THE CHANGING STRUCTURE OF THE HARDWOOD LUMBER INDUSTRY WITH IMPLICATIONS ON TECHNOLOGY ADAPTATION

William Luppold John Baumgras
USDA Forest Service
Northeastern Research Station
241 Mercer Springs Road
Princeton, WV 24740

ABSTRACT

The hardwood sawmilling industry has been changing over the last 50 years as a result of changes in hardwood sawtimber inventory and in the demand for hardwood lumber. In 1950 the industry was composed of numerous individual mills, few of which produced more than 3 million board feet of lumber annually. During this time the furniture industry was the major user of higher-grade hardwood lumber. By the early 1990's both the hardwood sawtimber inventory and lumber production had increased by 50 percent and the industry was dominated by mills producing more than 5 million board feet per year. Furniture manufacturers remained an important user of hardwood lumber but exports of higher-grade lumber increased dramatically. Changes in the demand for hardwood lumber caused mills to concentrate on producing higher-grade lumber, which in turn, increased the demand for higher-grade sawtimber. The combination of increased demand for higher-grade sawtimber, increasing efficiency in hardwood lumber production, and the competitive nature of the hardwood lumber market has reduced the margin between stumpage and lumber cost. In the 1990's the hardwood industry reacted to these reduced margins by becoming even more efficient. Marketing efficiency has increased as the industry shifted from single mill operations to more multiple mill operations. Production also has increased as more mills used high-tech equipment to boost grade yield and reduce labor costs.

INTRODUCTION

In 1950 most hardwood forests contained smaller diameter pole timber while the volume of sawtimber size material was only half the volume of what would exist 40 years later (Powell et al. 1994). This emerging forest resulted from timber regeneration following extensive cutting during the late 19th and early 20th century, and from abandoned farmland that reverted to forestland. The sawmilling industry consisted primarily of small sawmills that produced less than 3 million board feet per year, primarily because procurement costs limited mill size. Demand for hardwood lumber in 1950 included local markets for construction material, railroad crossties, flooring, and furniture.

Although the period between 1950 and 1970 was marked by strong demand for black walnut, yellow birch, and yellow-poplar, there was little change in the hardwood sawmilling industry and overall market. Small and intermediate size mills were still the backbone of the industry, demand for lumber in appearance applications (furniture, dimension, flooring, cabinets, millwork, and exports) increased by a modest 16 percent (Luppold 1989), and hardwood lumber production cycled with the general economy. Meanwhile, the hardwood sawtimber resource continued to regenerate, increasing by 20 percent between 1952 and 1970 (USDA For. Serv. 1973). However, since the early 1970's there has been considerable change in markets for hardwood lumber, the hardwood sawtimber inventory, and the hardwood sawmilling industry.

In this paper we examine the changes in the hardwood sawmilling industry over the last 30 years with emphasis on the grade lumber industry. We also discuss current technologies used in hardwood sawmills and how they are changing the hardwood industry and hardwood markets.

1975 TO 1999: A PERIOD OF CHANGE

Between 1975 and 1990, the sawtimber inventory increased by 50 percent due to accretion and ingrowth. This increase is associated with a nearly 50 percent increase in lumber production. Another influential change in the hardwood lumber industry over the last 25 years was a five-fold expansion in lumber exports. This expansion led to changes in how lumber was priced and marketed and ultimately the type of timber that was cut. The first indicator of change was the $20 premium for a straight load of grade First and Second (PAS) red and white oak reported in the July 26, 1975, issue of the "Hardwood Market Report." Although such premiums had probably been paid for some time prior to this date, the codification of the FAS "export" premium signaled a changing market. The domestic furniture industry no longer would be the most important user of higher grades of hardwood lumber.

In addition to increasing timber volumes and increased exports of hardwood lumber, the average mill size increased by 50 percent and the number of mills decreased from 1975 to 1990 (Luppold 1996). Most importantly, by 1990, nearly 50 percent of eastern hardwood lumber was produced by 10 percent of the mills.

