

## **ASSESSING CHANGES IN THE U.S. HARDWOOD SAWMILL INDUSTRY WITH A FOCUS ON MARKETS AND DISTRIBUTION**

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The U.S. hardwood sawmilling industry has experienced significant changes over the past decade. A slowing housing industry, competition from imported products, higher transportation costs, and high stumpage prices have changed the business of manufacturing and marketing hardwood lumber. Also, hardwood lumber buyers are changing their business practices by shortening lead times, requiring a more customized product, and buying smaller lumber quantities to cut costs and increase operational flexibility. A survey of hardwood lumber manufacturers was conducted in the fall of 2009 to assess changes and adaptations within the industry. Among respondents, average hardwood lumber sales decreased by 13.2 percent during the study's focus period from 2004 to 2008. Respondents also identified a change in customer demand with smaller, more frequent orders becoming more common. Moreover, the species mix shifted, with red oak losing considerable market share. Intermediaries, such as hardwood lumber distributors, were able to capture more of the industry's business. Respondents identified the slowing housing market and high energy costs as major factors affecting their businesses. While the survey's responses reflected the extremely challenging economic conditions, industry participants are aggressively adapting their businesses and pursuing new opportunities with the understanding that markets will eventually recover.

*Keywords:* Hardwood lumber; Hardwood sawmills; Hardwood distribution channels; Supply chain

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### **INTRODUCTION**

On the basis of total value, lumber is the most important product derived from hardwood forests in the eastern United States (Luppold and Bumgardner 2008). However, the U.S. hardwood lumber industry has faced many challenges during the past several years. Increasing global competition, high stumpage and energy prices, and more recently, the slowing housing market have been cited as major reasons for declining production (Buehlmann et al. 2007, 2010a; Buehlmann and Schuler 2009; Gazo and Quesada 2005; Grushecky et al. 2006; Pepke et al. 2010). As a result of reduced demand, hardwood lumber prices have declined. Appalachian 1 Common red oak, for example, was priced 30 percent lower in 2008 than in 2004 (Cochran 2009). Declines in oak prices also reflect shifting fashion influences, as close-grained species have gained popularity in the marketplace (Luppold and Bumgardner 2007). Further changes are associated with changing markets for hardwood lumber, with industrial uses of hardwood lumber

becoming the largest use category in the 1980s, replacing furniture (Luppold and Bumgardner 2008). In 2008, industrial uses (pallets, railway ties, and board road/mat timbers) comprised the majority of hardwood lumber use (Hardwood Market Report 2009).

Hardwood sawmills are adapting to the changing economic environment. For example, Buehlmann et al. (2007) found that large sawmills were relying more on construction-related (flooring and cabinet) markets and on export markets in response to market pressures in the domestic wood furniture industry stemming from the ongoing globalization of furniture manufacturing. Hardwood lumber distributors also are playing an increasingly important role in the hardwood supply chain, as smaller and customized secondary manufacturers increase in number (Buehlmann et al. 2010a), and as furniture and kitchen cabinet manufacturers implement cost-cutting programs and improve the efficiency of their operations (Cumbo et al. 2006; Espinoza 2009). Such improvement programs usually target dramatic reductions in inventories, with smaller, more frequent orders for raw materials and supplies, which effectively shift inventories within the supply chain (Dasmohapatra 2009).

There also are indications that consolidation has been occurring in the hardwood lumber industry (Luppold and Bumgardner 2009; Luppold 2005; Manchester et al. 2009), generally as a way to maximize operational efficiency. Larger firms have more resources to invest in technology, professional management teams, and have larger negotiating power with suppliers and logistics services providers (Manchester et al. 2009). However, even as sawmills have been increasing in size, evidence suggests that smaller secondary wood manufacturers have several competitive advantages in declining markets, such as those related to housing (Bumgardner et al. undated). Reaching these smaller customers requires that sawmills develop new methods of market development and distribution.

Given the far-reaching changes that the U.S. hardwood lumber industry is facing, research was conducted to better understand the current competitive environment for hardwood sawmills, as well as the strategies being employed by industry participants. This work also serves as an overview of current trends within the U.S. hardwood lumber industry, with a focus on the evolving distribution function from the sawmill perspective. The objectives of the present study were to discern trends in hardwood lumber sales volume and species produced, customers and markets served, services provided, business environment, and respondents' perceptions about the role of distributors in the evolving hardwood supply chain.

