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Economic Implications of manufacturing sawed ties and timbers

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SAWED TIMBERS: A PROFITABLE PRODUCT

MOST HARDWOOD lumbermen recognize inherent advantages in manufacturing sawed timbers: higher overrun from reduced kerf loss; reduced sawing time and milling cost per unit of volume output; quicker return from the sale of green timbers; and no degrade loss from yard seasoning. They also see the disadvantages: lower prices than for most lumber grades; limited and fluctuating markets; and restricted suitability of logs for timber manufacture.

Many sawmill operators who have never cut timbers are reluctant to venture into this field. Other lumbermen have had an unsatisfactory experience in producing sawed timbers and have vowed never to enter this market again. Yet the extra income from sawing timbers along with standard lumber should entice some progressive mill managers to seek these valuable but somewhat erratic markets.

The purpose of this paper is to discuss those factors that affect the profitability of manufacturing timbers and show that the combined manufacture of both lumber and timbers will provide a greater daily income than the manufacture of lumber alone.

STUDY OBJECTIVES

The study was undertaken to investigate the profitability of manufacturing sawed timbers and to learn if sawing timbers and lumber would be more lucrative than sawing only lumber. We sought answers to four questions:

- What grades of lumber are enclosed within timbers sawed from each grade of factory logs?

- What operational and economic factors control the feasibility of sawed timber manufacture?
- If producing timbers and lumber from each log is more profitable than producing lumber only, what species and grades of logs provide the greatest financial gain when hearts are sawed into timbers of different sizes?
- How do management and marketing problems affect the profitability of sawing ties and timbers?

METHODS

The initial sawing of a log in a sawmill yields either lumber or lumber plus one or more timbers. Because the sawyer can cut either all lumber or lumber plus a timber, two questions arise: Which practice provides the greater profit to the millowner? And what generates this extra profit?

To effectively compare these two practices, approximately 700 randomly selected sample logs were sawed into standard lumber thickness. Then this lumber was graphically arranged to simulate its original position within the log. Finally, the board components of each log were restructured to simulate various sizes of timbers in the heart. Observed lumber thicknesses remained in residual peripheral sections. In the simulated sawing of the graphically reconstituted logs, no new saw lines were developed. The borders of the superimposed timbers followed the saw lines actually made during the initial log breakdown.

This simulation allowed us to develop accurate costs and production times for the two sawing methods. We computed the additional volume yields from sawed timber manufacture, the extra log volume required, and the net dollar yield from standard lumber and timbers of different sizes. This permitted us to show what combinations of species, log grades, and sawed timber sizes resulted in the largest increase in dollar income per hour to the millowners.

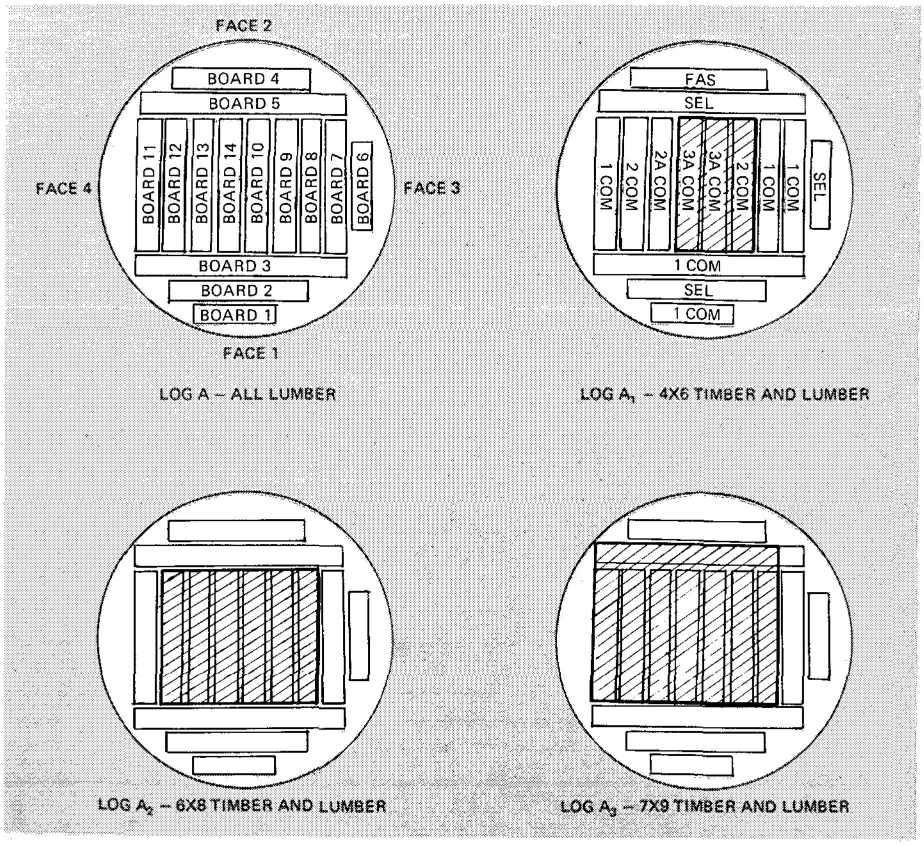
Data used in this study were collected at three West Virginia circular mills cutting 4.5 to 5.5 thousand board feet per day.

