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Material Usage Trends in the Wood Household Furniture Industry

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Abstract

The wood household furniture industry is a major user of a variety of traditional and modern wood products. In the last two decades, traditional products such as hardwood lumber, veneer, and plywood have been replaced, in part, by modern composite products such as particleboard, hardboard, and medium-density fiberboard. We analyzed the uses of traditional and modern wood products by the wood household furniture industry and found that the substitution of composite products for traditional hardwood products has subsided in recent years.

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Introduction

The wood household furniture industry (SIC 2411) is the largest user of higher grade hardwood lumber and one of the largest users of hardwood veneer. Therefore, long-term lumber and veneer usage trends by this industry will affect long-term demand and price movements for these products and ultimately affect hardwood timber management decisions.

The usage of wood materials by the furniture industry has long been of interest to forest economists. USDA Forest Service scientists have periodically collected information on wood use in manufacturing (Gill 1965, Gill and Phelps 1969, McKeever and Martens 1983). Trends in wood usage by the furniture industry also have been analyzed by Forest Service scientists (Spelter et al. 1978). More recently, Cardellichio and Binkley (1984) have examined furniture usage of hardwood lumber in development of the Hardwood Assessment Market Model. Our study is more specific than past studies because we analyze material usage in the wood household furniture industry on an application-by-application basis in the furniture production process.

A serious problem associated with the analysis of material usage by the wood household furniture industry over time is the quality of data. Much of the data about this industry is incomplete and/or inconsistent over time. Recent U.S. Census data and Forest Service wood use in manufacturing data vary significantly. Therefore, we attempted to interpret the data in an easy-to-understand manner, fill in the data gaps, and account for some of the inconsistencies between data sources. A detailed discussion of the techniques used to arrive at the data in the figures and tables in this paper is in the appendices.

Solid Wood Products and Panel Products

Wood products used in furniture production can be divided into two groups—solid wood products and panel products. Solid wood products include hardwood lumber, softwood lumber, hardwood dimension, and wood furniture frames. Panel products include hardwood plywood, softwood plywood, particleboard, hardboard, medium-density fiberboard, and other products that are constructed of wood veneers, fibers, or particles. In this report, hardwood veneer is also considered a panel product even though it is normally produced and purchased in sliced flitch form in the domestic market.

Hardwood dimension is hardwood lumber that has been planed, worked, or shaped into a rough or finished furniture part or blank. Furniture frames are structural bases or members constructed primarily from wood. These intermediate materials are used because some furniture manufacturers want to purchase rough or finished furniture parts rather than process these parts from rough hardwood lumber. This usage of dimension may occur because the furniture manufacturer's rough-mill capacity is less than the capacity of the rest of his plant, or because the manufacturer does not have a rough mill. Because hardwood dimension and wood furniture frames used in wood furniture production are developed from lumber, the hardwood lumber used to produce these parts is categorized with lumber in this paper.

Veneer core and solid core hardwood plywood are two other products that a furniture manufacturer may produce in-house from veneer, particleboard, or lumber or purchase in finished form from an outside vendor. The use of panel products in furniture construction is not new. In fact, veneer and hardwood plywood usage in wood furniture construction existed in ancient Egypt. The change is the use of composite panel products constructed from wood fibers or particles such as particleboard, hardboard, or medium-density fiberboard. In recent years, composite wood products have increasingly substituted for hardwood lumber and plywood in several applications.

Recent Census statistics do not reveal the extent of substitution of nontraditional wood products for hardwood lumber, plywood, and veneer. In 1982, hardwood lumber was the most important material used by the wood furniture industry and accounted for 18 percent of the total material cost (Fig. 1). The second most important material on a dollar basis was hardwood dimension. Together, these two hardwood products, along with hardwood veneer and plywood and wood furniture frames, accounted for nearly 36 percent of the material cost in wood furniture production.

