



40 Forty Years of Hardwood Lumber Consumption: 1963 to 2002

Summary

An analysis of hardwood lumber consumption found that demand has changed dramatically over the past four decades as a result of material substitution, changes in construction and remodeling product markets, and globalization. In 1963 furniture producers consumed 36 percent of the hardwood lumber used by domestic manufacturers. Producers of hardwood construction and remodeling (CR) products accounted for an additional 32 percent of hardwood lumber consumption with the bulk of this volume being consumed by manufacturers of hardwood flooring. Between 1967 and 1982 hardwood lumber consumption by furniture producers remained relatively constant. By contrast, lumber demand by CR product manufacturers declined by 33 percent as carpeting was substituted for wood flooring. However, this decline in demand was countered by increased production of pallets and crossties, which accounted for 41 percent of hardwood lumber consumption by 1982. In the 1980s and 1990s overall hardwood lumber consumption surged because of increased lumber use by pallet and CR product manufacturers. Since the late 1990s furniture imports have increased while domestic furniture production has declined, thus furniture manufacturers accounted for only 18 percent of domestic hardwood lumber consumption by 2002. By contrast, consumption by the hardwood millwork, cabinet, and flooring sectors have continued to increase, partially offsetting the decreased consumption by the domestic furniture industry.

Lumber is the most important product derived from eastern hardwood forests on the basis of total value. Domestic demand for hardwood lumber, however, has changed over the last 40 years. For example, between 1963 and 1997, consumption of hardwood lumber by the furniture industry (wood household, upholstered household, and office) remained relatively constant while consumption by manufacturers of industrial hardwood products (pallets and crossties) nearly tripled. Lumber consumption by manufacturers of construction and remodeling products (millwork, flooring, cabinets, and other building products) declined by

33 percent between 1963 and 1982 but increased by nearly 190 percent between 1982 and 2002 (**Fig. 1a and 1b**). Examining these changes in demand is an important step in determining how markets influence the volume and type of timber harvested. The objective of this paper is to describe and explain trends in domestic consumption of hardwood lumber between 1963 and 2002 by individual industries and by major industry groups. The results of this analysis will assist researchers and policy makers to develop products, processes, and incentives to help U.S. manufacturers of wood products remain competitive.

By William Luppold and Matthew Bumgardner

Facing Page Photos: Solid hardwood cabinetry has contributed to the resurgence of hardwood use by the construction and remodeling industry. (Top: Courtesy of Diamond Cabinets, division of MasterBrand Cabinets, Inc. Bottom: Courtesy of Aristokraft Cabinets, division of MasterBrand Cabinets, Inc.)

Figure 1a. — Hardwood lumber consumption by major industry groups in 1963, 1982, and 2002.

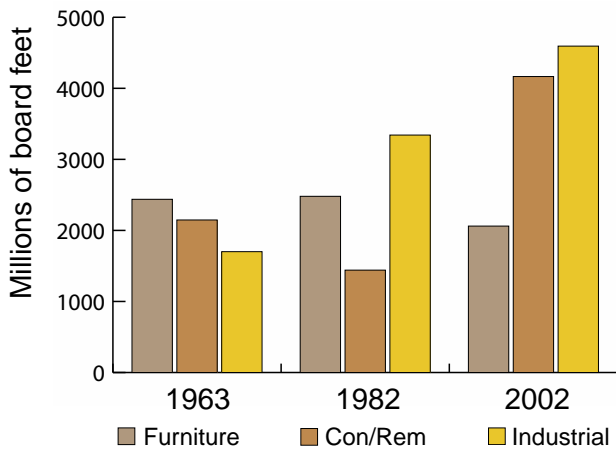
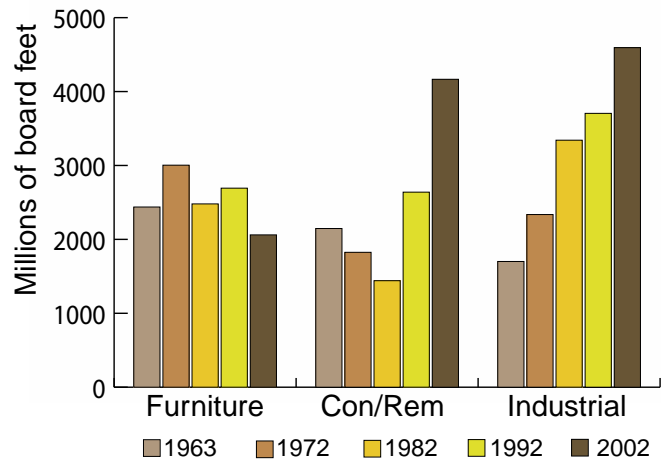


Figure 1b. — Major industry groups' consumption of hardwood at 10-year intervals.