## **MATERIALS AND METHODS**

### **Questionnaire**

U.S. hardwood lumber producers (NAICS code 3211131) were surveyed using Dillman's Total Design method (Dillman 2009). A questionnaire was developed and pre-tested by four members of academia and three hardwood lumber manufacturers. Changes were made according to the feedback received. The final version of the questionnaire contained 27 questions and covered aspects related to (1) firm characteristics (eight questions); (2) production characteristics (three questions); (3) changes in markets served

and services provided (three questions); (4) changes in purchase orders and customers (three questions); (5) perceptions about the current business environment (two questions); and (6) questions about hardwood lumber distributors as customers (eight questions). When trends were of interest, data for 2004 and 2008 were requested. Question types and measures included categorical (multiple choice), rating (7-point scales), and open-ended, where respondents either filled in a blank to indicate a volume (e.g., board feet sold), a percentage (e.g., percent of production that was red oak), or longer written responses to more general questions.

### **Data Collection**

An address list was compiled using Virginia Tech's Center for Forest Products Business address database. In the fall of 2009, a total of 1,216 postage-paid return questionnaires were mailed, all within the United States. The respondents' sales volume represented approximately 19.6 percent of the total U.S. hardwood lumber production in 2008, calculated using the total lumber sales reported by respondents to this survey and the total U.S. lumber output for 2008 as reported in the Hardwood Market Report (2009). Two sets of questionnaires and reminder postcards were mailed, with a two-week separation between mailings. At the closing of the survey, 137 usable questionnaires were obtained. After accounting for closed mills, undeliverable addresses, duplicates, and companies not in the lumber manufacturing business, the adjusted response rate for the survey was calculated to be 13.9 percent.

Nonresponse bias was assessed by comparing early and late respondents. This practice assumes that there is a continuum from early respondents to late respondents, and that late respondents can be used as a proxy for nonrespondents (Dalecki et al. 1993; Etter and Perneger 1997; Lahaut et al. 2003). Respondents were categorized in four "waves," corresponding with each mailing (two questionnaires and two postcards), and two demographic attributes were compared: lumber sales in 2008 and whether respondents sold to lumber distributors. The cutoff to separate early from late respondents was the mailing of the second questionnaire. The number of respondents in each wave was 75, 15, 30, and 15. The cutoff to separate early from late respondents was the mailing of the second questionnaire. No significant difference ( $\alpha=0.05$ ) was found between average lumber sales of early and late respondents (Kruskal-Wallis test), or in the percentage of respondents selling to lumber distributors (z-test of proportions). However, there was some evidence of differences in production among the waves ( $p=0.06$ ), with larger average sales in the first and last waves (17.3 and 15.1 million board feet, or mmbf, respectively), and smaller ones in the second and third waves (5.2 and 8.9 mmbf, respectively). Thus, some caution is warranted in interpreting the results, but the pattern of sales by wave did not necessarily point toward systematic nonresponse bias.

### **Firm Characteristics**

About three quarters of respondents (76.3 percent) were representatives of companies having one production facility. Hardwood lumber manufacturing comprised, on average, 80.6 percent of respondents' total sales. Apart from lumber manufacturing, companies reported being involved in some form of lumber re-sale (i.e., distribution,

brokering, or importing) for 8.0 percent of their business. Other activities making up the remaining 11.4 percent of respondents' businesses included log merchandising, sales of wood residue, pallet manufacturing, flooring manufacturing, railroad ties production, logging, and kiln drying. The geographic distribution of survey respondents was as follows: South (43.7 percent), Midwest (29.4 percent), Northeast (22.2 percent), and West (0.8 percent). Companies with operations in more than one region made up 4.0 percent of total respondents.

### **Study Limitations**

A peak of economic activity in the U.S. occurred prior to December of 2007, when a recessionary phase of economic activity officially started (National Bureau of Economic Research 2010). Thus, results of this research may reflect a considerable decline in economic activity in 2008 for respondents' businesses and a worrisome state of the economy, which might help explain the relatively low response rate (13.9 percent). Thus, generalization of findings from this survey can only be made on a limited basis and need to be viewed with care.

A potential source of bias exists because of survey respondents' association membership. The mailing list included members and non-members of the largest association of hardwood lumber manufacturers, the National Hardwood Lumber Association (NHLA). Perkins (2009) and Bowe (2000) for example, found that NHLA members are over three times more likely to complete and return questionnaires, a finding that was confirmed by this study. However, the average hardwood lumber output of NHLA members and nonmembers was not found to be significantly different (two-sided t-test,  $p=0.16$ ). Another potential source of bias originates from the wording in the list of factors rated by respondents, with some items including a prefix that could potentially have guided respondents' answers (e.g., slowing housing market). Lastly, other limitations pertaining to mail surveys apply, as discussed in Alreck (2004).

