Regional Analysis of U.S. Lumber Exports for Important Hardwood Species from 1990 to 2020

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Abstract

In 1990, Europe, North America, and the Asian democracies of Japan, Taiwan, and South Korea (JTK) were the major export markets for U.S. hardwood lumber and oak species accounted for 59 percent of total exports. In the 1990s, shipments to Europe and North America increased, while shipments to JTK declined. During the early 2000s, exports to China and Vietnam (CHV) increased. The worldwide recession of 2009 caused exports to decline in all regions, and oak species accounted for 37 percent of total shipments that year. Since 2010, CHV has become the most important export market for all species except maple. In 2020, oak species accounted for 43 percent of total export volume, and walnut ranked third in value of shipments. An examination of imputed prices found that exports tend to be composed of mid- to higher-quality hardwood lumber. Since 1997, real prices of exported lumber have declined for most species, and this decline occurred concurrently with increased U.S. sawtimber volume. In the 1990s, increased exports expanded the market for domestically produced hardwood lumber. Since the early 2000s, increased lumber exports have partially countered reduced domestic demand and have acted as a hedge against greater declines in overall demand for U.S. hardwood lumber.

Exports of hardwood lumber can lead to increased profits for hardwood sawmills and serve as a hedge against domestic economic conditions (Ifju and Bush 1993). Since 1990, exports have become an increasingly important part of the U.S. hardwood lumber market (Luppold and Bumgardner 2016). Exports increased in the early and mid-1990s, approaching 2,900 thousand m^3 in 1997 (U.S. Department of Agriculture Foreign Agricultural Service [USDA FAS] 2021) (Fig. 1). During this period, exports accounted for 16 percent of the U.S. market for ''grade lumber,'' which is lumber graded under National Hardwood Lumber Association (NHLA) (2019) rules for use in appearance applications. After 1997, exports trended upward and then declined between 2006 and 2009. In 2010, lumber exports started to rapidly increase, reaching 3,900 thousand m^3 in 2014. In combination with relatively low levels of domestic consumption in 2014, exports accounted for 37 percent of the U.S. grade lumber market that year. After a slight decline in 2015, exports approached 4,500 thousand m^3 in 2017, then declined to under 3,100 thousand m^3 in 2020.

Figure 1 illustrates the growth of U.S. hardwood lumber exports over the past three decades but precludes information on global destinations, the species and quality (grade) of this lumber, and the relationships with domestic markets and hardwood sawtimber volume. Several studies have sought to determine the characteristics of exporting hardwood sawmills at the state level (Ringe et al. 1987, Dickerson and Stevens 1998, Gazal and Wang 2012) or regional level (Hammett et al. 1991, 1992; Naka et al. 2009; Bumgardner et al. 2016). Fewer studies have sought to describe specific markets for hardwood exports (Wang et al. 2010, Luppold and Bumgardner 2013).

Export markets are dynamic and change with time; it is therefore important to keep abreast of export trends. In this article, we examine changes in hardwood lumber exports to major global regions for important species at pivotal periods in time. We then examine how exports have been distributed among regions by analyzing changes in proportional species volumes across destinations. The quality of lumber exported at global and regional levels will be examined by comparing imputed price (value divided by volume) to reported prices of higher-grade and mid-grade kiln-dried lumber. While it is generally recognized that exports often involve higher-valued hardwood lumber, little published research is

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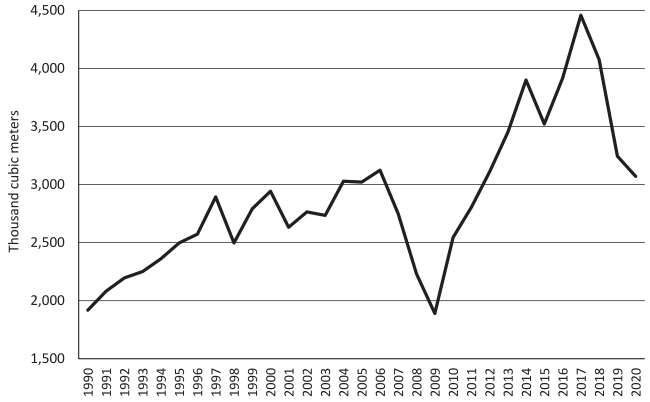

Figure 1.—Volume of U.S. hardwood lumber exports, 1990–2020 (USDA FAS 2021).

available. In the final section, we discuss the interplay of changing domestic markets and exports.

