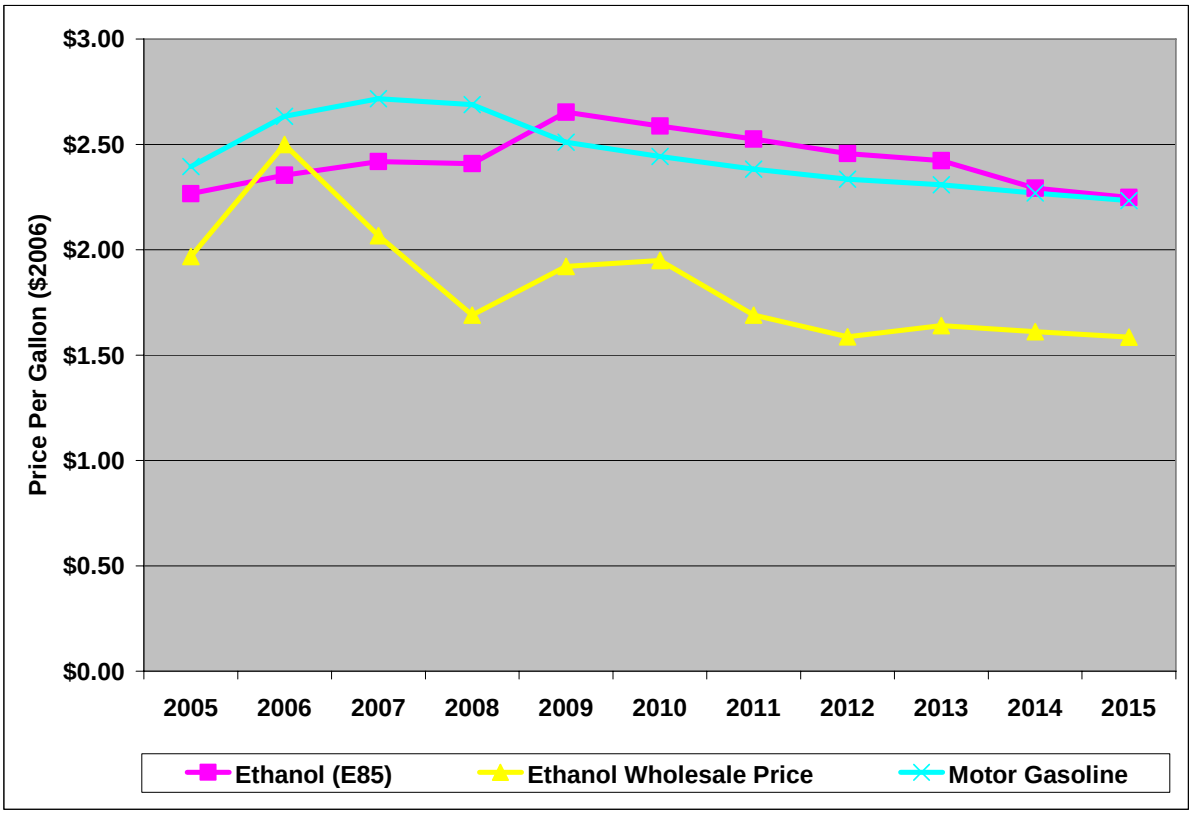
cost economics are uncertain today. Forecasts of future fuel prices depend not only on production costs, but also on global supply and demand conditions, which are subject to not only economic, but also political factors. With all of these this uncertainties in mind, Figure 73 shows the DOE's forecast of relevant fuel prices through 2015. Surprisingly, real prices for both gasoline and ethanol are projected to decline after 2009, based on the DOE's assumptions concerning slowing consumption, higher oil production, and higher renewables production. Should the DOE forecasts bear out, wood-based biofuels will have significant pricing hurdles to overcome.

Figure 72. US Consumption of Renewable Energy in the Industrial and Transportation Sectors, by Source, 2000-2006.



SOURCE: [58]

Figure 73. Forecast Real Prices of E85 Fuel, Ethanol, and Gasoline (2006 dollars).



SOURCE: [59]

3.7.4 Outlook

The outlook for wood-based biofuels is uncertain, but it is clear that large scale commercial production is at least five years away. The ultimate development of the industry depends on how a number of key issues are addressed:

- High initial capital costs. Forest products companies are already under pressure to reduce costs in their core businesses, which will get priority in capital allocation decisions. This suggests a need for partnering with government agencies and energy focused businesses.
- Need to reduce operating costs. If future fuel prices follow the path forecast by DOE, significant reductions in the capital cost and operating costs will be needed for cellulosic ethanol to be competitive with gasoline and corn-based ethanol. This suggests both a need for continuing R&D in the production process for cellulosic ethanol and "learning by doing" in the pilot projects already in planning.
- Availability and cost of biomass. Although often characterized as such wood biomass is not a "waste product" that requires disposal. This commodity formerly hauled away at no

charge now demands a price. Diversion away from existing uses to energy production will have price and availability implications.

- Undeveloped supply chains for biomass. Issues include biomass harvesting technology, landowner decision processes, forestry practices, availability of residues, transportation, supplier relationships, etc.

4 Cost Benchmarking

One of the major competitive factors in the forest products industry is the cost of wood. In this analysis, the benchmark is the cost of roundwood delivered to the mill gate. That delivered cost is then broken down into its three principal components:

- stumpage: the cost/price of the right to cut standing
- harvesting: the cost of felling, bucking or slashing, and skidding or forwarding to roadside
- transport: loading the roundwood onto a truck for delivery to the mill gate

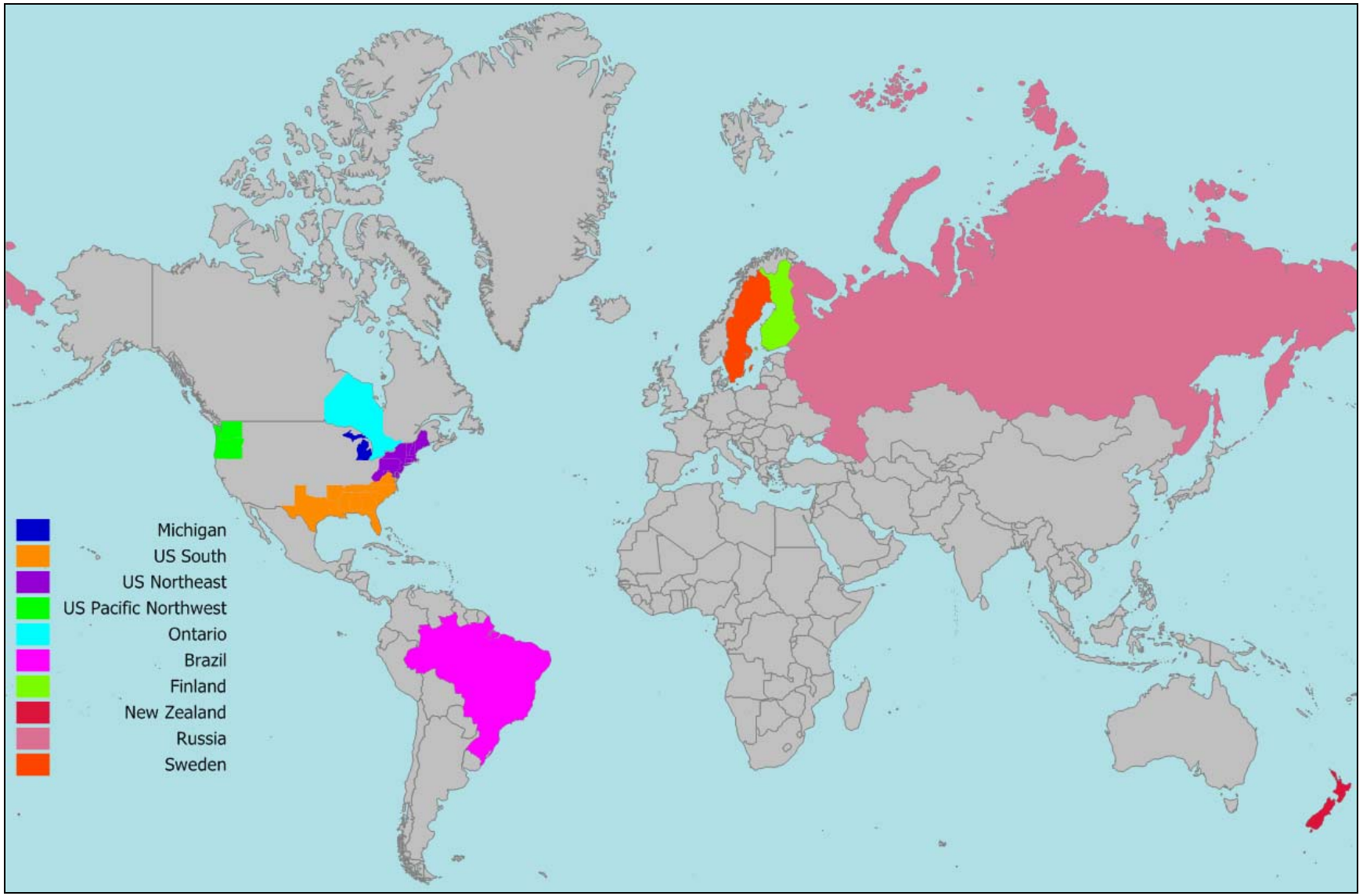
Costs were estimated based on a number of sources, and were converted to $/green ton by use of a number of volume and weight conversion factors [60] and 2007 exchange rates [61].

Because of the inherent variability in costs over large regions, the lack of comprehensive systematically collected cost data, the use of broad conversion factors, and the fact that a variety of sources were used, the cost estimates presented in the following sections should be considered only general indicators.

Michigan's average delivered wood costs were benchmarked against the following domestic and international regions, shown in Figure 74:

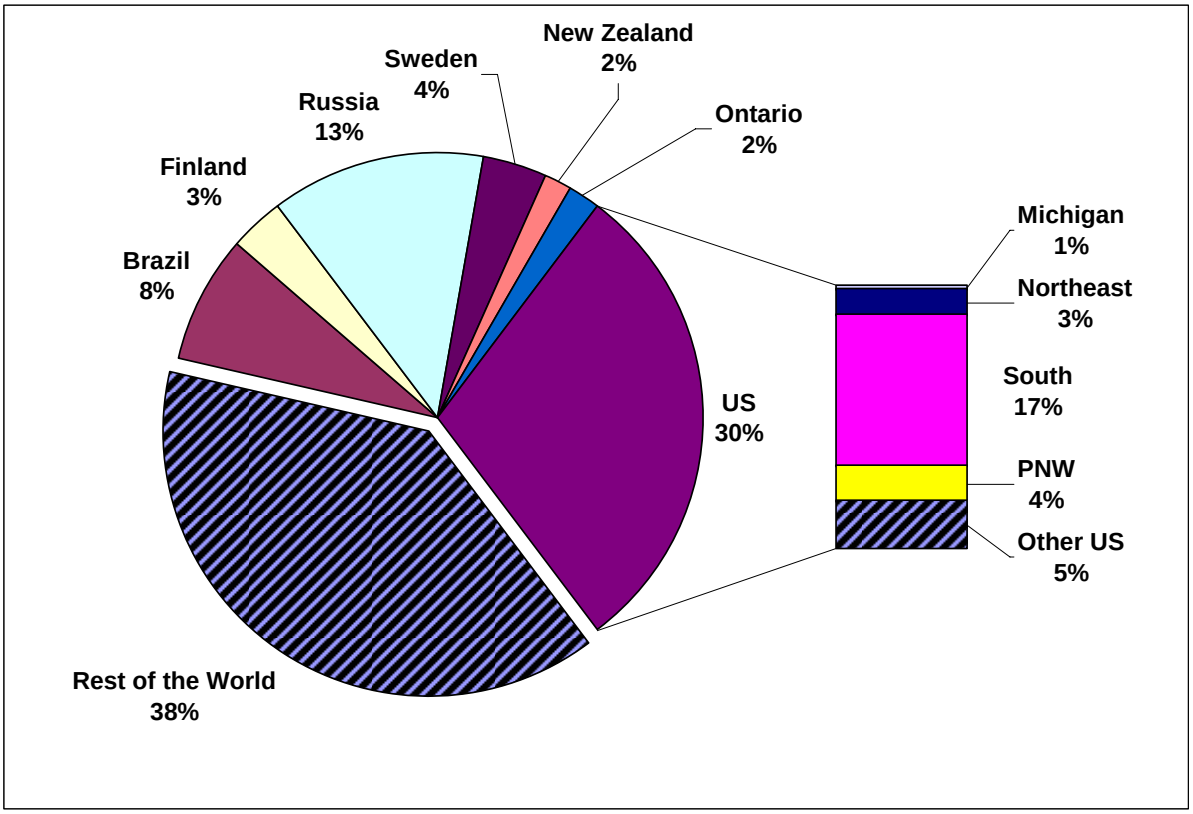
- US Northeast
- US South
- US Pacific Northwest
- Brazil
- Russia
- New Zealand
- Finland
- Sweden
- Ontario, Canada

Figure 74. Cost Benchmarking Regions.



