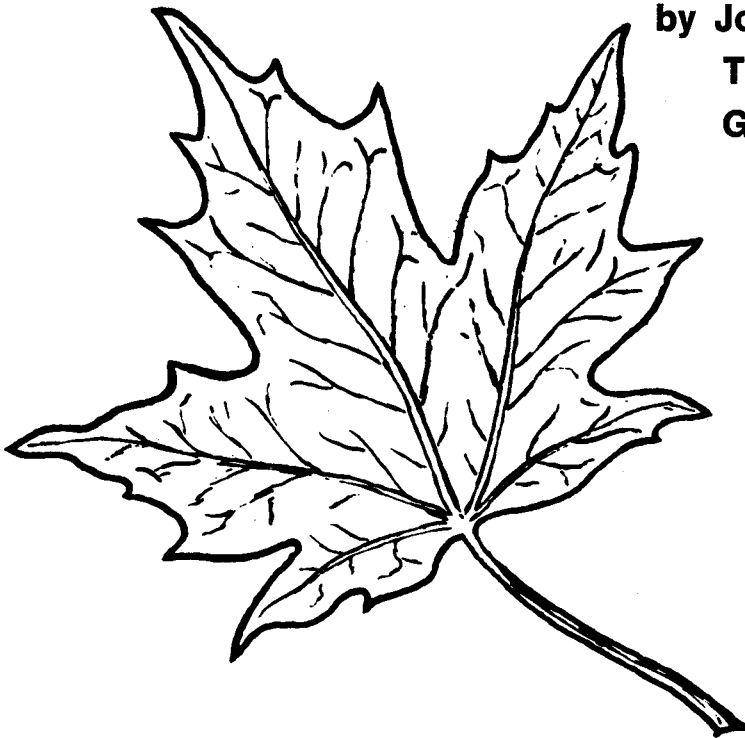


The Rate of Value Increase for SUGAR MAPLE

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The Rate of Value Increase for SUGAR MAPLE



Abstract

Presents financial-maturity information for sugar maple, based on tree growth and tree-quality data collected in Pennsylvania and West Virginia. Detailed rates of value increase and dollar value increase to be expected for a 10-year period are exhibited. Marking guides in the form of financial-maturity diameters are developed. The effects on financial maturity of operating at different levels of conversion costs and changing costs and prices are analyzed.



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BACKGROUND

THIS IS THE FOURTH in a series of reports about the rate of value increase of the more important hardwood timber species in the Northeast.

These reports have illustrated the relative importance of diameter growth, the increase in merchantable height, and the improvement in quality for determining present and future tree value. They have established the rates at which trees can be expected to increase in value over a 10-year period and have identified the relative sizes at which trees become financially mature. However, most important of all, these reports have characterized the joint relationship that must exist between silviculture and economics for determining the financial maturity of trees and stands for timber production.

Throughout the production of these reports, there has been a progressive development toward a higher order of timber-stand evaluation.

The first report—on the oaks—was concerned primarily with the development of methodology and the presentation of the expected rates of value increase and financial maturity diameters.

The second report—on yellow-poplar and beech—illustrated the differences in results between high- and low-value species, and a computer program was developed to produce the multitude of calculations necessary for the valuation of a single species.

The third report—on black cherry, white ash, and red maple—utilized the methodology to illustrate the application of financial maturity to the even-aged management of intolerant species. Detailed tables of the dollar-value increase were presented.

This fourth report, in addition to presenting the basic tables of expected rates of value increase and financial maturity diameters and detailed tables on the *rate* and *dollar* value increase for sugar maple (*Acer saccharum*), will show how different levels of conversion costs—

and the dynamic and realistic market situation of changing lumber prices and conversion costs—affect the determination of financial maturity.

THE RATE OF VALUE INCREASE

The value of a timber tree is influenced by its diameter, merchantable height, and quality. Over a period of time, we can expect improvements in these elements of a tree, which will increase its value. Our objective is to determine the rate at which this value increase takes place, so that valid comparisons with other financial investments can be made.

The rate of value increase is calculated by the use of the compound-interest formula

$$(1 + r)^n = \frac{V_n}{V_0}$$

in which

r is the rate of interest (value increase).

n is the time period (10 years).

V_n is the future value of the tree at the end of the 10-year period.

V_0 is the present value of the tree.

It is evident in the formula that, to calculate the rate of value increase, we must first determine the present and future value of the tree. The procedure used in developing the present and future values and computing the rates of value increase are presented in detail in two earlier research papers (*Trimble and Mendel 1969; Mendel and Trimble 1969*), and readers interested in the details of this procedure should refer to one of these publications.

We will briefly review the procedure, primarily for purposes of documentation of source material and data used. Figure 1 presents a schematic version of the basic procedure when there is no anticipated change over the 10-year period in the basic price of 4/4 No. 1 Common lumber or in the cost of converting the tree into lumber.

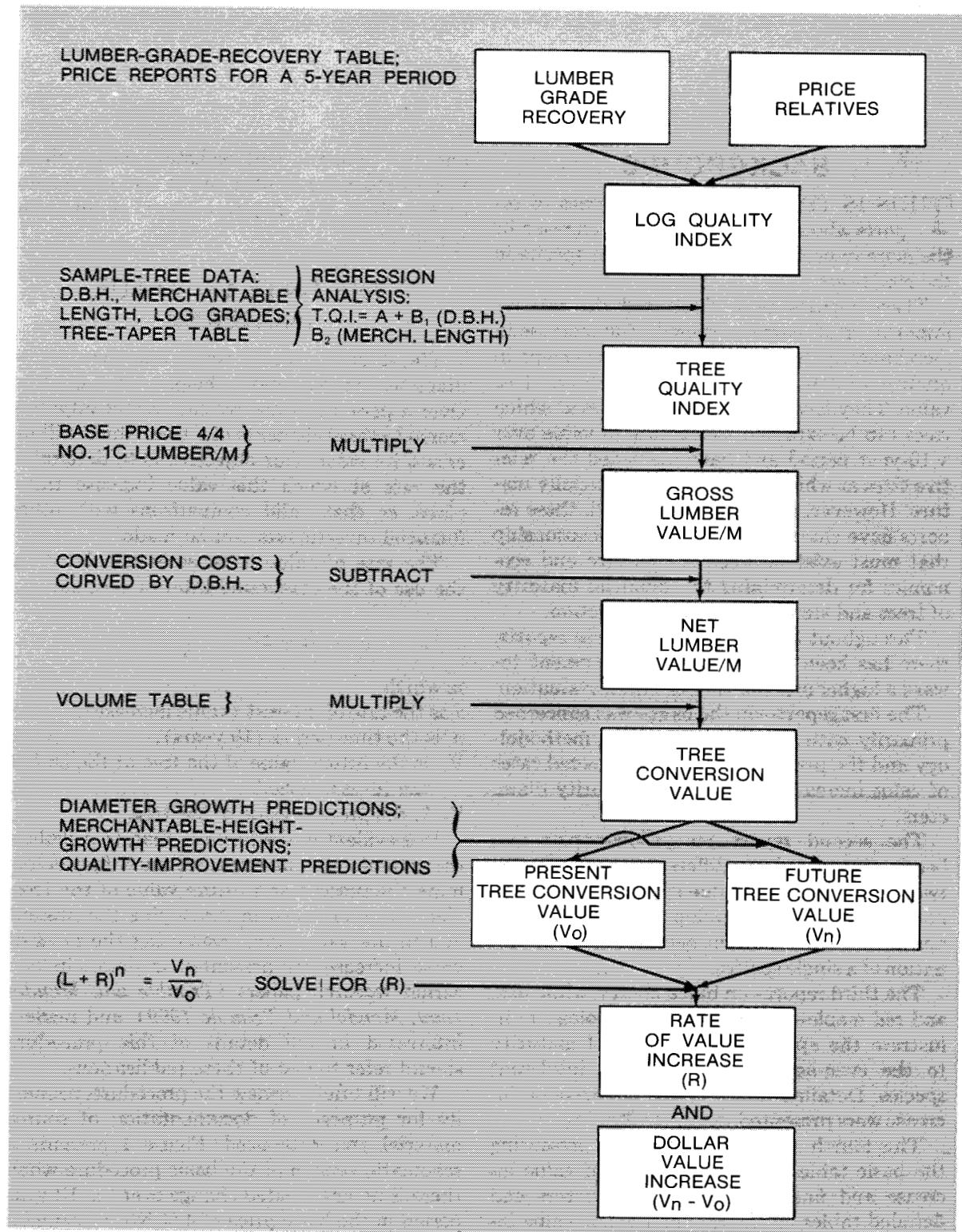


Figure 1.—Calculation of the rate of value increase.

Lumber-grade recovery data for sugar maple by log grade and size-grade combinations were obtained from the USDA Forest Products Laboratory (*Vaughan and others 1966*). Lumber prices used were those reported in the Hardwood Market Report (*Lemsky 1962-66 and 1968*). Prices for the 5-year period 1962-66 were used in developing the price relatives for calculation of the log-quality index (table 1). The 1968 report was used to determine the base price of \$185 per M (1,000) board feet for 4/4 No. 1 Common sugar maple. This was the base period for value determinations.

Sample-tree data for determining the log-grade relationship between the butt log and the upper merchantable logs for various diameters were obtained from 144 sugar maple trees selected at random in the Appalachian Region and 54 sugar maple trees similarly selected in the Allegheny Region.

In this study, three levels of conversion costs were recognized: \$60, \$70, and \$80 per M board feet for a 16-inch d.b.h. tree (table 2). The costs were curved by tree d.b.h.'s, and the results were applied by tree d.b.h. classes to determine the net value per M board feet.

Tree-conversion value was calculated by multiplying the net value per M board feet by the volume in the tree. The 1/4-inch International volume table was used to determine the volumes. Present values for trees can be read directly from the tree-conversion value tables resulting from these calculations.

To determine future value of the tree we must establish the changes that can occur over the 10-year period in diameter growth, merchantable height, and quality.

A study of 385 sugar maple trees from 12 to 30 inches d.b.h. was made to develop equations for estimating the 10-year diameter growth for each vigor class in northern hardwood stands (table 8, in appendix). It was assumed that vigor class would remain the same during the next 10 years.

To guide the projection of log-height increase, we made the following assumptions:

1. A tree growing 2.0 inches d.b.h. and more during the 10-year period could potentially grow a full 16-foot log in merchantable height. Trees growing less than 2.0 inches

Table 1.—Lumber price relatives for sugar maple ¹

Lumber grade	Price relative
FAS	\$1.57
SEL	1.51
No. 1C	1.00
No. 2C	.45
No. 3A	.38
No. 3B	.27

¹ Based on 1962-66 Hardwood Market Report prices for Appalachian hardwoods, f.o.b. mills in the area of Johnson City, Tennessee. 4/4 plain-sawn No. 1 Common grade was used as reference.

Table 2.—Conversion costs for hardwood trees

Tree d.b.h. (inches)	Cost per M board feet
\$60.00 LEVEL	
12	\$68.80
14	64.40
16	60.00
18	55.60
20	51.20
22	46.80
24	43.40
26	42.25
28	41.85
30	41.75
\$70.00 LEVEL	
12	78.85
14	74.50
16	70.00
18	65.70
20	61.35
22	57.00
24	53.50
26	52.25
28	51.95
30	51.85
\$80.00 LEVEL	
12	88.80
14	84.40
16	80.00
18	75.55
20	71.15
22	66.80
24	63.35
26	62.10
28	61.75
30	61.65

d.b.h. in 10 years were limited to a 1/2-log increase in merchantable height.