Methods

Data

The data used in this study were developed using the USDA FAS (2021) Global Agricultural Trade System (GATS) application. All volume estimates are in cubic meters. All value estimates have been inflation adjusted to 2019 dollars to be reflective of the market prices recently observed. The inflation adjustor was the U.S. Department of Labor, Bureau of Labor Statistics (USDL BLS) (2021), wholesale price index for all commodities. For a given species and grade, imputed prices are the inflation-adjusted values (2019 dollars) divided by the associated volume in cubic meters.

Between 1990 and 2006, maple exports could be separated into three product categories at the 10-digit harmonized code level: hard maple, other maple, and dressed (surfaced and edged) maple. After 2006, maple was reported as hard maple and other categories. Because of these ambiguities, maple exports are not separated into the soft and hard product classifications normally used in the United States but are reported as a single product at the six-digit code level. All other species examined in this study are also reported at the six-digit harmonized code level.

Time periods examined

Because of volumetric errors in U.S. export data in the 1980s (Luppold 1995), 1990 was selected as the starting point for this analysis. Exports grew by 50 percent between 1990 and 1997, fluctuated between 1997 and 2006, and then decreased below 1990 levels in 2009 (Fig. 1). Except for a relatively small downturn in 2015, the 2009–2017 period was one of unparalleled growth in hardwood lumber exports. This growth period was followed by a large decline from 2017 to 2020. This series of market fluctuations is analyzed by examining changes among five time periods: 1990–1997, 1997–2006, 2006–2009, 2009–2017, and 2017–2020.

Export market regions

Since 1990, three global regions have received high volumes of U.S. hardwood lumber: Europe (the European Union and the United Kingdom), North America (Canada and Mexico), and East Asia. In the early 1990s, the democracies of Japan, Taiwan, and South Korea (Korea) were the major East Asian importers of U.S. hardwood products. Improved trade relations with China in the early 2000s resulted in increased exports directly to this country or through Hong Kong intermediaries. Initially, a large portion of exports to China were to supply lumber to wood furniture manufacturers that migrated from Taiwan to China (Schuler and Buehlmann 2003). A trade dispute between China and the United States resulted in the bedroom furniture portion of the Chinese industry being substantially relocated to Vietnam (Luppold and Bumgardner 2011).

Japan, Taiwan, and Korea (JTK) and China and Vietnam (CHV) are examined as two separate trading regions in this article. Hong Kong is included in this latter grouping because it acted as a trading intermediary for China. During the study period, the regions of Europe, North America, JTK, and CHV accounted for at least 90 percent of annual U.S. hardwood lumber export volumes (USDA FAS 2021).

Species examined

Red and white oak (*Quercus* spp.), hard and soft maple (*Acer* spp.), and yellow-poplar (*Liriodendron tulipifera*) account for 65 percent of the hardwood sawtimber volume in the eastern United States (U.S. Department of Agriculture Forest Service [USDA FS] 2020) and have been exported in large volumes over the past 30 years (USDA FAS 2021). Three minor eastern species (by sawtimber volume) that also have been exported at relatively high levels are the ashes (*Fraxinus* spp.), cherry (*Prunus serotina*), and walnut (*Juglans nigra*) (USDA FAS 2021). Red alder (*Alnus rubra*), a species indigenous to the western United States, also will be examined because it has been a major export species during the time period examined.

Price and implied lumber grade

In this article, we compare imputed export prices and reported market prices of kiln-dried lumber graded under NHLA rules (NHLA 2019). The grades used in this comparison are FAS (highest quality) and 1C (mid-quality). These grades were selected because most hardwood lumber exports are within these grades (J. Johnson, personal communication, February 11, 2020).

The kiln-dried lumber market prices used in this study are based on the modal ''predominant'' price for 4/4 (1 in.) gross tally (measured before kiln drying) Appalachian lumber published in the Hardwood Market Report (HMR) (1990–2020). However, most exported lumber is measured using net tally (measure after kiln drying). During the drying process, hardwood lumber declines in volume, causing net volume prices to be greater than gross tally price. Net tally prices were not published by HMR until 2012. An examination of gross and net tally prices published in HMR in 2017 and 2020 found that the differences between these measures were 7.4 percent for red and white oak, 7.5 percent for hard maple, and 7.6 percent for ash, cherry, soft maple, yellow-poplar, and walnut. To adjust gross tally prices for the years 1990, 1997, 2006, and 2009, prices were adjusted using these percentage differences. All prices and costs were then adjusted to 2019 dollars to develop FAS and 1C kiln-dried market prices for the species examined.