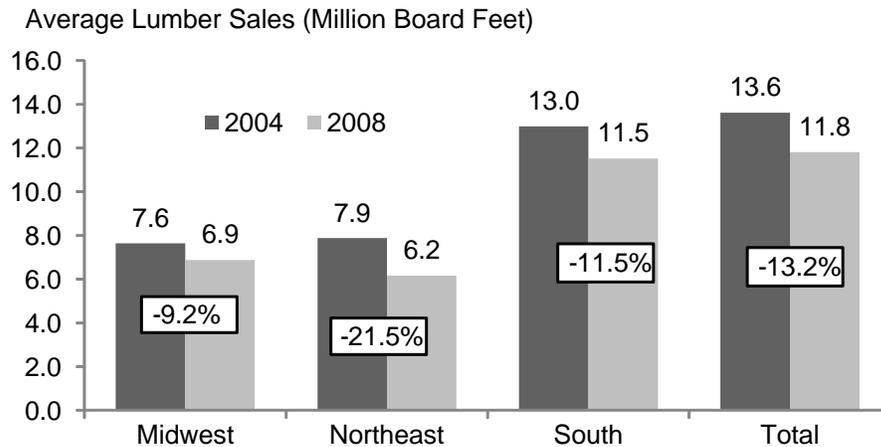
## **RESULTS AND DISCUSSION**

### **Hardwood Lumber Sales Volume**

Respondents reported a total of 1.8 billion board feet sold in 2008, down from 2.0 billion board feet in 2004. Based on hardwood lumber production figures for 2008 (Hardwood Market Report 2009), total lumber sales for the survey's respondents was 19.6 percent of the industry's total production. A little over half of respondents (52.5 percent) answered that they dry all or some of their lumber output. Those companies with drying operations reported that, on average, 53.4 percent of their lumber sold is dried at their facilities. Responses of percentage of lumber dried ranged from 5 to 100 percent.

Figure 1 shows the average lumber sales for responding sawmills in million board feet (mmbf) by region and overall. The average hardwood lumber sales over all respondents was 11.8 mmbf per sawmill in 2008. The average sales for single-facility companies was 7.4 mmbf and 33.1 for companies with multiple facilities. Perkins (2009) reported production volumes of 7.6 and 26.0 mmbf for single- and multi-facility sawmills

in 2007, respectively. However, results from the survey show that average sales fell by 13.2 percent from 2004 to 2008. The largest decrease in lumber output occurred among companies with operations in the Northeast (-21.5 percent, Fig. 1). All changes shown in Fig. 1 were significant ( $\alpha=0.05$ ) based on paired t tests (p values of 0.047, <0.001, and 0.043 for the Midwest, Northeast, and South, respectively).



\* In boxes the percent change in lumber sales from 2004 to 2008

\*\* West region not included (one respondent only); mills with facilities in more than one region were excluded from the regional analysis but included in the total.

Fig. 1. Average lumber sales for 2004 and 2008 and percentage change, by region

### Species Produced

The industry continues to experience reductions in demand for red oak (Buehlmann et al. 2007; Luppold and Bumgardner 2007). Figure 2 shows the average species distribution of hardwood lumber produced by respondents on a board foot basis for 2004 and 2008. Despite the continued losses of oaks, combined oak (red and white) accounted for almost two fifths (39.37 percent) of the respondents' lumber output in 2008. Among the major species, significant reductions ( $\alpha=0.05$ , paired t tests) were reported for red oak and cherry (-10.6 and -17.0 percent change and p value of 0.007 and 0.019, respectively), and also for basswood (-22.8 percent change and p value of 0.001). A significant increase occurred for yellow-poplar (14.0 percent change and p value of 0.017). The most common species included in the "others" category, which grew by 3.2 percent but was not significant, were cypress, elm, cottonwood, and sycamore.