Log costs, production costs, and prices received for manufactured products were essentially the same at the three mills. Therefore one set of cost and price data was used to represent all three mills (tables 7 to 10).[1]

The primary sawing method used by the three mills is illustrated by log A in figure 1. The order in which boards were sawed from the sample logs is represented by the sequential face and board numbers. The sawing method incorporated grade-sawing techniques in peripheral high-value sections and production sawing in the low-quality heart.

[1] All tables are in the appendix.

Figure 1.—Product alternatives cut from sample logs.



Four species groups and three log-grade classes provided the basic data. Red oak, white oak, and hickory were selected because they are used extensively for manufacture of ties and timbers. Hard maple was included to determine if sawed timbers could be produced economically from a high-value species. Log quality was measured by the U.S.D.A. Forest Service log-grading system for factory logs.[2] Tie-and-timber or local-use logs were classified in the factory grade 3 class. Approximately 50 logs were in each species group and log-grade class.

620 logs were graded and sawed into 1-inch lumber. Some 5/4-inch boards were cut when the sawyer thought this thickness would be best. All lumber was graded by National Hardwood Lumber Association inspectors. The restructured full-length 4-by-6-, 6-by-8-, and 7-by-9-inch timbers were not graded per se; however, the exposed face of each board sawed from each log was graded either acceptable or not acceptable for timber production. These timbers were graphically superimposed on the lumber actually sawed from each sample log. The placement of these superimposed timbers was controlled by the position of the pith or center of each log. The reason for using the pith or log center as criterion for timber location is due to the profound concentration of low-quality lumber in and around the pith.

ANALYTICAL PROCEDURES

To properly identify the factors influencing cost and value changes when timbers are sawed, and to accurately assess the profitability of sawing timbers, we used two analyses.

In the first analysis (I) we imposed the optimum condition that all logs studied could be manufactured into timbers. This control permitted us to evaluate the effects of species and log-grade differences and ultimately to define the logs most suited economically for production of timbers.

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[2] Ostrander, M. D., and others. A GUIDE TO HARDWOOD LOG GRADING (REVISED). U.S.D.A. Forest Serv. NE. Forest Exp. Sta., 50 pp., illus. Upper Darby, Pa. 1965.

In the second analysis (II) we studied 100 mill-run red oak logs to determine the expected economic effectiveness of producing timbers under actual conditions. Many of the logs were not suited for the manufacture of timbers because of the individual or combined effect of small diameter, center rot, sweep, and end shape. By studying the production of timbers under actual operating conditions, we were able to determine the effects of physical log suitability, price changes, and management control on the profitability of sawing timbers.

RESULTS AND DISCUSSION

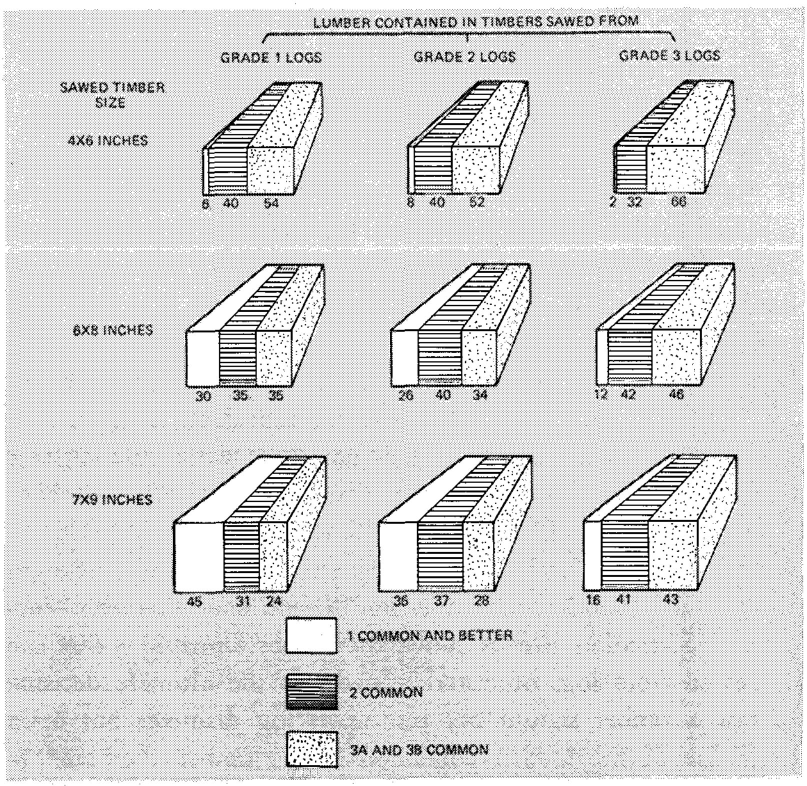
Our investigation revealed that, under the price and cost situations prevailing at the mills studied: (1) If sawed timbers are cut from the hearts of physically suitable hardwood logs, the combined profit from lumber and timber will be greater than if these same logs were sawed entirely into grade lumber. This prevails even when large timbers are sawed from high-grade logs. (2) If markets are available, a millowner should cut a tie or timber from *every* log physically suited for this product. If markets are restricted, tie and timber production should be confined to the lower grade logs. These statements are based on consistent relationships between the manufacture of timbers and lumber.