Imputed prices developed using GATS represent free-on-board prices developed from shippers' manifests. HMR

reports prices prior to shipping and documentation costs. While documentation costs are relatively low and consistent among shippers, transportation costs to international points of exit can vary considerably. For example, for exporters in the southern United States, transportation costs could range from $36 per thousand board feet ($15/m^3) if shipped from the port of Mobile to hundreds of dollars per thousand board feet if shipped from West Coast ports (B. Ousley, personal communication, March 2, 2021). The total cost (product, transportation to port, ocean freight, insurance, and additional costs) of shipping to an Asian customer may be lower from West Coast ports, depending on variable ocean freight costs. Since there is no easy method of consistently determining shipping costs, a value of $100 per thousand board feet ($42.37/m^3) was added to all estimated kiln-dried net tally prices to develop an adjusted kiln-dried net tally price.

The imputed export prices were compared to FAS and 1C adjusted price using five lumber grade categories:

1. Greater than (GT) FAS = price at least 11 percent greater than the adjusted price of FAS kiln-dried lumber for that species.
2. FAS = price within 10 percent plus or minus the adjusted FAS kiln-dried lumber price for that species.
3. 1C-FAS = price between the ranges of FAS and 1C adjusted prices.
4. 1C = price within 10 percent plus or minus the adjusted 1C kiln-dried lumber price for that species.
5. Less than (LT) 1C = price at least 11 percent less than the 1C adjusted kiln-dried lumber price for that species. This designation indicates greater volumes of lower-grade lumber (NHLA grade 2A and lower).

While NHLA grading rules exist for red alder, red alder price is not reported by the HMR because most shipments of this products are sold under proprietary rules. Because hard and soft maple prices have followed different paths in the time periods examined, maple prices are weighted by the proportions of the hard and other maple products reported for a specific year and region. All prices used in this study are ''color unselect'' price or its predecessor price (reported before November 1999 for hard maple and March 2006 for soft maple) prior to premium for color select.

Results

Regional volume analysis

In 1990, Europe was the most important export market for U.S. hardwood lumber, receiving 573 thousand m^3 (Fig. 2) at a value of $555 million (40% of total value) (Fig. 3). North America and JTK also were major export markets, receiving 639 and 532 thousand m,^{3} respectively. The volumetric market shares for Europe, North America, JTK, and CHV in 1990 were 35, 33, 26, and 1 percent, respectively.

The increased volume of U.S. hardwood lumber exported between 1990 and 1997 was primarily due to increased exports to North America (Fig. 2). Europe remained the most important market in terms of value (Fig. 3). The volume exported to JTK in 1997 was similar to the 1990 volume, but the value of exports to this region increased by $60 million. Exports to CHV increased in the 1990s and in 1997 were 161 thousand m^3 valued at $155 million, which represented 6 percent of the volume and 5 percent of the value that year.

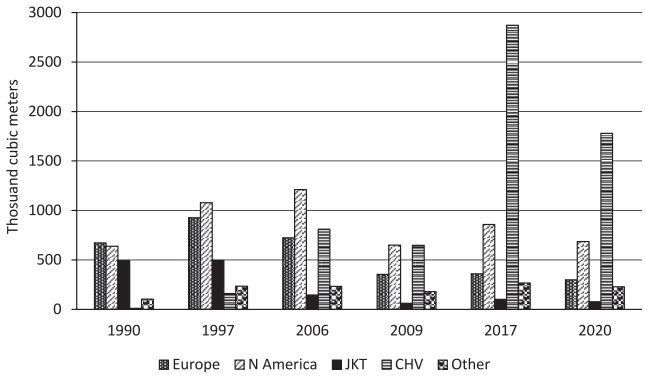

Figure 2.—Volume of U.S. hardwood lumber exported to Europe; North America; the Japan, Taiwan, and Korea (JTK) region; the China and Vietnam (CHV) region; and all other regions in select years (USDA FAS 2021). CHV includes Hong Kong as an intermediary for China.