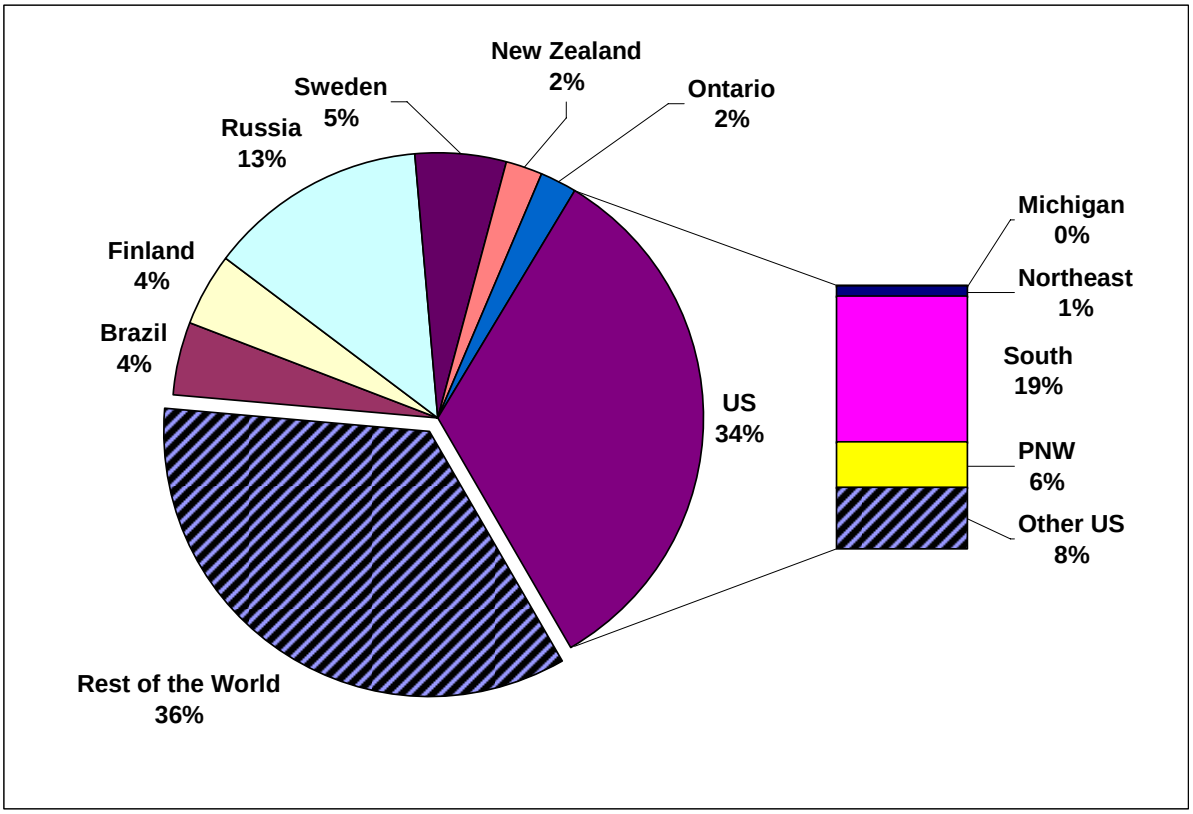
The benchmark regions represent a significant portion of the total global forest industry. As shown in Figure 75 through Figure 77, about 55% of the world's roundwood production occurs in the benchmark regions. About 65% of the world's production is in softwoods; softwood production is at least two-thirds of total production in every benchmark region but Michigan, the US Northeast, and Brazil. In those three regions, hardwood production is more than 60% of the total, with Michigan being the highest at 74% (Figure 78).

Figure 75. Estimated Roundwood Production by Benchmark Regions, All Species, 2006 (% of 1.45 billion m^3).



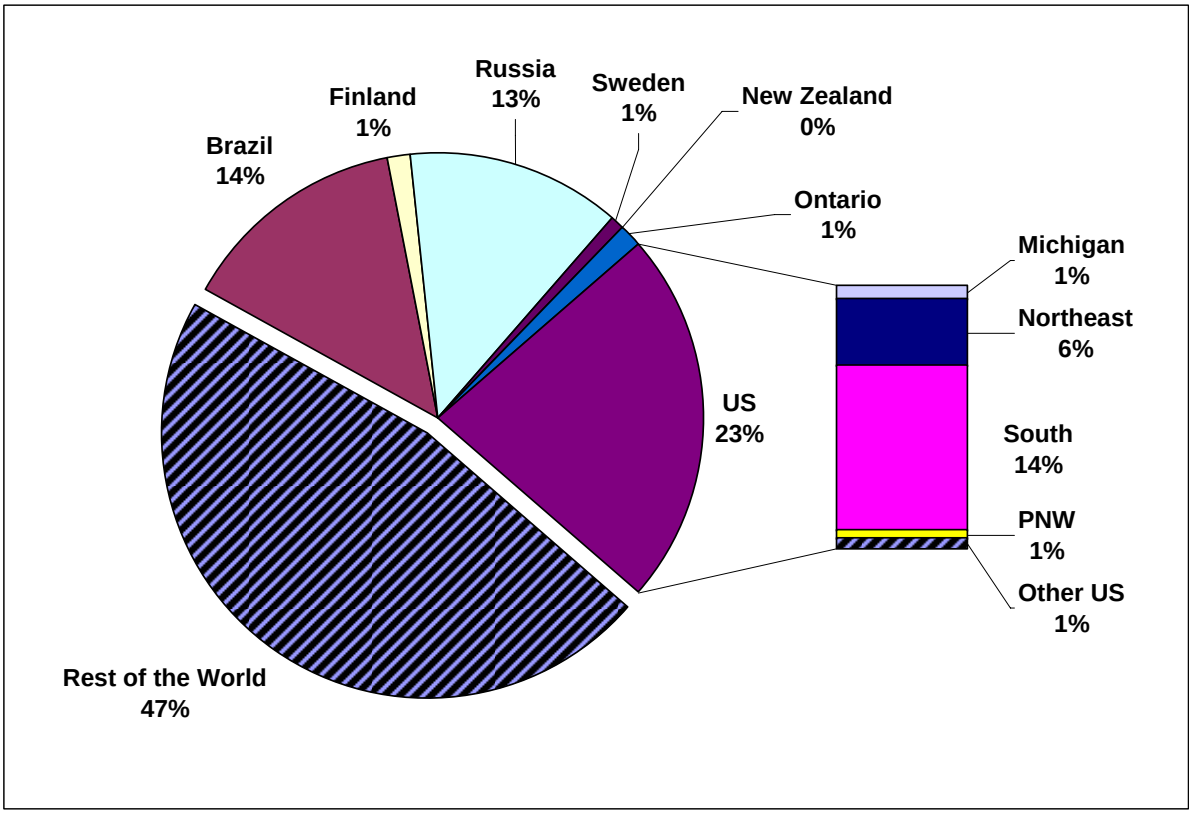
SOURCE:[62]

Figure 76. Estimated Roundwood Production by Benchmark Regions, Softwood Species, 2006 (% of 944 million m^3).



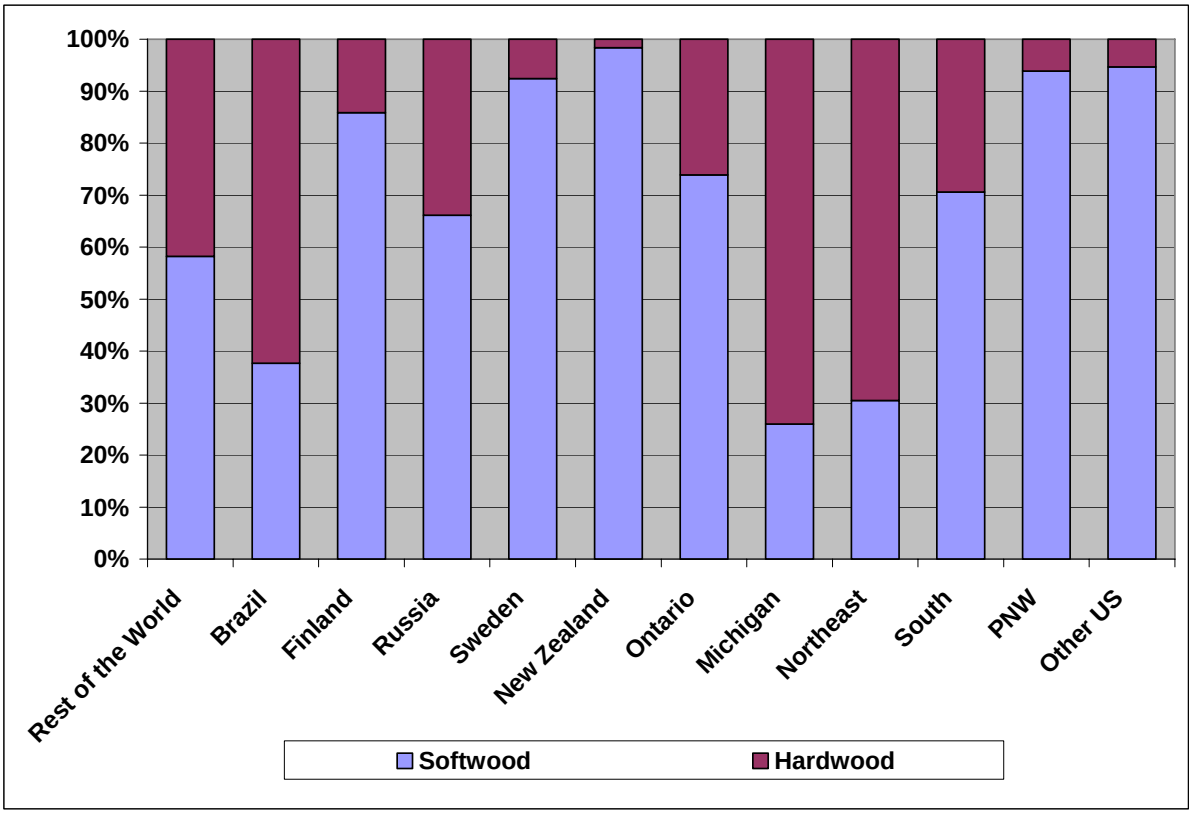
SOURCE: [62]

Figure 77. Estimated Roundwood Production by Benchmark Regions, Hardwood Species, 2006 (% of 503 million m^3).



SOURCE: [62]

Figure 78. Roundwood Production Breakdown by Species Groups for the Benchmark Regions, 2006.



SOURCE: [62]

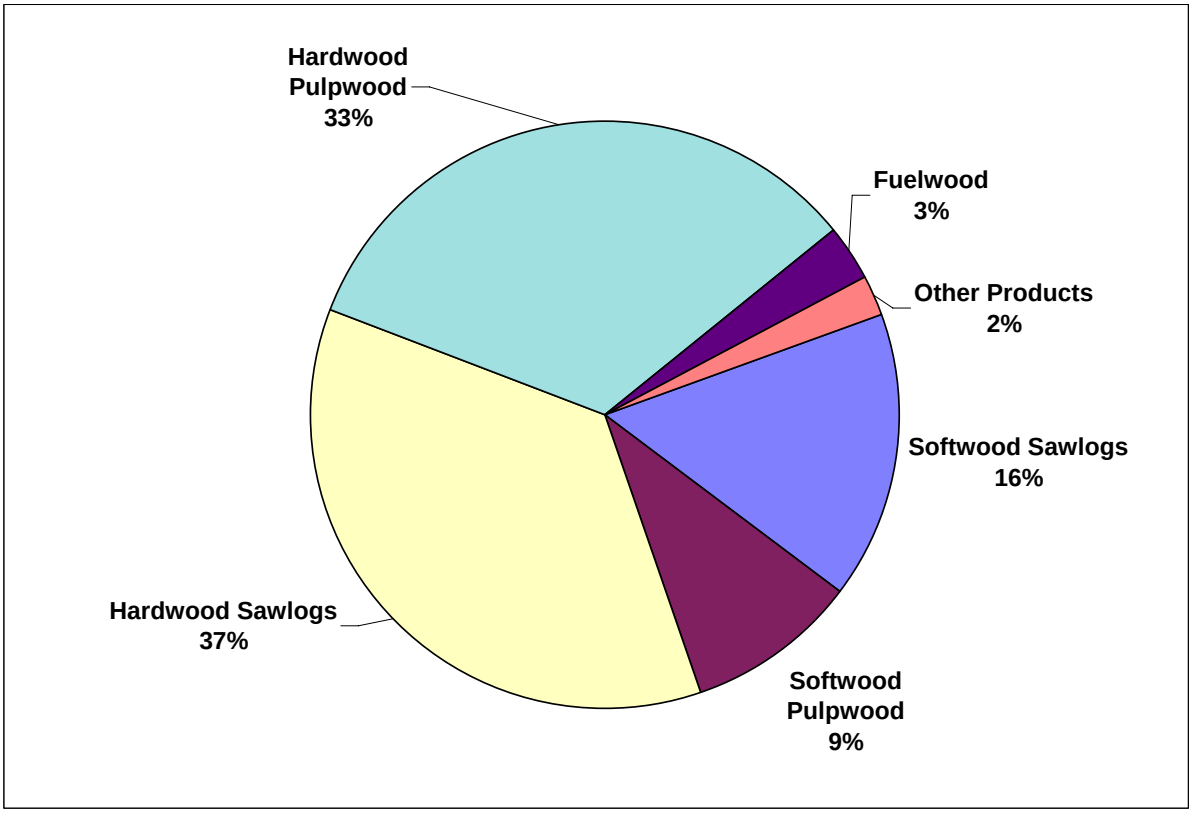
4.1 Michigan

As described above, Michigan is predominantly oriented toward hardwood production. More than 70% of total production, and nearly 80% of pulpwood production is in hardwood (Figure 79). Logging operations are carried out predominantly with mechanized operations, a significant portion with cut-to-length systems, which can be more expensive to operate but are well adapted to the individual tree selection methods that are used in northern hardwood stands. Transportation to the mill is primarily by truck, although there is some truck to rail hauling for longer distances.

The major portion of the hardwood production results from either thinning northern hardwood stands or clearcutting aspen stands. This approach is generally implemented on a 12-15 year cutting cycle, with the aim of producing high quality sawlogs. Hard maple and red oak are the most valuable sawtimber species in Michigan.

In softwoods, the principal sawlog species is red pine, which comes primarily from plantations. Jack pine, spruce, and balsam fir are the principal pulpwood species, and are generally sourced from natural stands in a variety of forest types.

Figure 79. Estimated Michigan Roundwood Production by Product, 2006 (% of 308 million ft^3).



SOURCE: [26]

Wood costs for Michigan are shown in Table 4. Variation among species is a function of differing stumpage prices, which reflect timber supply and demand conditions. One of the confounding aspects of Michigan stumpage prices is that smaller trees that can be sawed into lumber, but that do not fit the tree diameter specifications for sawtimber, are classified as pulpwood and sold as such. As a result, reported "pulpwood" stumpage prices actually represent some unknown fraction of timber that goes to sawmills. This is in contrast to the US South, where pine timber is classified and sold on the stump as either pulpwood, chip-n-saw, or sawtimber, chip-n-saw being a small sawtimber tree which is used by modern sawmills to manufacture smaller dimension lumber.

In Michigan, this problem extends to both softwoods (primarily red pine) used by Michigan's chip-n-saw type sawmills, and hardwoods, where smaller logs known as sawbolts are usually classified as pulpwood on the stump. Hardwood sawbolt markets tend to shrink as hardwood lumber demand falls, so the sawbolt component of current hardwood "pulpwood" stumpage prices is likely to be relatively small.

Conditions in Michigan are quite similar to those in the other Lake States, particularly Wisconsin, which represents a significant source of demand for Michigan timber. As a result, per unit costs tend to be quite close across the region, certainly within the margin of error. Therefore, the other Lake States are not included as a separate benchmark region.

Table 4. Estimated Delivered Wood Costs for Michigan Circa 2007 ($/green ton).