Results are presented by log grade rather than by log diameter because grade was felt to be a more meaningful control factor for mill managers. Although diameter represents a universally understood variable, it alone does not show value relationships that are so important in the alternatives of lumber versus timbers.

Log diameter does control maximum timber size. But the decision to saw a timber from a log that is big enough, straight enough, and sound enough does not depend upon diameter. Published information already shows the timber dimensions that can be sawed from logs of different sizes. So the ultimate decision to saw a timber should not rest upon log diameter but upon the value of the lumber contained in the timber compared to the selling price of the timber itself. Lumber values must be considered. And lumber values differ substantially within similar size timbers sawed from different log grades. Therefore log grade becomes a reasonable criterion for resolving the question of whether to saw lumber or a timber-lumber mix.

Because sawed timbers allow an unlimited number of defects that do not reduce strength, sawmill operators aim to cut these timbers from heart portions where grade defects are concentrated. Nevertheless, larger timbers often contain high-value lumber that may be worth more than the sawed timber. Before we assess the economics of sawed timber production, we must establish the lumber grade composition of different size timbers.

Figure 2.—Proportionate distribution of lumber grades in different size timbers sawed from three log grades—all species combined.



Timbers sawed from low-quality logs contain at least 75 percent 2 and 3 Common lumber regardless of timber size (table 1). However, the percentage of high-quality lumber in sawed timbers increases as log quality rises and timber size expands. For example, 4-by-6-inch timbers sawed from grade 3 logs have an expected yield of only 2 percent 1 Common and Better material, whereas 7-by-9-inch timbers sawed from grade 1 logs are composed of 45 percent 1 Common and Better lumber (figure 2).

Although grade-lumber yield from sawed timbers is important, it is not the only factor affecting the economics of producing timbers. Several changes occur when timbers are manufactured along with lumber, and each change affects the profitability of the venture.

ANALYSIS I: THE OPTIMUM RETURN

Six factors — overrun, grade yield, the difference between lumber and sawed timber prices, conversion time, log costs, and production costs—determine the profitability of sawing timbers. Some of these factors complement one another; for example, reduced conversion time lowers production cost per unit of volume sawed. However, some factors oppose each other; for example, the cost reduction from greater hourly output is blunted by the increased costs for the additional raw material required.

The interrelationships among these six factors and their joint effect upon net hourly income are illustrated in table 2. These tabular data contrast the economic merits of sawing either lumber or lumber plus 7-by-9-inch timbers from high-quality maple logs and low-quality hickory logs.

Overrun

Sawing timbers and lumber provides a greater overrun than sawing lumber only. Losses in salable volume from kerf and allowances for shrinkage and surfacing are entirely eliminated in the sawed-timber portion of a log. Therefore more salable volume is recovered. Because low-quality logs are generally smaller than high-quality logs, a greater portion of small low-quality logs are sawed into timbers. Consequently the percent overrun is greater from these logs.

The additional overrun from sawing 7-by-9-inch timbers from hickory and maple sample logs was 297 and 216 board feet, respectively (table 2). Although the volume increase from sawed timbers is higher in the small low-quality hickory logs, an appreciable increase in overrun occurred in both log groups.

Lumber Quality and Price

Although sawed timbers provide a greater overrun, the total product value of this lumber-timber mix from a given group of logs may be less than the income obtained when only lumber is sawed. Timbers cut from high-value logs will contain some high-quality lumber that commands a high market price. With high lumber prices, the enclosed lumber could be worth more than the entire timber even when increased overrun is considered.

For example, in table 2, the maple lumber enclosed in the timbers was worth $100.90, whereas the timbers were worth only $65.76. Thus high-value logs will usually show a decrease in total product value when timbers are sawed from them. In this example, the reduction was $35.14. Conversely, low-value logs usually show an increase in total product value from sawing both timbers and lumber. The gain for the low-grade hickory logs in table 2 amounted to $22.64 ($90.05 – $67.41).