Even though hardwood material cost represents a major portion of the total material cost in wood furniture production, a large amount of softwood and composite materials has been substituted for traditional hardwood material over the last 30 years (Fig. 2). The three trend lines in Figure 2 indicate that: (1) the proportion of material cost for nonwood products such as glass, plastic, door hardware, paint, and varnishes remained nearly constant; (2) the proportion of material cost for other wood products such as softwood lumber, particleboard, fiberboard, and medium-density fiberboard increased by 300 percent between 1963 and 1972; and (3) the proportion of material cost for traditional hardwood materials such as hardwood lumber, veneer, and plywood decreased by nearly 30 percent. To better understand these trends, we examine the usage of solid and panel material in greater detail.

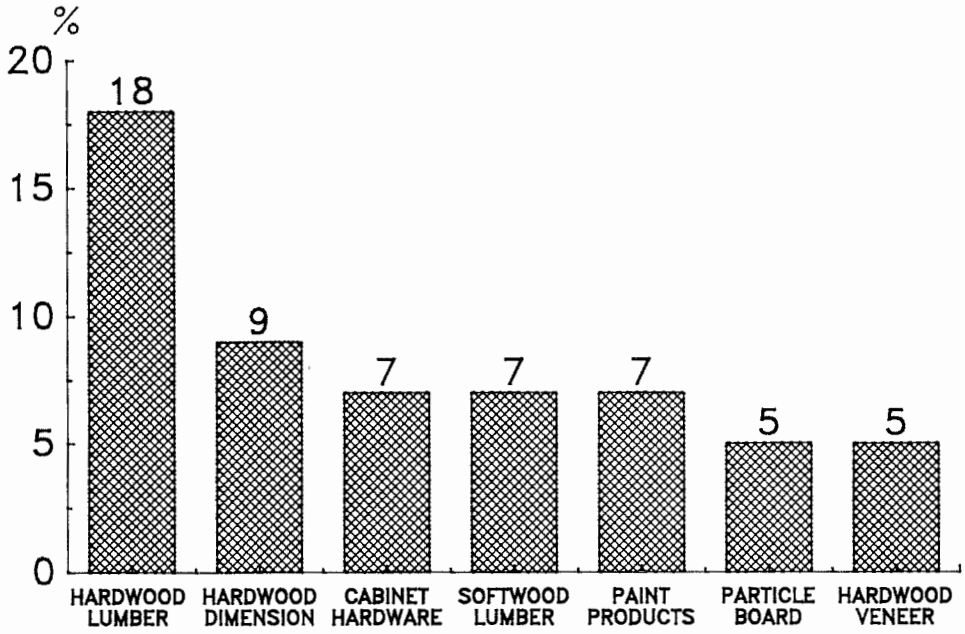

Figure 1.—Percentage of material cost for the seven predominant inputs in the wood household furniture product process.

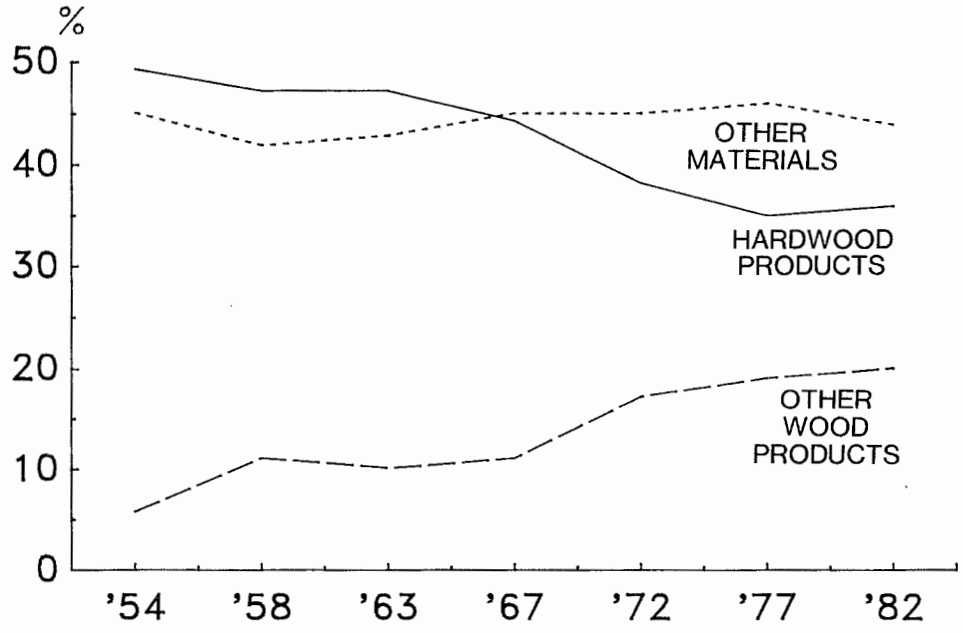

Figure 2.—Percentage of material cost for hardwood products, other wood products, and other materials, from 1954 to 1982.