Product	Species Group	Indicator Species	Stumpage	Harvest	Transport	Total
Pulpwood	Hardwood	Aspen	$10.00	$14.00	$10.50	$34.50
		Mixed Hdwd	$6.50	$13.50	$10.50	$30.50
	Softwood	Jack Pine	$16.50	$14.00	$10.50	$41.00
		Spruce/Fir	$9.50	$13.50	$10.50	$33.50
Sawtimber	Hardwood	Hard Maple	$96.00	$16.50	$10.00	$122.50
		Red Oak	$47.00	$16.00	$10.00	$73.00
	Softwood	Red Pine	$27.50	$20.00	$10.00	$57.50

SOURCE: [63]

4.2 US Northeast

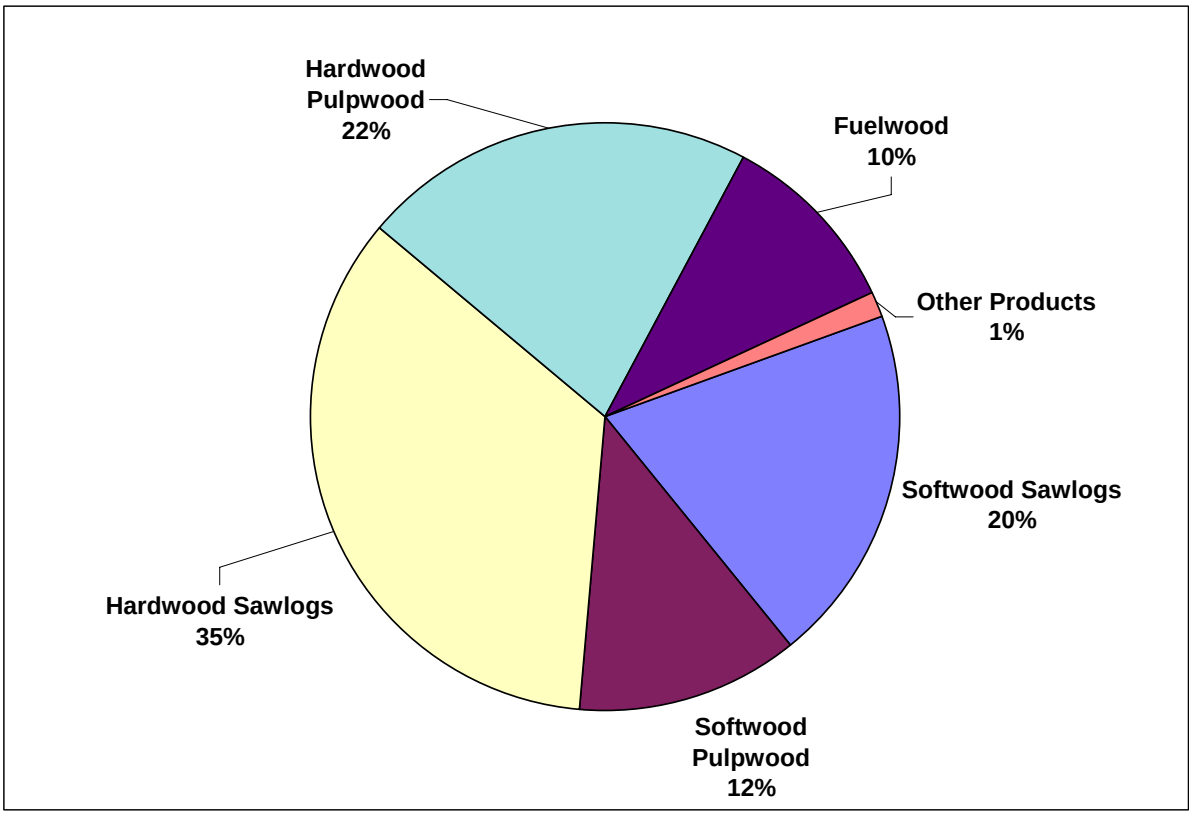
The Northeast as defined and used by the USDA Forest Service in its statistical programs is a large populous region of 12 states. Like Michigan, the region is more oriented toward hardwoods, which represent about 60% of roundwood production Figure 80.

Logging operations are carried out predominantly with mechanized operations, although chainsaw operations with cable skidders are required in rougher terrain. The Appalachian mountains stretch from Maine down through West Virginia, and essentially form the spine of the forested part of the region. Transportation to the mill is primarily by truck, with some truck to rail hauling for longer distances.

Hardwood production ranges from thinning northern hardwood stands and clearcutting aspen stands in the north, to clearcutting of Appalachian hardwoods in the south. In softwoods, the principal sawlog species is white pine, which is an important component of natural mixed forests but also is a

plantation species. In the north, jack pine, spruce, and balsam fir are the principal pulpwood species, and are generally sourced from natural stands in a variety of forest types.

Figure 80. Estimated US Northeast Roundwood Production by Product, 2006 (% of 1.0 billion ft^3).



SOURCE: [26]

Wood costs for the Northeast shown in Table 5, were drawn from the northern portion of the region, which is most comparable to Michigan. In this region, spruce and fir are harvested and hauled in tree-length form to sawmills and pulp mills. Hardwood pulpwood is mostly cut to 8-foot lengths. Higher harvest costs for sawtimber reflect additional care and sorting/handling required to optimally merchandise logs by grade.

Table 5. Estimated Delivered Wood Costs for the US Northeast Circa 2007 ($/green ton).

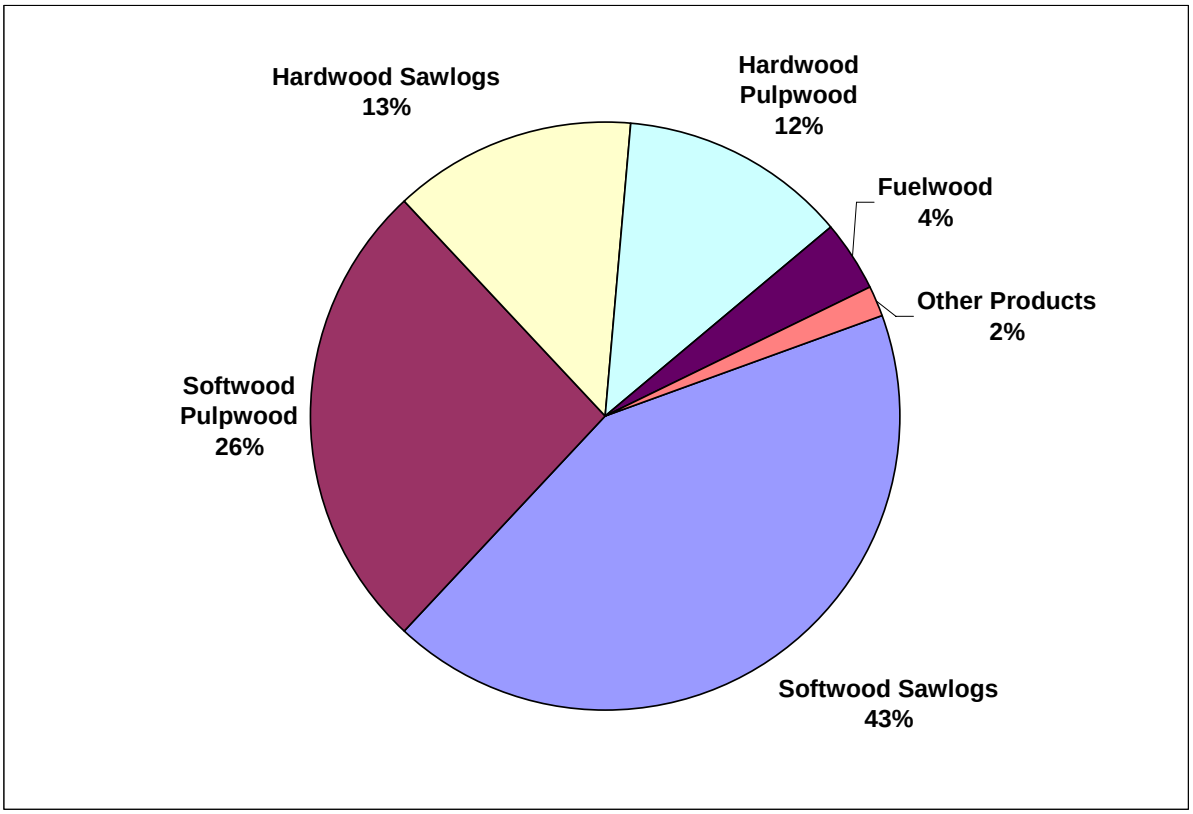
Product	Species Group	Indicator Species	Stumpage	Harvest	Transport	Total
Pulpwood	Hardwood	Aspen	$15.00	$14.50	$10.00	$39.50
		Mixed Hdwd	$8.50	$14.00	$10.00	$32.50
	Softwood	Spruce/Fir Treelength	$24.50	$15.50	$10.00	$50.00
Sawtimber	Hardwood	Hard Maple	$74.00	$17.00	$10.50	$101.50
		Red Oak	$55.00	$16.00	$10.50	$81.50
	Softwood	Spruce	$51.00	$23.50	$10.50	$85.00

SOURCE: [64]

4.3 US South

The US southern pine region, stretching from Virginia through Texas, is perhaps the most concentrated and technologically advanced timber production region in the world. The foundation of the industry is the fast-growing plantations of primarily loblolly pine, which are grown under intensive regimes of site preparation, genetically improved planting stock, fertilization, thinning, and final harvest on a relatively short rotation. In this region, about 70% of roundwood production is softwood, and 60% of that is sawtimber (Figure 81).

Figure 81. Estimated US South Roundwood Production by Product, 2006 (% of 7.9 billion ft^3).



SOURCE: [26

Logging operations are carried out predominantly with mechanized operations consisting of feller bunchers and skidders. Tree-length logging is most common, and transportation to the mill is primarily by truck, with some truck to rail hauling for longer distances.

Hardwood production results from clearcutting upland stands, or selectively thinning lowlands. Clearcutting is the favored silviculture either because intolerant species are to be regenerated, or the site is to be converted to pine. Red and white oak are the most valuable hardwood species, and in the South, these species attain significantly higher growth rates than in Michigan.

Wood costs for the South are shown in Table 6. These are some of the lowest operating costs in the world, due to a variety of factors: high volumes per acre in well spaced stems, typically gentle terrain, highly mechanized and skilled operations, tree-length harvesting that minimizes bucking and handling, and deep markets that keep haul distances relatively low.

Table 6. Estimated Delivered Wood Costs for the US South Circa 2007 ($/green ton).

Product	Species Group	Indicator Species	Stumpage	Harvest	Transport	Total
Pulpwood	Hardwood	Mixed Hdwd	$10.00	$12.50	$7.00	$29.50
	Softwood	Southern Pine	$10.50	$12.50	$7.00	$30.00
Sawtimber	Hardwood	Mixed Hdwd	$22.00	$12.00	$7.00	$41.00
		Oak	$30.50	$12.00	$7.00	$49.50
	Softwood	Southern Pine	$37.00	$11.50	$7.00	$55.50

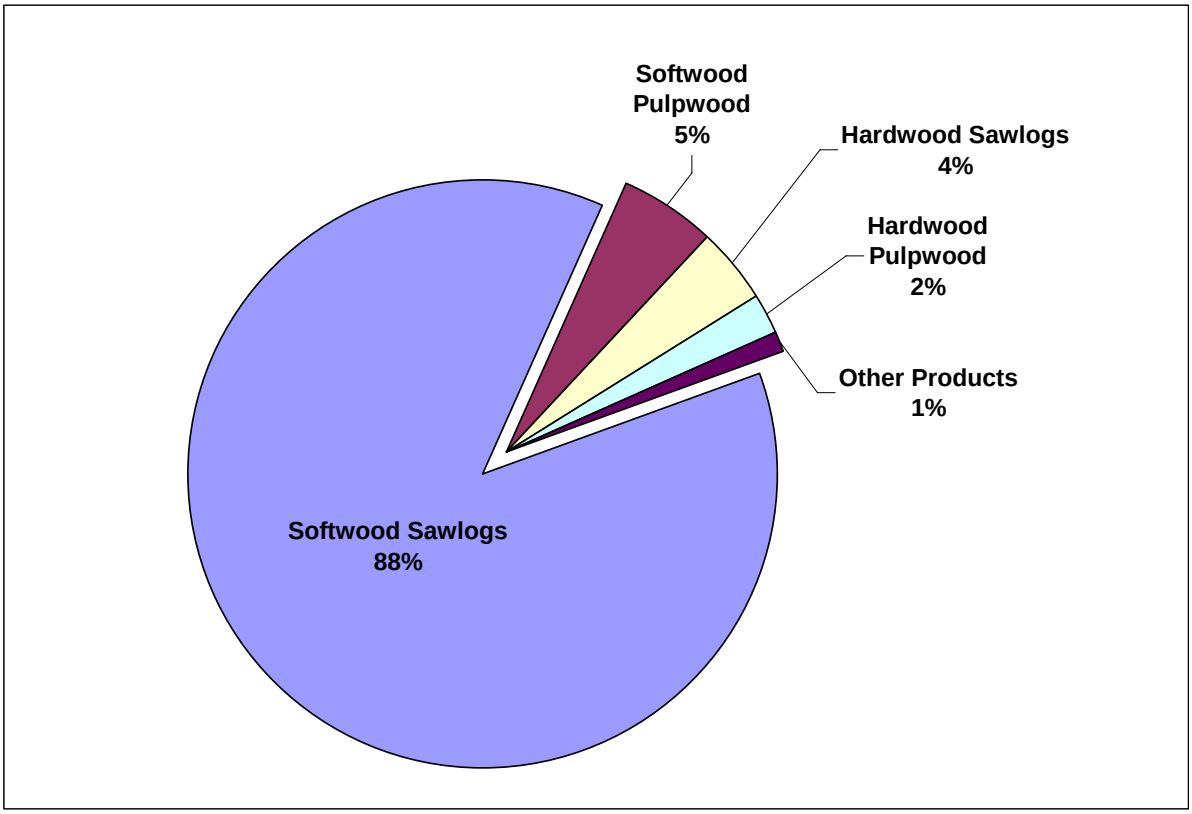
SOURCE: [65]

4.4 US Pacific Northwest

The Pacific Northwest consists of the states of Oregon and Washington. This region is dominated by coniferous forest types, and nearly 95% of roundwood production is softwood (Figure 82).

The major end-uses of roundwood are for the production of softwood lumber, softwood plywood and softwood pulp. The softwood lumber industry is, by far, the largest log consumer, accounting for about 75% of total consumption of roundwood in the region. The principal softwood species are Douglas-fir, hemlock/fir and ponderosa pine.

Figure 82. Estimated US Pacific Northwest Roundwood Production by Product, 2006 (% of 1.8 billion ft^3).



SOURCE: [26

Use of hardwood is minor relative to softwood production, but the total volume of hardwood sawlog production in the region is about 80% of Michigan's hardwood roundwood volume.