Conversion Time

Conversion time per thousand board feet of output should always decline when timbers are sawed. Sawed-timber manufacture eliminates the time required to saw up the center portion of a log. As a result, more volume can be produced in less time.

The largest reduction in sawing time occurs in the small low-quality logs. Low-quality logs normally have smaller diameters than high-quality logs. If timbers of equal size were cut from both groups, a greater portion of the volume in the low-quality logs would be sawed into timbers. Thus a greater percent of total conversion time would be eliminated by sawing timbers from the poorer logs.

This principle needs to be illustrated for greater emphasis. Figures in table 2 show that 2.45 hours were needed to saw 1,595 board feet of lumber from large grade 1 maple logs and 2.59 hours were needed to saw 1,552 board feet of lumber from smaller grade 3 hickory logs. Thus hourly lumber output was 651 board feet for maple and 600 board feet for hickory. This relationship is plausible because the hickory logs were smaller, and the wood was more difficult to saw.

Now, when both lumber and 7-by-9-inch timbers were sawed from the large maple logs, hourly output totalled *875* board feet (1,811/2.07). The hourly output of lumber plus 7-by-9-inch timbers from the smaller hickory logs jumped to *943* board feet (1,849/1.96). Thus the increased hourly yield from sawing timbers from smaller low-grade hickory logs was *343* board feet, whereas the increased hourly yield from sawing timbers from the larger high-grade maple was only *224* board feet. This comparison shows why the smaller low-grade logs require less conversion time.

Conversion time per board-foot unit produced is a critical factor controlling the size of profits when sawing both lumber and timbers because: (1) it is easily altered; and (2) it is one of the major determinants of hourly product value. To effect a decrease in conversion time per thousand board feet, a millowner only needs to increase the production of timbers. The immediate result is a marked increase in the volume of products manufactured hourly. In all the species groups studied, dollar yields from this increased volume more than offset the lower prices received from timbers. Therefore, *hourly product value* was always greater when timbers were produced.

For example, the total product value of the lumber sawed from the group of maple logs (table 2) was $279.51 compared to the total product value of $263.30 for both lumber and timbers. However, on the basis of *hourly* product value, which reflects the time required to saw, the lumber-timber mix yielded $13.11 more per hour in salable products. The higher hourly product value for the lumber-timber mix resulted from a 16 percent (0.38 ÷ 2.45) reduction in conversion time when timbers were sawed. In low-quality logs, like those in the grade 3 hickory group, total product value was greater when timbers were produced because of overrun alone. Therefore the $30.21 increase in hourly product value obtained from low-quality hickory logs was considerably larger than the increase from high-quality maple logs.

Log Costs

Costs incurred in producing both lumber and timbers can be designated as either material input costs (logs) or production costs.[3] Hourly log costs should always increase when timbers are sawed because the reduction in individual log sawing time means that more logs can be sawed per hour.

When a millowner saws both timbers and lumber, his increase in hourly log costs will be greater for high-quality logs than for low-quality logs. High-quality logs of a given species may cost $20 to $30 per thousand board feet more than an equal volume of low-quality logs (table 9). Also, a group of low-quality logs will yield a greater overrun because the average scaling diameter is smaller. Therefore the combined effects of overrun and purchase price favor sawed-timber manufacture from the smaller low-quality logs. For example, 7-by-9-inch timbers sawed from grade 1 maple logs increased log costs $7.24 per hour, whereas the same size timbers sawed from grade 3 hickory logs increased log costs only $2.42 per hour (table 2). Yet total salable volume from the hickory logs was 81 board feet greater than the total salable volume from maple logs; and this extra output from hickory required about 7 minutes less sawing time.

Production Costs

Sawed timber manufacture usually reduces production costs because grading, stacking, and loading sawed timbers normally require less manpower, machinery, and time compared to an

[3] Includes costs incurred in milling, stacking, drying, and loading for shipment.

equal volume of lumber. Timbers are normally graded at the expense of the buyer and do not need to be stacked for drying. Because timbers are sold green, inventory costs per unit of sawmill output are lower for the timber-lumber mix than for lumber alone. Consequently, a given volume of timbers can be produced at a lower cost than an equal volume of lumber.

With the increased output of sawed timbers, production costs per unit of volume should decrease because an operator can produce more volume with the same crew and equipment. However, mill size dictates the extent to which hourly production costs can be reduced. A small millowner often uses only one lift truck to handle both logs and lumber. He also employs fewer men to stack and handle this lumber. In this kind of operation, significant labor or equipment costs probably could not be eliminated even though inventory costs could be reduced. For example, at the small mills used in this study, hourly production costs did not differ between milling timbers and lumber and milling lumber only (table 2).

What Species and Grades of Logs Provide The Greatest Financial Gain?