Solid Material Consumption Trends

Solid wood material is used in furniture construction in four separate applications: (1) exterior solid parts, (2) interior parts, (3) core stock, and (4) banding material. Solid exterior parts are the solid boards, turning, or other parts that are visible when looking at a piece of wood furniture. Interior parts are the structural members, bracing, and drawer railing that are not usually seen when looking at a piece of furniture. One visible interior part is drawer slides, and these are visible when the drawer is pulled out. Core stock is lumber that is laminated with plywood veneer to form a veneered panel. Banding material is exterior lumber that is placed around the perimeter of a veneered panel.

Hardwood lumber still accounts for a large part of the total wood furniture material bill; however, Table 1 reveals some interesting trends. Total hardwood lumber usage increased by 19 percent from 1954 to 1982. However, hardwood lumber usage decreased by 7 percent between 1972 and 1982, while softwood lumber usage increased by 14 percent. It is more accurate to view quantity statistics after 1972 because before 1972 the kitchen cabinet industry was included as wood furniture. The inclusion of wood kitchen cabinets in 1967 and 1963 biased the lumber use statistics upwards; however, since fewer wood kitchen cabinets were manufactured in the early 1950's, the 1954 lumber use statistics are comparable to post-1972 statistics.

Table 1 also indicates continual increased usage of hardwood dimension by the wood furniture industry through the 1950's, 1960's and early 1970's. The large drop in hardwood dimension consumption indicated in 1977 resulted from the addition of rough-mill capacity by the furniture industry in anticipation of the baby-boom generation's demand for furniture. This increase in demand never materialized to expected levels, leaving the furniture industry with overcapacity. Since the dimension manufacturers have traditionally provided furniture manufacturers with the extra rough-mill capacity needed during peak production periods, the overcapacity in the furniture industry's rough end reduces the dimension industry's market.

The increase in dimension usage indicated in 1982 is seriously biased by the imports of unassembled furniture. This unassembled furniture is primarily chairs from Yugoslavia and occasional tables and dining room furniture from Taiwan. Because of unassembled furniture imports, the 1982 figures for dimension usage and lumber and dimension usage reported in Table 1 are not strictly comparable with previous years.

Table 1.—Estimated lumber consumed by the wood household furniture industry in the form of hardwood and softwood lumber and dimension stock and total amount of lumber, by Census year
(in million board feet)

Census year	Rough hardwood lumber	Softwood lumber	Dimension stock[a]	Total lumber	Total lumber and dimension[b]
1954	1,058	228	159	1,286	1,604
1958	1,112	258	180	1,369	1,729
1963	1,407	304	215	1,711	2,141
1967	1,333	307	295	1,640	2,230
1972	1,147	407	347	1,555	2,249
1977	1,251	495	274	1,746	2,294
1982	1,072	464	304	1,536	2,144

[a]Dimension stock includes wood household furniture frames.
[b]Includes rough material used to produce dimension.
NOTE: The information in this table has been estimated. For a detailed discussion of the estimation procedures used to generate these numbers, see Appendix 4.

Much of the decrease in hardwood lumber and total lumber usage between 1972 and 1982 can be attributed to the level of wood furniture production in these two periods. To better illustrate lumber usage over time by the furniture industry, hardwood lumber usage, total lumber usage, and furniture production are shown relative to one another since 1954 (Fig. 3). Since the base year is 1954, inconsistencies result from the inclusion of kitchen cabinet production. However, it is evident that the use of solid wood material by the furniture industry is decreasing over time. This figure indicates that alternative products had substituted for hardwood lumber prior to 1972, and since 1972 the use of hardwood lumber per piece of furniture seems to have increased slightly.