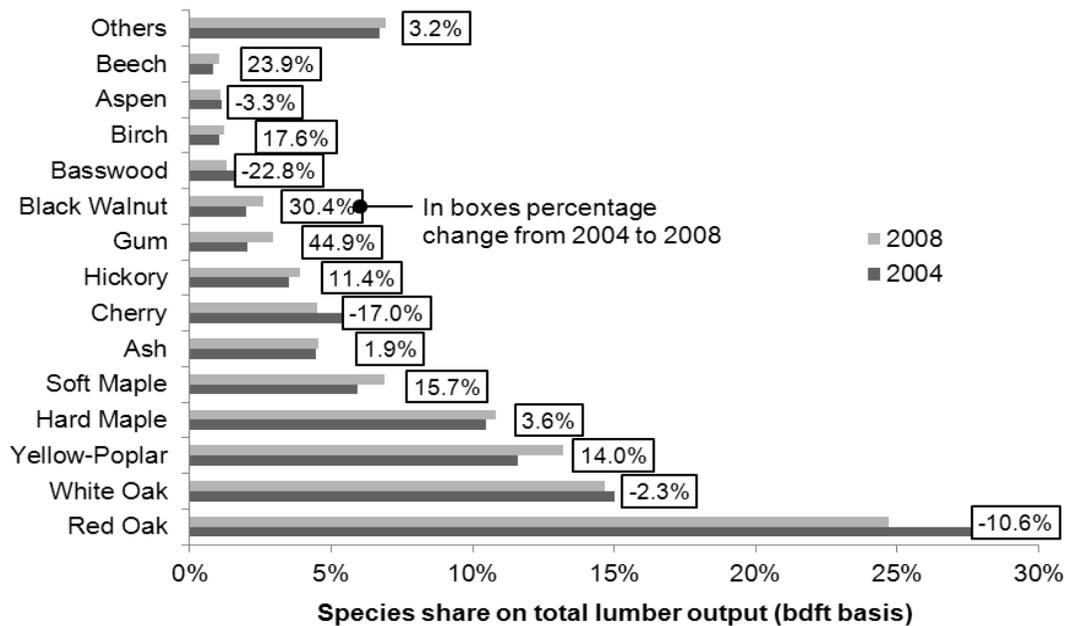


Fig. 2. Species distribution of respondents' lumber production, 2004 and 2008

### Markets Served

Respondents were asked to report the major market segments served in 2004 and 2008, and the share of each market in total sales (on a board foot basis; Fig. 3). Ninety percent of respondents answered this question. The results demonstrate a noteworthy move from direct sales (sales to manufacturers of kitchen cabinets (-27.7 percent), furniture (-40.7 percent), and millwork (-11.3 percent)) to intermediaries (distribution yards (+8.1 percent) and lumber retailers (+34.4 percent)), although only the changes associated with furniture and cabinets were statistically significant ( $p$  values lower than 0.001, paired  $t$  tests). Sales to railroad tie markets, however, increased and became the third-largest direct market in 2008. The "Other" markets, including blocking, caskets, crane mats, frame stock, custom sawing, and pulp, saw a statistically significant increase gaining 122.7 percent from 2004 to 2008 ( $p$  value of 0.025). Pallets remained the single-largest user of hardwood lumber, but experienced negligible growth. The reader needs to keep in mind that gains in some segments may also be due to decreases in sales to other markets and do not necessarily reflect growth in specific product segments.

### Changes in the Customer Base

One of the objectives of the study was to learn about changes in customer size and order size; thus, respondents were asked whether their typical order size changed, and, in a separate question, if their typical customers' company size had changed between 2004 and 2008. Company size in this context is measured by production or sales output of customer. Figures 4 and 5 summarize the responses. Nearly 83 percent of responding hardwood sawmills indicated that, on average, their customers' size decreased or had not changed from 2004 to 2008. Only 12.3 percent of respondents reported that their average customer increased in size from 2004 to 2008 (Fig. 4).