Lumber value is a key factor in defining the most economically suited logs for production of timbers. Of the six factors, the value of lumber sawed into timbers had the only negative effect upon total product value: for example, total product value dropped from $279.51 to $263.30 when timbers were manufactured from the hearts of grade 1 maple logs (table 2). This reduction occurred because sawed timber prices usually range from $55 to $75 per thousand board feet, whereas prices for Common lumber grades range from $65 to $130+ per thousand board feet. To minimize or eliminate this reduction in total product value, timbers should be cut primarily from lower quality logs containing low-value lumber. These logs provide the millowner with his greatest gain when sawing timbers.

When timbers are cut from logs of the same grade but of different species, dollar gains will be greatest from those logs that would provide the least return when sawed into lumber. In this study, grade 3 hickory logs lost $6.40 per hour if sawed into only 4/4 lumber, yet these same logs would allow an optimum return of $21.39 per hour if sawed into lumber and 7-by-9-inch timbers (table 3). Therefore, the total gain from sawed-timber manufacture would be $27.79 per hour. However, for grade 1 maple logs the total gain from lumber plus 7-by-9-inch timber manufacture would amount to only $5.87 per hour. This smaller increase for maple may be attributed to the higher value of the lumber contained within the sawed timber.

Similarly, when only one species group is considered, the lowest quality logs in that group will yield the greatest dollar gain when sawed into timbers. For example, hourly gains of $20.05, $13.87, and $9.20 accrued when 7-by-9-inch timbers were cut from red oak logs of grades 3, 2, and 1, respectively (table 3).

Log quality alone does not always provide an accurate criterion for comparing the economic merits of sawing timbers of the same size from two different species. For example, data in table 3 show that when 7-by-9-inch timbers were sawed, grade 2 hickory logs yielded a higher hourly gain—$19.56—than grade 3 maple logs—$17.99. However, because many interacting factors affect dollar yields from different groups of logs, log grade is the best indicator to use.

ANALYSIS II: EXPECTED RETURN TO SMALL MILLOWNERS

Up to this point, we have discussed the economic advantages that accrue from sawing timbers from different species and grades of logs. Now we want to consider the practical aspects. Under actual operating conditions, sawmill owners must cope with problems like physical suitability of logs for timber manufacture, fluctuating price levels, byproduct losses, and the material flow and marketing of a multiproduct output. All these factors affect sawmill profits.

Physical Suitability of Logs

Every millowner knows that all logs are not physically suited for the manufacture of timbers. A study completed at the Forest Products Marketing Laboratory[4] revealed that, as log quality decreases, the physical suitability of these logs for production of timbers also decreases (fig. 3).

Dollar gains from sawing timbers are directly related to the number of logs from which timbers are sawed. The maximum return occurs when a timber is manufactured from every log (analysis I, table 3). However, under actual operating conditions

[4] Garrett, Lawrence D. PHYSICAL SUITABILITY OF APPALACHIAN HARDWOOD SAW-LOGS FOR THE MANUFACTURE OF SAWED TIMBERS. Unpublished report on file at the Forest Products Marketing Laboratory, Princeton, West Virginia. 1967.

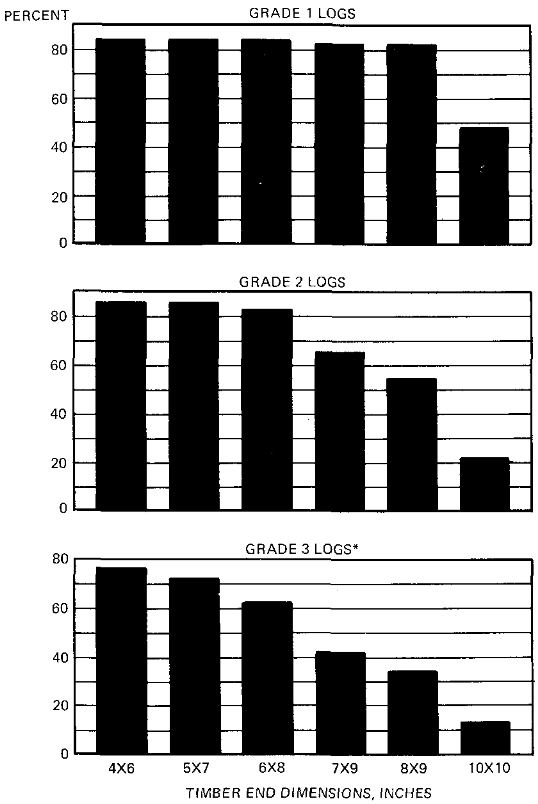


Figure 3. — Portion of sample logs suitable for the manufacture of various size timbers. Sample logs represent the mean percent of three species groups: red oaks, white oaks, and hickories. Grade 3 includes tie-and-timber and local - use grades.

many logs cannot be used for sawed timbers. For example, about two-thirds of the grade 3 red oak logs studied were suitable for producing 6-by-8-inch timbers, but only two-fifths were suitable for 7-by-9-inch timbers (table 4). Therefore sawmill operators must not expect the substantial dollar increases shown in table 3 because these data apply to optimal situations where all logs are suitable for sawed-timber production.