Figure 3 shows that softwood lumber usage has increased in recent years at the expense of hardwood lumber usage. Because the kitchen cabinet industry's statistics are included in the 1963 and 1967 observations, it is difficult to determine from the figure when this increase in usage occurred. However, it is still interesting to note that before 1972, softwood volume accounted for about 15 percent of the total wood use; while in 1972 and later, softwood volume accounted for about 20 percent of the total wood use. This increase probably resulted from the acceptance of character-marked material by furniture producers and consumers and the relatively low price of softwood lumber versus open-grained hardwood lumber, coupled with an increase in the popularity of Early American and rustic-styled furniture.

Panel Product Consumption Trends

Although hardwood lumber and dimension have been and are currently the major hardwood products used in wood furniture production, a tremendous amount of material substitution has taken place in the panel product market. Specifically, softwood panel products have substituted for hardwood plywood, lumber, and dimension.

In the early 1950's, thin veneer core hardwood plywood was used to construct drawer bottoms, dust bottoms, and furniture backs and sometimes was used to construct furniture sides. Lumber core hardwood plywood was used in the construction of visible furniture tops and sides and thus was an alternative to solid lumber. Softwood plywood at times was covered with a hardwood veneer to produce furniture tops. Since the 1950's, panel products application and variety have changed substantially.

Figure 4 shows the usage of the various panel products over time as a percentage of total dollars spent on materials. In 1954, more than 18 percent of the material cost of wood furniture was for hardwood plywood and veneer. By 1977, the proportion of the material dollar spent on hard-

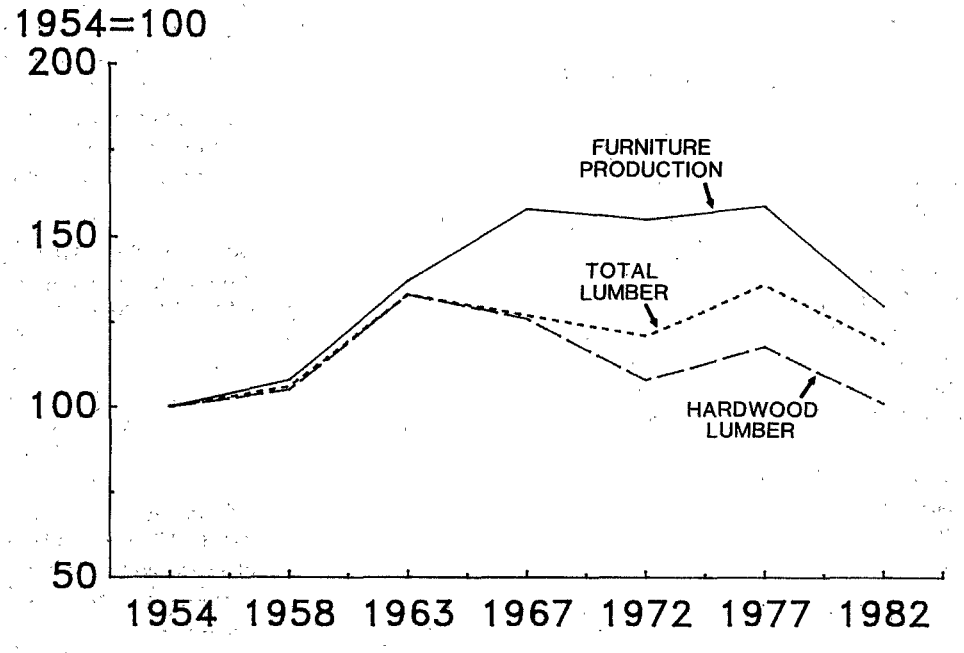

Figure 3.—Index of wood household furniture production, total lumber consumption, and hardwood lumber consumption, 1954 to 1982 (1954 = 100).