Total hardwood lumber exports trended upward between 1997 and 2006 as a result of large increases in shipments to CHV and smaller increases to North America (Figs. 2 and 3). Shipments to JTK declined during this period by 349 thousand m^3 in volume and by $300 million in value. European exports declined by 201 thousand m^3 in volume and by $272 million in value. In 2006, the relative market shares for Europe, North America, JTK, and CHV on a volume basis were 23, 39, 5, and 25 percent, respectively.

Lumber exports declined between 2006 and 2009 to all regions, but exports to Europe had the largest declines, and CHV experienced the smallest (Figs. 2 and 3). Exports to JTK continued the decline that began in the late 1990s, with the region accounting for 62 thousand m^3 (3%) of the volume of shipments in 2009. Volume of exports to CHV in 2009 was only 2 thousand m^3 lower than shipments to North America.

The increase in export volume between 2009 and 2017 was primarily the result of increased exports to CHV (Figs. 2 and 3). In 2010, CHV displaced North America as the most important receiving region for U.S. exports (USDA FAS 2021). In 2017, CHV accounted for 64 percent of both

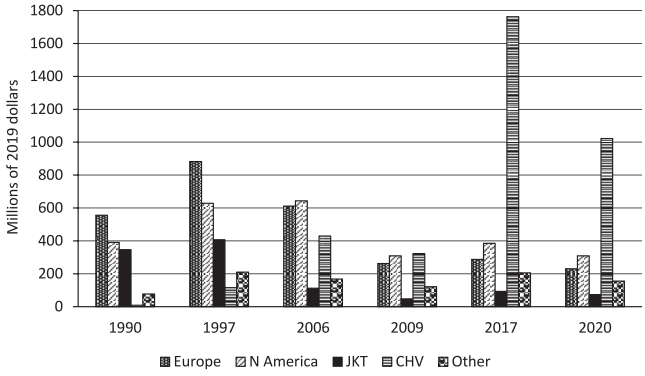

Figure 3.—Value of U.S. hardwood lumber exported to Europe; North America; the Japan, Taiwan, and Korea (JTK) region; the China and Vietnam (CHV) region; and all other regions in select years (USDL BLS 2021, USDA FAS 2021). CHV includes Hong Kong as an intermediary for China.

volume (2,871 thousand m^3) and value ($1,763 million) of exports. The decline in exports after 2017 was primarily the result of decreased exports to CHV, but this region still accounted for the majority of U.S. hardwood lumber shipments in 2020. The volumetric market shares for Europe, North America, JTK, and CHV in 2020 were 10, 22, 3, and 58 percent, respectively.

Species analysis: Worldwide U.S. exports

In 1990, the volume of red and white oak lumber was 600 and 526 thousand m^3 respectively and combined accounted for 59 percent of total exports volume (Table 1). Of six other species identified in Table 1, ash, yellow-poplar, red alder, and maple had volumes in approaching or exceeding 100 m^3 in 1990. The increase in exports between 1990 and 1997 was led by large increases in maple and red alder shipments combined with smaller increases in white oak and yellow-poplar. The volumetric increase in red oak shipments was less than the increased volume in cherry exports during this period. As a result, the combined red and white oak market share of total export volume in 1997 was 45 percent. Red alder exports peaked in the late 1990s at 303 thousand m^3 in 1997 (USDA FAS 2021).

Between 1997 and 2006, red oak and white oak exports declined as shipments of all other eastern species increased (Table 1). In 2006, combined red oak and white oak shipments were 1,090 thousand m^3 (35% of total), while combined maple, yellow-poplar, ash, cherry, and walnut shipments were 1,233 thousand m^3. The decline in exports between 2006 and 2009 occurred across all species, but the oaks had relatively smaller declines.

The growth of hardwood exports after 2009 occurred across all species with the largest volumetric increase occurring in red oak and yellow-poplar shipments (Table 1). The highest relative increases between 2009 and 2017 were for cherry, red oak, ash, and walnut with proportional increases of 340, 270, 254, and 232 percent, respectively. In 2017, export volumes of yellow-poplar, ash, walnut, and cherry exceeded that of maple. Exports of all species declined between 2017 and 2020 with the exception of walnut. While walnut is a minor species accounting for less than 1 percent of the U.S. sawtimber resource (USDA FS 2020), in 2020 it was the third most important exported species on a value basis and fifth most important on a volume basis (USDA FAS 2021).