Although the pulp industry is a significant consumer of roundwood, the main fiber source for pulp manufacturing is residual chips from the lumber and plywood industry. Historically about three-fourths of the wood fiber consumed by the pulp industry was residual chips. Between 2001 and 2005, the sawmilling sector grew by 18%, but over the past two years the industry has struggled due to the decline in prices for lumber and the high costs of logs. As a result, the availability of residual chips for the pulp industry has declined, requiring the industry to rely more on roundwood.

Wood costs for the Pacific Northwest are shown in Table 7. Stumpage values for sawlogs vary substantially depending on species, log size and quality. Costs in Table 7 are for average log quality of hemlock roundwood. In this region, harvest and transport costs are relatively high due to the mountainous terrain and large timber.

Sawlog costs are mainly driven by demand from the sawmilling industry. This industry is very dependent on US housing starts and the domestic consumption of lumber. Over the past ten years there has also been some minor impact on log pricing by the log export market. Lately, domestic hemlock prices have stayed up due to pressure from Korean log buyers despite lower log demand by domestic sawmills.

Sawlog costs did go up from 2002-2006 because lumber prices in the US were high and lumber production in the US Northwest increased. During the five-year period, production was up 13%, peaking in the summer of 2006. Since that time, production and sawlog costs have fallen and Douglas-fir prices were 28% lower in the 4Q/07 than in the 2Q/06. Hemlock sawlog prices have not fallen as much from their peak as the log export market has stayed strong, keeping domestic prices at about the same level for three years.

Pulpwood prices are mainly impacted by the health of lumber industry and the weather conditions. With reduced lumber production, and as a consequence, less residual supply, pulpwood prices typically go up. Roundwood prices also often increase when the weather restricts logging and hauling activities, typically during the spring and fall.

Table 7. Estimated Delivered Wood Costs for the US Pacific Northwest Circa 2007 ($/green ton).

Product	Species Group	Indicator Species	Stumpage	Harvest	Transport	Total
Pulpwood	Hardwood	Red Alder	$4.00	$23.00	$12.00	$39.00
	Softwood	Douglas Fir, Hemlock	$6.00	$20.00	$10.00	$36.00
Sawtimber	Hardwood	Red Alder	$39.00	$35.00	$16.50	$90.50
	Softwood	Hemlock	$31.00	$27.00	$13.50	$71.50

SOURCE: [66]

4.5 Brazil

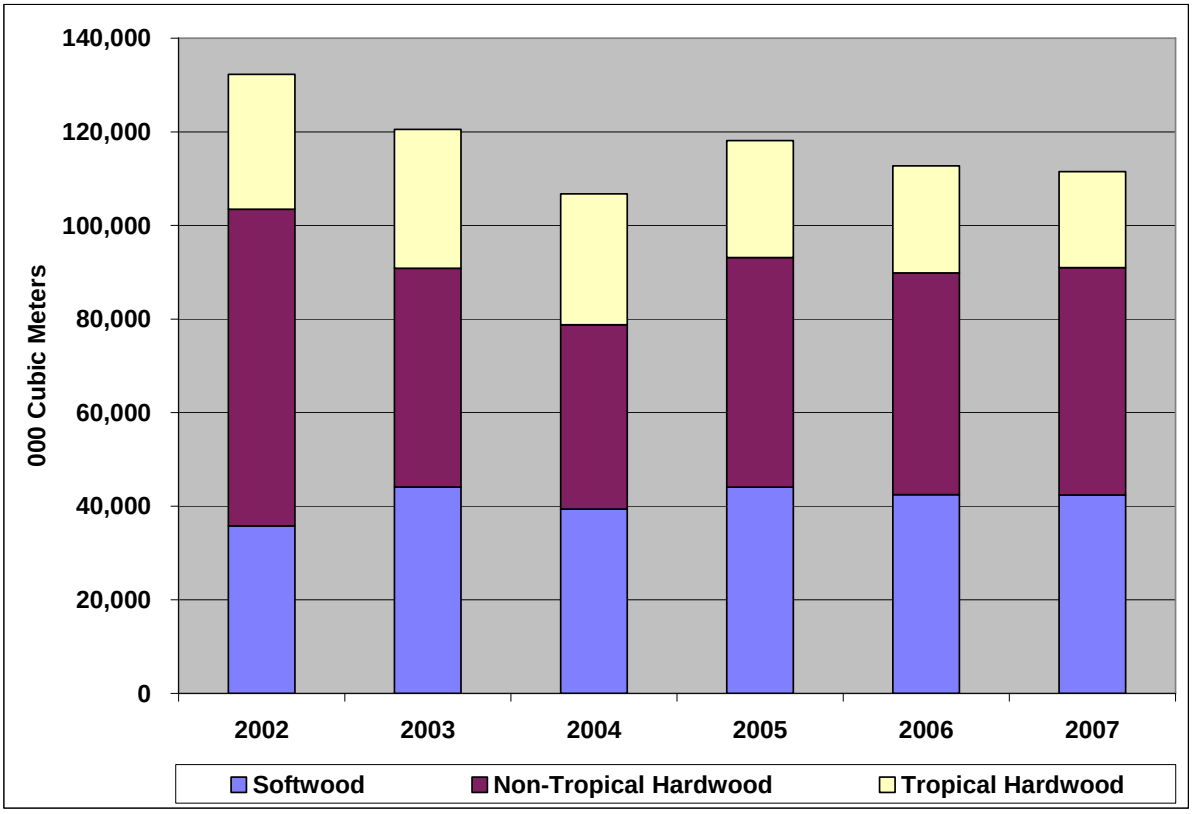
Although most of the popular news coverage of Brazilian forests concerns deforestation in the Amazon region, and Brazil is one of the world's largest producers of tropical logs, that production accounts for only about 20% of the country's total roundwood production (Figure 83). The remainder is primarily in fast-growing plantations of eucalyptus, acacia and southern pine in the south and southeast regions of the country.

The pulp industry is, by far, the largest consumer of logs in Brazil (not including the charcoal industry). The manufacturing of eucalyptus pulp has increased steadily the past ten years, while the production of softwood-based pulp has been fairly stable.

The lumber industry was originally based on native parana pine but has shifted production to the rapidly expanding Southern Yellow pine species resources in plantations in southern Brazil.

The wood-based panel industry in Brazil manufactures veneer, plywood and composite panels such as particle board and MDF. Volumes are relatively small compared to pulp and lumber, but have increased since the 1990's. In contrast to many other composite panel industries around the world, panel producers in Brazil generally utilize plantation roundwood as raw-material rather than sawmill residuals.

Figure 83. Roundwood Production in Brazil, 2002-07.



SOURCE: [67]

Delivered log costs in Brazil, shown in Table 8, are among the lowest in the world. Costs in Table 8 are for logs traded in the open market. Sawlogs and pulpwood from forest industry-owned land in Brazil account for a large share of the total log consumption by the industry. The costs for these internally sourced logs are substantially lower than for raw-material traded in the open market. Logging costs for eucalyptus pulpwood in Brazil are substantially lower than most other regions as the harvesting operations are very efficient, the growing stock per hectare is high and the stands are on flat land close to logging roads.

Costs of sawlogs purchased in the open market have traditionally been mostly impacted by the health of the lumber export market, although that is slowly changing as the domestic market is increasing in importance.

Open market pulpwood costs are mostly influenced by competition from the energy and the composite board sectors. Higher transport costs have also pushed delivered log prices higher over the past five years.

Table 8. Estimated Delivered Wood Costs for Brazil Circa 2007 ($/green ton).

Product	Species Group	Indicator Species	Stumpage	Harvest	Transport	Total
Pulpwood	Hardwood	Eucalyptus, Acacia	$15.50	$8.00	$16.50	$40.00
	Softwood	Southern Pine	$10.00	$16.50	$11.00	$37.50
Sawtimber	Softwood	Southern Pine	$23.00	$12.00	$15.50	$50.50

SOURCE: [66]

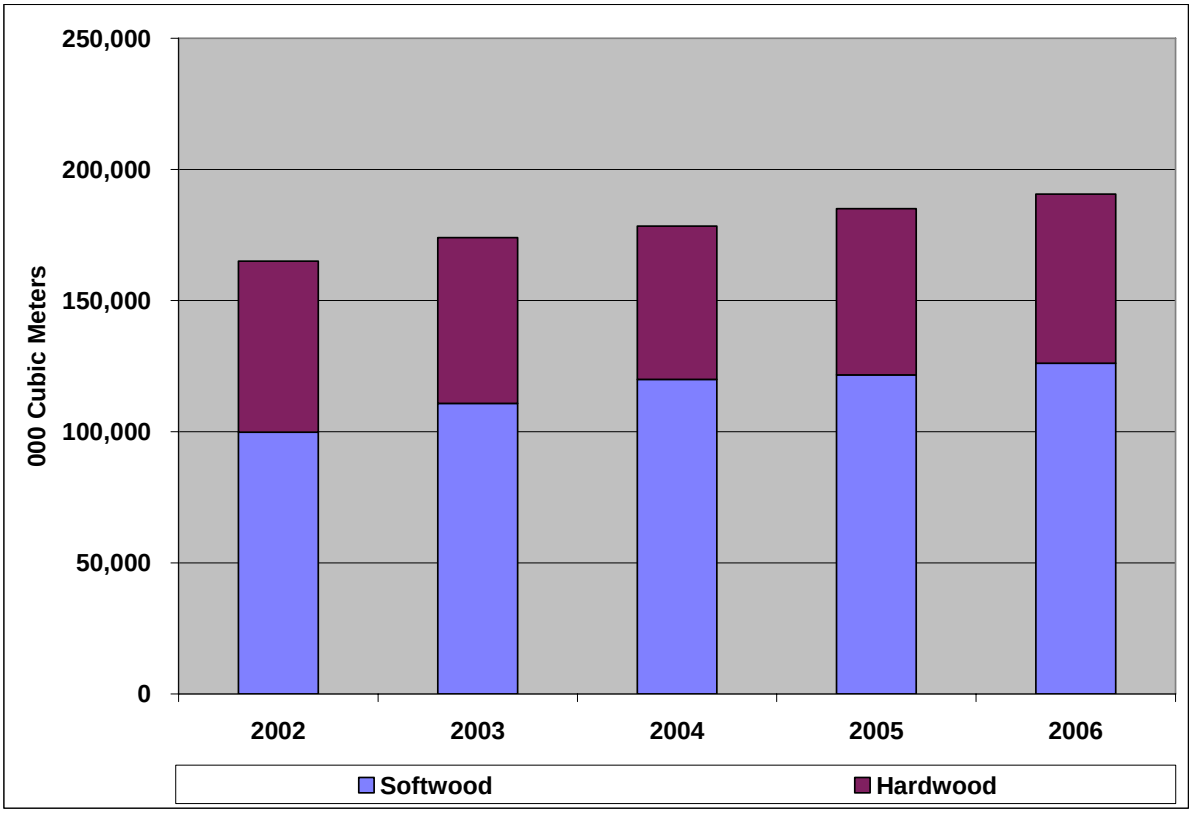
4.6 Russia

Russia, with about 20% more growing stock than all of North America, produces less than one-third of the roundwood produced in North America [68]. Russian production is about two-thirds softwood and was steadily rising during 2002-06 (Figure 84).

The largest forest companies in Russia are concentrated in the western provinces, while the production of lumber and pulp in Siberia and Russian Far East makes up a smaller share of the total Russian production. Almost two-thirds of pulp production occurs in northwest Russia, while an estimated 70% of lumber production comes from western Russia.

A clear majority of plywood plants are located in western Russia, although there have been recent investments in veneer and plywood plants in Siberia and the Far East for exportation to China and Russia.

Figure 84. Roundwood Production in Russia, 2002-06.



SOURCE: [69]

Table 9 shows delivered wood costs in Russia. The Russian Federal Forestry Agency sells stumpage for long-term leases at a very low rate compared to most other countries in the world. However, logging companies have to pay for forest inventory, regeneration, special taxation, as well as significant costs related to corruption. An estimate of these costs is included in the harvest and transport components in Table 9.

Log costs have been driven mainly by available supply and industry demand. In recent years, the costs of transportation have also had an increasing impact on delivered log costs. The log export market in both western and eastern provinces increased substantially during the late 1990's and early 2000's. The large volumes of logs being exported in 2005 and 2006 (35% of total harvest) also impacted domestic log costs in regions close to railroads and ports.

Table 9. Estimated Delivered Wood Costs for Russia Circa 2007 ($/green ton).

Product	Species Group	Indicator Species	Stumpage	Harvest	Transport	Total
Pulpwood	Hardwood	Birch, Aspen	$4.00	$18.00	$15.50	$37.50
	Softwood	Pine, Spruce	$5.00	$24.00	$20.50	$49.50
Sawtimber	Hardwood	Birch, Aspen	$4.00	$23.50	$18.50	$46.00
	Softwood	Pine, Spruce	$6.00	$37.50	$31.50	$75.00

SOURCE: [66]

4.7 New Zealand

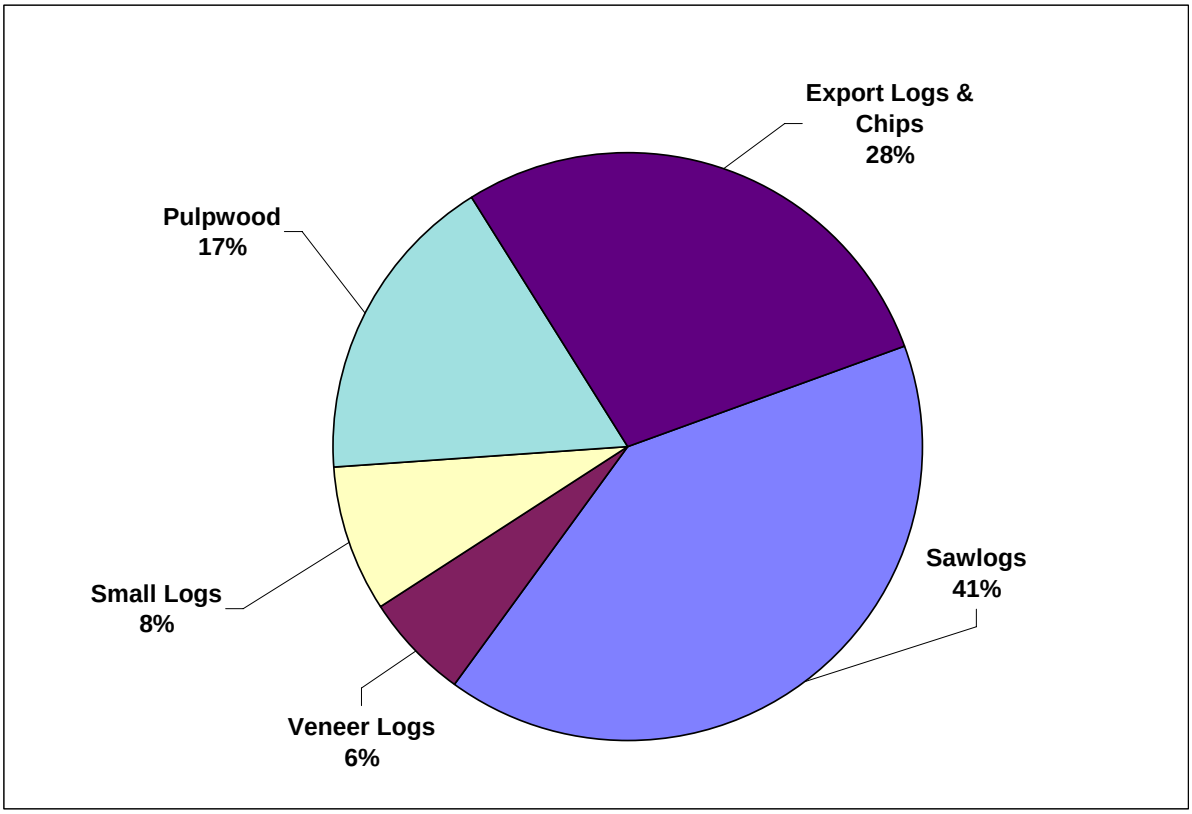
New Zealand's rapidly growing forest products industry has been built almost entirely on maturing conifer plantations. About 80% of roundwood production is in softwood logs, either for domestic consumption or exports. One-third of the log production is exported, primarily to China, Korea, and Japan.