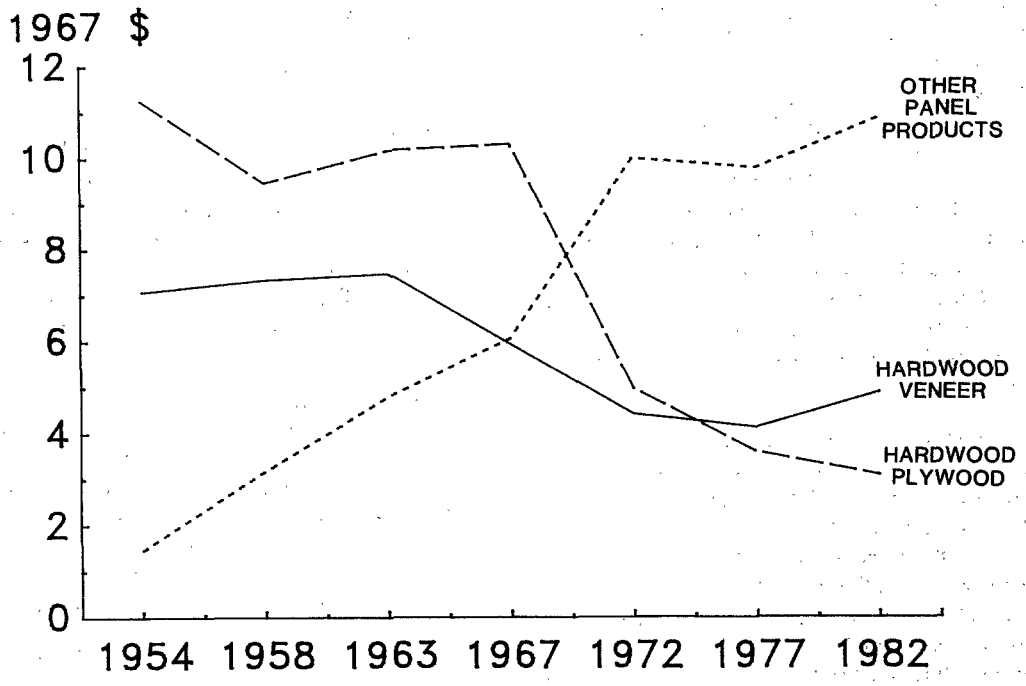

Figure 4.—Consumption of hardwood veneer, plywood, and other panel products over time (in 1967 constant dollars).

wood plywood and veneer was less than 8 percent. Although some of the decline in hardwood veneer and plywood used resulted from the use of thermo resins and other plastic products, the availability of less expensive composite panel products was the major reason for the decline.

Estimated usage of panel products by the wood furniture industry as reported by the USDA Forest Service and as derived from the Census of Manufacturers is shown in Table 2. The differences in these two data sources are apparent for the year 1977. This difference seems to emanate from the differences in product name versus physical specifications. Forest Service questionnaires list products by physical properties, while Census surveys ask for product by name. However, thin (1/8 inch) medium-density fiberboard is sometimes confused for thin hardboard because both these products are used for drawer bottom, dust bottom, and case-back applications. Some manufacturers also may term 3/4-inch medium-density fiberboard as 3/4-inch particleboard. However, when all composite board products are summed together on a 3/4-inch basis, the results of both surveys are similar.

As indicated in Table 2, the first major composite panel product used by the wood household furniture industry was particleboard. This product was used in place of hardwood lumber as core stock material in the production of furniture tops and sides. However, the use of particleboard as core material made usage of lumber banding material a necessary rather than optional part of solid core hardwood plywood construction. This necessity resulted from the fact that, unlike solid lumber core material that allowed for a smooth edge finish, particleboard only allowed for a rough-edge finish.

It is difficult to show the rate at which particleboard was substituted for lumber core stock over time because particleboard core and lumber core plywood are lumped together in Census data. However, the total impact of this substitution over time can be discussed. In 1954, 44 million square feet of lumber core hardwood plywood was used by the wood household furniture industry. If we assume a 70-percent yield of grade 2B poplar lumber into core stock material, approximately 63 million board feet of hardwood lumber was used to produce 44 million square feet of hardwood plywood. In 1982, 64 million board feet of solid core hardwood plywood was purchased by the wood household furniture industry, but the vast majority of this material was particleboard core. If we assume that 90 percent of the solid core hardwood plywood purchased in 1982 was particleboard core, the use of particleboard displaced 82 million feet of hardwood core stock in this