Data Consideration

The only consistent source of data on hardwood lumber consumption across all industries is the periodic Census of Manufactures. This census was conducted in 1963 and 1967 and has been conducted every 5 years since. Interpreting Census data is difficult. A firm that is primarily involved in producing millwork products might also produce wood flooring. Firms also might change their product line over time but continue to report under a previously established industry classification. These challenges require that we look at broad aggregates of industries in addition to individual industries.

Additional major data issues associated with Census information include aggregation issues resulting from the implementation of the North American Industry Classification System (NAICS) in 1997 and subsequent scrapping of the Standard Industrial Classification (SIC) system, incomplete data on volumes of materials consumed, the consumption of lumber via dimension or frame purchases, and firms not reporting material consumption by kind. Because of these limitations, one must make assumptions in order to interpret Census data. While major assumptions regarding data are presented in the appendix or mentioned throughout this paper, a detailed explanation of all assumptions and industries included in each industrial group is presented in a companion publication, "Procedures Used to Estimate Hardwood Lumber Consumption from 1963 to 2002" (Luppold and Bumgardner 2008).

Furniture industry group

The furniture group includes wood household, upholstered household, and office and institutional furniture manufacturers. The wood household furniture (SIC 2511) category includes case good manufacturers, hardwood TV and radio cabinets, and other household furniture not elsewhere classified (NEC). In 1963 and 1967, manufacturers of kitchen cabinets were included under SIC 2511, requiring the volume of lumber consumed by this industry to be adjusted downward.

Upholstered furniture manufacturers use hardwood lumber for exposed surfaces such as legs and arms and for frame productions. Furniture frames have traditionally

been manufactured from low-grade lumber and could be made in-plant or outsourced. By the late 1990s, however, plywood and other panel products started to displace hardwood lumber in frame production. It is difficult to determine how much hardwood lumber has been displaced by plywood. In this study it is assumed that plywood frames constituted 50 percent of the market in 1997 and 80 percent of the market in 2002.

Office, institutional, and other manufacturers of commercial furniture tend to purchase lumber in dressed or dimension form. However, some wood household furniture plants also manufacture hotel furniture. In this study it is assumed that office and institutional manufacturers purchase higher quality kiln-dried lumber.

Construction and remodeling industry group

The construction and remodeling (CR) group is composed of manufacturers of kitchen cabinets, hardwood flooring, hardwood millwork, and other building products made from hardwood lumber. Before 1972, kitchen cabinets were classified under wood household furniture, but dollar volume of cabinet sales was also reported, permitting an estimate of hardwood lumber consumption to be developed. These estimates were then subtracted from lumber consumption estimates for the wood household furniture industry.

Historically, hardwood flooring has been combined with the dimension industry in the Census of Manufactures, but the Census also provides estimates of the volume produced by product group. Traditionally, however, oak and maple strip flooring have been measured on a nominal basis while other forms of flooring have been measured on an actual basis. For this reason it was assumed that it took 1.66 board feet of rough lumber for every board foot of strip flooring and 2 board feet of rough lumber for every board foot of other flooring products.

Two other construction-related industries are trusses and prefabricated wood buildings and components. Truss manufacturers use hardwood lumber for appearance applications such as glued-up beams or exposed post-and-beam structures. Prefabricated wood buildings and components manufacturers use hardwood lumber for trim or other appearance applications and also manufacture millwork products. These manufacturers are identified under other building products in the remainder of this paper.

Industrial products group

The industrial group is composed of pallet and container producers and wood preservers that treat railroad crossties. During the 1960s, pallets also were produced by firms that manufactured boxes and other containers. The expansion of this industry in the 1970s was facilitated in part by the large volume of low-grade oak available as the flooring industry declined. Because the lumber used by the pallet industry does not have to be clear, pallets have become the largest user of nongraded lumber and cants.