2. Since log-height increases are related to the diameter of the tree, the following limitations were made for computation purposes.

<i>Present d.b.h. (inches)</i>	<i>Tree height classes that will not increase in height in next 10 years</i>
18	1-log trees
20	1- and 1½-log trees
22	1-, 1½- and 2-log trees
24	1-, 1½-, 2-, and 2½-log trees
26	No increase in log height for any trees 26 inches d.b.h. or over

3. Maximum log height used in the computation was 64 feet.

The assumptions about quality-improvement predictions were:

1. The maximum butt-log grade improvement would be one grade class.
2. In trees larger than 15 inches d.b.h., no improvement was computed for trees with butt logs of construction or local-use class.
3. The probability of butt-log quality improvement is very low for sugar maple trees of large diameter. No butt-log quality improvement was computed for trees over 27 inches d.b.h.

Thus once the physical measurements of the future tree are calculated under the preceding predictions, and assuming that the price of 4/4 No. 1 Common lumber and conversion costs remain the same, the future value can be determined from the tree-conversion value table, and the rate of value increase can be obtained by solving the compound-interest formula.

THE BASIC SITUATION

Given the data already developed, we can now calculate the rate of value increase for the basic situation; that is, a situation in which prices and conversion costs are assumed to remain unchanged over the 10-year period, and conversion costs are determined to be at the median level of \$70 per M board feet. This is the situation presented in previous publications on the rate of value increase, thus allowing for comparison between species.

The rates of value increase and the corresponding dollar value increases were calculated by 2-inch classes for trees ranging in size from 12 to 30 inches in d.b.h. For this specific situation in price of 4/4 No. 1 Common lumber and conversion costs, more than a thousand calculations were necessary. It is apparent that such voluminous data must necessarily be summarized.

The Rate of Value Increase of Individual Trees

Some generalities about the rate of value increase for individual trees as reported in detail in the previous publications have held true for sugar maple trees. They are:

1. The rate of value increase is less for trees with larger diameters and of higher quality. That is, for trees of higher value at the beginning of the period under consideration (V_0), we can expect to get lower rates of value increase (r) at the end of the time period (n). There is a point in time at which these high-value trees will fail to produce a rate of value increase equal to the alternative rate of return. This is the point of financial maturity.
2. Trees of higher vigor, which therefore have a greater diameter growth rate, have a higher rate of value increase. Diameter growth is an important contributor to the increase in value, and these calculations place a value on it and serve to substantiate the important silvicultural desirability of selecting trees of high vigor as crop trees.
3. Improvement in tree quality over the 10-year period results in a higher rate of value increase. These calculations indicate not only the improved rate of value increase but also the dollar value of an improvement in quality. The ability to select prospective crop trees, not only on the basis of volume but also for prospective future quality, contributes immeasurably to the financial success of the timber-growing enterprise.
4. Trees with greater merchantable height, or trees that increase in merchantable height, usually have a higher rate of value increase. In some instances, trees will have very low-quality upper logs that have negative values, thus reducing the rate of value increase.

Expected Rates of Value Increase

What are the rates of value increase we can expect from sugar maple trees of various diameters, which grow at different rates and may or may not improve in quality over the 10-year

Table 3.—Expected rate of value increase for sugar maple trees,
price and conversion costs remaining stable ¹

[In percent]

D.b.h. (inches)	Due to growth only			Due to growth and quality increase ²		
	Vigor I	Vigor II	Vigor III	Vigor I	Vigor II	Vigor III
				V _o	V _n	
	PRICE NO. 1C			\$185/M	\$185/M	
	CONVERSION COSTS			70/M	70/M	
12	—	—	—	³ 30-60	28-57	26-54
14	6-12	5-8	3-7	12-26	11-24	9-21
16	4-11	3-8	2-6	10-19	8-18	7-15
18	3- 7	3-5	2-4	7-14	7-13	6-12
20	3- 5	2-4	1-3	6-13	6-12	5-10
22	2- 4	2-3	1-3	6-10	5-10	4- 9
24	2- 3	1-3	1-2	5- 9	4- 8	4- 8
26	2	1	1	4- 7	4- 6	4- 6
28	1- 2	1	1	(⁴)	(⁴)	(⁴)
30	1	1	1	(⁴)	(⁴)	(⁴)

				V _o	V _n	
				\$185/M	\$185/M	
				60/M	60/M	
	PRICE NO. 1C					
	CONVERSION COSTS					
12	—	—	—	17-26	15-21	14-20
14	6-12	4-8	3-7	11-23	9-19	8-17
16	4-11	3-7	2-6	9-17	7-13	6-12
18	3- 7	3-5	2-4	6-13	6-11	5-10
20	3- 5	2-4	1-3	6-11	5-10	4- 8
22	2- 4	2-3	1-3	5- 9	4- 8	4- 8
24	2- 3	1-2	1-2	4- 8	3- 7	3- 7
26	2	1	1	4- 6	3- 6	3- 6
28	1- 2	1	1	(⁴)	(⁴)	(⁴)
30	1- 2	1	1	(⁴)	(⁴)	(⁴)

				V _o	V _n	
				\$185/M	\$185/M	
				80/M	80/M	
	PRICE NO. 1C					
	CONVERSION COSTS					
12	—	—	—	—	—	—
14	7-13	6-9	4-7	15-81	13-77	12-74
16	5-11	4-8	2-6	11-34	10-32	9-29
18	3- 8	3-5	2-4	8-20	8-19	7-18
20	3- 5	2-4	1-3	7-16	6-15	5-13
22	3- 4	2-4	1-3	6-13	5-12	4-11
24	2- 3	1-3	1-2	5-10	4- 9	4- 9
26	2	1	1	4- 8	4- 8	4- 7
28	1- 2	1	1	(⁴)	(⁴)	(⁴)
30	1- 2	1	1	(⁴)	(⁴)	(⁴)

¹ Based on 4/4 factory-grade lumber recovery. These rates can have a variation of 1 to 2 percent due to differences in location, volume estimates, and quality estimates.

² The high portion of the range in rates is due largely to low-grade trees that have a low present value and thus produce a relatively high rate of value increase when considered in the ratio V_n/V_o . For this reason butt-log grade-3 logs have not been considered in the estimates "due to growth only".

³ The high rates of value increase in the 12- to 16-inch diameter classes are due to two factors: (1) the butt-log grade-3 trees becoming positive in present value, and (2) the improvement of butt-log grade-3 to butt-log grade-2.

⁴ No quality improvement in trees larger than 27 inches d.b.h.

period? The answer to this question is provided in table 3, in which are summarized the expected rates for the situation in which both the price of 4/4 No. 1 Common lumber and the conversion costs of \$70 per M board feet remain stable throughout the 10-year period.

The expected rates of value increase are presented as a range of rates by 2-inch d.b.h. classes for each of the three vigor classes. Further, table 3 is subdivided into two sections, which present the rates for trees in which growth alone is expected and for trees in which both growth and improvement in quality are expected over the 10-year period.

Two features of the table are especially noteworthy. First, note the decreasing rates as diameters of the trees increase. Trees 24 inches d.b.h. and over, with growth only, earn at best a rate of value increase of 3 percent. Second, note the increase in the rate when an improvement in quality occurs over the 10-year period. This again emphasizes the importance of identifying trees with potential grade improvement when marking the stand for cutting or when selecting crop trees.

An expanded version of the expected rate of value increase for this basic situation appears in table 9 (in appendix).

Financial-Maturity Marking Guide

The rate of value increase is a measure of a tree's earning power. It can be used to develop marking guides for selection cutting under uneven-aged systems and for improvement cutting in previously unmanaged stands. The guide is presented in tabular form for the alternative rates of return of 2, 4, and 6 percent and for each of the three vigor classes (table 4).

The diameters shown are the maximums that will earn the indicated interest rates over the next 10 years. Trees grown to diameters greater than indicated will fail to produce the alternative rate of return. Note that this table is based on diameter growth alone. Where grade improvement or log-height increase is probable over the next 10 years, these diameters should be adjusted upward. When using financial maturity as a guide to harvesting, give full consideration to silvicultural and management requirements.

Table 4.—Sugar Maple diameters for financial maturity, based on value increase determined by diameter growth alone¹

[In inches]			
Vigor class	Percent return		
	2	4	6
		V _o	V _n
PRICE NO. 1C LUMBER		\$185/M	\$185/M
CONVERSION COSTS		70/M	70/M
I	27	19	16
II	23	16	14
III	20	14	—
		V _o	V _n
PRICE NO. 1C LUMBER		\$185/M	\$185/M
CONVERSION COSTS		60/M	60/M
I	26	18	15
II	22	16	14
III	20	14	—
		V _o	V _n
PRICE NO. 1C LUMBER		\$185/M	\$185/M
CONVERSION COSTS		80/M	80/M
I	27	20	17
II	24	18	15
III	22	16	14
		V _o	V _n
PRICE NO. 1C LUMBER		\$185/M	\$185/M
CONVERSION COSTS		70/M	60/M
I	29	20	16
II	25	18	15
III	23	15	13
		V _o	V _n
PRICE NO. 1C LUMBER		\$185/M	\$195/M
CONVERSION COSTS		70/M	80/M
I	24	17	14
II	22	15	13
III	18	—	—
		V _o	V _n
PRICE NO. 1C LUMBER		\$185/M	\$195/M
CONVERSION COSTS		70/M	60/M
I	32	22	17
II	30	20	16
III	29	18	15

¹ Based on trees with butt-log grades of 1 and 2.

Dollar Value Increase

Some forest land managers may have a greater concern for the dollar earning capacity of their holdings than for the rate of value in-

crease. The actual dollar increases in conversion value to be expected over a 10-year period through increases in diameter, merchantable height, and quality improvement are presented in table 10 (in appendix).

In general, trees with larger diameters, greater merchantable heights, or higher log quality will have greater *dollar* value increases during the 10-year period (fig. 2).

This is opposite of what was true for the rate of value increase. For trees of larger diameters, of greater merchantable height, or of higher quality, we can expect that the *rates* of value increase will be lower for the 10-year period (fig. 3).

You must understand the difference between the *dollar value* increase table and the *rate of value* increase tables. The *dollar value* increase tables account for the increases in the value of the tree because of the additional value that results from expected increases in diameter, merchantable height, or improvement in quality. The *rate of value* increase table, on the other hand, accounts for the initial investment in capital (the value of the tree at the beginning of the 10-year period) that must be made to attain the dollar value increase (value added at the end of the 10-year period). The rate of return on the investment (rate of value increase) over the 10-year period is determined by the relationship between the values at the beginning and end of the time period.

Figure 2.—Relation of dollar value increase to d.b.h. over a 10-year period. Based on trees of vigor I, butt-log grade I, and 32 feet merchantable height.