All commercial forests are tree farms of which radiata pine accounts for 91% and Douglas-fir 5%. Most of the actively managed forestland is either owned by small private landowners or by foreign investors (TIMO's). The forest industry has sold off a majority of its forests during the past five years.

The biggest domestic users of logs in New Zealand are softwood lumber producers (64% of total log consumption) and softwood pulp manufacturers (23%). The wood-based panel industry expanded throughout the 1990's, consuming almost 13 % of domestically utilized roundwood in 2006.

Production of both lumber and pulp increased during much of the period 1995-2005, but has since fallen due to difficulties competing in the export market.

Figure 85. New Zealand Roundwood Production from Planted Coniferous Forests, 2006 (% of 18.8 million m^3).



SOURCE: [70]

New Zealand has very competitive wood fiber costs (Table 10) compared to most softwood pulp-producing regions in the world. Both stumpage and harvesting costs are low, making the forest industry very competitive. The growing costs set a floor price under which landowners typically will not sell. The high volume of exports means that log export price has a major impact on domestic log prices. As exports of logs, lumber and pulp have fallen the past few years, so have domestic sawlog and pulpwood prices.

Exports of logs and lumber have been in decline and demand for logs has decreased due to the unfavorable exchange rate of the NZ dollar relative to the US dollar and due to high shipping rates. As a result, log prices declined by 5% in 2007. Prices would have fallen further if it wasn't for diminishing log availability. An increasing number of landowners in New Zealand have decided to turn the forestland into grazing land for dairy production, thus reducing sawlogs and pulpwood entering the market place.

Table 10. Estimated Delivered Wood Costs for New Zealand Circa 2007 ($/green ton).

Product	Species Group	Indicator Species	Stumpage	Harvest	Transport	Total
Pulpwood	Softwood	Radiata Pine	$10.00	$13.50	$10.00	$33.50
Sawtimber	Softwood	Radiata Pine	$28.50	$25.00	$12.50	$66.00

SOURCE: [66]

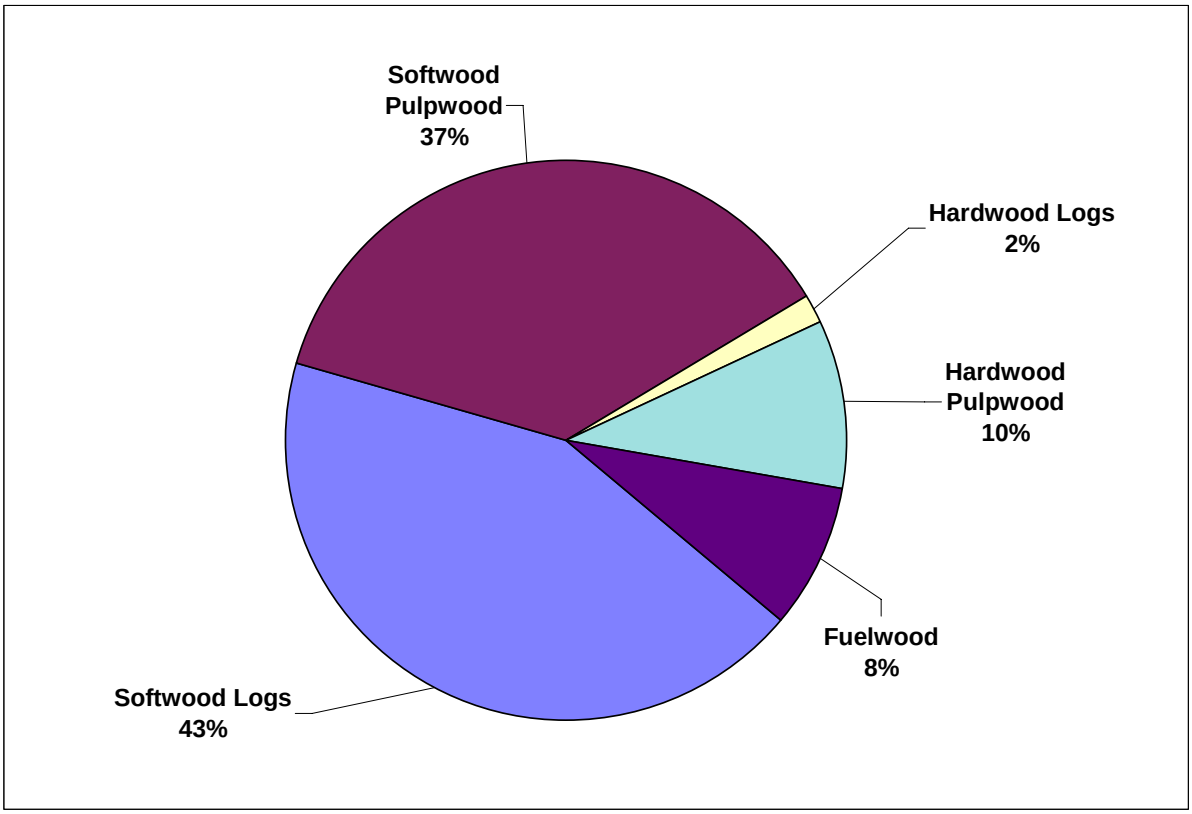
4.8 Finland

Finland is a softwood dominated forest region, and softwoods account for about 80 percent of roundwood production (Figure 86). Most production is consumed domestically, and in addition, up to 25% of roundwood consumption is imported, primarily from Russia.

The pulp industry consumes 54% of all roundwood in Finland making it by far the largest consumer of logs in the forest industry. The sawmilling sector consumes 40% of harvested timber, and the remaining 6% is used by the plywood industry. Finland is the largest plywood producer in Europe.

Because Finland has high sawlog costs, the sawmilling sector has had difficulty staying competitive, and production has diminished the past few years despite strong lumber markets in Europe. Although the pulp sector produced at record levels in 2006, it is expected that the sector will also have to downsize due to high wood costs.

Figure 86. Roundwood Production in Finland, 2004 (% of 53.8 million m^3).



SOURCE: [71]

The private landowners in Finland have been very successful in recent years in negotiating high prices for sawlogs and pulpwood through their forest owners' associations. As a result, the Finnish forest industry has some of the highest wood costs in the world (Table 11). Logging costs for pulpwood are fairly high because a large share of the pulpwood volume is coming from thinning operations, which are more costly to log.

A large share of forestland in Finland is owned by more than 900,000 small private landowners [72]. Many of them are not directly dependent on income from their forests as they have full-time jobs elsewhere. This means that the floor price for logs is high.

The Finnish industry has had to import logs from Russia, which until recently, were cheaper than the costliest domestic logs. With higher log costs in Russia and with the Russian authorities imposing higher taxes on exported logs in 2005, the major Finnish forest companies reduced log imports and increased the usage of domestic timber. As a result domestic sawlog prices have gone up by almost

20% in one year. Log prices have also, to a lesser degree, been impacted by higher energy costs the past three years.

Table 11. Estimated Delivered Wood Costs for Finland Circa 2007 ($/green ton).

Product	Species Group	Indicator Species	Stumpage	Harvest	Transport	Total
Pulpwood	Hardwood	Birch	$20.50	$19.50	$11.50	$51.50
	Softwood	Pine, Spruce	$34.50	$21.00	$13.50	$69.00
Sawtimber	Softwood	Pine, Spruce	$97.00	$14.00	$12.00	$123.00

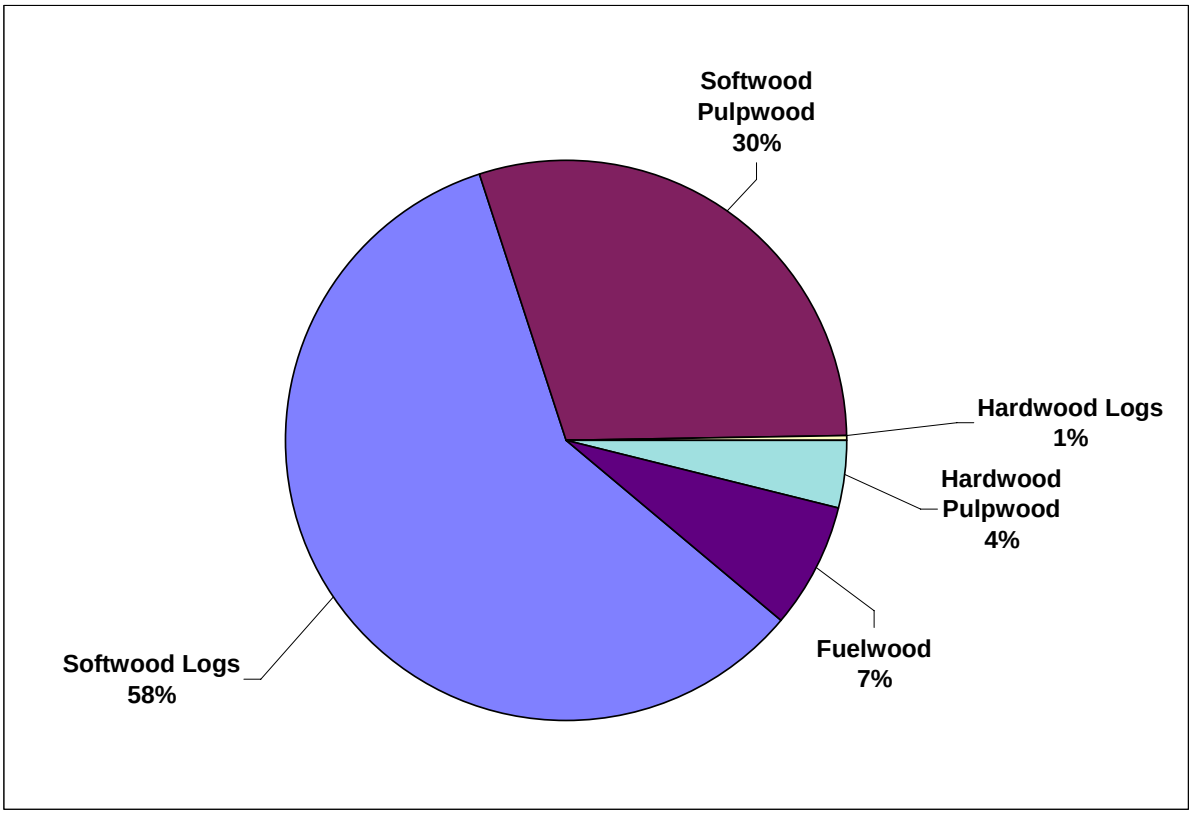
SOURCE: [66]

4.9 Sweden

Like Finland, Sweden is a softwood-dominated country largely in the ownership of private individuals and companies, with less than 20% in public ownership [73]. Also like Finland, Sweden consumes most roundwood production domestically. Figure 87 shows that nearly 60% of roundwood production is in softwood sawlogs.

Softwood lumber producers and pulp manufacturers are the two largest consumers of roundwood in Sweden. The lumber sector has grown 7% the past two years as the demand for lumber has been strong throughout Europe. Wood-based pulp production has been fairly stable for five years, and Sweden continues to be the second largest manufacturer in Europe after Finland.

Figure 87. Roundwood Production in Sweden, 2005 (% of 98.2 million m^3).



SOURCE: [74]

Sweden, together with Finland, has some of the most efficient logging and hauling operations in the Northern Hemisphere, resulting in relatively low operating costs (Table 12). This somewhat compensates for the very high stumpage costs in this region.

The health of forest industry in Sweden is very dependent on the export market because the majority of produced lumber and paper is being exported. Over 74% of manufactured lumber was exported in 2006 and 90% of paper production was shipped from Sweden to other countries in Europe and elsewhere.

With higher market prices for lumber and market pulp, forest companies in Sweden have offered higher prices for both sawlogs and pulpwood as incentives for less active landowners to increase harvest levels. Sawlog prices were 25% higher in the 4Q/07 than in the same quarter in 2005. The higher prices have increased logging activities and harvest levels in 2007 were an estimated 7% higher than in 2006.

Table 12. Estimated Delivered Wood Costs for Sweden Circa 2007 ($/green ton).