In the 1960s, estimates of hardwood lumber consumption by the entire wood treatment industry as reported in the Census of Manufactures appeared to be lower than reported crosstie usage alone. Because of this apparent underreporting, estimates of hardwood lumber consumption for crossties developed by Cardellichio and Binkley (1984) were used for the 1963, 1967, and 1972 census periods.

Miscellaneous hardwood products group

This category includes a diverse and changing group of manufacturers ranging from producers of jewelry boxes to manufacturers of wooden bowls. In 1963 and 1967 pallet manufacturers were included in this category, requiring the volume of lumber consumed by this industry to be adjusted downward for those two census years. Although lumber can be used for core stock for plywood or composite panels or edgbanding, most lumber used in this application is most likely captured under wood household furniture manufacturers. Lumber also can be used in combination with veneer to make containers or to produce veneer. Therefore, lumber used by the plywood industry is included with miscellaneous hardwood products. It should be noted that several uses of hardwood lumber are not covered by the census, including road beds, mine props, local construction, and dunnage.

Changes in Hardwood Lumber Consumption by Decade

1963 to 1972

In 1963 furniture producers consumed more than 2.4 billion board feet (BBF) of hardwood lumber, or 36 percent

of the lumber used by domestic hardwood-using industries (Table 1). Wood household furniture producers accounted for nearly 68 percent of the lumber consumed by furniture manufacturers, with the bulk of the lumber directly purchased as lumber and the remainder purchased in the form of dimension (Table 2). Upholstered furniture manufacturers used nearly 700 million board feet (MMBF); more than 40 percent was consumed indirectly through purchases of furniture frames and other dimension products. Producers of CR products consumed 2.1 BBF of hardwood lumber in 1963 (Table 1), with the bulk of this volume being consumed by manufacturers of oak strip flooring (Table 2). Industrial product manufacturers collectively consumed 1.7 BBF, with 70 percent of this volume being consumed by manufacturers of pallets and containers.

Domestic consumption of hardwood lumber increased by more than 1.6 BBF between 1963 and 1972 (Table 1) as consumption by the furniture industry reached 3 BBF. Factors that influenced this large increase in consumption included a high volume of furniture shipments and relatively low use of medium density fiberboard (MDF). In subsequent years MDF was substituted for hardwood lumber in low- and mid-priced furniture. It should be noted that the relatively high volume of indirect purchases by wood and upholstered furniture manufacturers was influenced by flooring manufacturers converting to dimension manufacturing.

Demand for industrial products also increased to 2.3 BBF between 1967 and 1972 as lumber use by pallet and crosstie manufacturers increased. By contrast, lumber consumption by flooring producers decreased by more than 55 percent as carpet replaced wood flooring in home construction and remodeling. This decline was partially offset by increased hardwood lumber consumption by millwork, cabinet, and other building product manufacturers.

1972 to 1982

Domestic hardwood lumber consumption decreased by more than 500 MMBF between 1972 and 1977 as the hardwood industry struggled to recover from the 1975 recession. However, while consumption of hardwood lumber by furniture, millwork, cabinet, flooring, and crosstie producers

Table 1. — Hardwood lumber consumption by industrial group for census years 1963 to 2002.

Industry group	1963	1967	1972	1977	1982	1987	1992	1997	2002
	—Million board feet—								
Furniture	2,438	2,728	3,004	2,766	2,480	2,699	2,693	2,657	2,061
Construction & remodeling	2,147	2,165	1,825	1,784	1,441	2,447	2,639	3,693	4,166
Industrial	1,701	2,161	2,336	2,498	3,342	4,118	3,705	4,993	4,594
Miscellaneous	492	1,127	1,251	828	873	997	956	740	567
Total domestic	6,778	8,181	8,416	7,876	8,136	10,261	9,993	12,083	11,388
Exports	131	164	237	240	321	688	919	1,213	1,162
Total domestic plus exports	6,909	8,345	8,653	8,116	8,457	10,949	10,912	13,296	12,550

Table 2. — Direct and indirect hardwood lumber consumption by major industries for census years 1963 to 2002.