Even though many logs are unsatisfactory for sawed timbers, this does not make the venture unprofitable. With costs and prices reflected in this report, small mill operators can expect an additional $5 per hour from producing 4-by-6-inch red oak timbers and lumber (table 5). If they can saw 6-by-8inch timbers from about two-thirds of their red oak logs, the net increase in hourly income should range from $6 to $8. Gains from sawing 7-by-9-inch timbers should range from $7 to $10 per hour, depending upon the grades of oak logs sawed. Thus small millowners can legitimately expect daily gains of $35 to $70 by converting a portion of their lumber output into sawed timbers. Larger mills could, of course, expect a greater daily gain.

Decreased Prices for Timbers

We also found that the study mills could absorb a significant drop in the prices they received for timbers and still produce them at a greater profit than if they had sawed the same logs into lumber. For example, when prices were purposely reduced $10 per thousand board feet (price level I to II), net values dropped only $1 to $3 per hour (table 6). With an additional $10 per thousand board feet price reduction (price level II to III), hourly values dropped another $1 to $3. Therefore, even if timbers sold for $20 per thousand board feet less than their current market value, the mills could still expect a greater hourly return from a combined lumber-timber output than from lumber alone.

Management Considerations

In addition to the physical suitability of logs and the potential changes in sawed timber prices, a millowner should be aware of other problems affecting profits.

First, logs cut to specified tie-and-timber lengths may give a high proportion of short boards in packaged lumber shipments. Millowners who buck all logs to specified timber lengths will accumulate odd lengths of lumber, such as 8-foot 6-inch, 9-foot, and 11-foot boards. Lumber-grading regulations permit only 50 percent of a lumber shipment in odd lengths without incurring a price reduction. In addition, grading rules specify that FAS lumber shipments may include only 15 percent in shorts 8 and 9 feet long or else the lot is subject to penalty. Similar restrictions are imposed on other grades.

Second, sawmill operators who do *not* tailor log lengths to specified timber lengths may incur losses from throw-away ends of timbers that exceed commercial lengths. For example, a standard 7-by-9-inch, 8-foot 6-inch crosstie cut from a 10-foot log produces a waste block 7 by 9 by 18 inches, containing 7.8 board feet. If 50 of these blocks were discarded daily, volume losses would total 390 board feet. The value of this waste material if sold as timbers at $60 per thousand board feet would amount to $23.40.

When sawing 6-by-8-inch timbers from suitable logs, the study mills produced approximately 40 waste blocks per 8-hour shift. Because the average length of these blocks was 6 inches, daily losses amounted to 160 board feet, worth $9.60. However, this *daily* loss from waste blocks was almost balanced by the *hourly* gain achieved from sawing timbers instead of lumber.

Third, grade sawing is not always compatible with the sawing procedures best suited for timbers. When logs are sawed for maximum grade recovery, the sawyer must concentrate on the log faces that have fewer discernible surface defects. These faces are sawed deeper to permit recovery of as much clear lumber as possible. However, most railroads prefer ties with boxed hearts to reduce the likelihood of severe splitting and to permit better penetration of creosote in surrounding sapwood zones. Also, for sawed timbers, specifications on knot size are more lenient if these defects are placed within the face rather than along the edge. For grade lumber, defects should be positioned along the board edges to permit the greatest yield in high-value clear cuttings.

Thus the sawing method customarily used for lumber does not always complement the practice best suited for timbers.

Good supervision of log bucking and sawing practices should minimize the losses from short boards, over-length timbers, and miscut lumber. However, a millowner should continuously be aware of losses from inadequate supervision and management, and he should remedy them as soon as they are discovered.

CONCLUSIONS

In this report, we investigated the economic implications of manufacturing sawed ties and timbers in conjunction with factory-grade lumber. Based on the results, these conclusions appear pertinent:

- When markets for sawed timbers are available, the combined production of both lumber and timbers from physically suitable logs will give a greater dollar return than the production of lumber alone. Millowners can expect increased dollar gains from sawed timbers cut from low-, medium-, or even high-grade logs. With current price structures, the study mills received up to $70 per day more from sawed-timber manufacture. Even if sawed-timber prices should decline $20 per thousand board feet below current levels, a timber-lumber mix would provide a greater income than lumber alone.

- Because lumber grades are directly linked to dollar yields, lumbermen want to know the lumber grade volume contained within sawed timbers of various dimensions. This study showed that more than 90 percent of the lumber contained in a 4-by-6-inch timber would grade 2 Common or poorer. In fact, over half the volume was 3 Common regardless of log grade. Even the larger 7-by-9-inch timbers contained 55 to 84 percent of 2 Common and poorer grades. Therefore, only when large timbers are cut from high-grade logs should the millowner expect to enclose significant amounts of high-grade lumber.