Product	Species Group	Indicator Species	Stumpage	Harvest	Transport	Total
Pulpwood	Hardwood	Birch	$18.50	$16.00	$16.00	$50.50
	Softwood	Pine, Spruce	$24.00	$21.50	$19.50	$65.00
Sawtimber	Softwood	Pine, Spruce	$55.00	$22.50	$14.00	$91.50

SOURCE: [66]

4.10 Ontario, Canada

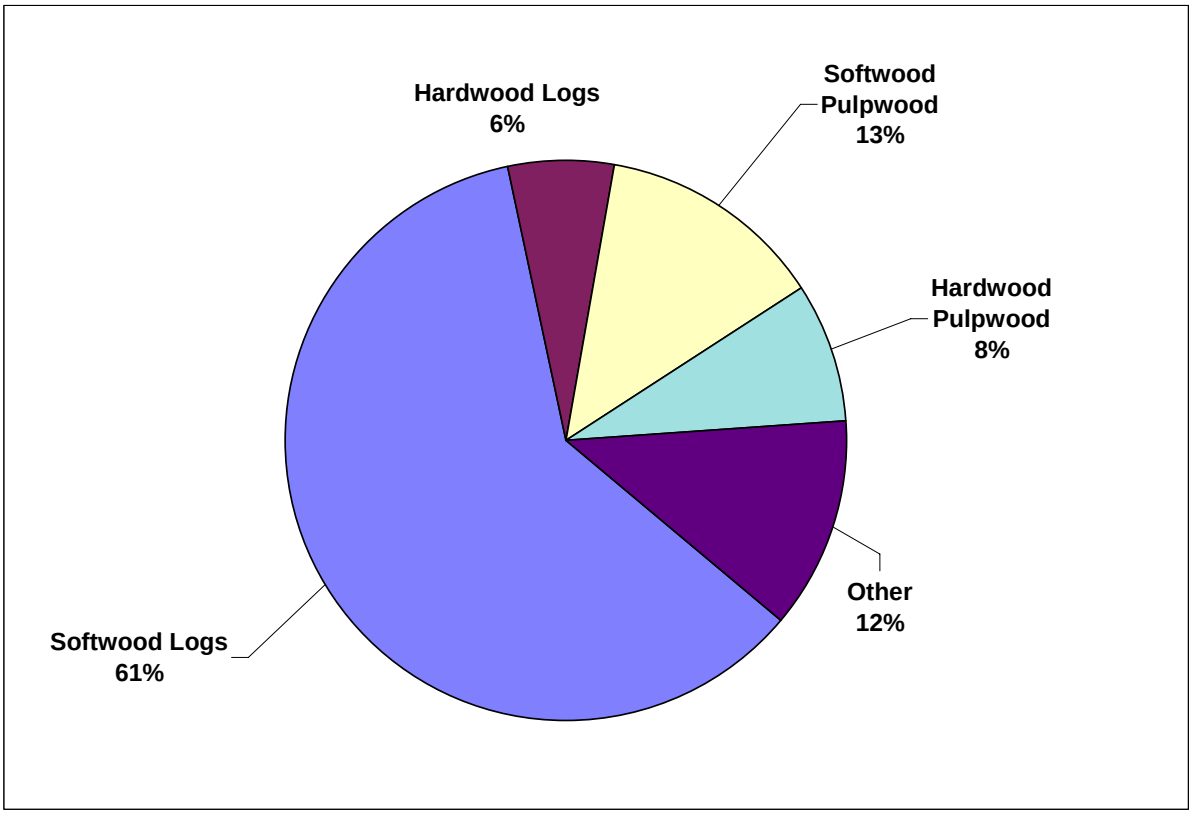
Although Ontario borders Michigan, it differs in a number of important ways. Its forests are principally boreal types, as opposed to Michigan's extensive northern hardwoods. Forest land in Ontario is about 90% owned by the province, and timber is sold under long term forest licenses, as opposed to the short term stumpage sales that are common in Michigan.

Roundwood production in Ontario is predominantly softwood, with softwood logs accounting for more than 60% of total roundwood production (Figure 88). The pulp industry (softwood and hardwood) and lumber industry (mainly softwood) are the largest consumers of logs in the province. Both sectors have struggled the past 3-4 years and the industry is consolidating and downsizing. Lumber production in 2007 was 11% lower than in 2005.

The pulp and paper industry is not in a good position to compete globally due to high wood fiber costs. Energy and labor costs have also gone up the past few years, which makes the province one of the highest cost producing regions in North America.

Ontario is, together with Quebec, the only major producer of hardwood lumber in Canada. This sector has been negatively impacted by the reduced housing starts in the US the past two years, so production is down.

Figure 88. Roundwood Production in Ontario, 2005 (% of 23.2 million m^3).



SOURCE: [75]

Roundwood costs (Table 13) have historically been very stable due to the high percentage of public ownership, and as a consequence, a high level of wood self-sufficiency on the part of Crown License holders. Stumpage values are determined by the provincial government and partly adjusted based on market prices for lumber, panels and paper; as a result, when product prices decline, as they did in 2007, the stumpage costs for the industry also fall. Harvesting costs are fairly high compared to many other world regions due to older logging equipment, less optimized logistics, and in some cases unionized labor. Transport costs have increased the past few years as a result of higher energy costs and longer hauling distances.

Most roundwood removed from the forests is sent preferentially to a sawmilling operation. In Canadian dollars, softwood sawlog costs have been fairly stable the past five years, fluctuating between C$75-80/$m^3$ (solid wood). The dominant factors influencing log prices in Ontario have been the US demand for lumber, the Canadian exchange rate and energy costs. The pulp industry operates on residual woodchips or logs too small for utilization by lumber manufacturers.

Table 13. Estimated Delivered Wood Costs for Ontario Circa 2007 ($/green ton).

Product	Species Group	Indicator Species	Stumpage	Harvest	Transport	Total
Pulpwood	Hardwood	Aspen	$1.50	$22.00	$14.50	$38.00
	Softwood	Jack Pine, Spruce/Fir	$7.00	$31.50	$25.50	$64.00
Sawtimber	Hardwood	Birch, Aspen, Maple	$4.00	$22.00	$14.00	$40.00
	Softwood	Jack Pine, Spruce/Fir	$8.00	$32.50	$25.50	$66.00

SOURCE: [66]

4.11 Summary Comparisons

The wood cost estimates for the stumpage, harvest, and transport components are summarized by region in Table 14 through Table 16. The most variable cost component is stumpage. This variability owes to several factors:

- Principal timber sale methods. In some regions, including Michigan, timber is sold at auction or by negotiation in relatively small lots, on relatively short term contracts. In other regions, timber is sold under long-term leases or licenses, where the lessee or licensee has the responsibility for managing the forest property. In these regions, including Ontario and Russia, stumpage appears to be low, but it is difficult to make apples to apples comparisons because of the significant differences in sale methods. In fact, this inability to make unambiguous comparisons is a significant reason why the US/Canada softwood lumber dispute has dragged on for about thirty years.
- Timber quality. In Michigan, the hardwood sawtimber prices reflect the principal species of hard maple and red oak. Most other regions do not have the same high quality resource as Michigan, nor do they reflect the same species. There are examples of higher stumpage than in Michigan, such as cherry prices in Pennsylvania, which in 2007 averaged over $225 per green ton [76].
- Stumpage as a residual. By this perspective, the amount paid for stumpage is the residual of the value of wood delivered to the mill gate, less harvest and transport costs. This partially explains why in regions of high operating costs, stumpage is relatively low.
- Pure supply and demand conditions. Timber supply can be limited by physical scarcity, or by harvest policies of landowners. Typically, where forest ownership is heavily public (Michigan, Pacific Northwest) or heavily small private landowners (Finland, Sweden) stumpage prices tend to be higher because of landowner reluctance to harvest.

Harvest and transport costs are less variable than stumpage. Variability tends to be related to:

- Fuel costs, which depend on regional production capacity, global supply/demand and energy tax levels.
- Labor costs, which obviously vary across the globe. In some regions, logging and transportation functions are integrated with the destination mill, and may be unionized operations, which tends to raise costs. In Michigan, company logging operations are rare, and often harvest and transportation are performed by separate firms. In the extreme case, even some harvest operations, such as skidding, may be subcontracted.

- Technology in use. More modern technologies such as cut-to-length systems can be expensive to employ but are better adapted to certain forest conditions and silvicultural techniques. Manual felling is most expensive, but is necessary in some regions where topography is difficult.
- Silvicultural techniques. Where partial cutting systems predominate, as they do in Michigan, per unit costs tend to be higher than in regions where clearcutting is the dominant production method.
- Transport distances. Average haul distances are difficult to estimate over wide regions with hundreds of destination points, but cost per ton-mile seems to fall within a fairly narrow range of $.13 to $.18/ton/mile across regions. Transport distance can vary widely, with the longest distances in some of the more remote regions such as Ontario and Russia.

Table 14. Comparative Average Stumpage Costs by Region ($US/green ton).

Region	Hardwood Pulpwood	Hardwood Sawtimber	Softwood Pulpwood	Softwood Sawtimber
Brazil	$15.50		$10.00	$23.00
Finland	$20.50		$34.50	$97.00
Michigan	$8.50	$71.50	$13.00	$27.50
New Zealand			$10.00	$28.50
Ontario, Canada	$1.50	$4.00	$7.00	$8.00
Russia	$4.00	$4.00	$5.00	$6.00
Sweden	$18.50		$24.00	$55.00
US Northeast	$11.50	$64.50	$24.50	$51.00
US Northwest	$4.00	$39.00	$6.00	$31.00
US South	$10.00	$26.00	$10.50	$37.00

Table 15. Comparative Average Harvest Costs (stump to roadside) by Region ($US/green ton).

Region	Hardwood Pulpwood	Hardwood Sawtimber	Softwood Pulpwood	Softwood Sawtimber
Brazil	$8.00		$16.50	$12.00
Finland	$19.50		$21.00	$14.00
Michigan	$14.00	$16.00	$14.00	$20.00
New Zealand			$13.50	$25.00
Ontario, Canada	$22.00	$22.00	$31.50	$32.50
Russia	$18.00	$23.50	$24.00	$37.50
Sweden	$16.00		$21.50	$22.50
US Northeast	$14.50	$16.50	$15.50	$23.50
US Northwest	$23.00	$35.00	$20.00	$27.00
US South	$12.50	$12.00	$12.50	$11.50

Table 16. Comparative Average Transportation Costs by Region ($US/green ton/mile).

Region	Hardwood Pulpwood	Hardwood Sawtimber	Softwood Pulpwood	Softwood Sawtimber
Brazil	$16.50		$11.00	$15.50
Finland	$11.50		$13.50	$12.00
Michigan	$10.50	$10.00	$10.50	$10.00
New Zealand			$10.00	$12.50
Ontario, Canada	$14.50	$14.00	$25.50	$25.50
Russia	$15.50	$18.50	$20.50	$31.50
Sweden	$16.00		$19.50	$14.00
US Northeast	$10.00	$10.50	$10.00	$10.50
US Northwest	$12.00	$16.50	$10.00	$13.50
US South	$7.00	$7.00	$7.00	$7.00

In Figure 89 through Figure 96, component costs are compared relative to an average cost across regions. In each chart, “error bars” are indicated as $\pm$ 15% of the total cost, representing the uncertainty in estimation which has been described above. Given this uncertainty, the general patterns revealed by the charts suggest:

- Finland, Sweden, Russia, and Ontario have some of the highest wood costs in the world, due to a combination of effective supply/demand conditions and operating conditions.
- The US South appears to be the lowest cost region in the world, but if Brazil’s integrated operations were able to be considered, their costs would likely be lower.
- Michigan’s costs appear to be within a reasonable range of most other benchmark regions, and are generally lower than the most comparable region, the US Northeast, although differences are within the likely margins of error.

Figure 89. Comparison of Delivered Softwood Pulpwood Costs Among Benchmark Regions.

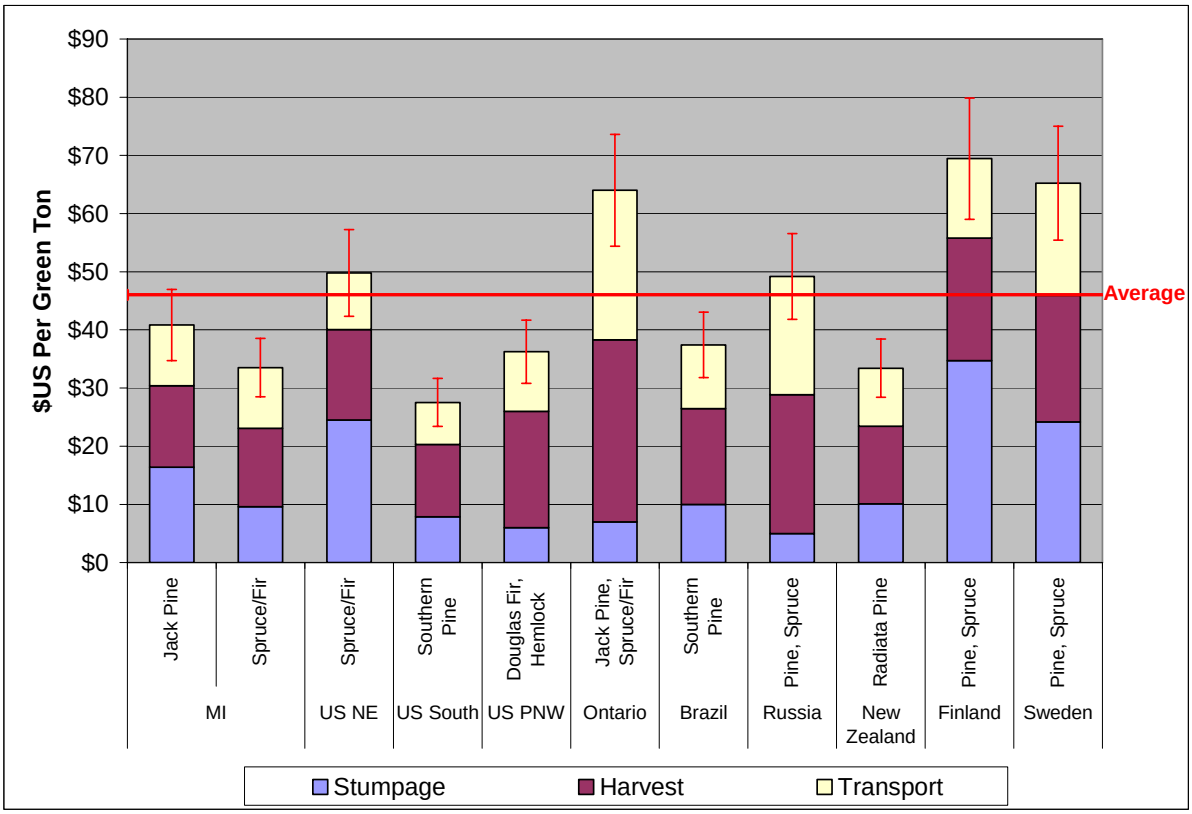


Figure 90. Comparison of Softwood Pulpwood Harvest and Transport Costs Among Benchmark Regions.