Industry	1963	1967	1972	1977	1982	1987	1992	1997	2002
	—Million board feet—								
Wood furniture	1,594	1,689	1,926	1,783	1,613	1,781	1,546	1,592	1,248
Direct	1,186	1,119	1,206	1,301	1,009	976	842	1,114	827
Indirect	408	570	720	482	604	804	704	478	421
Upholstered furniture	671	795	865	720	545	583	663	492	442
Direct	395	439	427	354	205	195	246	237	212
Indirect	276	356	438	366	340	388	417	255	230
Office and institutional furniture	173	244	213	263	322	335	484	573	371
Kitchen cabinets	221	213	293	288	312	550	898	1,266	1,367
Millwork	256	370	614	485	436	653	644	726	923
Other building products	48	261	212	481	307	565	342	539	684
Pallets & containers	1,201	1,511	1,486	1,761	2,508	3,349	3,127	4,109	3,666
Crossties	500	650	850	737	834	769	578	884	928
Flooring	1,622	1,321	706	530	386	679	755	1,162	1,191
Miscellaneous	492	1,127	1,251	828	873	997	956	740	567

decreased, lumber consumption by pallet manufacturers increased (Table 2).

Domestic furniture shipments plummeted during the 1982 recession, resulting in continued declines in lumber consumption by household furniture manufacturers. However, use of hardwood lumber by manufacturers of office and institutional furniture increased. Lumber use by the flooring industry continued to decrease, hitting a post-WWII low in 1982. Lumber consumption by millwork and other building product manufacturers also decreased, but this decline appears to be recession related. By contrast, hardwood lumber consumption by the pallet sector continued to increase (Table 2).

1982 to 1992

Between 1982 and 1987, consumption of hardwood lumber by domestic manufacturers increased 2.1 BBF. Nearly 50 percent of this increase resulted from increased lumber consumption by CR product manufacturers. Furniture manufacturers also increased consumption of hardwood lumber consumption during the 1980s, but these increases were relatively small as furniture imports increased.

Lumber consumption decreased slightly between 1987 and 1992, but this decrease was disparate across and within industries. Use of hardwood lumber by wood household furniture manufacturers decreased as imports continued to increase. By contrast, consumption by manufacturers of upholstered and office furniture increased (Table 2). Similarly, consumption by flooring and kitchen cabinet manufacturers increased. The decrease in lumber consumption by industrial product manufacturers between 1987 and 1992 resulted from a reduction in both pallet and crosstie production.

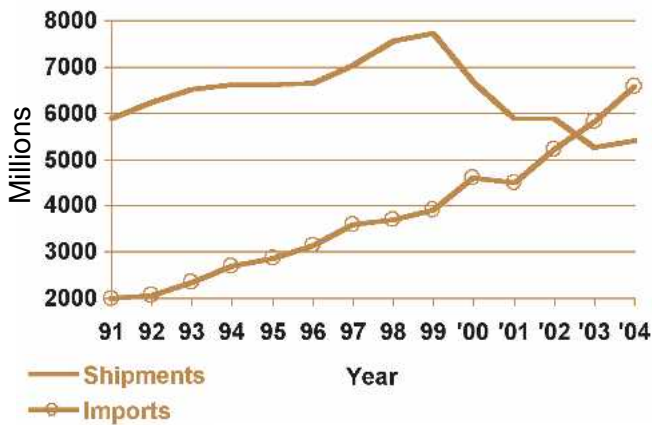
1992 to 2002

In the mid-1990s, domestic hardwood lumber consumption surged as use by CR producers increased. The nearly 1.1 BBF increase in lumber usage by the CR group over a 5-year period (1992-1997) was largely the result of increased use of hardwood material in home construction, as well as larger homes being built. By 1997, CR usage had surpassed that of the furniture group. However, industrial product manufacturers continued to be the largest users of hardwood lumber, consuming nearly 5 BBF in 1997.

Hardwood lumber consumption by the wood household and office and institutional furniture industries increased between 1992 and 1997, but this increase was offset by decreased lumber use in upholstered furniture. The decreased use of lumber by upholstered furniture manufacturers was the result of increased use of plywood in furniture.