- The combined production of lumber and timbers from suitable factory-grade logs will normally increase log overrun, hourly volume output, and net hourly income. Reduced sawing time per unit of output is a critical factor in affecting the dollar gains achieved from sawed-timber manufacture.

- Hourly log costs increase when timbers are manufactured; but the increase is less for the smaller low-quality logs. However, increased volume and value yields from sawed timbers far outweigh increased raw-material costs.

- Production costs per unit of volume output decrease when timbers are sawed. Large mills have a greater opportunity to reduce production costs because labor and equipment can be manipulated more readily.

- Mill operators who engage in the dual production of lumber and timbers must carefully direct log-bucking and sawing practices to provide maximum income. If logs are bucked to conform to sawed-timber lengths, then potential dollar yields from high-value side lumber are sacrificed because of the preponderance of short boards. Conversely, if logs are bucked to produce long high-grade lumber, then overlength waste blocks from timbers reduce volume yield and dollar income. There is no perfectly satisfactory solution. However, when a sawmill operator has a choice, he should saw timbers from those species and log grades that normally would give him the *lowest* hourly return if sawed exclusively into lumber.

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Table 1.—*Lumber grade composition of three sawed-timber sizes, by species and log grade*

(In percent)

Species	Lumber grade	Sawed timber size: 4 by 6 inches, log grade —			6 by 8 inches, log grade —			7 by 9 inches, log grade —		
		1	2	3[1]	1	2	3[1]	1	2	3[1]
Red oak	FAS-Select	7	—	—	31	11	—	43	15	2
	1 Common	1	6	1	9	19	14	9	25	17
	2 Common	34	36	23	26	33	53	24	36	38
	3 Common[2]	58	58	76	34	37	33	24	24	43
White oak	FAS-Select	1	—	—	3	2	—	11	3	1
	1 Common	3	2	1	7	10	1	12	12	4
	2 Common	13	10	5	30	24	18	31	28	27
	3 Common[2]	83	88	94	60	64	81	46	57	68
Hickory	FAS-Select	7	9	2	27	19	8	39	27	10
	1 Common	3	6	4	15	13	15	16	20	15
	2 Common	72	72	74	42	59	58	37	46	53
	3 Common[2]	18	13	20	16	9	19	8	7	22
Hard maple	FAS-Select	3	7	—	23	10	1	34	11	1
	1 Common	([3])	3	1	7	20	9	15	25	18
	2 Common	40	42	26	41	43	40	31	39	41
	3 Common[2]	57	48	73	29	27	50	20	25	40

[1] Includes tie-and-timber and local-use grades.
[2] 3A and 3B Common.
[3] Less than 1 percent.

Table 2.—*Comparison of cost and value changes when both lumber and lumber plus 7-by-9-inch timbers are sawed from grade 1 maple logs and grade 3 hickory logs*

Item	Grade 1 maple logs		Grade 3 hickory logs	
	All lumber	Lumber and 7-by-9-inch timbers	All lumber	Lumber and 7-by-9-inch timbers
Product volume (board feet):				
Volume in salable lumber	1,595	935	1,552	650
Lumber volume in timbers	—	660	—	902
Overrun from timbers	—	216	—	297
Volume in salable timber	—	876	—	1,199
Total salable volume	1,595	1,811	1,552	1,849
Total product value:				
Value salable lumber	$303.81	$202.91	$128.75	$61.34
Value lumber in timber	—	100.90	—	67.41
Value salable timbers	—	65.76	—	90.05
Value salable lumber and timbers	—	268.67	—	151.39
Value corrected for degrade [1, 2] loss	279.51	263.30	118.47	148.36
Production time (hours):				
All lumber	2.45	—	2.59	—
Lumber in timber	—	0.38	—	0.63
Adjusted time—lumber and timber	—	2.07	—	1.96
Product value per hour	$114.08	$127.19	$ 45.60	$75.81
Costs per hour:				
Log costs	$ 48.42	$ 55.66	$ 18.20	$20.62
Production costs	33.80	33.80	33.80	33.80
Total	82.22	89.46	52.00	54.42
Net value per hour to mill owner (before taxes)	$ 31.86	$ 37.73	$ -6.40	$21.39

[1] Loss in volume and grade due to checking, splitting, shrinkage, and cupping.

[2] Cuppett, Donald G. AIR-DRYING PRACTICES IN THE CENTRAL APPALACHIANS. U.S. Forest Serv. Res. Paper NE-56, NE. Forest Exp. Sta., Upper Darby, Pa., 19 pp. 1966.