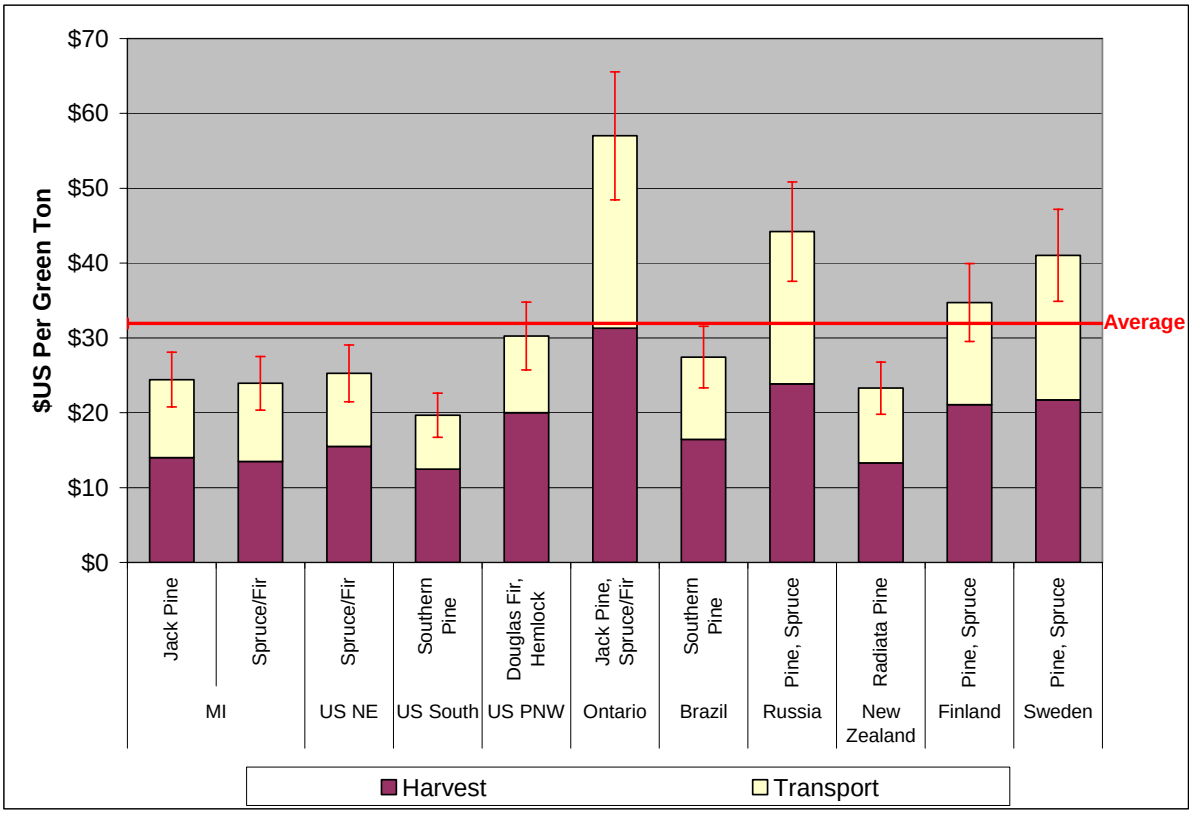


Figure 91. Comparison of Delivered Hardwood Pulpwood Costs Among Benchmark Regions.

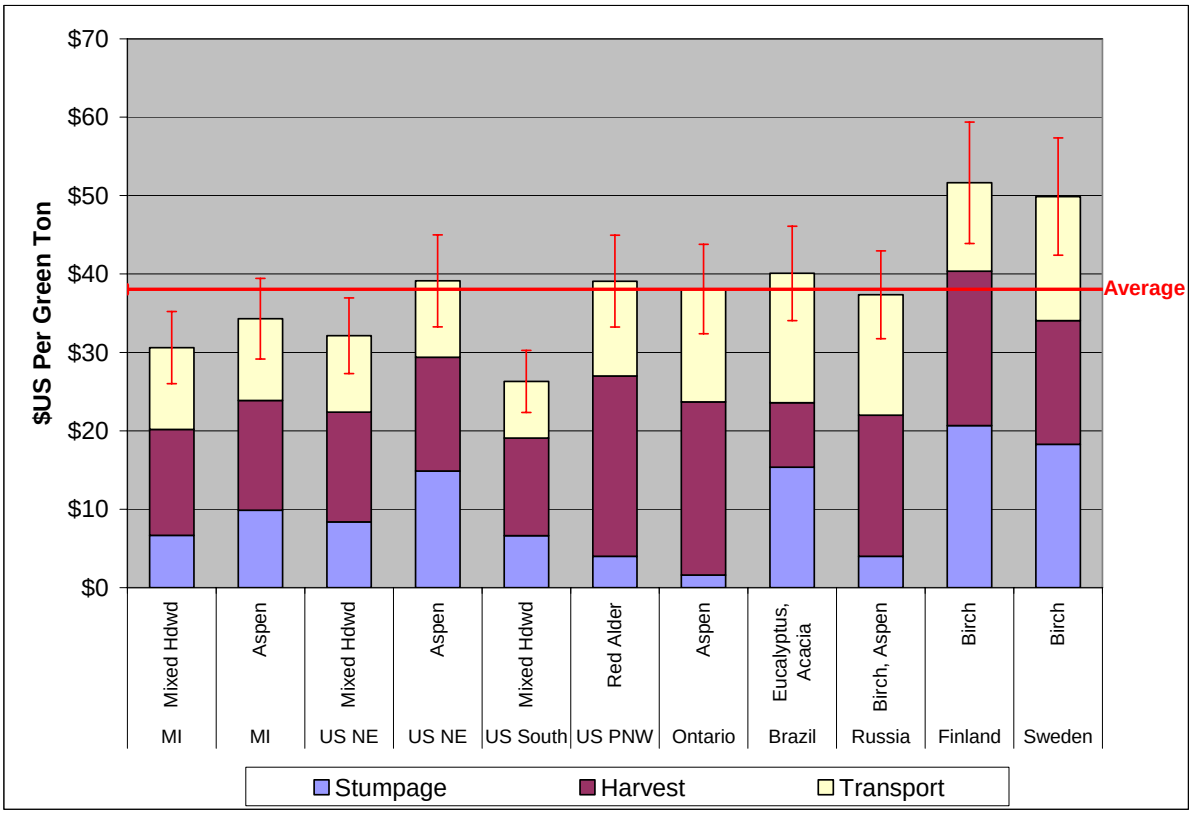


Figure 92. Comparison of Hardwood Pulpwood Harvest and Transport Costs Among Benchmark Regions.

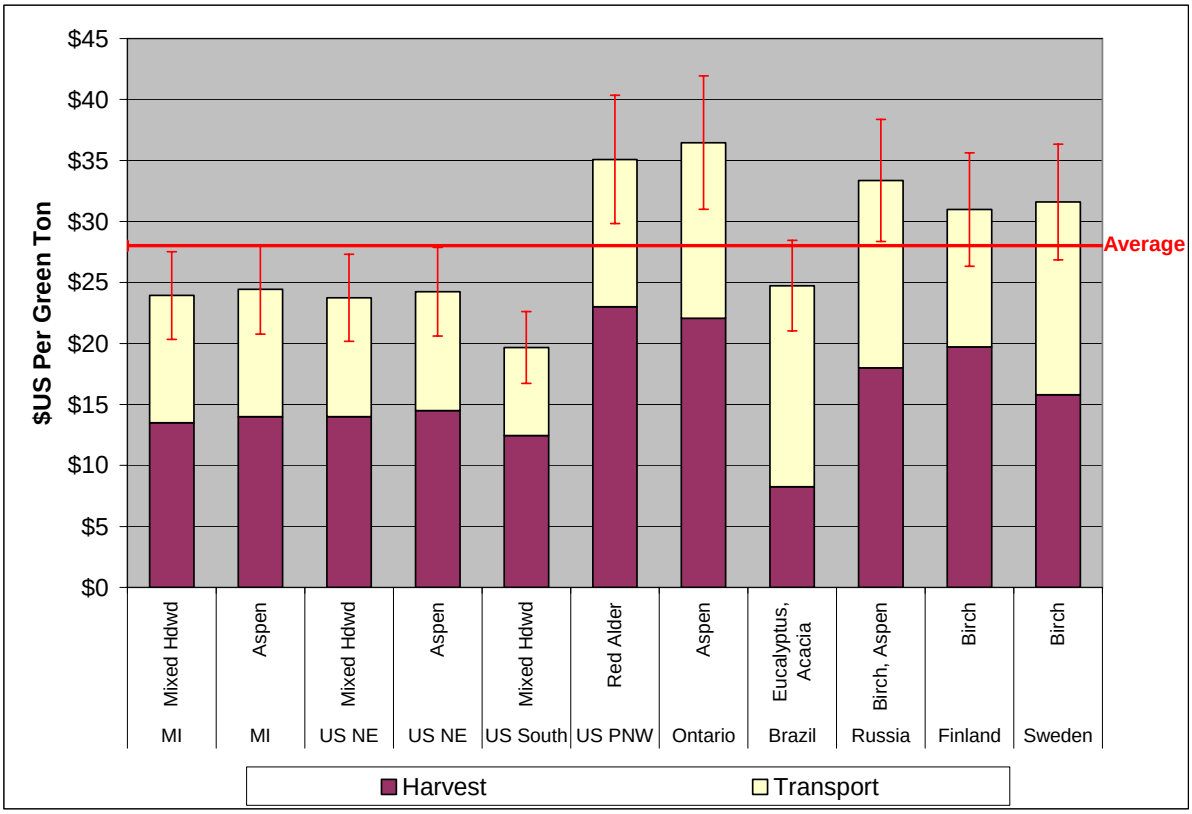


Figure 93. Comparison of Delivered Softwood Sawtimber Costs Among Benchmark Regions.

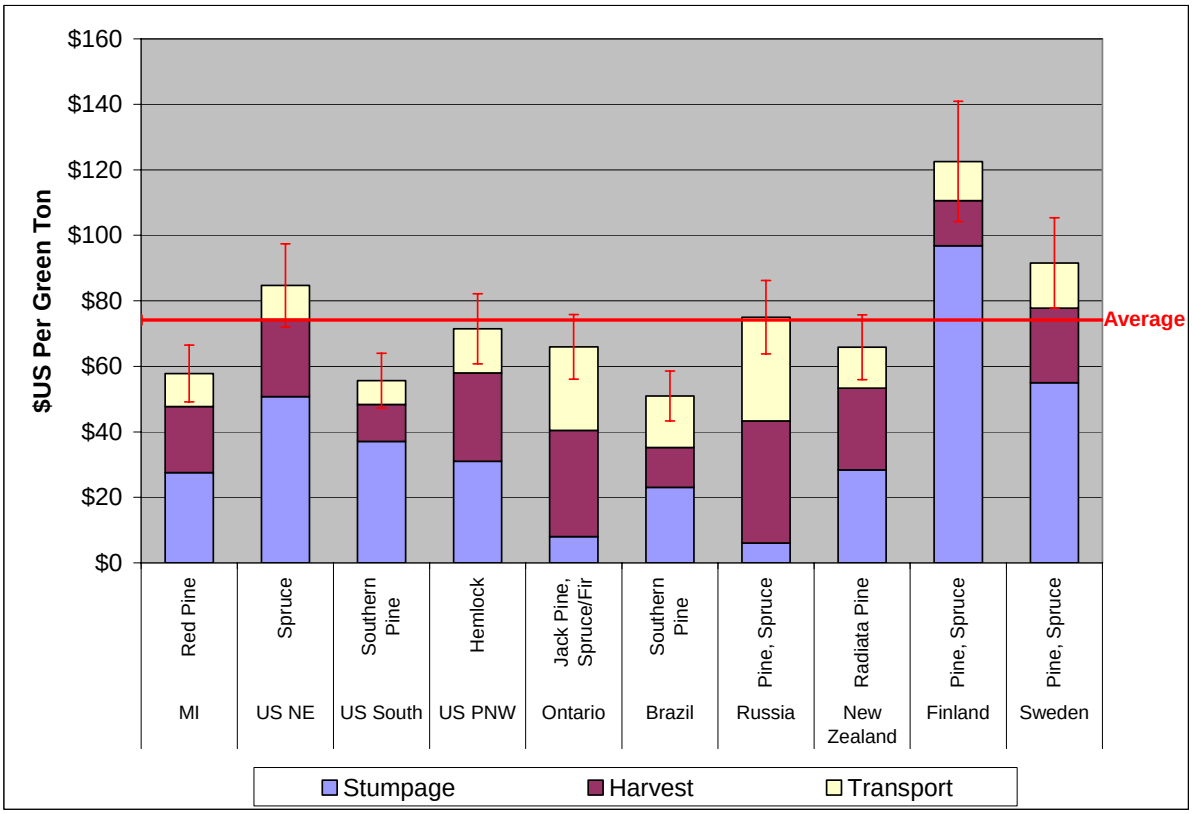


Figure 94. Comparison of Softwood Sawtimber Harvest and Transport Costs Among Benchmark Regions.

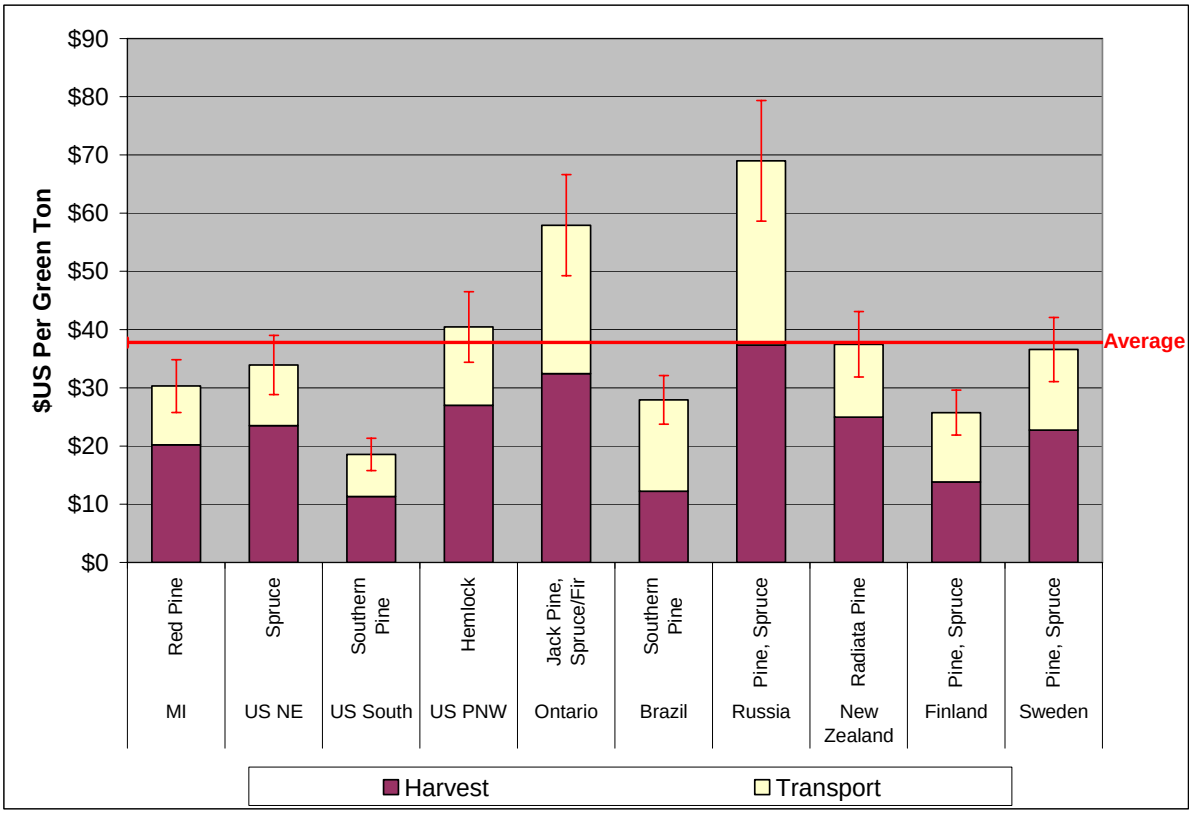


Figure 95. Comparison of Delivered Hardwood Sawtimber Costs Among Benchmark Regions.