Table 2.—Panel usage by the wood household furniture industry for select years
(in million square feet)

Year	Particleboard (3/4″ basis)	Hardboard (1/8″ basis)	Medium-density fiberboard (3/4″ basis)	Total composite board (3/4″ basis)	Adjusted total composite board (1954 basis)
1958[a]	29	—	—	29	26.8
1960[b]	35	—	—	35	31.1
1963[a]	136	196	—	169	123.4
1965[c]	196	368	—	257	163.1
1967[a]	173	386	—	237	149.9
1972[a]	490	491	—	572	370.0
1977[a]	319	446	106	499	314.0
1977[d]	246	186	206	483	304.1
1982[a]	316	221	106	458	352.8

[a]Derived from Census of Manufactures.
[b]Reported by Gill (1968).
[c]Reported by Gill and Phelps (1969).
[d]Reported by McKeever and Martens (1983).
NOTE: All Census figures were estimated. See Appendix 4 for derivation.

Census year. In addition to particleboard purchased in solid core plywood form, at least another 420 million square feet of particleboard and medium-density fiberboard was purchased by the furniture industry. If we assume a 90-percent yield from board products and a 70-percent yield on lumber, each square foot of particleboard displaces 1.29 feet of rough lumber. Under this assumption, the total displacement of hardwood lumber by particleboard in 1982 was more than 620 million board feet.

The second composite product that displaced traditional hardwood products in furniture production was high-density fiberboard or hardboard. Unlike particleboard, which is an aggregate of wood particle held together by a resin, hardboard is composed of interlocking wood fiber formed with resins under pressure. The introduction of hardboard in the early 1960's and gradual acceptance of this product displaced thin veneer core hardwood plywood used in the production of drawer bottoms, dust bottoms, and chest backs in lower and middle-priced furniture. Drawer bottoms made of hardboard are many times covered with a thin vinyl cover that simulates the color and grain of oak. Today, thin plywood drawer bottoms and case backs are usually found only in the more expensive lines of furniture.

As shown in Table 2, hardboard usage by the furniture industry has decreased greatly since 1972. This decrease resulted from the adoption of a thin medium-density fiberboard, which has replaced hardboard in drawer bottoms and chest back application in lower priced furniture.

Medium-density fiberboard is constructed from wood fibers and is less dense than hardboard. The extent to which medium-density fiberboard has displaced hardboard is indicated in Table 2; however, medium-density fiberboard also has been used in place of solid wood, hardwood plywood, and particleboard. Because of its construction, medium-density fiberboard panels do not require edgebanding, and in painted furniture, no veneer. Since medium-density fiberboard was still being adopted after 1982, the impact of this product may be underestimated by the figures presented in this paper.

One other area where composite products have displaced hardwood lumber is in drawer-side production. Traditionally, hardwood drawer sides have been made of oak, sycamore, or other hardwood species. Although oak, sycamore, or mahogany drawer sides are still used in the production of more expensive furniture, less expensive furniture may have plywood or vinyl-wrapped particleboard or medium-density fiberboard drawer sides.

Material Substitution Over Time

The substitution of softwood lumber and composite panel product for hardwood lumber, veneer, and products constructed from hardwood lumber and veneer has occurred over several years. The actual extent of this substitution is difficult to determine because of changes in the level of furniture production. Therefore, the material usage indexes shown in Table 3 are adjusted for the level of furniture

Table 3.—Hardwood lumber, veneer core plywood, solid core plywood, veneer, softwood lumber, and composite board product usage indexes, adjusted for the level of furniture production, 1954 to 1982 (1963 = 100)

Year	Hardwood lumber	Veneer core plywood	Solid core plywood	Veneer	Softwood lumber	Composite panel products
1954	103	NA	82	95	103	NA
1958	100	133	75	105	108	22
1963	100	100	100	100	100	100
1967	85	NA	NA	70	91	122
1972	72	112	335	58	119	300
1977	77	85	129	40	141	255
1982	80	60	104	63	161	286

NA = not available.

production. All indexes are based on 1958 usage levels because that was the first year that Census data reported the use of composite panel products.