Table 3.—*Net hourly income from both lumber and timbers sawed from different species and log grades*

Species	Log grade	Lumber only	Lumber plus timbers measuring—		
			4 by 6 inches	6 by 8 inches	7 by 9 inches
Red oak	1	$25.37	$31.14	$32.20	$34.57
	2	9.30	13.64	17.70	23.17
	[1]3	2.40	6.65	13.60	22.45
White oak	1	13.98	19.55	25.33	29.02
	2	.63	5.58	12.46	19.95
	[1]3	−2.20	.97	11.23	23.89
Hickory	1	12.45	20.89	23.16	27.98
	2	1.94	9.20	15.93	21.50
	[1]3	−6.40	−.68	8.86	21.39
Maple	1	31.86	38.91	39.09	37.73
	2	27.17	34.15	37.08	42.44
	3	18.96	24.93	33.31	36.95

[1] Includes tie-and-timber and local-use grades.

Table 4.—*Physical suitability of red oak logs for the manufacture of sawed timbers*

(In percent)

Log grade	Timber size		
	4 by 6 inches	6 by 8 inches	7 by 9 inches
1	88	90	71
2	88	88	51
[1]3	85	66	41

[1] Includes tie-and-timber and local-use grades.

Table 5.—*Hourly net values obtained from red oak logs[1] that were sawed into lumber and timbers at the study mills*

Grade	All lumber	4-by-6-inch timbers and lumber	6-by-8-inch timbers and lumber	7-by-9-inch timbers and lumber
1	$24.53	$29.24	$30.16	$31.20
2	7.86	12.50	14.10	15.21
[2]3	–1.98	3.48	5.62	7.53

[1] All logs were not sawed into timbers.
[2] Includes tie-and-timber and local-use grades.

Table 6.—*Effect of diminishing price levels received for red oak timbers upon the hourly net values received for both lumber and timbers*

Price levels	All lumber	4-by-6-inch timbers and lumber	6-by-8-inch timbers and lumber	7-by-9-inch timbers and lumber
		GRADE 1 LOGS		
I[1]	$24.53	$29.24	$30.16	$31.20
II[2]	24.53	28.15	28.30	28.00
III[3]	24.53	27.05	26.20	25.00
		GRADE 2 LOGS		
I	7.86	12.50	14.10	15.21
II	7.86	9.60	11.06	11.92
III	7.86	7.96	8.30	8.50
		GRADE 3 LOGS[4]		
I	–1.98	3.48	5.62	7.53
II	–1.98	1.43	3.94	5.50
III	–1.98	–.61	2.26	3.46

[1] 4- by 6-, 6- by 8-, and 7- by 9-inch timbers; $60, $65, and $75 per MBF, respectively.
[2] 4- by 6-, 6- by 8-, and 7- by 9-inch timbers; $50, $55, and $65 per MBF, respectively.
[3] 4- by 6-, 6- by 8-, and 7- by 9-inch timbers; $40, $45, and $55 per MBF, respectively.
[4] Includes tie-and-timber and local-use grades.

Table 7.—*Lumber prices per thousand board feet*[1] *received by study mills*

Species	Lumber grade				
	FAS	Select	1 Common	2 Common	3 Common [2]
Red oak	$200	$190	$130	$80	$70
White oak	210	200	130	80	70
Hickory	160	150	140	50	50
Maple	250	230	200	85	70

[1] Prices f.o.b. mill yard.
[2] Price weighted by relative volumes of 3A and 3B Common produced.

Table 8.—*Negotiated prices per thousand board feet*[1] *at mills studied for manufactured ties and timbers*

Species[2]	Timber size		
	4 by 6 inches	6 by 8 inches	7 by 9 inches
Red oak	$60	$65	$75
White oak	60	65	75
Hickory	60	65	75
Maple	60	65	75

[1] F.o.b. mill yard.
[2] No price difference existed for the species studied.

Table 9.—*Log costs per thousand board feet,*[1] *f.o.b. yards at study mills*

Species	Log grade		
	1	2	3[2]
Red oak	$65	$50	$40
White oak	60	50	40
Hickory	60	50	40
Maple	70	50	40

[1] Doyle scale.
[2] Includes tie-and-timber and local-use grades.

Table 10.—*Hourly mill and yard costs for the study mills*

MILL COSTS:	
Labor	$ 6.20
Supplies and expenses	1.95
Group insurance, payroll taxes, and compensation	.95
Depreciation expense	3.85
Fire insurance	.47
Interest on debt:	
Capital investment	2.25
Borrowed operating income	1.15
Total mill costs per hour	$16.82
YARD COSTS:	
Labor (includes mill manager)	6.40
Supplies and miscellaneous expenses	3.10
Group insurance, payroll taxes, and compensation	1.05
Depreciation expense	1.85
Fire insurance	1.38
Administration expense (sales, accounting)	3.20
Total yard costs per hour	16.98
Total production costs per hour (excluding log costs)	33.80

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