Between 1997 and 2002 furniture manufacturers' consumption of hardwood lumber decreased by 700 MMBF as numerous domestic furniture plants closed because they could not compete with offshore producers (Schuler and Buehlmann 2003) (Figs. 2 and 3). Hardwood lumber consumption by the pallet industry also declined more than 400 MMBF between 1997 and 2002. This reduction was not a function of reduced pallet use but of increased recycling of pallets and pallet parts. One factor that encouraged the pallet industry to adopt recycling was increased prices of lower grade oak lumber resulting from increased flooring production. By contrast, hardwood lumber consumption by CR product manufacturers increased by nearly 500 MMBF to 4.2 BBF as home construction and remodeling activities increased in 2002.

Figure 2. — Value of domestic wood household furniture shipments and imports in constant 1982 dollars, 1991 - 2004.



Sources – 1989 to 1998: Emanuel and Rhodes 2002; 1999 to 2004: Akers 2006.

Conclusions

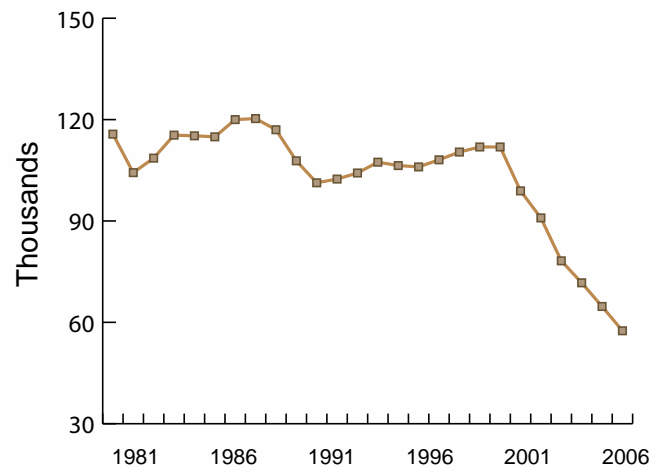
Consumption of hardwood lumber by domestic manufacturing industries increased nearly 78 percent between the early 1960s and late 1990s, before declining in the current century. Still, there is little consistency in demand for hardwood lumber when examining specific manufacturing categories or larger industry groups. Manufacturers of industrial products realized the largest increase in lumber use between 1963 and 2002, which seems to track with a generally expanding overall economy. However, while consumption of lumber by the pallet and container industry has increased almost continually, consumption by the crosstie industry has been somewhat erratic.

Although the furniture industry has long been considered the dominant consumer of hardwood lumber, the proportion of hardwood lumber consumed by these manufacturers has declined since the 1970s. In 1972 furniture producers accounted for 36 percent of domestic consumption, and wood household furniture manufacturers were the most important users. Furniture manufacturers were surpassed in hardwood lumber consumption by the industrial group in the early 1980s, and by the CR group in the late 1990s. Increased imports of wood furniture and the substitution of panel products for lumber caused relative consumption by the furniture industry to drop to 18 percent by 2002.

Lumber demand by CR product manufacturers declined between 1963 and 1982, largely as a result of reduced flooring production. Since 1982 there has been a steady increase in lumber consumption by these manufacturers as purchasers of residential homes have continued to increase their demand for hardwood flooring, cabinets, and millwork (Fig. 4). In 2002, these industries consumed 4.2 BBF of hardwood lumber.

The variability in demand for hardwood lumber over the last four decades demonstrates the dynamic and unpredictable nature of hardwood markets. Much of this unpredictability could be related to the fact that higher quality hardwood is consumed by industries that produce aesthetic or fashion-based products, such as flooring and

Figure 3. — Domestic wood furniture employment of production workers.