Construction of dry kilns associated with individual mills also increased dramatically as greater numbers of mills participated in the growing export market. Because the most lucrative export was higher quality (mainly FAS) material sought by Europe and Japan, there also was a change in the type of log desired by these mills. The use and price of higher quality logs of species most likely to be exported increased rapidly while the price of lower quality logs, and less exportable species, failed to keep up with inflation (Luppold and Baumgras 1995). This escalating cost of logs caused mill owners to seriously consider increasing grade recovery.

The economic recession that occurred during the first two years of the 1990's purged hundreds of the smaller and less efficient producers from the sawmilling industry. However, the firms that remained in business would partake in a unique period of the hardwood lumber industry. During the 1990's annual hardwood lumber production rarely fell below 11 billion board feet. This volume was the highest of any l0-year period in history, including the early 1900's (Steer 1948, Luppold 2000)[1,2]. In 1997, exports of hardwood lumber reached a record 1.2 billion board feet (Emanuel and Rhodes 1999).

Higher hardwood lumber production was accompanied by higher prices for hardwood stumpage and sawlogs. As producers became more efficient, the margin between the price of stumpage and the price of lumber declined (Luppold et al. 1998). Prices of higher grades of hardwood logs continued to increase faster than prices of lower grade logs. Because of these market pressures, hardwood lumber producers looked for ways to increase efficiency. A recent

[1] Although current production of hardwood lumber apparently is at an all time high, we believe that considerably more timber was cut at the turn of the century than today. Large amounts of hardwood timber were used to build railroads and other log transfer systems. Also, the proportion of the tree processed and the level of log utilization probably were lower at the turn of the century than today.

[2] Luppold, W.G. 2000. Estimates of hardwood lumber production, an internal database maintained at the Northeastern Research Station, Princeton, WV.

examination of the grade hardwood lumber industry revealed that efficiency has increased due to an increase in the number of multiple mill firms (which has increased marketing efficiency) and greater use of high tech-equipment.

TYPES OF FIRMS IN THE GRADE LUMBER INDUSTRY

In 1998, the "Weekly Hardwood Review" surveyed its readership to gain information on the current state of the hardwood sawmilling industry. Respondents fell into five categories: those with a single band mill (SB), multiple band mills (MB), a single circle mill (SC), multiple circle mills (MC), and firms with both band and circle mills (MBC) (Table 1). The most common survey respondents were firms with a single band mill. On average,

Table 1. Comparison of characteristics of eastern hardwood grade mills that participated in the survey conducted by "Weekly Hardwood Review" in 1997.

	Single band mill firms (SB)	Multiple band mill firms (MB)	Multiple band and circle mill (MBC)	Single circle mill firms (SC)	Multiple circle mill firms (MC)
Number of firms	56	11	15	40	8
Number of mills	56	44	54	40	21
Average annual production capacity of mills (mmbt)	10.16	14.00	7.15	6.41	3.60
Average annual production capacity of firms (mmbt)	10.16	56.00	25.75	6.41	9.45
Average annual kiln-drying capacity (mbt)	53.4	299.9	149.0	99.6	61.4
Average annual export volume (mbt)	1.41	2.01	0.87	0.75	0.14
Mills or firms that produce crossties (%)	26.8	54.6	73.3	42.5	87.5
Mills or firms with resaws (%)	66.1	63.6	60.0	60.0	50.0
Mills or firms with computerized edgers (%)	25.0	9.1	13.3	12.5	0.0
Mills or firms with bin sorters (%)	16.1	27.3	6.7	5.0	0.0

SB firms produced more than 10 mmbf of lumber annually, exported more than 1.4 mmbf, and accounted for nearly 30 percent of the lumber produced by firms surveyed. The 11 MB firms operated 44 mills and accounted for 32 percent of lumber production, 36 percent of the lumber exported, and 40 percent of the kiln capacity. This level of dominance by the MB firms may indicate economies of size in lumber distribution.