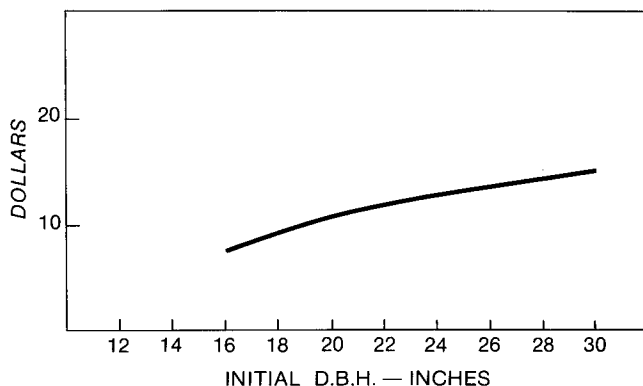
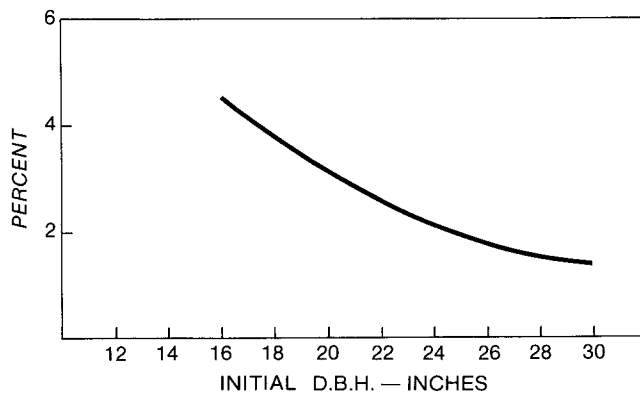


Figure 3.—Relation of rate of value increase to d.b.h.



It is the timberland owner alone who must determine the financial objectives of his ownership. Will it be dollar value increase regardless of the amount of capital investment? Or will it be a prescribed rate of return on the capital investment?

THE RATE OF VALUE INCREASE IN A DYNAMIC MARKET SITUATION

The basic situation we have discussed portrays only one of the many real-life situations encountered in a dynamic market. We can expect to have fluctuations, both up and down, in the price of No. 1 Common lumber and conversion costs over the 10-year period. How these fluctuations affect the expected rate of value increase and the financial-maturity diameters are worth further consideration.

We modified our procedure (fig. 1) to account for prospective changes in price and costs (fig. 4). This adaptation did not require any great change in methodology. All that was necessary was an additional series of separate calculations based on the new price and conversion cost to determine the future tree-conversion value. The important factor is the influence of costs and price on the rate of value increase and what it means in terms of financial maturity.

The Influence of Conversion Cost

Of all the factors that bear on the rate of value increase, the one most subject to manipulation and change is conversion cost. Standing timber trees of the same size and quality may not necessarily have the same value because of the conversion costs involved. Location of the timber tract, difficulties of logging, proximity to roads and mills, and efficiency of the mills all play a role in determining the value of the timber and the return on the capital that the owner has invested in the standing timber. One can easily conceive of a rather large number of different conversion costs generated by a variety of combinations of such factors.

It is for this reason that we have shown three levels of conversion costs (table 2), which we hope encompass the wide spectrum of possible costs. We wanted to illustrate the influence of these different levels of cost on the rate of value increase and on financial maturity diameters. So we investigated the rates and diameters resulting from two situations in which the conversion-cost levels were at \$60 and \$80 per M board feet and remained stable throughout the entire 10-year period (tables 3 and 4).

We should also mention that the basic situation, which we previously discussed in detail, is a similar situation, with conversion costs at the \$70 level (tables 3 and 4).

An analysis of the expected rates of value increase for these three situations reveals a unique relationship between conversion costs and the rate of value increase, which is not readily apparent nor eminently logical. The lower the conversion costs (as long as they remain the same at the beginning and end of the period), the lower the rate of value increase. And conversely, the higher the conversion costs, the higher the rates of value increase. What actually occurs is that lower conversion costs result in higher value of the standing timber, with a resulting increased capital investment carried on through the 10-year period and, therefore, a lower rate of value increase. The absolute reverse is true for higher conversion costs.

Table 3 indicates that for every \$10 per M board feet increase in conversion costs, there is 1-percent or less increase in the expected rate of value increase. These increases are especially

small in the 24- to 30-inch diameter classes, in which the expected rates in the "due-to-growth only" section are almost identical for all three levels of conversion costs.

The influence of conversion costs is somewhat more evident in the financial-maturity tables (table 4). For every \$10 per M board feet increase in conversion costs, financial-maturity diameters increase about 1 inch, indicating that in stands with higher conversion costs—such as in remote areas or with steeper slopes or with longer hauls to the mills—the trees would be retained to larger sizes to reach financial maturity.

We investigated one other situation regarding conversion costs: a reduction of \$10 per M board feet *during* the 10-year period (table 5). Logically, such a reduction could occur as a result of efficiencies in harvesting or in transportation, or as a result of innovations in milling. The effect is an improvement of 1 to 3 percent in the expected rate of value increase as compared to that of the basic situation. The improvement would be inversely proportional to the d.b.h. of the tree. That is, as the d.b.h. increases, the magnitude of the improvement decreases. In sugar maple trees of 20 inches d.b.h. or larger, the differences between the two situations amount to 1 percent (table 5).

This reduction of \$10 per M board feet in conversion costs also has a significant effect on financial-maturity diameters. When these diameters are the guiding influence in determining the maturity of sugar maple trees or stands, the advantages of a reduction in conversion costs are evident. Sugar maple trees under such a situation can be grown to a larger diameter before they achieve financial maturity. Increases of 1 to 3 inches in d.b.h. are calculated for the different alternative rates of return as compared to those in the basic situation (table 4).

The Influence of Prices

The price of 4/4 No. 1 Common lumber is also an influencing factor in determining financial maturity of timber trees and stands. However, it is considerably different from conversion costs. For the most part, it is beyond the control of the timber grower, operator, or saw-

Table 5—Expected rate of value increase for sugar maple trees,
price remaining stable but conversion costs decreasing ¹

[In percent]						
D.b.h. (inches)	Due to growth only			Due to growth and quality increase ²		
	Vigor I	Vigor II	Vigor III	Vigor I	Vigor II	Vigor III
12	—	—	—	³ 33-64	31-61	29-59
14	8-15	7-11	6-9	14-29	12-27	11-24
16	6-13	5- 8	4-8	11-21	10-20	9-17
18	5- 9	4- 7	3-6	9-16	8-15	7-14
20	4- 6	3- 5	3-5	8-15	7-14	6-12
22	3- 5	3- 5	2-4	6-12	6-11	5-11
24	3- 4	2- 4	2-3	6-10	5- 9	4- 9
26	2- 3	2- 3	2-2	5- 8	4- 8	4- 8
28	2- 3	2- 2	1-2	(⁴)	(⁴)	(⁴)
30	2- 3	1- 2	1-2	(⁴)	(⁴)	(⁴)

¹ Based on 4/4 factory-grade lumber recovery under the following circumstances:

	V ₀	V _n
Price No. 1C	— \$185/M	\$185/M
Conversion costs	— 70/M	60/M

These rates can have a variation of 1 to 2 percent due to differences in location, volume estimates, and quality estimates.

² The high portion of the range in rates is due largely to low-grade trees that have a low present value and thus produce a relatively high rate of value increase when considered in the ratio V_n/V_0 . For this reason butt-log grade-3 logs have not been considered in the estimates "due to growth only".

³ The high rates of value increase in the 12- and 14-inch diameter classes are due to two factors: (1) the butt-log grade-3 trees becoming positive in present value, and (2) the improvement of butt-log grade-3 trees to butt-log grade-2.

⁴ No quality improvement in trees larger than 27 inches d.b.h.

mill man, as it is subject to the intricacies of supply and demand of the market place.

The effect of a price increase is similar to a reduction in conversion costs. An increase of \$10 per M board feet in the price of 4/4 No. 1 Common lumber would have an effect on financial maturity similar to that of a reduction of \$10 per M board feet in conversion costs. Either of these changes, occurring during the 10-year period, would result in an improvement in the rate of value increase.

So rather than duplicate the findings we had in our analysis of conversion costs, we extended our investigation to include two situations in which both price and conversion costs changed during the 10-year period (tables 6 and 7).

The first analysis depicts a situation that would occur during an inflationary period characterized by rising lumber prices as well as increased conversion costs. We assumed that both lumber prices and conversion costs would increase by \$10 per M board feet. The expected rates of value increase under such assumptions would be about 1 percent less than those cal-

culated in our basic situation of stable price and conversion costs. Also, financial-maturity diameters would be reduced by 1 to 2 inches. Thus, in this inflationary situation under which lumber prices rose only 5.4 percent and conversion costs rose 14.3 percent, standing timber would approach financial maturity at an earlier date, and diameter limits would be lower than those calculated for a stable economy.

A number of different situations with rising prices and conversion costs can easily be visualized to which a rule of thumb can be applied. When a combination of rising lumber prices and conversion costs are such that the net value of the lumber is reduced (as in the above situation), financial maturity is at an earlier period and financial maturity diameters are lower. When the combination of lumber prices and conversion costs are such that the net value of the lumber is increased, financial maturity is at a later period and financial-maturity diameters are higher than those of the basic situation.

The second situation we investigated was a rather idealistic one. Prices were assumed to

Table 6.—Expected rate of value increase for sugar maple trees,
prices and conversion costs increasing ¹

[In percent]

D.b.h. (inches)	Due to growth only			Due to growth and quality increase ²		
	Vigor I	Vigor II	Vigor III	Vigor I	Vigor II	Vigor III
12	—	—	—	³ 29-58	27-54	25-52
14	5-11	4-7	2-6	12-24	10-23	9-20
16	4-10	3-7	2-6	9-18	8-16	7-14
18	3-7	2-5	2-4	7-14	6-12	5-11
20	3-4	2-3	1-3	6-12	5-11	4-9
22	2-4	2-3	1-3	5-10	5-9	4-9
24	2-3	1-2	1-2	4-8	4-8	3-7
26	2-2	1-1	1-1	4-7	3-6	3-6
28	1-2	1-1	1-1	(⁴)	(⁴)	(⁴)
30	1-2	1-1	1-1	(⁴)	(⁴)	(⁴)

¹ Based on 4/4 factory-grade lumber recovery under the following circumstances:

	V _o	V _n
Price No. 1C	— \$185/M	\$195/M
Conversion costs	— 70/M	80/M

These rates can have a variation of 1 to 2 percent due to differences in location, volume estimates, and quality estimates.

² The high portion of the range in rates is due largely to low-grade trees that have a low present value and thus produce a relatively high rate of value increase when considered in the ratio V_n/V_o . For this reason butt-log grade-3 logs have not been considered in the estimates "due to growth only".

³ The high rates of value increase in the 12- and 14-inch diameter classes are due to two factors: (1) the butt-log grade-3 trees becoming positive in present value, and (2) the improvement of butt-log grade-3 trees to butt-log grade-2.

⁴ No quality improvement in trees larger than 27 inches d.b.h.

Table 7.—Expected rate of value increase for sugar maple trees,
prices increasing and conversion costs decreasing ¹

[In percent]

D.b.h. (inches)	Due to growth only			Due to growth and quality increase ²		
	Vigor I	Vigor II	Vigor III	Vigor I	Vigor II	Vigor III
12	—	—	—	³ 35-66	33-63	31-61
14	9-16	8-12	7-11	15-30	13-28	12-25
16	6-14	6-10	4-9	12-22	11-21	10-18
18	6-10	5-8	4-7	9-17	9-16	8-15
20	5-7	4-6	3-6	9-16	8-15	7-13
22	4-6	3-6	3-5	7-13	6-12	6-12
24	3-5	3-5	2-4	6-11	6-10	5-10
26	3-4	3-3	2-3	6-9	5-9	5-8
28	3-4	2-3	2-3	(⁴)	(⁴)	(⁴)
30	3-3	2-3	2-3	(⁴)	(⁴)	(⁴)

¹ Based on 4/4 factory-grade lumber recovery under the following circumstances:

	V _o	V _n
Price No. 1C	— \$185/M	\$195/M
Conversion costs	— 70/M	60/M

These rates can have a variation of 1 to 2 percent due to differences in location, volume estimates, and quality estimates.