Table 1.—Volume, in thousand cubic meters, of U.S. hardwood lumber exports of important species and all species in select years (USDA FAS 2021).

	1990	1997	2006	2009	2017	2020
Red oak	600	649	487	335	1,239	768
White oak	526	665	603	370	715	553
Maple	98	391	404	162	177	131
Yellow-poplar	107	204	388	326	757	451
Ash	140	152	180	124	439	265
Cherry	47	112	165	42	185	134
Walnut	22	20	96	65	216	222
Red alder	103	303	259	133	221	154
All species[a]	1,918	2,893	3,123	1,890	4,458	3,071

[a] Includes listed species plus birch, beech, hickory, tropical, and other species.

Species analysis: Regional U.S. exports

In 1990, U.S. export volumes of the eight species were distributed among Europe, North America, and JTK (Table 2). Europe received over 60 percent of the white oak exports, while North America and JTK received nearly three-quarters of the red oak shipments. Relatively high volumes of yellow-poplar and red alder were shipped to Europe and JTK. Cherry was exported primarily to North America and Europe, while ash exports were somewhat evenly distributed over the three regions.

In 1997, Europe continued to account for over half of U.S. white oak exports; this region was also the most important market for yellow-poplar, cherry, and red alder (Table 2). North America accounted for most of the maple shipments and also was the largest importer of red oak and walnut. Total exports to JTK remained relatively constant between 1990 and 1997, but proportional exports to this region declined for most species. Exports to CHV increased for all species by 1997, but this region's market share for any species that year was still less than 10 percent.

Table 2.—Percent volume of U.S. hardwood lumber of important species groups exported to Europe; North America; the Japan, Taiwan, and Korea (JTK) region; and the China and Vietnam (CHV) region in select years (USDA FAS 2021).

	1990	1997	2006	2009	2017	2020
Europe						
Red oak	19	10	3	4	2	3
White oak	61	59	52	42	24	28
Maple	17	13	5	4	2	2
Yellow-poplar	48	46	32	24	12	14
Ash	30	24	29	21	5	7
Cherry	44	43	22	11	1	1
Walnut	32	34	27	21	9	8
Red alder	32	57	17	10	5	1
North America						
Red oak	46	64	66	56	18	20
White oak	20	15	19	9	10	12
Maple	45	53	73	68	54	62
Yellow-poplar	4	17	11	14	8	3
Ash	24	32	25	24	4	7
Cherry	51	40	44	55	9	8
Walnut	24	40	39	45	26	17
Red alder	6	5	30	16	12	22
JTK region						
Red oak	28	14	2	2	1	2
White oak	13	14	4	3	2	2
Maple	32	18	4	4	3	3
Yellow-poplar	45	20	4	2	1	1
Ash	40	24	13	9	5	6
Cherry	4	7	4	5	1	1
Walnut	40	19	8	8	8	6
Red alder	61	28	6	6	3	4
CHV region						
Red oak	1	6	23	30	76	69
White oak	0	2	15	30	49	44
Maple	1	7	13	18	36	26
Yellow-poplar	0	8	48	52	74	78
Ash	2	7	23	33	76	68
Cherry	0	3	22	16	88	89
Walnut	0	1	16	19	49	63
Red Alder	0	6	45	66	79	70

In 2006, Europe still accounted for over 50 percent of white oak shipments, but this region's market shares for all species declined from 1997 with the exception of ash (Table 2). North America continued to be the most important market for red oak, maple, cherry, and walnut. Declining exports to JTK was reflected in the fact that ash was the only species with an export market share of greater than 10 percent. By contrast, the market shares for CHV exceeded 15 percent for most species, and this region was the largest importer of yellow-poplar and red alder.

Europe and North America remained the most important markets for white oak, red oak, maple, ash, cherry, and walnut in 2009 (Table 2). CHV realized increased market share for all species except cherry, while JTK experienced no species with greater than 9 percent market share in 2009. In 2017, CHV was the most important export market for all species except maple. This species continued to be exported in relatively large volumes to North America. While total exports to CHV declined by 38 percent between 2017 and 2020, this region still commanded a dominant share of the U.S. hardwood market for every species except maple.

Imputed price analysis

An examination of Table 3 finds that imputed prices of total exports for all species over the years examined are in grade category 1C or higher with the greatest frequency being in category 1C-FAS. The highest grade levels occurred in 2009 with all imputed prices being equal to or greater than 1C-FAS. Walnut had no imputed prices above category 1C-FAS but had the highest price per cubic meter for most years examined (USDA FAS 2021).