Fifteen firms operated both band and circle mills. Although these MBC firms are more numerous than the MB firms, the average mill produces about one-half the amount of lumber, and total firm production level is less than one-half that, of MB firms. Lumber exports by MBC firms are considerably less than by SB or MB firms. The reason for this may be that circle mills owned by these firms tend to saw lower grade logs. The SC operations are smaller, averaging 6.4 mmbf per year and exporting less. Average production levels of the MC operations exceeded 9 mmbf per year per firm and 3.6 mmbf per mill. These firms also had the lowest export volume but the highest percentage of firms producing railroad crossties.

While quantity of lumber exported may be an indicator of the use of higher-grade logs, crosstie production is an indicator of the consumption of lower grade logs. Less than 27 percent of the SB firms reported crosstie production compared to more than 42 percent of the SC firms. As firm type changes from MB to MBC to MC, the percentage of mills producing ties increases from 54.1 to 73.3 to 87.5, respectively. The information on export levels and tie production shown in Table 1 supports the commonly held belief that, on average, band mills use higher quality logs to produce higher valued lumber while circle mills use lower quality logs to produce a greater volume of industrial lumber.

CHARACTERISTICS OF FIRMS USING IDGH TECH EQUIPMENT

The survey revealed that the resaw is a common piece of equipment in mills (Table 1). In general, resaws allow for maximum grade yield without slowing the headsaw, thus increasing capacity and grade yield. More than 60 percent of the SB, MJ3, SC, and MBC operations use resaws (Table 1). Unfortunately, the questionnaire used in the survey did not seek information on the amount of computerized controls used in headsaws or resaws.

Two other pieces of downstream equipment mentioned in the questionnaire are computerized edgers and bin or automatic sorters. Twenty-five percent of the SB firms use computerized edgers compared to 12.5 percent of the SC firms. Less than 10 percent of the MB firms use edgers, but more than 25 percent of these firms have at least one bin sorter.

Seventy percent of the mills with computerized edgers and nearly 94 percent of mills with bin sorters have band headsaws while only 53 percent of the mills without these devices have band headsaws. The reason for these differences may be related to higher production associated with mills with band headsaws. Unlike mills with band headsaws, none of the MC firms reported using a computerized edger or bin sorter.

Another way to analyze the use of computerized edgers and bin sorters is to examine the characteristics of the firms that use these devices versus the firms that do not (Table 2). The two largest multiple mill producers were excluded from Table 2 to provide a better representation of a typical hardwood sawmilling firm. Most eastern grade mills and saw milling firms do not have computerized edgers or bin sorters. The average annual production of these firms is 7.7 million board feet compared with average annual of 13.2 and 19.2 million board feet for operations with edgers and bin sorters respectively. Annual production of the relatively few operations that used both pieces of equipment was 21.9 million board feet. It is interesting that most of the firms with computerized edgers operated only one mill.

Table 2. Comparison of characteristics of surveyed eastern hardwood grade mills with and without computerized edgers and bin sorters.

	Operations without computerized edgers or bin sorters.	Operations with computerized edgers	Operations with bin sorters	Operations with computerized edgers and bin sorters
Number of mills	153	20	16	7
Number of firms	99	19	13	6
Average mill size (mmbf/year)	7.7	13.2	19.2	21.9
Range of mill size (mmbf/year)	1 to 30	4 to 50	10 to 50	10 to 50
Mills with band head saws (%)	52.9	70.0	93.8	85.7
Mills with resaws (%)	52.2	71.4	50.0	62.5

The mill sizes of the surveyed firms ranged from 1 to nearly 50 million board feet annually. Again, fIrms that do not use edgers or sorters were smaller, with production ranging from 1 to 30 million board feet. The smallest mill that used a computerized edger reported an annual volume of 4 million board feet, while the smallest mill using a bin sorter reported a volume of 10 million board feet.

Although resaws are used routinely to increase production and grade yield, the association between resaws, computerized edgers, and bin sorters is not clear. Of the sampled firms without these devices, 52 percent had resaws. More than 70 percent of the firms with edgers had resaws but only 50 percent of the firms with bin sorters used resaws. There are two possible reasons for this. Mills that use computerized edgers do so to increase yield, particularly grade yield; such mills also may be using resaws to increase grade yield. Some larger mills use alternative designs such as dual head rigs or thin kerf gang saws to increase capacity. It is likely that most of the mills using bin sorters without resaws have an alternative design such as dual headrigs.