² The high portion of the range in rates is due largely to low-grade trees that have a low present value and thus produce a relatively high rate of value increase when considered in the ratio V_n/V_o . For this reason butt-log grade-3 logs have not been considered in the estimates "due to growth only".

³ The high rates of value increase in the 12- and 14-inch diameter classes are due to two factors: (1) the butt-log grade-3 trees becoming positive in present value, and (2) the improvement of butt-log grade-3 trees to butt-log grade-2.

⁴ No quality improvement in trees larger than 27 inches d.b.h.

rise by \$10 per M board feet, while conversion costs were reduced by \$10 per M board feet. Such a situation could possibly be achieved through the introduction of efficient timber-harvesting machinery and mill innovations. Under this situation, the expected rates of value increase were the greatest (table 7). Improve-

ments of 1 to 3 percent over those of the basic situation were calculated. Considerable increases were recorded in financial-maturity diameters (table 4)—from 1 to 9 inches, indicating that financial maturity for trees and stands under this idealistic situation is arrived at after a longer period.

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APPENDIX

Table 8.—Ten-year d.b.h. growth rate for sugar maple, in inches

D.b.h. (inches)	Vigor I	Vigor II	Vigor III & IV
12.0	2.4	1.8	1.3
14.0	2.2	1.7	1.2
16.0	2.1	1.6	1.1
18.0	2.0	1.5	1.1
20.0	1.9	1.4	1.0
22.0	1.8	1.3	1.0
24.0	1.7	1.2	.9
26.0	1.6	1.1	.9
28.0	1.5	1.0	.8
30.0	1.4	.9	.8

Table 9.—Ten-year rate of value increase for sugar maple, in percent

D.b.h. (inches)	Butt- log grade	Mer- chant- able height (feet)	Initial value (dollars)	Vigor I						Vigor II						Vigor III					
				No change in butt-log grade with height increase (feet) of—			Increase in butt-log grade with height increase (feet) of—			No change in butt-log grade with height increase (feet) of—			Increase in butt-log grade with height increase (feet) of—			No change in butt-log grade with height increase (feet) of—			Increase in butt-log grade with height increase (feet) of—		
				0	8	16	0	8	16	0	8	16	0	8	16	0	8	16	0	8	16
12	2	16	1.44	7.1	10.8	12.9	14.5	18.0	19.6	5.3	8.7	10.7	12.9	16.1	17.7	3.8	6.9	8.8	11.6	14.4	16.0
		24	1.78	8.5	10.5	—	15.5	17.1	—	6.5	8.5	—	13.7	15.2	—	4.7	6.6	—	12.1	13.6	—
		32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12	3	16	.21	18.4	20.4	19.7	30.1	34.6	37.1	15.0	16.0	13.9	28.0	32.1	34.6	11.7	11.5	7.3	26.1	29.9	32.3
		24	.04	40.2	39.3	—	(*)	(*)	—	35.0	32.7	—	(*)	(*)	—	29.8	24.9	—	(*)	(*)	—
		32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12	4	16	.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		24	.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14	2	16	2.56	6.3	9.9	12.1	12.8	16.1	18.0	4.8	8.4	10.7	11.5	14.8	16.6	3.4	7.0	9.1	10.2	13.5	15.2
		24	3.57	6.3	8.5	9.6	12.4	14.2	14.7	4.9	7.1	8.2	11.1	12.8	13.4	3.5	5.6	—	9.8	11.5	—
		32	4.26	6.6	7.7	—	12.1	12.7	—	5.2	6.3	—	10.8	11.3	—	3.7	—	—	9.5	—	—
		40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14	3	16	.92	9.8	12.4	13.4	17.8	21.7	24.2	7.7	10.2	10.9	16.2	20.1	22.6	5.6	7.9	8.2	14.6	18.5	20.9
		24	1.04	11.1	12.1	11.6	20.3	22.7	24.1	8.8	9.6	8.8	18.6	21.1	22.4	6.6	6.9	—	17.1	19.4	—
		32	.91	13.6	13.1	—	24.4	25.7	—	11.1	10.3	—	22.8	24.1	—	8.4	—	—	21.1	—	—
		40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14	4	16	.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		24	.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		32	.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16	1	16	8.20	4.6	7.7	9.3	—	—	—	3.6	6.6	8.2	—	—	—	2.6	5.5	7.0	—	—	—
		24	10.89	4.7	6.2	6.9	—	—	—	3.6	5.1	5.8	—	—	—	2.6	4.0	4.7	—	—	—
		32	12.81	4.5	5.2	5.7	—	—	—	3.4	4.1	4.7	—	—	—	2.3	3.0	—	—	—	—
		40	13.43	4.7	5.2	—	—	—	—	3.6	4.2	—	—	—	—	2.5	—	—	—	—	—
16	2	16	4.48	5.3	8.8	10.8	11.1	14.4	16.1	4.1	7.5	9.6	10.1	13.2	14.9	3.0	6.3	8.3	9.0	12.1	13.7
		24	6.20	5.3	7.3	8.6	10.7	12.4	13.1	4.1	6.1	7.4	9.6	11.2	12.0	2.9	4.8	6.1	8.5	10.0	10.8
		32	7.66	5.1	6.3	7.5	10.0	10.8	11.3	3.9	5.1	6.4	8.9	9.6	10.2	2.6	3.9	—	7.7	8.4	—
		40	8.50	5.2	6.4	—	9.6	10.2	—	4.0	5.3	—	8.5	9.1	—	2.8	—	—	7.3	—	—
16	3	16	2.17	7.0	9.9	11.2	13.2	16.9	19.2	5.5	8.2	9.4	12.0	15.6	17.8	4.0	6.5	7.6	10.7	14.3	16.4
		24	2.73	7.4	8.7	9.1	14.3	16.5	17.9	5.8	7.0	7.3	13.0	15.2	16.6	4.2	5.2	5.3	11.7	13.8	15.2
		32	2.98	7.8	8.1	8.3	15.5	16.8	18.1	6.1	6.3	6.3	14.2	15.5	17.9	4.2	4.4	—	12.8	14.2	—
		40	2.82	8.7	8.9	—	17.5	18.8	—	6.9	6.9	—	16.2	17.5	—	4.9	—	—	14.8	—	—
18	1	16	12.69	3.8	6.8	8.4	—	—	—	2.8	5.8	7.4	—	—	—	2.1	5.1	6.6	—	—	—
		24	16.83	3.8	5.4	6.0	—	—	—	2.9	4.4	5.1	—	—	—	2.2	3.7	4.4	—	—	—
		32	19.48	3.8	4.5	5.1	—	—	—	2.9	3.6	4.2	—	—	—	2.1	2.9	3.4	—	—	—
		40	20.89	3.8	4.4	3.8	—	—	—	2.9	3.5	—	—	—	—	2.2	2.7	—	—	—	—
18	2	16	7.36	4.3	7.7	9.7	9.6	12.7	14.4	3.2	6.6	8.6	8.6	11.8	13.4	2.4	5.8	7.7	7.8	11.0	12.6
		24	10.14	4.3	6.2	7.4	9.2	10.8	11.6	3.2	5.2	6.4	8.3	9.8	10.6	2.4	4.3	5.6	7.5	9.0	9.8
		32	12.27	4.2	5.4	6.6	8.8	9.5	10.1	3.2	4.4	5.5	7.8	8.5	9.1	2.4	3.6	4.7	7.0	7.7	8.3
		40	13.84	4.1	5.3	5.3	8.1	8.8	8.2	3.2	4.3	—	7.2	7.8	—	2.3	3.4	—	6.4	7.0	—
18	3	16	4.17	5.3	8.2	9.8	10.4	14.0	16.1	4.0	6.9	8.4	9.2	12.8	15.0	3.0	5.9	7.2	8.4	12.0	14.0
		24	5.41	5.5	6.9	7.5	11.0	13.1	14.4	4.2	5.6	6.2	9.9	12.0	13.3	3.1	4.5	5.1	9.1	11.1	12.4
		32	6.09	5.7	6.3	6.8	11.8	13.0	14.3	4.3	4.9	5.3	10.7	12.0	13.2	3.2	3.8	4.1	9.8	11.1	12.3
		40	6.32	5.9	6.4	5.6	12.6	13.9	13.9	4.5	4.9	—	11.6	12.8	—	3.4	3.7	—	10.7	11.9	—
20	1	16	18.46	3.1	6.0	7.7	—	—	—	2.4	5.2	6.8	—	—	—	1.7	4.5	6.2	—	—	—
		24	24.52	3.0	4.7	5.4	—	—	—	2.3	3.8	4.6	—	—	—	1.6	3.2	3.9	—	—	—
		32	28.40	3.1	3.9	4.7	—	—	—	2.3	3.0	3.8	—	—	—	1.7	2.4	3.1	—	—	—
		40	30.27	3.2	4.0	3.7	—	—	—	2.4	3.2	2.8	—	—	—	1.7	2.4	2.0	—	—	—
20	2	16	32.15	3.4	3.1	3.2	—	—	—	2.5	2.1	2.3	—	—	—	1.8	1.4	—	—	—	—
		24	30.33	3.7	3.9	—	—	—	—	2.7	2.9	—	—	—	—	2.0	—	—	—	—	—
		32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