When examining grade categories by region and species, Europe had the greatest frequency of higher imputed prices (Table 4). White oak has been the most important species exported to Europe, and the imputed price of this species has been consistently high in this region. Europe had no species with an imputed price below category 1C-FAS in any year examined. North America had the greatest frequency of lower grade categories with no observations above category 1C-FAS and the highest number of observations in grade category 1C or LT 1C.

While exports to JTK have declined over the past 30 years, the grade categories of these shipments have been increasing (Table 4). In 1990, 70 percent of the shipments to this region were grade category 1C-FAS and the remainder category FAS. In the combined 2009 and 2020 periods, over half the imputed prices for this region were in the GT FAS category. Since 2006, the imputed price for walnut shipped to JTK was considerably larger than imputed prices for the other regions.

Table 3.—Grade categories of imputed prices of U.S. hardwood lumber exports for important species in select years.

	1990	1997	2006	2009	2017	2020
Red oak	1C-FAS	1C	1C	FAS	1C	FAS
White oak	1C-FAS	1C-FAS	1C-FAS	FAS	1C	1C-FAS
Maple	1C-FAS	1C	1C	1C-FAS	1C-FAS	1C-FAS
Yellow-poplar	FAS	FAS	1C-FAS	FAS	1C-FAS	1C-FAS
Ash	FAS	FAS	1C-FAS	FAS	FAS	FAS
Cherry	1C-FAS	1C-FAS	1C	1C-FAS	FAS	FAS
Walnut	1C-FAS	1C-FAS	1C-FAS	1C-FAS	1C-FAS	1C-FAS

The CHV region did not become a major export market until after 1997. Since 2006, the CHV region had the largest variation in the grade categories with imputed prices ranging from category GT FAS to LT 1C (Table 4). Two species that had declines in grade categories in the CHV region since 2009 are white oak and yellow-poplar. Since 2009, white oak had the largest price increase of any of the species examined, with HMR KD FAS and 1C prices increasing by 65 and 52 percent, respectively, by 2020 (HMR 2009–2020). As a result, lower-value 1C white oak appears to have been substituted for increasingly expensive FAS white oak. The decline in quality of yellow-poplar exports also appears to be cost related, as the nominal imputed price has remained relatively constant between 2009 and 2020, while the inflation-adjusted KD FAS and 1C prices have increased by 28 and 19 percent, respectively.

Interplay of changing domestic markets and exports

While hardwood lumber exports have declined since 2017, domestic consumption of grade hardwood lumber has remained near 6,900 thousand m^3 (Luppold et al. 2019). This indicates that exports accounted for 39 percent of the combined domestic and export grade lumber demand in 2017 and 32 percent of the grade lumber market in 2019. The above imputed price analysis indicates that a large percentage of hardwood lumber exports is in mid- and high-quality grades. If we assume that 90 percent of the exports are grade 1C or higher and that 60 percent of appearance lumber available is within these grades, then exports accounted for 59 percent of the U.S. market for higher-quality lumber (1C or higher) in 2017 before declining to 48 percent in 2019.

While exports have become the most important market for higher-grade U.S. hardwood lumber in recent years, the effect of exports on domestic hardwood production has changed over time. In 1990, Europe was the largest market for U.S. exports, and most of the lumber shipped to Europe was manufactured into products consumed in Europe. Similarly, exports to the Japanese portion of the JTK region tended to stay in Japan. In the cases of Europe and Japan, increased exports increased total demand for U.S. lumber since this increase was in addition to domestic consumption.

The economic relationship between the United States and the rest of North America is one of bilateral trade in lumber and secondary hardwood products. A portion of lumber exported to Canada and Mexico is used in the manufacturing of furniture, flooring, and other products that are then exported to the United States. Much of the lumber exported to Taiwan also was manufactured into products exported to the United States. In 1990, the Taiwanese furniture industry complemented the domestic furniture industry in the production of chairs, dining room tables, and other products that could be coupled with bulky, domestically produced ''case goods'' (furniture with drawers and cabinets) in furniture showrooms.