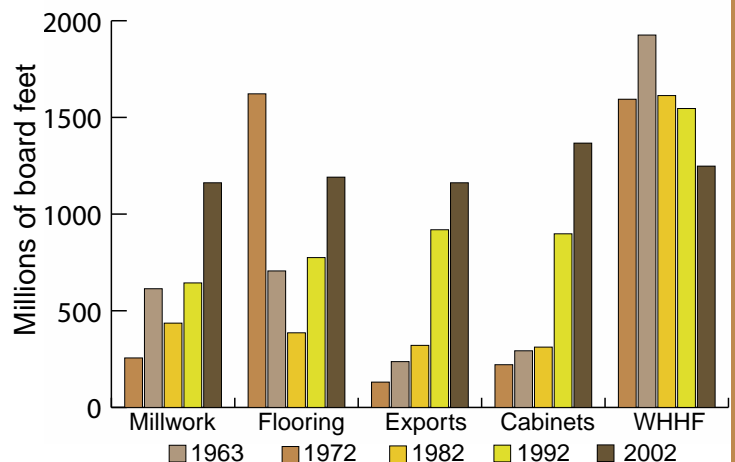


cabinetry, which cycle in and out of popularity. However, both the demise of the domestic furniture industry and the large increase in hardwood lumber use by pallet manufacturers would have been difficult to predict 40 years ago.

Material and product substitution also has played a major role in shaping some hardwood markets. In 1963 veneered table tops were normally constructed using hardwood plywood with a lumber core; by the 1980s particleboard and other composite substrates had replaced lumber. In the 1960s carpet became the favored floor covering, but in the 1990s wood flooring reemerged as a desirable product.

Of all impacts on demand for hardwood lumber over the last 40 years, none seems more influential than globalization. Sectors less sensitive to imported products (e.g., low-end industrial products and construction-related products that can be customized) have fared better than the domestic furniture industry, where products have been manufactured as commodities with a large labor component. Consumption by industrial product manufacturers has grown the most consistently over time and has tracked well with the expanding U.S. and world economies

Figure 4. — Forty years of hardwood lumber consumption by sector. (WHHF is wood household furniture).



and the corresponding need to transport and store manufactured goods.

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Appendix

This appendix briefly describes the data problems encountered while developing this paper and the procedures used to resolve them. These problems included: changes in the industrial coding of individual industries, the suppression of volume of materials consumed, indirect purchases of lumber via dimension and frame purchases, and material purchases not reported by kind. A copy of the companion publication detailing these procedures (Luppold and Bumgardner 2008) can be obtained online at: www.nrs.fs.fed.us/pubs/4226.

Problem: Changes in the industrial coding of individual industries over time. Between 1963 and 1992 the U.S. Department of Commerce, Bureau of the Census, combined, added, or deleted specific Standard Industrial Classifications (SIC) for several wood consuming industries. In 1997, the North American Industry Classification System (NAICS) was implemented. Although SIC and NAICS classifications are in many respects similar, there are some major differences for specific industries.

Procedure used to resolve problem: Combined several SIC or NAICS codes into individual industries and then combined these industries into five broader industry groups and developed a crosswalk table that explained these aggregations.

Problem: Reported volumes of material consumed by secondary hardwood processors has been increasingly suppressed over time. In 1963, the Bureau of the Census provided volume information for logs, lumber, and dimension purchases for every SIC category consuming hardwood. By 2002, the only volume estimate reported by Census was for dressed lumber consumed by the pallet industry.

Procedure used to resolve problem: Volume information developed by dividing a proxy price of the material consumed into reported value information. A proxy price is a reported price that is representative of the grade and species of lumber normally consumed by an industry.

Problem: Considerable quantities of hardwood lumber are purchased indirectly in the form of dimension or furniture frames. Dimension consumption was initially reported on both a volume and value basis but later reported only on a value basis. Furniture frame consumption was always reported on a dollar value basis.

Procedure used to resolve problem: When dimension volumes were reported it was assumed that 2 board feet of lumber were required to produce each board foot of dimension purchased. The proxy price procedure explained above was used to develop the volume of dimension consumed when only value information was reported. The indirect consumption of lumber in the form of furniture frames was estimated by assuming that lumber cost equaled 50 percent of production cost and that delivered cost was twice production costs. Therefore, lumber cost equals 25 percent of the cost of delivered frames. Volume of lumber was then developed by the proxy price procedures explained above.

Problem: Smaller firms are not required to provide detailed information on materials consumed. Rather, small firms report total value of material consumed in the category "not specified by kind" (nsk).

Procedure used to resolve problem: Total volume of material consumed by all firms was developed by assuming that small firms consumed different materials in the same proportions as reporting firms and inflating volume used by reporting firms by an nsk multiplier = $\{(cost\ of\ all\ material\ -value\ reported\ nsk) / (value\ reported\ nsk)\}$.