20.....2.....16	11.18	3.5	6.7	8.8	8.4	11.5	13.2	2.6	5.8	7.9	7.6	10.6	12.3	1.9	5.1	7.2	6.9	10.1	11.8
24	15.40	3.4	5.4	6.6	8.0	9.6	10.5	2.5	4.5	5.6	7.1	8.8	9.5	1.8	3.8	4.9	6.5	8.3	9.0
32	18.56	3.4	4.6	5.9	7.6	8.4	9.2	2.5	3.7	5.0	6.8	7.5	8.3	1.9	3.0	4.2	6.1	6.8	7.8
40	20.71	3.5	4.7	5.0	7.2	8.0	7.7	2.5	3.8	4.0	6.3	7.1	6.7	1.8	3.1	3.2	5.7	6.4	6.1
48	23.17	3.6	3.8	4.6	6.8	6.5	6.7	2.7	2.8	3.7	5.9	5.5	5.7	1.9	2.0	—	5.2	4.7	—
56	23.21	3.8	4.6	—	6.5	6.7	—	2.8	3.6	—	5.5	5.7	—	2.0	—	—	4.7	—	—
64	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20.....3.....16	6.98	4.1	7.0	8.7	8.5	11.9	14.0	3.1	6.0	7.6	7.6	10.9	13.1	2.2	5.1	6.7	6.8	10.2	12.3
24	9.21	4.1	5.7	6.6	8.8	10.9	12.2	3.1	4.7	5.4	7.9	10.0	11.2	2.2	3.8	4.4	7.2	9.3	10.4
32	10.58	4.3	5.1	5.9	9.4	10.7	12.0	3.2	3.9	4.7	8.5	9.7	11.0	2.4	3.0	3.7	7.7	8.9	10.2
40	11.17	4.5	5.3	5.0	10.1	11.4	11.6	3.3	4.1	3.7	9.1	10.4	10.6	2.4	3.1	2.6	8.3	9.6	9.8
48	11.73	4.8	4.5	4.7	10.9	11.1	12.0	3.6	3.2	3.4	9.9	10.1	11.0	2.6	2.1	—	9.1	9.2	—
56	10.91	5.2	5.5	—	11.9	12.8	—	3.9	4.1	—	10.9	11.8	—	2.9	—	—	10.0	—	—
64	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
22.....1.....16	25.52	2.6	5.3	7.1	—	—	—	2.0	4.7	6.4	—	—	—	1.6	4.3	6.0	—	—	—
24	33.62	2.5	4.2	5.1	—	—	—	1.8	3.5	4.4	—	—	—	1.4	3.1	3.9	—	—	—
32	39.30	2.6	3.5	4.4	—	—	—	1.9	2.7	3.6	—	—	—	1.5	2.3	3.2	—	—	—
40	42.32	2.7	3.6	3.5	—	—	—	2.0	2.9	2.8	—	—	—	1.5	2.4	2.3	—	—	—
48	45.65	2.9	2.8	3.1	—	—	—	2.1	2.0	2.2	—	—	—	1.6	1.5	1.7	—	—	—
56	44.32	3.1	3.4	3.4	—	—	—	2.3	2.5	—	—	—	—	1.8	2.0	—	—	—	—
64	45.19	3.2	—	—	—	—	—	2.3	—	—	—	—	—	1.8	—	—	—	—	—
22.....2.....16	15.99	2.9	5.9	8.0	7.5	10.4	12.0	2.1	5.2	7.3	6.9	9.7	11.5	1.7	4.8	6.8	6.4	9.3	11.1
24	21.78	2.7	4.7	6.1	7.0	8.8	9.8	2.0	4.0	5.3	6.3	8.1	9.0	1.6	3.6	4.8	5.9	7.7	8.5
32	26.42	2.7	4.1	5.4	6.7	7.7	8.7	2.1	3.3	4.6	6.0	6.9	7.8	1.6	2.8	4.2	5.6	6.4	7.4
40	29.63	2.9	4.2	4.6	6.5	7.4	7.3	2.1	3.4	3.8	5.7	6.6	6.5	1.6	3.0	3.3	5.2	6.1	6.0
48	33.48	3.0	3.3	4.2	6.1	6.0	6.3	2.2	2.6	3.4	5.3	5.2	5.4	1.7	2.0	2.9	4.8	4.7	4.9
56	34.25	3.1	4.0	—	5.8	6.1	—	2.3	3.1	—	5.0	5.2	—	1.8	2.6	—	4.4	4.7	—
64	37.08	3.1	—	—	5.2	—	—	2.3	—	—	4.4	—	—	1.8	—	—	3.9	—	—
22.....3.....16	10.65	3.3	6.0	7.9	7.1	10.3	12.5	2.5	5.2	7.0	6.4	9.5	11.8	2.0	4.7	6.5	5.9	9.1	11.3
24	14.05	3.1	4.9	5.9	7.3	9.4	10.8	2.3	4.1	5.0	6.5	8.7	10.0	1.9	3.6	4.5	6.1	8.2	9.5
32	16.45	3.3	4.3	5.3	7.7	9.1	10.5	2.5	3.4	4.3	7.0	8.3	9.7	2.0	2.8	3.8	6.5	7.8	9.2
40	17.74	3.5	4.5	4.5	8.3	9.7	10.1	2.6	3.5	3.5	7.5	8.9	9.3	2.0	3.0	2.9	7.0	8.4	8.7
48	19.18	3.9	3.7	4.1	8.9	9.3	10.2	2.7	2.7	3.3	8.0	8.4	9.3	2.2	2.1	2.4	7.5	7.9	8.8
56	18.66	4.0	4.4	—	9.6	10.5	—	3.0	3.3	—	8.7	9.6	—	2.4	2.7	—	8.2	9.1	—
64	19.08	4.1	—	—	10.2	—	—	3.1	—	—	9.4	—	—	2.5	—	—	8.8	—	—
24.....1.....16	33.89	2.0	4.7	6.5	—	—	—	1.4	4.1	5.9	—	—	—	1.0	3.7	5.5	—	—	—
24	43.98	2.0	3.8	4.9	—	—	—	1.4	3.1	4.3	—	—	—	1.0	2.8	3.9	—	—	—
32	51.95	2.1	3.2	4.1	—	—	—	1.4	2.5	3.4	—	—	—	1.1	2.2	3.1	—	—	—
40	56.95	2.2	3.1	3.3	—	—	—	1.6	2.5	2.6	—	—	—	1.2	2.1	2.1	—	—	—
48	62.25	2.2	2.4	2.7	—	—	—	1.6	1.7	2.0	—	—	—	1.2	1.3	1.5	—	—	—
56	61.85	2.4	2.7	—	—	—	—	1.7	2.0	—	—	—	—	1.3	1.6	—	—	—	—
64	63.64	2.3	—	—	—	—	—	1.7	—	—	—	—	—	1.3	—	—	—	—	—
24.....2.....16	21.74	2.1	5.1	7.3	6.6	9.4	11.3	1.5	4.5	6.6	6.0	8.8	10.7	1.1	4.0	6.2	5.6	8.3	10.3
24	29.10	2.0	4.2	5.7	6.3	8.1	9.3	1.5	3.5	5.1	5.7	7.5	8.7	1.1	3.2	4.7	5.3	7.2	8.3
32	35.57	2.1	3.6	4.9	6.0	7.2	8.1	1.5	3.0	4.3	5.3	6.5	7.4	1.1	2.6	3.9	5.0	6.1	7.2
40	40.48	2.3	3.6	4.2	5.8	6.7	6.9	1.7	2.9	3.5	5.2	6.1	6.2	1.3	2.5	3.1	4.8	5.8	5.9
48	46.13	2.2	2.8	3.6	5.3	5.5	5.8	1.6	2.1	2.9	4.7	4.8	5.1	1.2	1.7	2.5	4.3	4.3	4.6
56	48.02	2.4	3.2	—	5.1	5.4	—	1.7	2.5	—	4.4	4.7	—	1.3	2.1	—	3.9	4.2	—
64	52.07	2.4	—	—	4.5	—	—	1.7	—	—	3.8	—	—	1.3	—	—	3.4	—	—
24.....3.....16	15.13	2.3	5.0	7.0	5.8	8.9	11.2	1.7	4.4	6.2	5.3	8.4	10.5	1.2	3.9	5.8	4.8	7.9	10.2
24	19.74	2.3	4.2	5.4	6.1	8.3	9.9	1.7	3.5	4.7	5.5	7.6	9.2	1.2	3.1	4.2	5.1	7.3	8.8
32	23.46	2.4	3.6	4.6	6.5	8.1	9.4	1.7	2.9	3.9	5.8	7.4	8.7	1.3	2.5	3.4	5.4	7.0	8.3
40	25.88	2.6	3.6	3.9	7.0	8.3	8.9	1.9	2.9	3.2	6.3	7.6	8.2	1.5	2.4	2.6	5.9	7.2	7.8
48	28.50	2.6	2.9	3.3	7.3	7.9	8.7	1.9	2.1	2.6	6.6	7.2	8.0	1.4	1.6	2.0	6.2	6.7	7.6
56	28.56	2.8	3.3	—	7.9	8.7	—	2.0	2.5	—	7.2	8.0	—	1.6	2.0	—	6.7	7.6	—
64	29.69	2.9	—	—	8.3	—	—	2.2	—	—	7.6	—	—	1.6	—	—	7.1	—	—
26.....1.....16	42.61	1.7	4.5	6.4	—	—	—	1.2	4.0	5.8	—	—	—	1.0	3.8	5.6	—	—	—
24	55.23	1.8	3.7	4.9	—	—	—	1.3	3.1	4.3	—	—	—	1.1	2.9	4.0	—	—	—
32	65.85	1.9	3.1	3.9	—	—	—	1.3	2.5	3.3	—	—	—	1.1	2.2	3.1	—	—	—
40	73.77	1.9	2.7	3.0	—	—	—	1.3	2.1	2.4	—	—	—	1.1	1.9	2.2	—	—	—
48	80.43	1.8	2.1	2.1	—	—	—	1.3	1.5	1.8	—	—	—	1.0	1.3	1.6	—	—	—
56	81.72	2.0	2.3	—	—	—	—	1.4	1.7	—	—	—	—	1.1	1.4	—	—	—	—
64	84.22	2.0	—	—	—	—	—	1.4	—	—	—	—	—	1.1	—	—	—	—	—
26.....2.....16	27.63	1.7	4.9	7.1	6.2	9.2	11.1	1.2	4.3	6.5	5.7	8.6	10.5	1.0	4.1	6.3	5.4	8.3	10.3
24	36.89	1.7	4.0	5.6	6.0	8.0	9.2	1.3	3.5	5.0	5.5	7.4	8.6	1.1	3.2	4.7	5.3	7.1	8.3
32	45.40	1.9	3.4	4.6	5.7	7.0	7.8	1.3	2.8	4.1	5.2	6.3	7.2	1.1	2.6	3.8	4.9	6.1	7.0
40	52.67	1.9	3.1	3.8	5.4	6.2	6.5	1.3	2.5	3.2	4.8	5.6	5.9	1.1	2.3	3.0	4.5	5.4	5.7
48	59.68	1.8	2.5	3.3	4.9	5.2	5.5	1.3	1.9	2.7	4.3	4.6	4.9	1.0	1.7	2.5	4.1	4.4	4.7
56	63.28	1.9	2.7	—	4.6	5.2	—	1.3	2.1	—	4.0	4.3	—	1.1	1.9	—	3.8	4.0	—
64	68.39	1.9	—	—	4.1	—	—	1.3	—	—	3.5	—	—	1.1	—	—	3.2	—	—