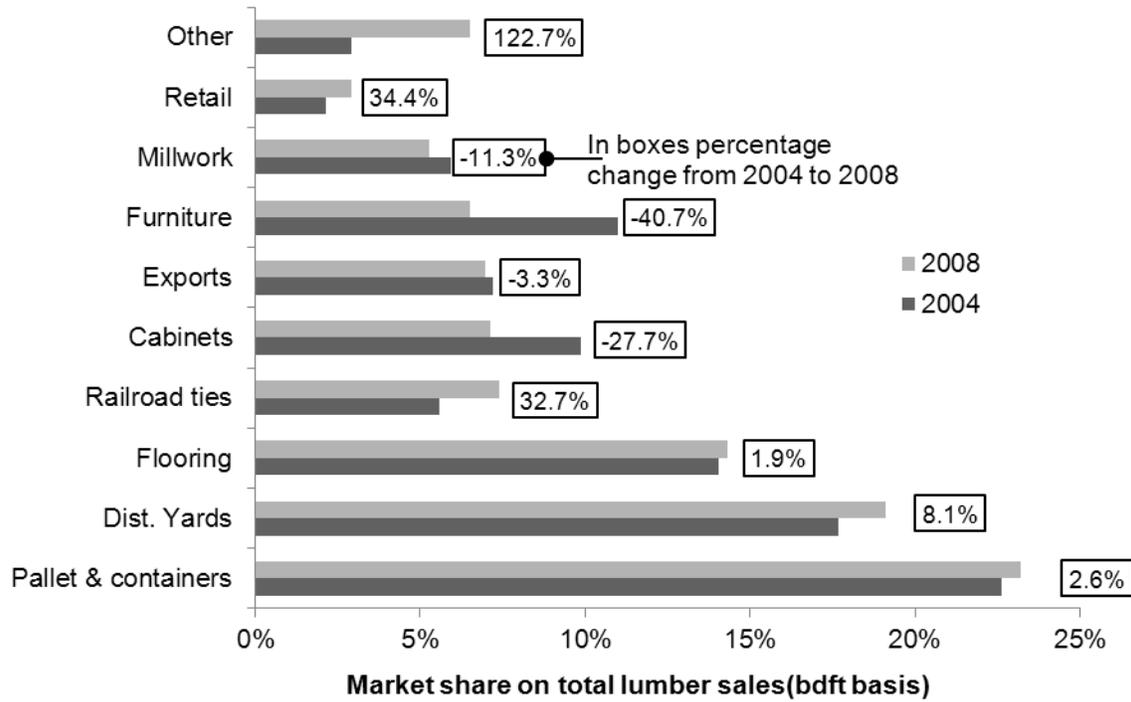


Fig. 3. Market distribution of respondents' lumber sales, 2004 and 2008

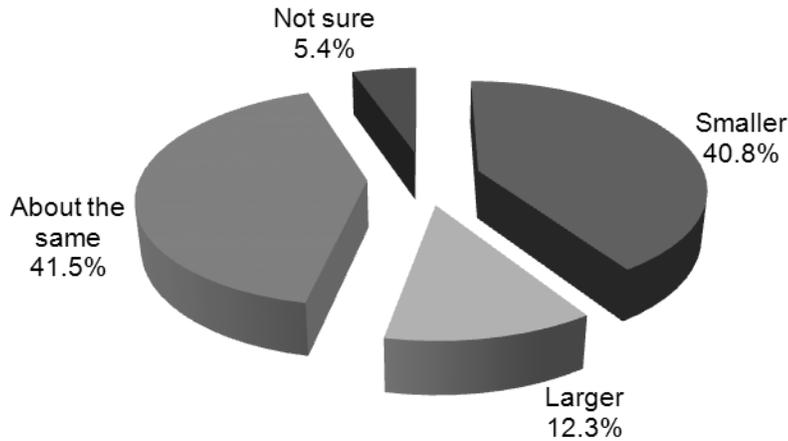
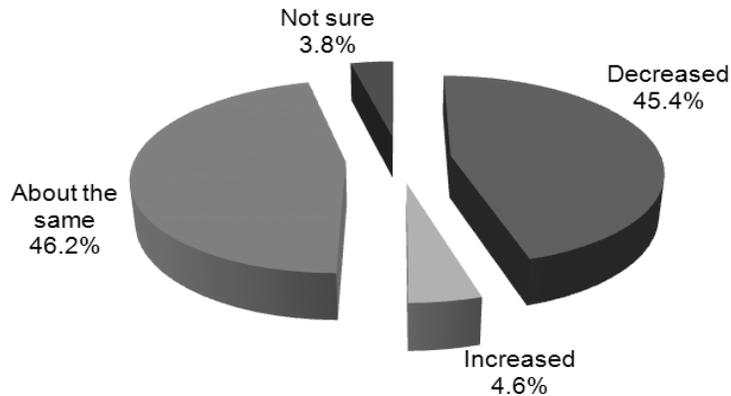


Fig. 4. Perceptions about changes in hardwood sawmills' customer size

Results for average order size followed a similar trend (Fig. 5). Ninety-one percent of respondents answered that average order size either remained the same or decreased in size from 2004 to 2008; only 4.6 percent reported an increase in average order size.