CONCLUSION

The hardwood sawmilling industry has undergone considerable change over the last quarter century. Much of this change can be associated with changes in hardwood lumber markets and the export market. However, the increase in sawtimber volume that has occurred during this period has allowed mill size to expand and the number of multiple mills to increase. Still the increases in marketing efficiency of multiple mill operations does not account for the total reduction in market margins between lumber and stumpage prices. Equipment such as resaws and computerized edgers have been used to increase grade yield and have helped firms combat decreasing margins. However, competitive market pressure means that any increases in efficiency eventually will accrue to the resource, causing the margins between timber and lumber prices to decrease.

Bin sorters also have been used by mills to reduce production costs. However, unlike edgers that have been used to increase yield, bin sorters are used to reduce labor costs. The green chain is the most labor intense part of most sawmills; yet the use of bin sorters may not offset high labor cost associated with the green chain because only large mills (10 million board feet and larger) have used such devices. Should labor regulations start to clamp down on tasks that require repetitive moti-on, the hardwood lumber industry may be forced to use bin sorters.

Although the hardwood lumber industry has been using high-tech equipment during the last decade, much of this technology was first developed for use in softwood mills. The current level of automation in softwood mills suggests that computerized equipment will become even more commonplace in the hardwood sawmilling industry. One barrier to increased automation in hardwood sawmills is the lack of sufficient personnel with the education and skills necessary to operate this equipment. Perhaps it is time to examine the skills needed to operate the sawmill of the future and to initiate programs that allow potential mill workers to develop these skills.

I would like to conclude this paper with a warning that technology does not get developed in a vacuum, there has to be a need for the technology and the ability of the firm to pay for the technology. No feasibility analysis can come close to the realities of the markets because of the complexity of individual sawmills and the local timber and lumber market conditions that face individual mills. Therefore, it is probably more important for forest product researchers to work on the development of high-tech sawmilling equipment rather than try to convince sawmills to use such equipment.

LITERATURE CITED

Emanuel, D. and C. Rhodes. 1999. Bulletin of hardwood market statistics: first half - 99. USDA For. Serv Res. Note NE-370. 22 p.

Luppold, W.G. 1989. Hardwood material use, past, present, and future. In: Proceedings of pine hardwood mixtures: a symposium on management and ecology of the type, 1989 April 18-19, Atlanta, GA. 236 - 241.

Luppold, W.G. 1996. Structural changes in the Central Appalachian hardwood sawmilling industry. Wood and Fiber Sci. 28(3): 346-355.

Luppold, W. G. and J.E. Baumgras. 1995. Price trends and relationships for red oak and yellow-poplar stumpage, sawlogs, and lumber in Ohio: 1975-1993. North. J. Appl. For. 12(4): 168-173.

Luppold, W.G., J.P. Prestemon, and J.E. Baumgras. 1998. An examination of the relationships between hardwood lumber and stumpage prices in Ohio. Wood and Fiber Sci. 30(3): 281-292.

Powell, D.S., J.L. Faulkner, D.R. Darr, Z. Zhu, and D.W. MacCleery. 1994. Forest resources of the United States, 1992. USDA For. Servo Gen. Tech. Rep. RM-234. 132p.

Steer, H. B. 1948. Lumber production in the United States: 1799-1946. USDA For. Ser. Misc. Pub. 669.

U.S. Department of Agriculture, Forest Service. 1973. The outlook for timber in the United States. USDA. For. Servo For. Resour. Rep. 20. 367p.

PROCEEDINGS OF THE TWENTY-EIGHTH

ANNUAL HARDWOOD SYMPOSIUM

West Virginia Now-The Future For The Hardwood Industry?

EDITED BY

DAN A. MEYER NATIONAL HARDWOOD
LUMBER ASSOCIATION MEMPHIS, TN

Canaan Valley Resort & Conf. Center
Davis, West Virginia
May 11-13,2000"