CONTINUED

Table 9.—Continued

D.b.h. (inches)	Butt- log grade	Mer- chant- able height (feet)	Initial value (dollars)	Vigor I						Vigor II						Vigor III					
				No change in butt-log grade with height increase (feet) of—			Increase in butt-log grade with height increase (feet) of—			No change in butt-log grade with height increase (feet) of—			Increase in butt-log grade with height increase (feet) of—			No change in butt-log grade with height increase (feet) of—			Increase in butt-log grade with height increase (feet) of—		
				0	8	16	0	8	16	0	8	16	0	8	16	0	8	16	0	8	16
26.....	3.....	16	19.72	1.9	4.8	6.8	5.2	8.5	10.8	1.3	4.2	6.1	4.7	7.9	10.1	1.1	3.9	5.9	4.5	7.7	9.9
		24	25.73	2.0	4.0	5.3	5.6	7.9	8.9	1.5	3.4	4.6	5.1	7.3	8.9	1.2	3.1	4.3	4.8	7.0	8.6
		32	30.90	2.1	3.4	4.3	5.9	7.5	8.7	1.5	2.7	3.7	5.3	6.9	8.2	1.2	2.4	3.4	5.1	6.6	7.9
		40	34.91	2.1	3.0	3.5	6.2	7.4	8.2	1.5	2.4	2.8	5.6	6.8	7.6	1.2	2.1	2.5	5.3	6.6	7.3
		48	38.42	2.0	2.5	2.9	6.4	7.1	7.9	1.4	1.8	2.2	5.8	6.5	7.3	1.2	1.5	2.0	5.6	6.3	7.1
		56	39.46	2.2	2.6	—	6.9	7.6	—	1.5	2.0	—	6.2	7.0	—	1.3	1.7	—	6.0	6.8	—
		64	41.18	2.2	—	—	7.2	—	—	1.5	—	—	6.6	—	—	1.3	—	—	6.3	—	—
28.....	1.....	16	52.12	1.4	4.5	6.4	—	—	—	.9	4.1	5.9	—	—	—	.7	3.5	5.6	—	—	—
		24	69.13	1.6	3.4	4.7	—	—	—	1.1	2.9	4.2	—	—	—	.9	2.7	3.9	—	—	—
		32	82.88	1.6	2.8	3.5	—	—	—	1.1	2.3	3.0	—	—	—	.9	2.1	2.8	—	—	—
		40	93.16	1.6	2.3	2.8	—	—	—	1.1	1.8	2.3	—	—	—	.9	1.6	2.0	—	—	—
		48	100.48	1.5	2.0	2.3	—	—	—	1.0	1.5	1.8	—	—	—	.8	1.3	1.5	—	—	—
		56	103.93	1.7	1.9	—	—	—	—	1.2	1.4	—	—	—	—	.9	1.3	—	—	—	—
		64	107.19	1.6	—	—	—	—	—	1.1	—	—	—	—	—	.9	—	—	—	—	—
28.....	2.....	16	34.01	1.4	4.9	7.0	5.8	9.1	11.1	1.0	4.3	6.5	5.3	8.6	10.5	.8	4.1	6.3	5.1	8.3	10.2
		24	46.39	1.7	3.8	5.4	5.8	7.7	9.0	1.2	3.2	4.8	5.2	7.1	8.4	.9	3.0	4.6	5.0	6.9	8.2
		32	57.31	1.6	3.2	4.2	5.4	6.7	7.4	1.1	2.6	3.7	4.9	6.1	6.9	.9	2.4	3.5	4.7	5.9	6.7
		40	66.57	1.6	2.7	3.6	5.1	5.8	6.3	1.1	2.2	3.0	4.5	5.3	5.8	.9	2.0	2.8	4.3	5.1	5.5
		48	74.43	1.5	2.4	3.1	4.6	5.1	5.4	1.0	1.9	2.6	4.1	4.6	4.9	.8	1.6	2.4	3.9	4.3	4.6
		56	80.10	1.7	2.3	—	4.4	4.6	—	1.1	1.8	—	3.8	4.1	—	.9	1.6	—	3.6	3.9	—
		64	86.31	1.6	—	—	3.9	—	—	1.1	—	—	3.3	—	—	.9	—	—	3.1	—	—
28.....	3.....	16	24.69	1.5	4.8	6.7	4.7	8.3	10.5	1.0	4.2	6.1	4.3	7.7	10.0	.8	4.0	5.9	4.1	7.5	9.7
		24	33.00	1.8	3.7	5.0	5.2	7.4	9.0	1.2	3.1	4.4	4.7	6.8	8.4	1.0	2.9	4.2	4.4	6.6	8.2
		32	39.88	1.7	3.1	3.9	5.4	7.0	8.1	1.2	2.5	3.3	4.8	6.4	7.5	.9	2.2	3.1	4.6	6.2	7.3
		40	45.24	1.8	2.6	3.2	5.6	6.7	7.6	1.2	2.0	2.6	5.1	6.2	7.1	1.0	1.8	2.4	4.8	6.0	6.8
		48	49.29	1.7	2.3	2.7	5.8	6.7	7.4	1.2	1.7	2.1	5.3	6.2	6.9	.9	1.5	1.9	5.1	5.9	6.7
		56	51.58	1.9	2.3	—	6.2	6.9	—	1.3	1.7	—	5.7	6.4	—	1.0	1.4	—	5.4	6.2	—
		64	53.91	1.8	—	—	6.5	—	—	1.2	—	—	5.9	—	—	1.0	—	—	5.7	—	—
30.....	1.....	16	62.64	1.2	4.5	6.4	—	—	—	.8	4.0	5.9	—	—	—	.7	4.0	5.8	—	—	—
		24	85.35	1.4	3.2	4.5	—	—	—	.9	2.7	4.0	—	—	—	.8	2.6	3.9	—	—	—
		32	102.04	1.4	2.6	3.3	—	—	—	.9	2.1	2.8	—	—	—	.8	2.0	2.7	—	—	—
		40	115.32	1.4	2.0	2.7	—	—	—	.9	1.5	2.2	—	—	—	.8	1.4	2.0	—	—	—
		48	122.93	1.4	2.0	2.4	—	—	—	.9	1.5	1.8	—	—	—	.8	1.4	1.7	—	—	—
		56	129.95	1.5	1.8	—	—	—	—	.9	1.3	—	—	—	—	.8	1.2	—	—	—	—
		64	133.23	1.6	—	—	—	—	—	1.0	—	—	—	—	—	.9	—	—	—	—	—
30.....	2.....	16	41.09	1.3	4.8	7.0	5.6	9.0	11.0	.8	4.3	6.5	5.2	8.5	10.5	.7	4.3	6.4	5.1	8.4	10.4
		24	57.48	1.4	3.5	5.1	5.4	7.3	8.7	.9	3.0	4.6	5.0	6.8	8.2	.8	2.9	4.5	4.9	6.7	8.1
		32	70.73	1.4	3.0	3.9	5.2	6.5	7.1	.9	2.5	3.4	4.7	6.0	6.6	.8	2.4	3.3	4.6	5.8	6.5
		40	82.44	1.4	2.4	3.4	4.9	5.5	6.2	.9	1.9	2.9	4.3	5.0	5.6	.8	1.8	3.6	4.2	4.9	5.5
		48	90.91	1.4	2.4	3.1	4.5	5.2	5.5	.9	1.9	2.6	4.0	4.6	5.0	.8	1.8	2.5	3.9	4.5	4.8
		56	99.71	1.5	2.2	—	4.2	4.6	—	.9	1.6	—	3.7	4.0	—	.8	1.5	—	3.5	3.9	—
		64	106.46	1.5	—	—	3.9	—	—	1.0	—	—	3.3	—	—	.9	—	—	3.2	—	—
30.....	3.....	16	30.27	1.4	4.8	6.7	4.4	8.1	10.4	.9	4.2	6.2	4.0	7.6	9.8	.8	4.1	6.1	3.9	7.5	9.7
		24	41.56	1.5	3.4	4.8	4.7	6.9	8.6	1.0	2.9	4.3	4.2	6.4	8.1	.9	2.8	4.1	4.1	6.3	7.9
		32	50.13	1.5	2.9	3.6	4.9	6.6	7.6	1.0	2.3	3.1	4.4	6.1	7.1	.9	2.2	2.9	4.3	5.9	6.9
		40	57.19	1.5	2.3	3.1	5.2	6.2	7.3	1.0	1.7	2.5	4.7	5.7	6.7	.9	1.6	2.4	4.6	5.5	6.6
		48	61.62	1.5	2.3	2.8	5.4	6.5	7.2	1.0	1.7	2.2	4.9	5.9	6.7	.9	1.6	2.1	4.8	5.8	6.5
		56	65.93	1.6	2.1	—	5.7	6.5	—	1.0	1.5	—	5.2	5.9	—	.9	1.4	—	5.1	5.8	—
		64	68.51	1.7	—	—	6.1	—	—	1.1	—	—	5.5	—	—	1.0	—	—	5.4	—	—

* Over 50 percent.

Table 10.—Ten-year value increase for sugar maple, in dollars

D.b.h. (inches)	Butt- log grade	Mer- chant- able height (feet)	Initial value (dollars)	Vigor I						Vigor II						Vigor III					
				No change in butt-log grade with height increase (feet) of—			Increase in butt-log grade with height increase (feet) of—			No change in butt-log grade with height increase (feet) of—			Increase in butt-log grade with height increase (feet) of—			No change in butt-log grade with height increase (feet) of—			Increase in butt-log grade with height increase (feet) of—		
				0	8	16	0	8	16	0	8	16	0	8	16	0	8	16	0	8	16
12.....	2.....	16	1.44	1.52	2.59	3.40	4.14	6.10	7.17	0.98	1.89	2.57	3.44	4.99	5.91	0.65	1.36	1.94	2.89	4.13	4.93
		24	1.78	2.25	3.06	—	5.76	6.83	—	1.55	2.23	—	4.65	5.57	—	1.02	1.60	—	3.79	4.59	—
		32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12.....	3.....	16	.21	.91	1.11	1.03	2.65	3.82	4.63	.62	.70	.55	2.22	3.12	3.80	.42	.40	.21	1.88	2.60	3.17
		24	.04	1.27	1.20	—	3.98	4.79	—	.86	.71	—	3.28	3.96	—	.57	.37	—	2.76	3.33	—
		32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12.....	4.....	16	.00	.03	.04	.06	1.11	1.32	1.24	.00	.00	.00	.83	.90	.76	.00	.00	.00	.62	.61	.42
		24	.00	.04	.06	—	1.32	1.24	—	.00	.00	.00	.90	.76	—	.00	.00	.00	.61	.42	—
		32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14.....	2.....	16	2.56	2.16	4.00	5.49	6.01	8.89	10.83	1.55	3.17	4.50	5.04	7.61	9.37	1.02	2.47	3.57	4.19	6.55	7.99
		24	3.57	3.00	4.49	5.39	7.89	9.83	10.51	2.17	3.50	4.26	6.61	8.37	8.92	1.47	2.57	—	5.55	6.98	—
		32	4.26	3.79	4.69	—	9.13	9.81	—	2.80	3.57	—	7.67	8.23	—	1.87	—	—	6.29	—	—
14.....	3.....	16	.92	1.42	2.04	2.32	3.80	5.65	7.13	1.01	1.50	1.68	3.19	4.82	3.19	.66	1.04	1.10	2.66	4.12	5.21
		24	1.04	1.92	2.20	2.07	5.53	7.02	7.92	1.38	1.56	1.37	4.70	6.02	6.79	.92	.99	—	4.00	5.09	—
		32	.91	2.33	2.20	—	7.15	8.05	—	1.69	1.50	—	6.15	6.93	—	1.12	—	—	5.23	—	—
14.....	4.....	16	.00	.43	.63	.82	2.34	2.96	3.24	.30	.44	.57	1.93	2.42	2.60	.18	.27	.35	1.58	1.96	2.02
		24	.00	.63	.82	.97	2.96	3.24	3.11	.44	.57	.68	2.42	2.60	2.41	.27	.35	—	1.96	2.02	—
		32	.00	.82	.97	—	3.24	3.11	—	.57	.68	—	2.60	2.41	—	.35	—	—	2.02	—	—
16.....	1.....	16	8.20	4.68	9.02	11.68	—	—	—	3.51	7.30	9.75	—	—	—	2.40	5.83	7.91	—	—	—
		24	10.89	6.33	8.98	10.40	—	—	—	4.61	7.06	8.31	—	—	—	3.14	5.22	9.02	—	—	—
		32	12.81	7.06	8.47	9.59	—	—	—	5.13	6.39	7.50	—	—	—	3.30	4.01	—	—	—	—
16.....	2.....	16	4.48	3.00	5.92	8.06	8.39	12.73	15.39	2.24	4.77	6.72	7.23	11.02	13.47	1.52	3.78	5.45	6.12	9.55	11.63
		24	6.20	4.20	6.34	7.93	11.01	13.67	15.08	3.05	5.00	8.14	9.30	11.75	13.00	2.06	3.73	6.72	7.83	9.91	12.74
		32	7.66	4.88	6.47	8.12	12.22	13.63	14.75	3.54	4.97	6.53	10.29	11.55	12.65	2.28	3.55	—	8.46	9.57	—
16.....	3.....	16	2.17	2.09	3.41	4.11	5.31	8.23	10.37	1.54	2.61	3.19	4.55	7.08	9.03	1.03	1.92	2.34	3.83	6.09	7.76
		24	2.73	2.86	3.56	3.79	7.67	9.81	11.40	2.06	2.63	2.77	6.52	8.47	9.89	1.37	1.78	2.39	5.54	7.20	9.03
		32	2.98	3.30	3.54	3.61	9.56	11.15	12.80	2.38	2.52	2.53	8.22	9.65	11.21	1.53	1.58	—	6.96	8.22	—
18.....	1.....	16	12.69	5.77	11.83	15.71	—	—	—	4.08	9.72	13.25	—	—	—	2.96	—	—	—	—	—
		24	16.83	7.69	11.57	13.44	—	—	—	5.58	9.11	10.96	—	—	—	4.06	7.26	—	—	—	—
		32	19.48	8.92	10.79	12.67	—	—	—	6.46	8.31	9.85	—	—	—	4.61	6.37	—	—	—	—
18.....	2.....	16	7.36	3.82	8.04	11.20	11.10	17.16	21.04	2.70	6.58	9.45	9.41	15.05	18.58	1.95	—	—	8.30	—	—
		24	10.14	5.26	8.42	10.57	14.38	18.26	20.13	3.80	6.67	8.74	12.26	15.80	17.65	2.76	5.37	—	10.75	13.95	—
		32	12.27	6.30	8.44	10.90	16.14	18.01	19.89	4.55	6.61	8.75	13.67	15.53	17.06	3.24	5.19	—	11.83	13.59	—
18.....	3.....	16	4.17	2.81	5.04	6.41	7.01	11.23	14.39	1.98	3.97	5.14	5.89	9.77	12.64	1.42	—	—	5.15	—	—
		24	5.40	3.80	5.17	5.76	9.99	13.16	15.30	2.73	3.91	4.44	8.53	11.41	13.48	1.96	2.97	—	7.49	10.10	—
		32	6.09	4.49	5.08	5.64	12.47	14.62	17.08	3.32	3.75	4.13	10.72	12.79	14.93	2.29	2.74	—	9.42	11.36	—