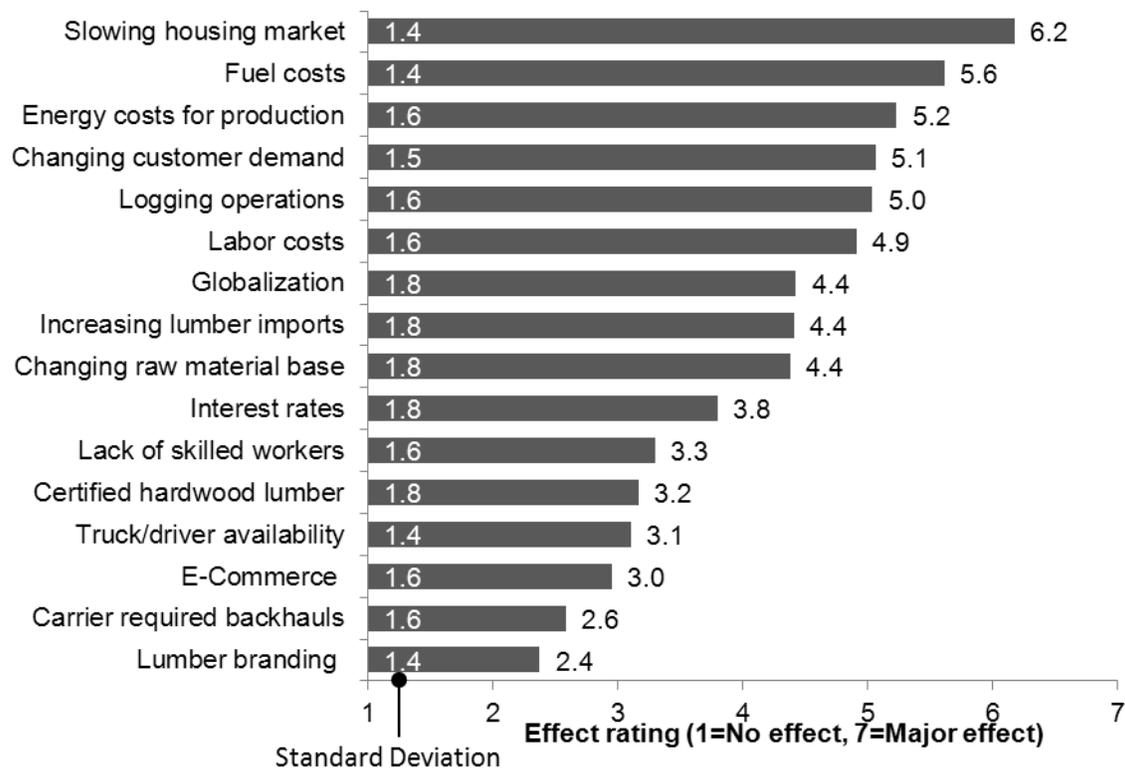
**Fig. 5.** Perceptions about changes in size of hardwood lumber orders

These numbers suggest a shift in the hardwood lumber supply chain from serving fewer, larger customers to serving more numerous and smaller customers with the average order size declining accordingly. Smaller order sizes might be attributed, in part, to hardwood lumber buyers' pursuit of "lean manufacturing" principles, thereby reducing their inventories through the purchase of smaller quantities at increased frequency (Cumbo et al. 2006; Kocakülâh et al. 2008). Or this finding could be a function of reduced overall demand from secondary manufacturers resulting from the current housing crisis.

Hardwood sawmills also were asked to comment, in an open-ended question, about changes in their customer base. One fifth (20.5 percent) answered that they have fewer customers and that demand has shrunk, while 11.4 percent said that customers have become more specific with dimension and quality requirements. Eight percent mentioned that customers are demanding higher quality and flexibility. Some other responses were that customers have more specific needs (6.8 percent) and that customers are becoming more demanding in general (6.8 percent).

### Factors Affecting Hardwood Sawmill Businesses

Survey respondents were asked to rate, on a scale anchored with 1 (no effect) and 7 (major effect), the effect of several factors on their businesses (Fig. 6). The "Slowing housing market" received the highest average rating (6.2). This finding is not surprising, considering that construction and remodeling markets have become the most important buyer of appearance-grade lumber (Luppold and Bumgardner 2008). According to the U.S. Census Bureau (2010), new housing units authorized by building permits fell by 56 percent from 2004 to 2008. After housing market, the factors rated highest by respondents were "Fuel costs" (5.6) and "Energy costs for production" (5.2). This is understandable as marked price increases for energy occurred during the same time period (U.S. Energy Information Administration 2010a and 2010b). Next among the factors was "Changing customer demand." This might be in part related to the changing order and customer size reported previously (Figs. 4 and 5).



**Fig. 6.** Effects of business factors on the U.S. hardwood sawmill business (numbers inside bars are standard deviations)