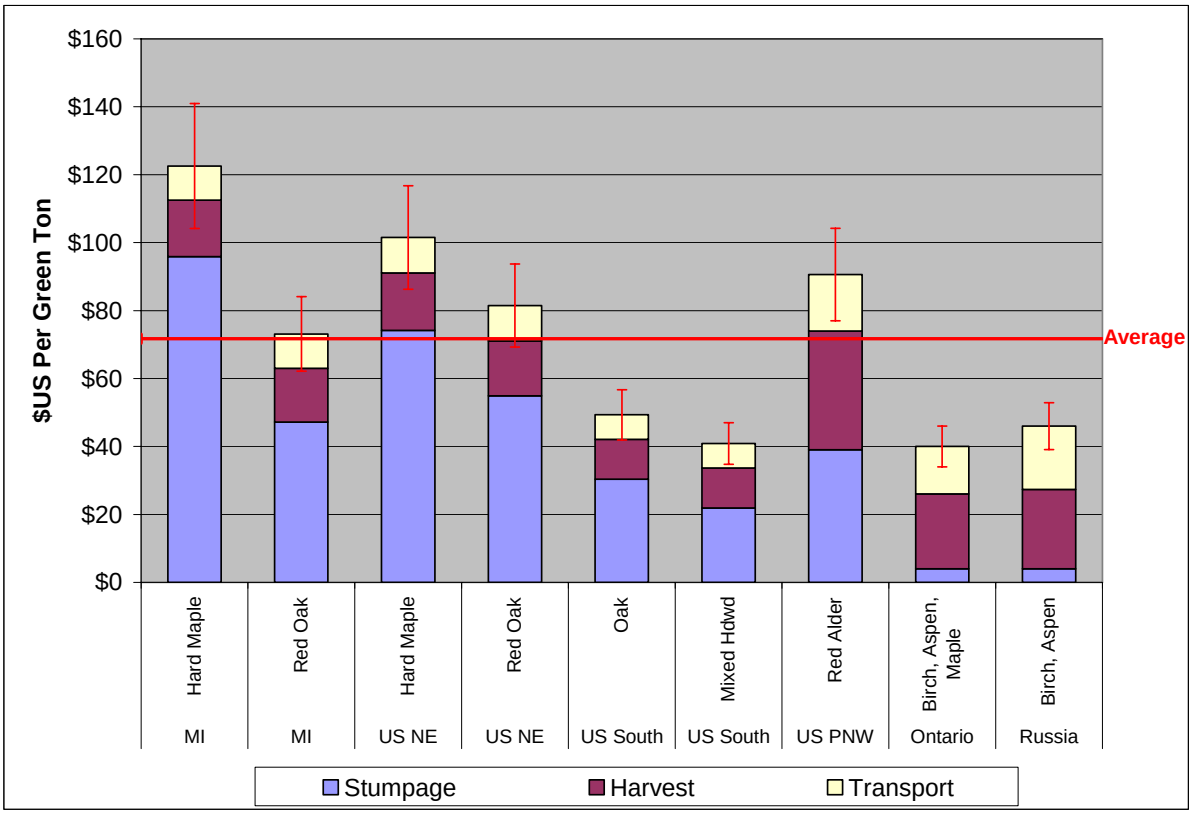
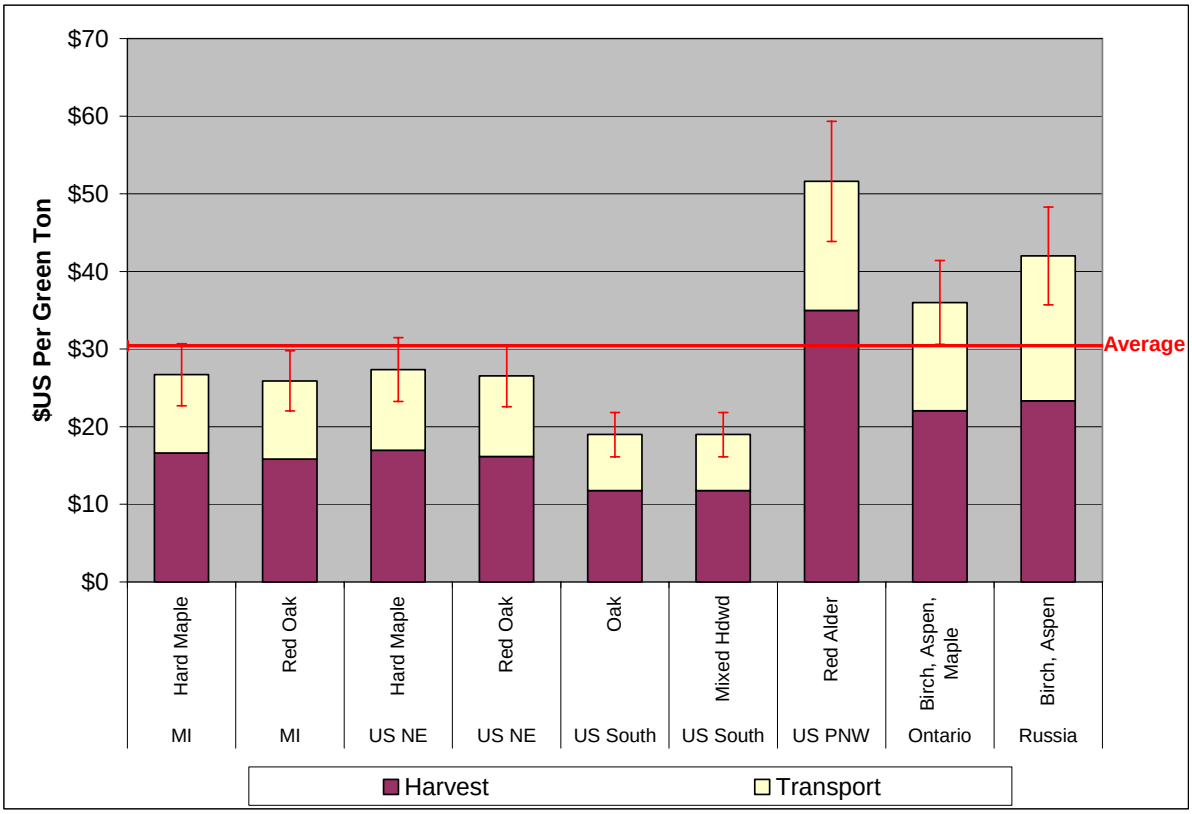


Figure 96. Comparison of Hardwood Sawtimber Harvest and Transport Costs Among Benchmark Regions.



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	Softwood	Hardwood
US, Northwest	435	370
Ontario	390	500
Finland	385	510
Sweden	385	510
Russia	385	510
Brazil	500	475
New Zealand	400	N/A

Other volume and weight conversion factors:

Solid Wood Equivalents (SWE)
Cubic Meter = 35.3 cubic feet
Cord = 80 cubic feet

Species Group	Units	Green Tons/Unit
Hard Maple	MBF Scribner	5.90
Red Oak	MBF Scribner	6.19
Spruce	MBF Scribner	4.25
Red Pine	MBF Scribner	4.55
Hard Maple	MBF Int'l 1/4	5.46
Red Oak	MBF Int'l 1/4	5.73
Mixed Hardwood	cords	2.61
Aspen	cords	2.33
Jack Pine	cords	2.13
Spruce/Fir	cords	2.06

Measure	Cu Ft SWE/MBF	Cords/MBF
Doyle MBF	218	2.7255
Scribner MBF	171	2.1330
Int'l MBF	158	1.9750

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Canada (C$)	1.074
Finland (€)	0.731
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Brazil (BRL)	1.953
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Appendix B: Analysts Qualifications

Samuel J. Radcliffe is Vice President of Prentiss & Carlisle Management Company (PCMC), where he directs valuation services and Lake States forest management operations. Prior to PCMC's acquisition of George Banzhaf & Company (GB&CO) in September 2005, he had been President of GB&CO for 17 years, and its chief timber industry analyst since 1980. Mr. Radcliffe is a forest economist by training and has extensive experience in valuation and price analysis.

Before joining George Banzhaf & Company in 1980, he was a Research Fellow in the Forest Economics and Policy Program of Resources for the Future, a non-profit research organization located in Washington, DC. Mr. Radcliffe's professional experience also includes several positions with the USDA Forest Service. His relevant experience includes:

- Appraised more than ten million acres of timberland in the US South, Lake States, and Northeast, and more than two million acres in the eastern provinces of Canada, using comparable sales and discounted cash flow methods
- Developed statistical sampling designs and data processing systems, and directed timber inventory projects on millions of acres of land in both the Lake States and the South
- Completed wood feasibility studies for corporations that collectively involved capital decisions of more than $2.5 billion
- Served as critical reviewer and expert witness on timberland appraisal, timber inventory, and forest management issues
- Authored or co-authored articles on international trade in forest products, timberland appraisal, geographic information systems, forest policy, ethics, investment, and timber taxation issues

Mr. Radcliffe holds a BS in forest management from Virginia Polytechnic Institute and a MS in forest economics from the University of California at Berkeley. He has held a number of elected and appointed positions with the Society of American Foresters: Forest Policy specialist on the Editorial Board of the Journal of Forestry, Chair of the Wisconsin Society of American Foresters, Chair of the SAF Ad Hoc Committee on Land Ethic Implementation, member of the first SAF Task Force on Strategic Planning, and Chair of SAF's National Ethics Committee. He was a member of the Technical Advisory Committee for the Lake States Forest Assessment, the Scientific Roundtable on Socio-Economic Issues for the Wisconsin National Forests, and the National Blue Ribbon Panel on Forest Inventory and Analysis (AF&PA). He is a member of the School of Forestry and Wood Products Advisory Committee for Michigan Tech University. Mr. Radcliffe is a federally Certified General Appraiser (Alabama, Maine, Michigan, Wisconsin).

In addition to more than 200 proprietary client reports, Mr. Radcliffe has authored the following published and unpublished papers:

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"Organization and Coordination of Minnesota Timber Programs." Presented at the Minnesota Timber Study Conference sponsored by the Legislative Commission on Minnesota Resources, Bloomington, Minnesota, December, 1980.

"The Political Process and Forest Resource Management: Can We Be Successful?" Presented at the joint Annual Meeting of the Michigan, Minnesota, and Wisconsin Sections of the Society of American Foresters, Green Bay, Wisconsin, February, 1981.

"World Trade and its Effect on U.S. Forest Products Production: An Input-Output Approach." Presented at the Annual Meeting of the Forest Products Research Society, St. Paul, Minnesota, June, 1981.

"U.S./Canada Softwood Lumber Trade and the Alleged Canadian Stumpage Subsidy." Presented at the Annual Meeting of the Midwest Forest Economists, Madison, Wisconsin, August, 1983.

"Capital Gains Tax Reform and How it Affects the Forest Products Industry." Presented at the Annual Meeting of the Southeastern Lumber Manufacturers Association, Hot Springs, Virginia, August, 1985.

"The Probable Impact of the Administration's Tax Reform Proposals on "Timber Investment and Supply." Presented at the Timberland Market Place

Symposium sponsored by Duke University, New Orleans, Louisiana, December, 1985.

"Problem Analyses to Meet Client Needs." Guest lecture to the Consulting Forestry Seminar, School of Forestry and Wildlife Resources, Virginia Polytechnic Institute & State University, Blacksburg, Virginia, April, 1986.

"New Tax Law Changes and the Impacts on Timber Income." Presented at the Annual Meeting of the Association of Consulting Foresters, Green Bay, Wisconsin, June, 1986.

"On Import/Export Prices." Presented at the "Growing Taxes, Growing Trees" conference sponsored by Duke University, Durham, North Carolina, April, 1987.

"Foresters and Information Management in the 21st Century." Keynote address to the Boise Cascade Forestry Users Group, Point Clear, Alabama, June, 1989.

"Forestry Issues in Minnesota." Keynote forestry speaker at the Minnesota Natural Resources Congress sponsored by the Legislative Commission on Minnesota Resources, St. Paul, Minnesota, October, 1989.

"Wisconsin Stumpage Prices: An Historical Perspective." Presented at the "Growing Trees -- Return on Investment" Conference sponsored by the Wisconsin Society of American Foresters, Green Bay, Wisconsin, March, 1990.

"Forest Policy and the Endangered Species Act." Presented at the Mid-America Expo sponsored by the Mid-America Lumbermens Association, Kansas City, Missouri, February, 1992.

"Timber Economics and Management." Presented at the annual conference of the National Trust Real Estate Association, Milwaukee, Wisconsin, May, 1994.

"The Timberland Investment Climate." Presented at the Institutional Investment in Lake States Timberland conference, sponsored by Michigan State University Cooperative Extension Service and the USDA North Central Forest Experiment Station, Livonia, Michigan, September, 1994.

"Consultant Perspective on FIA Data Needs." Presented at the FIA Strategy Workshop, sponsored by the Lake States Forest Alliance, Bloomington, Minnesota, October, 1995.

"Sustainability." Remarks as Panel Chair, Global Fiber Supply Symposium, sponsored by the Technical Association of the Pulp and Paper Industry (TAPPI), Chicago, Illinois, October 1995.

"Challenges and Opportunities for Forestry Consultants in the 21st Century." Presented at a meeting of the Southwest Wisconsin Chapter of the Society of American Foresters, Madison, Wisconsin, March, 1996.

"Virtual Ethics and the Virtue of Ethical Codes." Keynote address to the Winter Meeting of the New York Society of American Foresters, Syracuse, New York, January, 1997.

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"What Happened to Industrial Ownership of Timberland?" Forthcoming at the Wisconsin State Society of American Foresters Conference, Milwaukee, WI, March, 2008.

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