CONTINUED

Table 10.—Continued

D.b.h. (inches)	Butt- log grade	Mer- chant- able height (feet)	Initial value (dollars)	Vigor I						Vigor II						Vigor III					
				No change in butt-log grade with height increase (feet) of—			Increase in butt-log grade with height increase (feet) of—			No change in butt-log grade with height increase (feet) of—			Increase in butt-log grade with height increase (feet) of—			No change in butt-log grade with height increase (feet) of—			Increase in butt-log grade with height increase (feet) of—		
				0	8	16	0	8	16	0	8	16	0	8	16	0	8	16	0	8	16
20.....1.....	16	18.46	6.68	14.64	20.19	—	—	—	4.87	12.20	17.33	—	—	—	3.34	10.33	15.18	—	—	—	
	24	24.52	8.57	14.13	17.14	—	—	—	6.14	11.27	13.76	—	—	—	4.27	9.12	11.39	—	—	—	
	32	28.40	10.25	13.26	16.49	—	—	—	7.39	9.88	12.88	—	—	—	5.24	7.50	10.12	—	—	—	
	40	30.27	11.39	14.62	13.23	—	—	—	8.00	11.01	9.40	—	—	—	5.63	8.25	6.57	—	—	—	
	48	32.15	12.74	11.35	12.16	—	—	—	9.13	7.52	8.27	—	—	—	6.37	4.69	—	—	—	—	
	56	30.33	13.17	13.97	—	—	—	—	9.34	10.09	—	—	—	—	6.51	—	—	—	—	—	
	64					—	—	—				—	—	—				—	—	—	
20.....2.....	16	11.18	4.55	10.23	14.77	13.96	21.92	27.47	3.30	8.51	12.69	12.14	19.48	24.61	2.26	7.20	11.13	10.62	17.61	22.46	
	24	15.40	6.01	10.55	13.75	17.70	23.25	26.26	4.29	8.47	11.23	15.26	20.39	22.87	2.98	6.91	9.47	13.39	18.24	20.51	
	32	18.56	7.38	10.58	14.34	20.09	23.10	26.33	5.30	8.07	11.57	17.23	19.71	22.72	3.75	6.30	9.46	15.07	17.34	17.35	
	40	20.71	8.44	12.19	12.90	20.96	24.19	22.79	5.93	9.43	9.87	17.57	20.58	18.96	4.16	7.31	7.63	15.20	17.81	16.13	
	48	23.17	9.73	10.44	13.19	21.72	20.34	21.14	6.96	7.41	10.01	18.12	16.51	17.25	4.85	5.17	—	15.35	13.67	—	
	56	23.21	10.39	13.14	—	20.29	21.09	—	7.36	9.96	—	16.46	17.21	—	5.13	—	—	13.63	—	—	
	64					—	—	—				—	—	—				—	—	—	
20.....3.....	16	6.98	3.48	6.79	9.12	8.76	14.43	18.97	2.50	5.47	7.55	7.51	12.71	16.89	1.71	4.47	6.37	6.47	11.40	15.33	
	24	9.21	4.57	6.89	8.17	12.20	16.74	19.94	3.25	5.32	6.31	10.48	14.66	17.42	2.25	4.14	5.00	9.17	13.10	15.66	
	32	10.58	5.52	6.80	8.17	15.37	18.57	22.32	3.95	4.94	6.14	13.29	16.05	19.55	2.77	3.63	4.61	11.73	14.29	17.44	
	40	11.17	6.21	7.58	7.03	17.98	21.73	22.44	4.35	5.55	4.88	15.46	18.96	19.41	3.03	4.02	3.29	13.70	16.85	17.17	
	48	11.73	7.02	6.47	6.84	21.17	21.88	24.63	4.99	4.32	4.59	18.40	18.85	21.45	3.45	2.73	—	16.29	16.61	—	
	56	10.91	7.29	7.66	—	22.69	25.44	—	5.14	5.41	—	19.67	22.26	—	3.55	—	—	17.43	—	—	
	64					—	—	—				—	—	—				—	—	—	
22.....1.....	16	25.52	7.58	17.35	25.04	—	—	—	5.50	14.74	21.98	—	—	—	4.36	13.27	20.09	—	—	—	
	24	33.62	9.25	16.94	21.81	—	—	—	6.65	13.88	17.83	—	—	—	5.17	11.99	15.71	—	—	—	
	32	39.30	11.26	16.13	21.21	—	—	—	8.19	12.15	16.89	—	—	—	6.31	10.03	14.45	—	—	—	
	40	42.32	13.11	18.19	17.64	—	—	—	9.13	13.88	13.25	—	—	—	7.02	11.44	10.51	—	—	—	
	48	45.65	14.86	14.31	16.03	—	—	—	10.54	9.92	11.26	—	—	—	8.10	7.18	8.57	—	—	—	
	56	44.32	15.63	17.36	—	—	—	—	11.25	12.59	—	—	—	—	8.51	9.89	—	—	—	—	
	64	45.19	16.49	—	—	—	—	—	11.72	—	—	—	—	—	9.03	—	—	—	—	—	
22.....2.....	16	15.99	5.20	12.33	18.58	17.11	26.88	34.57	3.78	10.50	16.37	15.03	24.27	31.51	3.00	9.47	15.02	13.88	22.80	29.62	
	24	21.78	6.54	12.79	17.58	21.09	28.78	33.65	4.72	10.58	14.66	18.49	25.72	29.67	3.68	9.23	13.10	17.01	23.83	27.55	
	32	26.42	8.15	12.94	18.39	24.15	29.01	34.09	5.95	10.02	15.13	21.08	25.03	29.77	4.59	8.46	13.28	19.19	22.91	27.33	
	40	29.63	9.72	15.17	16.91	25.80	30.87	30.33	6.80	11.91	13.49	21.81	26.56	25.94	5.25	10.07	11.36	19.70	24.12	23.20	
	48	33.48	11.33	13.06	17.01	27.03	26.48	28.20	8.07	9.64	13.17	22.71	22.09	23.43	6.23	7.51	10.99	20.27	19.35	20.74	
	56	34.25	12.29	16.24	—	25.70	27.43	—	8.87	12.39	—	21.32	22.66	—	6.74	10.22	—	18.58	19.96	—	
	64	37.08	13.41	—	—	24.60	—	—	9.57	—	—	19.83	—	—	7.39	—	—	17.14	—	—	
22.....3.....	16	10.65	4.05	8.49	12.05	10.54	17.67	23.92	2.94	7.07	10.36	9.12	15.84	21.71	2.33	6.27	9.33	8.33	14.81	20.36	
	24	14.05	5.08	8.65	10.99	14.27	20.52	25.31	3.67	6.96	8.82	12.44	18.31	22.39	2.87	5.93	7.67	11.40	16.96	20.83	
	32	16.45	6.24	8.59	11.07	18.12	22.91	28.36	4.55	6.42	8.69	15.91	19.99	25.10	3.53	5.27	7.34	14.56	18.43	23.25	
	40	17.74	7.29	9.78	9.76	21.61	27.06	28.80	5.13	7.40	7.30	18.69	23.81	25.38	3.97	6.05	5.80	17.14	21.96	23.25	
	48	19.18	8.35	8.33	9.39	25.63	27.37	31.31	5.96	5.86	7.68	22.37	23.95	27.47	4.62	4.36	5.16	20.53	21.81	25.29	
	56	18.66	8.48	9.91	—	27.88	31.83	—	6.38	7.20	—	24.46	27.99	—	4.88	5.68	—	22.33	25.81	—	
	64	19.08	9.49	—	—	31.41	—	—	6.78	—	—	27.57	—	—	5.26	—	—	25.39	—	—	
24.....1.....	16	33.89	7.34	19.48	29.78	—	—	—	5.18	16.65	25.97	—	—	—	3.70	14.70	24.10	—	—	—	
	24	43.98	9.39	19.78	27.20	—	—	—	6.56	15.88	22.92	—	—	—	4.61	14.01	20.43	—	—	—	
	32	51.96	11.71	19.13	25.56	—	—	—	7.91	14.94	20.92	—	—	—	6.03	12.45	18.21	—	—	—	
	40	56.95	14.14	20.57	21.71	—	—	—	9.96	15.93	16.56	—	—	—	7.47	13.22	13.61	—	—	—	
	48	62.25	15.27	16.41	18.77	—	—	—	10.63	11.26	13.43	—	—	—	7.92	8.31	10.33	—	—	—	
	56	61.85	16.81	19.17	—	—	—	—	11.66	13.82	—	—	—	—	8.71	10.73	—	—	—	—	
	64	63.64	17.38	—	—	—	—	—	12.04	—	—	—	—	—	8.94	—	—	—	—	—	
24.....2.....	16	21.74	4.97	13.86	22.12	19.49	31.63	41.93	3.51	11.92	19.45	17.33	28.80	38.12	2.52	10.58	18.12	15.85	26.85	36.25	
	24	29.10	6.50	14.76	21.64	24.27	34.57	41.99	4.56	12.09	18.62	21.44	30.76	37.80	3.22	11.76	16.81	19.49	28.89	35.31	
	32	35.57	8.30	15.17	21.95	28.10	35.52	41.95	5.62	12.15	18.51	24.29	31.33	37.31	4.29	10.34	16.49	22.42	28.84	34.60	
	40	40.48	10.26	17.04	20.47	30.61	37.04	38.18	7.24	13.60	16.53	26.43	32.40	33.03	5.44	11.58	14.26	23.94	29.69	30.08	
	48	46.13	11.40	14.82	19.74	31.39	32.54	34.89	7.96	10.88	15.53	26.76	27.39	29.55	5.94	8.62	11.18	24.04	24.43	26.45	
	56	48.02	12.93	17.85	—	30.65	33.00	—	8.99	13.64	—	25.50	27.66	—	6.73	11.19	—	22.54	24.56	—	
	64	52.07	13.80	—	—	28.95	—	—	9.59	—	—	23.61	—	—	7.13	—	—	20.51	—	—	
24.....3.....	16	15.13	3.86	9.62	14.61	11.57	20.47	28.73	2.73	8.12	12.60	10.1									