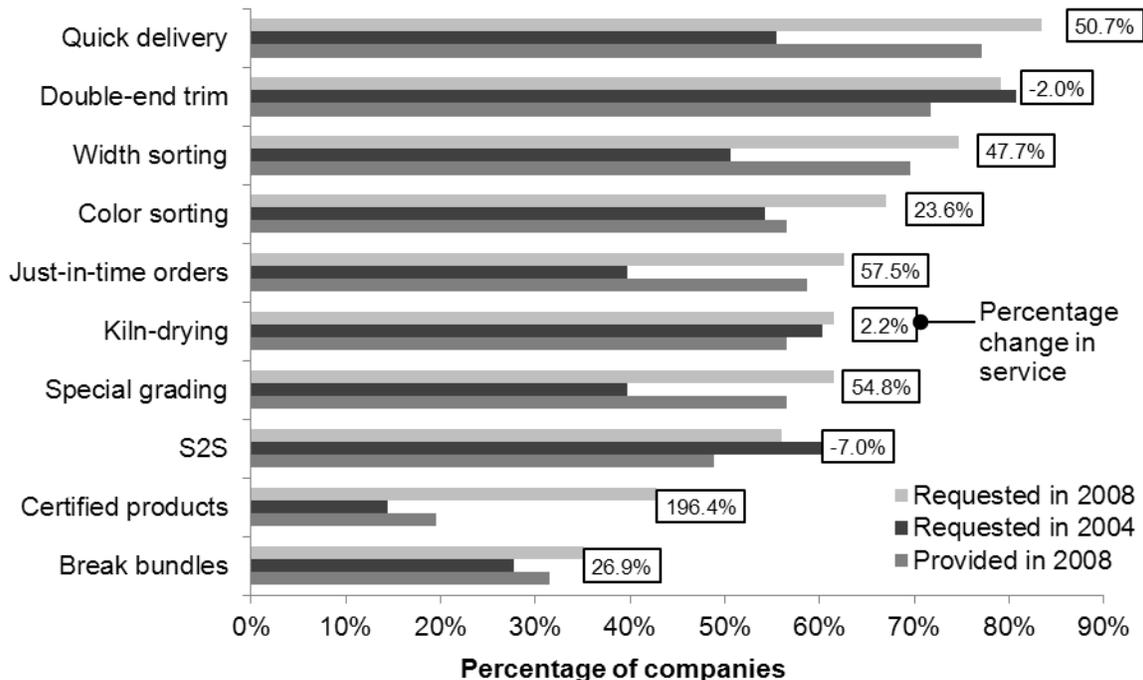
Globalization and increasing imports were rated moderately (average of 4.4 for both factors) by respondents, despite the attention these topics have received in recent literature. Buehlmann et al. (2007), for example, reported that three of the top five issues for hardwood manufacturers in the Appalachian region were related to competition from imported products in 2005. This shift in the perception illustrates how pressing the current economic situation for hardwood lumber manufacturers had become by 2008, due in large part to an increasing reliance on markets directly related to housing.

### Role of Hardwood Lumber Distributors

Given the increasing importance of the distribution function in the hardwood lumber industry, respondents were asked a series of questions related to their interactions with hardwood distributors and distribution yards. Seventy-five percent of respondents reported selling products to hardwood distributors or distribution yards. In terms of volume, almost one-fifth (18.2 percent) of the total hardwood lumber sold by survey respondents (i.e., 322.9 mmbf) went to lumber distributors in 2008, up from 13.8 percent in 2004 (281.7 mmbf). Using observations from the early 1990s (Bush et al. 1991), it appears that a major trend in the industry at that time was the shortening of distribution channels (with distributors becoming less relevant) that has again shifted back to distributors becoming more important in the current environment.

Respondents were asked about services that were most requested by their hardwood lumber distribution customers. The top ten services requested are listed in Fig. 7. Quick delivery, double-end trimming, and width sorting were the most frequently

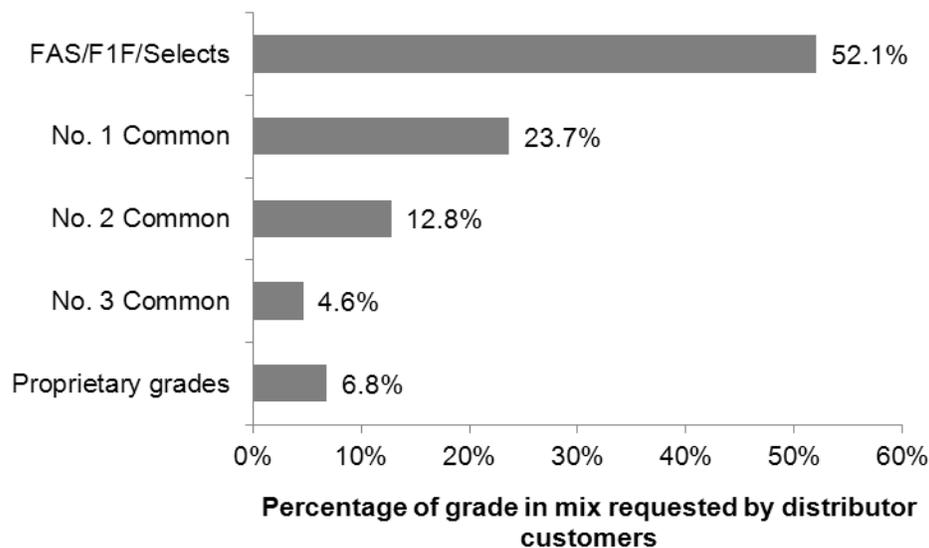
requested services by distributors from hardwood sawmills in 2008. Increases were also reported for width and color sorting, special grading, and breaking bundles. These findings reveal a shift in customer needs towards higher flexibility of volume (smaller orders); an increased importance for the time factor (a shorter lead time); and more diverse, refined product offerings. While "Certified hardwood lumber" was only ranked eleventh as an "Effect of business factors on the U.S. hardwood sawmill business" (Fig. 6), the demand for environmentally certified products grew almost three-fold (+196.4 percent; Fig. 7), reflecting the increasing importance of green products to secondary wood products manufacturers.