Three distinct growth periods in panel products usage are shown in Table 3. The growth in this index is tremendous because composite panels use grew from 1 percent of total material cost in 1958 to 12 percent of the total material cost in 1972. The first period was the late 1950's and was associated with the introduction of particle core stock material. The second period occurred in the 1960's with the introduction of hardboard and the continual growth in particleboard hardwood plywood. The third period occurred in the 1970's concurrently with print technology and consumers' acceptance of low-priced furniture containing very little traditional hardwood products. The second and third periods are where the greatest amount of material substitution occurred and need to be discussed in more detail.

The sharp jump in composite panel use between 1958 and 1963 corresponded to a drop in hardwood lumber, softwood lumber, veneer core plywood, and veneer usage. Three separate types of substitutions occurred at this point. The first substitution was particleboard for lumber as core stock material. The second substitution was particleboard core hardwood plywood for lumber in exterior part production. The third substitution was hardboard for veneer core plywood. Hardwood lumber usage dropped because less lumber core stock was used in-house, the use of hardwood lumber plywood increased, and less lumber was used for exterior applications. Veneer usage dropped because of less in-house production of veneer core plywood. However, face veneer usage probably increased because of increased usage of in-house production of particleboard core hardwood plywood.

The use of composite panel products reached its peak in the early 1970's as indicated by the 1972 indexes for hardwood plywood and composite panel products. This increase in panel product use is reflected by the decrease in hardwood lumber and veneer use. However, the decrease in hardwood lumber usage due to the substitution of softwood lumber accounted for nearly three-quarters of the 8 percent decrease in hardwood lumber usage between 1972 and 1977.

Between 1972 and 1982, hardwood lumber and veneer usage reversed historic trends and showed moderate increases against decreases in hardwood plywood and composite panel product usage. The decrease in veneer core plywood usage during this period indicates that there was substitution of composite products for veneer core hardwood plywood and, therefore, the substitution of lumber and veneer for panel products is understated by the composite products index. The increase in lumber and veneer usage has been attributed to the popularity of the rustic, historic look made popular by the U.S. bicentennial celebration and the rejection of the Mediterranean and printed furniture of the early 1970's.

Even though the current trend indicated in Table 3 shows an increase in the usage of traditional hardwood lumber and veneer, several other factors must be considered. First, 1982 was an unusual year in furniture demand because the recession affected lower priced furniture more than higher priced furniture. Since higher priced furniture tends to be constructed from more traditional materials, there is an upward bias for hardwood lumber and veneer usage in Table 3. Second, the more wood-intensive rustic look of the mid-1970's is in part being replaced by the less wood-intensive modern look of the mid-1980's.

Conclusion

The availability and adoption of composite panel products have resulted in much of the lower priced furniture containing none of the traditional hardwood products. The opposite extreme is high-priced furniture, which is still produced from hardwood and veneer. In the future, the less expensive furniture will most likely continue to be produced from composite panel products and plastics, while very expensive furniture will be produced using traditional material. The medium-priced furniture market, however, is where the interchange of new and traditional wood-based and nonwood-based material will occur in the future. The word interchange is used instead of substitute because future demand and supply conditions may merit more or less use of traditional hardwood materials rather than continual substitution away from these materials.

Future levels of wood material uses by the wood household furniture industry will depend on the level of furniture demand, the quality of furniture purchased, the quantity of furniture that is imported from other countries, the production technique used to produce furniture, furniture styling, and the physical dimension and size of furniture. If current trends persist, though, hardwood lumber usage may decrease if only because of increases in imports of rough or finished dimension. Hardwood veneer use could increase if veneer-wrapped medium-density fiberboard replaced hardwood lumber in applications where hardwood molding was previously used. No matter what happens in furniture production techniques, however, domestic furniture producers will have to become more cost conscious to stem the tide of furniture imports that have persisted since the early 1980's.