In the early and mid-1990s, lumber exports to and furniture imports from North America and Taiwan increased (Luppold and Bumgardner 2011, USDA FAS 2021). During this period, hardwood lumber consumption by the U.S. furniture industry remained relatively constant (Luppold and Bumgardner 2016). In the cases of North America and Taiwan, increased exports in the 1990s created a net gain in lumber demand when exports were added to domestic

Table 4.—Grade categories of imputed prices of U.S. hardwood lumber exports for important species shipped to Europe; North America; the Japan, Taiwan, and Korea (JTK) region; and the China and Vietnam (CHV) region in select years.

	1990	1997	2006	2009	2017	2020
Europe						
Red oak	1C-FAS	FAS	FAS	FAS	FAS	GT FAS
White oak	1C-FAS	FAS	FAS	FAS	1C-FAS	1C-FAS
Maple	FAS	FAS	GT FAS	GT FAS	GT FAS	GT FAS
Yellow-poplar	FAS	FAS	FAS	GT FAS	FAS	GT FAS
Ash	FAS	GT FAS	GT FAS	GT FAS	GT FAS	GT FAS
Cherry	1C-FAS	1C-FAS	1C-FAS	GT FAS	GT FAS	GT FAS
Walnut	1C-FAS	FAS	FAS	FAS	1C-FAS	FAS
North America						
Red oak	1C	LT 1C	1C	1C	LT 1C	LT 1C
White oak	1C	LT 1C	LT 1C	1C-FAS	LT 1C	1C-FAS
Maple	1C	LT 1C	LT 1C	1C-FAS	1C	1C
Yellow-poplar	1C-FAS	1C	1C-FAS	1C-FAS	1C-FAS	1C-FAS
Ash	1C-FAS	LT 1C	LT 1C	1C	1C	1C-FAS
Cherry	1C-FAS	1C-FAS	LT 1C	1C-FAS	1C	1C-FAS
Walnut	1C-FAS	1C-FAS	1C	1C	LT 1C	LT 1C
JTK						
Red oak	1C-FAS	1C-FAS	1C-FAS	GT FAS	FAS	GT FAS
White oak	1C-FAS	FAS	1C-FAS	FAS	1C-FAS	1C-FAS
Maple	1C-FAS	1C-FAS	GT FAS	GT FAS	GT FAS	GT FAS
Yellow-poplar	FAS	FAS	FAS	FAS	FAS	FAS
Ash	FAS	FAS	FAS	GT FAS	GT FAS	FAS
Cherry	1C-FAS	1C-FAS	1C	1C-FAS	GT FAS	GT FAS
Walnut	1C-FAS	1C-FAS	GT FAS	GT FAS	FAS	GT FAS
CHV						
Red oak	1C-FAS	1C	1C-FAS	FAS	1C-FAS	FAS
White oak	1C-FAS	1C-FAS	1C-FAS	1C-FAS	1C	1C
Maple	FAS	1C-FAS	1C-FAS	1C-FAS	1C-FAS	1C-FAS
Yellow-poplar	GT FAS	1C-FAS	1C-FAS	1C-FAS	1C	1C
Ash	GT FAS	FAS	1C	FAS	FAS	FAS
Cherry	FAS	1C-FAS	LT 1C	1C-FAS	FAS	FAS
Walnut	1C-FAS	FAS	1C-FAS	1C-FAS	1C-FAS	1C-FAS

consumption. However, this increase in exports reduced potential growth in U.S. furniture and other secondary product manufacturing.

The late 1990s to early 2000s was a period when U.S. hardwood lumber production and domestic consumption were at historically high levels (Luppold and Bumgardner 2016, 2017). These increases coincided with continued growth in eastern U.S. sawtimber volume and average diameter (Luppold and Bumgardner 2021). However, by 2002, hardwood lumber consumption by the wood household furniture industries had declined by 25 percent as a result of increased furniture imports from China and Vietnam. This decline was partially offset by increased domestic consumption by construction-related industry and relatively high levels of exports to CHK. However, as domestic lumber production and sawtimber removals declined, sawtimber volume continued to increase. Between 2006 and 2016, sawtimber removals declined by 27 percent, while estimated sawtimber volume increased by 18 percent (Oswalt et al. 2019, USDA FS 2021).While furniture manufactured in China and Vietnam can be sold under U.S. brand names, the complementary relationship between domestic and CHV producers is limited because Chinese and Vietnamese producers also manufacture case goods. Another difference between furniture imported from China and Vietnam versus Taiwan and Canada is the apparent decline in the proportion of lumber sourced from the United States used in this furniture. The effect of these changes was a 2,500 thousand m^3 increase in exports to CHV between 2000 and 2018 (USDA FAS 2021) and a 3,600 thousand m^3 decline in hardwood lumber consumption by the U.S. wood furniture industry (Luppold and Bumgardner 2016). Also associated with increased furniture imports from the CHV region was a decline in Canadian furniture imports (Luppold and Bumgardner 2011) and a 22 percent reduction in U.S. hardwood lumber production between 1997 and 2019.