**Fig. 7.** Top 10 services requested by distribution customers in 2004 and 2008, and services provided by hardwood sawmills in 2008

In Fig. 7, differences between the number of companies reporting a particular service requested by customers and the number of companies providing that service indicate unsatisfied demand in the market, especially for those services increasing in importance. Most notably, opportunities seem to exist for providing quick delivery, width and color sorting, special grading, and certified products.

Sawmill respondents reported that the grade mix demanded by hardwood lumber distributors is skewed towards the highest quality lumber grades, as defined by the National Hardwood Lumber Association (2004). Figure 8 shows that 52.1 percent of all grades demanded by lumber distribution customers are of the higher quality classes, e.g., FAS, F1F, or Selects. In addition, 27.0 percent of survey respondents reported that distributors requested proprietary grades as part of their grade mix, and these grades make up 6.8 percent of the typical mix.



**Fig. 8.** Average grade mix demanded by responding hardwood sawmills' distributor customers

Two open-ended questions were included in the questionnaire regarding respondents' perceptions about hardwood lumber distributors; similar responses were grouped and results are listed here. The first open question was answered by 86 companies, or 63.7 percent of respondents, and asked hardwood sawmills about their perception on changes in the role of hardwood lumber distributors during the next five years. Among those answering this question, 28.6 percent of respondents thought that distributors would provide more customized orders and more and different services, and 15.6 percent answered that distributors would face a more challenging environment. Equal numbers of respondents (7.8 percent) thought that the role of hardwood lumber distributors would increase and diminish. A second question asked about respondents' perceptions of the services that hardwood lumber distributors are uniquely positioned to provide, and was answered by 73 companies, or 54.1 percent of respondents. More than two fifths (42.3 percent) of respondents to this question answered that hardwood lumber distributors can more effectively provide flexible orders (in the form of smaller orders, break bundles, mixed loads, and product diversity) and completely customized orders. Other frequent responses were access to smaller users and alternative markets (17.6 percent), a more diverse inventory and product mix (15.3 percent), and the ability to provide faster shipping (11.8 percent).

## SUMMARY

Hardwood sawmills in the U.S. were surveyed to identify changes in their supply chains, operations, market demand, and the role of hardwood lumber distributors. The current recession and the continued globalization of markets have severely affected U.S. hardwood lumber sales, with respondents reporting a 13.3 percent average decline in sales from 2004 to 2008. Not surprisingly, the slowing housing market was rated as

having the largest impact on respondents' businesses, overshadowing concerns over globalization, which have been paramount in previous surveys of the industry. A decline in oak and cherry sales has given way to increases in sales of yellow-poplar.

1. Results from this study reveal important changes in the hardwood lumber supply chain. Notably, average order sizes and average size of customers have become smaller, while at the same time customers are demanding more customized products and more timely deliveries. Similar results were obtained in a separate recent study of the U.S. hardwood lumber distribution sector (Buehlmann et al. 2010b), suggesting these pressures exist throughout the hardwood supply chain. Thus, opportunities exist for sawmills to achieve differentiation by providing customized orders and improving channels of distribution to shorten delivery times, or to utilize distribution yards to provide such services.
2. Three quarters of responding hardwood sawmills reported selling to hardwood distributors, and distributors were the second-largest market for respondents after pallets and containers. However, unlike pallet and container producers, distributors were shown to demand generally higher grades of hardwood lumber. Thus, distributors might be increasingly important for reaching higher end markets in the current competitive environment, even as industrial uses (e.g., typically users of lower grades of lumber) become increasingly important to hardwood lumber demand.
3. Eventually, higher end markets will recover in conjunction with the housing market, but trends in customization and specialized production are likely to continue as domestic secondary manufacturers seek niches protected from offshore commodity production, which competes mostly on price. To remain profitable, hardwood sawmills will need to continue to adapt to these changes.
4. Ultimately, only time will tell which of the changes observed in this survey are structural and which are temporary. However, changes like the decrease in lumber output or the low confidence in the US housing markets are likely to improve with the ongoing economic recovery. Changes like the decreasing order size or the increasing demand for customized products, however, are likely structural and reflect the ongoing re-orientation of consumer preferences. Such changes, thus, are likely to be more permanent.

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