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Appendix 1

Accounting for Material Not Specified by Kind (nsk)

There are two aggregate categories in the Census of Manufacturers:

(1) All other material and component parts, containers, and supplies
(2) Material, parts, containers, and supplies (nsk)

The first category includes materials that were not specifically listed on the questionnaire. The second category includes materials used by establishments that did not report detailed material use data. This second category is of interest since it includes materials that are also listed by kind. Thus, the figures for material listed by kind are underestimates. To account for these underestimates, all value and quantity figures used in this paper have been adjusted using the following formula:

$$\frac{0}{1 - \text{pnsk}}$$

where:

0 = original value of figure being adjusted
pnsk = percentage of total material usage classified in the nsk category

Appendix 2

Development of Figures

Figure 1. Proportions shown were derived by dividing material cost for specific item by total material cost less material cost in nsk category.

Figure 2. Proportions shown were derived by dividing material cost for specific groups of items by total material cost less material cost in nsk category. Hardwood products group is composed of hardwood lumber, veneer, plywood, dimension, and furniture frames. Other wood products group is composed of softwood plywood, particleboard, hardboard, medium-density fiberboard, and softwood lumber. Other materials group is composed of all other materials not included in the first two groups.

Figure 3. Wood household furniture production index was developed by dividing value of shipments by price index for furniture, then indexed with 1954 = 100. Hardwood lumber usage index was developed by indexing hardwood lumber usage information presented in Table 1. Total lumber usage index was developed by indexing total lumber usage information presented in Table 1.

Figure 4. Dollars spent on hardwood veneer, hardwood plywood, and other panel products were adjusted upward for Census-reported figure to account for percentage of material in nsk category. Other panel products include softwood plywood, hardboard, particleboard, and medium-density fiberboard.

Appendix 3

Development of Missing Quantity Information

Quantity figures were suppressed for several wood products, especially in recent Census years. These omitted figures were estimated using the formula:

$$Q = (V/PI)s$$

where:

Q = the quantity of the commodity

V = the value of the commodity as reported in the Census of Manufactures

PI = the price index for the commodity

s = a scaler calculated from quantity, value, and price index data for the Census year closest to the missing observation. The formula for s is:

$$s = PI_c\,(Q_c/V_c)$$

where:

PI_c = the price index for the commodity in a Census year closest to the missing observation

Q_c = the quantity of the commodity in a Census year closest to the missing observation

V_c = the value of the commodity in a Census year closest to the missing observation

Appendix 4

Development of Information Reported in Tables

Table 1. Rough hardwood lumber usage adjusted upward to account for nsk category (Appendix 1). The 1982 figure was estimated using formula outlined in Appendix 3. Softwood lumber usage was adjusted upward to account for nsk category (Appendix 1). Dimension stock usage was figured on dimension and frames. The price used to estimate board-foot quantity of frames was the imputed price for dimension. Quantities were adjusted upward to account for nsk category (Appendix 1). The 1977 and 1982 figures were estimated using formula outlined in Appendix 3. Total lumber usage figure was calculated by adding total hardwood lumber usage figures to softwood lumber usage figures. Total lumber and dimension usage figure was calculated by adding lumber usage with 2 times dimension stock usage. This assumes a 50-percent yield from lumber to dimension.

Table 2. Particleboard usage figures were derived from Census information and adjusted upward to account for nsk category (Appendix 1). The 1958 figures were converted from 3/8-inch basis to 3/4-inch basis. The 1977 and 1982 figures were estimated using the formula outlined in Appendix 3. Hardboard usage figures were derived from Census information and adjusted upward to account for nsk category (Appendix 1). The 1967, 1977, and 1982 figures were estimated using the formula outlined in Appendix 3. Medium-density usage figures derived from Census information were adjusted upward to account for nsk category (Appendix 1). The 1977 figure was estimated using formula outlined in Appendix 3. Total composite board usage was derived by adjusting all data to a 3/4-inch basis and summing.

Table 3. Hardwood lumber usage index was based on information presented in Table 1. Veneer core plywood usage index was based on raw data adjusted upward to account for nsk category (Appendix 1). The 1982 raw veneer usage data was estimated using formula outlined in Appendix 3. Solid core plywood usage index was based on raw data adjusted upward to account for nsk category. The 1977 and 1972 raw veneer usage data was estimated using formula outlined in Appendix 3. Softwood lumber usage index was based on information presented in Table 1. Composite panel product index was based on information presented in Table 2.

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Examines wood material usage by the wood furniture industry in descriptive and numerical terms.

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