Prior to 2009, hardwood lumber exports to China and Vietnam were influenced by U.S. furniture imports from these countries. Between 2009 and 2020, the value of furniture imports from China and Hong Kong declined by 27 percent, while the value of lumber exports increased by 251 percent (USDA FAS 2021; U.S. Department of Commerce, International Trade Administration [USDC ITA] 2021), suggesting increased use within China. In contrast, the value of furniture imports and lumber exports to Vietnam increased by 251 and 273 percent, respectively, during this period. Walnut in particular appears to be a species favored by Chinese consumers, as export volumes of this species to China and Hong Kong increased by 35 percent, while export volumes of all other species declined by at least 27 percent between 2017 and 2020. Improved

U.S.–China trade relations provide greater access to the fastest-growing consumer market in the world. The potential size of the Chinese market for any product is without parallel in world history because of a combination of factors: a large population, growing incomes, and a growing upper middle class purchasing furniture and other wood products. Two U.S. species that seem to be especially desired by Chinese consumers are walnut and red oak. However, the effect of trade frictions with the United States, coupled with a reduced rate of economic growth in China, has caused lumber exports of all species with the exception of walnut to decline between 2017 and 2020.

Conclusions

Europe, North America, and the JTK region were the major export markets for U.S. hardwood lumber in 1990, and red and white oak comprised 59 percent of shipment volume. Between 1990 and 1997, hardwood lumber exports to Europe and North America increased, while shipments to JTK remained relatively flat (Fig. 2). This increase occurred across most species with the greatest growth occurring for red alder, yellow-poplar, and maple (Table 1). Walnut was the only species to have a reduction in export value and volume between 1990 and 1997.

Between 1997 and 2006, increased exports of all species to the CHV region countered decreased shipments to JTK. Combined oak shipments declined to 35 percent of the total volume. All of the increases that occurred between 1990 and 2006 were erased during the world economic downturn of 2008 and 2009. The large increase in exports that began in 2010 was primarily the result of increased shipments to CHV. In 2017, the combined market share of oak species increased to 43 percent, and volumes of yellow-poplar, ash, walnut, and cherry exceeded that of maple. Exports of all species declined between 2017 and 2020 with the exception of walnut.

Much of the decline in exports between 2017 and 2020 was the result of reduced shipments to China. Even with this decline, CHV still accounted for over 50 percent of the exports of most species and the plurality of white oak (Table 2). Maple was the only species that had a dominant market outside of CHV but also was the species with the largest decline in exports between 2006 and 2020 (Table 1). While walnut is a minor component species of the forest, accounting for less than 1 percent of the U.S. sawtimber resource, it became the third most important U.S. export species on a value basis and fifth most important on a volume basis in 2019 (USDA FAS 2021).

A comparison of imputed price of exports and reported market prices of kiln-dried lumber found that most exports are composed of mid- and high-quality lumber. These prices have been variable among species and regions with Europe having the greatest frequency of higher prices. Real imputed prices and, by implication, mid- and high-quality lumber prices have declined since 1997 with the exception of walnut (Table 3). One factor that may be contributing to the reduced price and apparent increase in the availability of hardwood lumber is increasing sawtimber volume.

There is no question that exports now account for a large proportion of the total demand for appearance-graded hardwood lumber produced in the United States. The importance of export markets coincides with several other changes in the hardwood market. The loss of the domestic furniture industry and the reduced consumption of hardwood lumber used in construction-based and remodeling markets have contributed to the decline in total demand for higher-quality hardwoods. These changes are major factors helping explain the decline in prices of higher-quality lumber since 1997 and the decline in hardwood lumber production. Without exports acting as a hedge against the decline in domestic consumption of higher-grade hardwood lumber, the decline in prices and domestic production could have been considerably larger.

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