26	1	16	42.61	7.61	23.63	36.75	—	—	—	5.32	20.32	32.54	—	—	—	4.32	18.99	30.90	—	—	—
		24	55.23	11.00	24.13	33.74	—	—	—	7.70	19.92	28.74	—	—	—	6.36	18.28	26.84	—	—	—
		32	65.85	13.51	23.12	30.46	—	—	—	9.30	18.12	25.35	—	—	—	7.66	16.22	23.34	—	—	—
		40	73.77	15.20	22.54	25.49	—	—	—	10.20	17.43	19.81	—	—	—	8.30	15.42	17.71	—	—	—
		48	80.43	15.87	18.83	21.85	—	—	—	10.77	13.15	15.95	—	—	—	8.75	11.05	13.68	—	—	—
		56	81.72	17.54	20.56	—	—	—	—	11.85	14.66	—	—	—	—	9.76	12.39	—	—	—	—
		64	84.22	18.06	—	—	—	—	—	12.16	—	—	—	—	—	9.89	—	—	—	—	—
26	2	16	27.63	5.10	16.78	27.22	22.59	38.61	51.73	3.56	14.52	24.28	20.29	35.30	47.52	2.90	13.60	23.13	19.30	33.97	45.88
		24	36.89	7.52	17.96	26.69	29.35	42.47	52.08	5.26	15.02	23.11	26.05	38.26	47.08	4.35	13.87	21.74	24.71	36.62	45.18
		32	45.40	9.45	18.18	25.97	33.96	43.57	50.91	6.51	14.60	22.22	29.75	38.57	45.80	5.36	13.23	20.74	28.11	36.67	43.79
		40	52.67	10.90	18.70	23.90	36.30	43.64	46.59	7.32	14.95	19.61	31.30	38.53	40.91	5.96	13.47	18.02	29.40	36.52	38.81
		48	59.68	11.69	16.89	22.81	36.62	39.58	39.00	7.94	12.60	18.22	31.52	33.90	36.70	6.45	11.01	16.45	29.50	31.80	34.43
		56	63.28	13.29	19.21	—	35.98	39.00	—	8.99	14.62	—	30.29	33.10	—	7.41	12.85	—	28.20	30.83	—
		64	68.39	14.10	—	—	33.89	—	—	9.51	—	—	27.99	—	—	7.74	—	—	25.72	—	—
26	3	16	19.72	3.97	11.75	18.29	13.02	24.69	35.13	2.77	10.01	16.07	11.48	22.43	32.19	2.25	9.31	15.20	10.81	21.51	31.04
		24	25.73	5.74	12.28	17.27	18.68	29.12	37.85	4.00	10.06	14.61	16.41	26.18	34.27	3.30	9.19	13.60	15.50	25.03	32.90
		32	30.90	7.11	12.10	16.12	23.95	32.68	40.47	4.88	9.44	13.35	21.00	29.10	36.72	4.02	8.43	12.26	19.86	27.73	35.24
		40	34.91	8.09	12.11	14.11	28.66	36.46	41.66	5.43	9.34	11.01	25.08	32.71	37.37	4.42	8.25	9.86	23.72	31.23	35.78
		48	38.42	8.60	10.60	12.76	32.95	38.15	44.07	5.83	7.50	9.49	29.20	33.86	39.48	4.74	6.35	8.23	27.71	32.27	37.71
		56	39.46	9.56	11.72	—	37.11	43.03	—	6.46	8.45	—	32.81	38.44	—	5.31	7.19	—	31.23	36.67	—
		64	41.18	10.00	—	—	41.31	—	—	6.73	—	—	36.72	—	—	5.47	—	—	34.95	—	—
28	1	16	52.12	7.71	29.13	44.85	—	—	—	5.10	25.26	40.02	—	—	—	4.03	23.67	38.11	—	—	—
		24	69.13	12.12	27.84	40.24	—	—	—	8.25	23.01	35.69	—	—	—	6.66	21.10	32.49	—	—	—
		32	82.88	14.10	26.49	34.26	—	—	—	9.27	20.94	28.60	—	—	—	7.35	18.74	26.41	—	—	—
		40	93.16	16.22	23.98	29.83	—	—	—	10.67	18.32	23.38	—	—	—	8.47	16.13	20.74	—	—	—
		48	100.48	16.67	22.51	25.57	—	—	—	11.01	16.06	19.12	—	—	—	8.81	13.42	16.63	—	—	—
		56	103.93	19.05	22.12	—	—	—	—	12.61	15.67	—	—	—	—	9.97	13.18	—	—	—	—
		64	107.19	18.86	—	—	—	—	—	12.41	—	—	—	—	—	9.92	—	—	—	—	—
28	2	16	34.01	5.18	20.67	33.16	25.81	47.24	62.96	3.43	18.02	29.79	23.20	43.37	58.13	2.71	16.93	28.45	22.14	41.78	56.22
		24	46.39	8.29	20.78	31.80	34.86	50.58	62.98	5.64	17.41	27.83	30.99	45.75	57.43	4.55	16.07	26.25	29.40	43.84	55.23
		32	57.31	9.86	20.88	29.35	39.66	52.06	59.83	6.49	16.91	25.21	34.83	46.51	54.17	5.15	15.33	23.60	32.92	44.31	51.98
		40	66.57	11.61	20.09	27.90	42.80	50.57	56.42	7.64	15.95	23.05	37.25	44.91	49.97	6.07	14.34	21.06	35.05	42.72	47.33
		48	74.43	12.23	20.04	26.48	42.71	48.56	51.62	8.08	15.19	21.50	37.05	42.11	45.17	6.47	13.20	19.57	34.86	39.47	42.68
		56	80.10	14.36	20.81	—	42.89	45.95	—	9.52	15.83	—	36.44	39.50	—	7.52	13.90	—	33.80	37.01	—
		64	86.31	14.60	—	—	39.74	—	—	9.62	—	—	33.29	—	—	7.69	—	—	30.80	—	—
28	3	16	24.69	4.08	14.69	22.71	14.50	29.99	42.48	2.70	12.64	20.13	12.75	27.34	39.11	2.13	11.79	19.11	12.03	26.25	37.77
		24	33.00	6.38	14.40	20.98	21.68	34.17	45.19	4.33	11.82	17.98	19.03	30.80	41.22	3.49	10.80	16.79	17.94	29.46	39.64
		32	39.88	7.52	14.10	18.55	27.29	38.31	46.78	4.94	11.10	15.44	23.92	34.34	42.64	3.92	9.91	14.23	22.58	32.76	41.03
		40	45.24	8.74	13.19	16.84	32.95	41.42	49.23	5.74	10.08	13.28	28.98	37.28	44.38	4.56	8.87	11.82	27.40	35.67	42.39
		48	49.29	9.13	12.79	15.20	37.37	45.18	51.62	6.02	9.23	11.57	33.23	40.33	46.64	4.82	7.77	10.17	31.62	38.34	44.71
		56	51.58	10.49	12.91	—	42.89	49.33	—	6.93	9.28	—	38.04	44.35	—	5.48	7.88	—	36.05	42.42	—
		64	53.91	10.58	—	—	47.00	—	—	6.95	—	—	42.02	—	—	5.55	—	—	40.09	—	—
30	1	16	62.64	8.26	35.07	54.20	—	—	—	5.30	30.59	48.84	—	—	—	4.65	29.74	47.81	—	—	—
		24	85.35	12.36	31.49	47.21	—	—	—	7.88	26.13	40.77	—	—	—	7.03	25.10	39.45	—	—	—
		32	102.05	14.79	30.51	38.84	—	—	—	9.43	24.07	32.03	—	—	—	8.40	22.75	30.72	—	—	—
		40	115.32	17.24	25.57	35.26	—	—	—	10.80	18.76	27.47	—	—	—	9.48	17.45	25.91	—	—	—
		48	122.93	17.95	27.65	32.81	—	—	—	11.15	19.86	24.55	—	—	—	9.84	18.30	22.90	—	—	—
		56	129.95	20.63	25.79	—	—	—	—	12.84	17.53	—	—	—	—	11.28	15.88	—	—	—	—
		64	133.23	22.51	—	—	—	—	—	14.25	—	—	—	—	—	12.60	—	—	—	—	—
30	2	16	41.09	5.57	24.87	40.00	29.82	56.62	75.75	3.57	21.80	36.24	26.85	52.14	70.39	3.13	21.21	35.52	26.20	51.29	69.36
		24	57.48	8.48	23.61	37.30	40.23	59.36	75.08	5.40	19.85	32.69	35.75	54.00	68.64	4.82	19.13	31.75	34.90	52.97	67.32
		32	70.73	10.36	24.05	33.33	46.11	61.83	70.16	6.60	19.44	28.34	40.75	55.39	63.35	5.88	18.50	27.38	39.72	54.07	62.04
		40	82.44	12.34	21.62	30.99	50.12	58.45	68.14	7.73	16.63	26.92	43.68	51.64	60.35	6.78	15.67	25.75	42.36	50.33	58.79
		48	90.91	13.15	24.30	32.94	49.98	59.67	64.83	8.17	18.45	26.57	43.17	51.88	56.57	7.21	17.28	25.30	41.86	50.32	54.92
		56	99.71	15.50	24.14	—	50.87	56.03	—	9.65	17.77	—	43.08	47.77	—	8.48	16.50	—	41.52	46.12	—
		64	106.46	17.39	—	—	49.28	—	—	11.02	—	—	41.02	—	—	9.75	—	—	39.37	—	—
30	3	16	30.27	4.41	17.91	27.86	16.39	35.69	50.82	2.82	15.50	24.94	14.39	32.62	47.06	2.48	15.05	24.39	13.95	32.03	46.34
		24	41.56	6.62	16.57	25.04	24.40	39.53	53.22	4.21	13.65	21.52	21.33	35.77	48.61	3.75	13.10	20.80	20.74	35.05	47.67
		32	50.13	8.00	16.47	21.43	30.96	44.65	53.93	5.09	12.95	17.66	27.20	40.04	48.94	4.53	12.23	16.94	26.48	39.10	47.98
		40	57.19	9.40	14.37	20.22	37.59	46.87	58.02	5.89	10.60	15.88	32.98	41.88	52.17	5.17	9.88	15.02	32.04	40.92	51.00
		48	61.62	9.93	15.79	19.54	42.44	53.59	62.23	6.17	11.45	14.88	37.45	47.74	55.86	5.44	10.59	13.96	36.49	46.57	54.59
		56	65.93	11.48	15.23	—	49.28	57.92	—	7.14	10.57	—	43.43	51.55	—	6.28	9.65	—	42.26	50.28	—
		64	68.51	12.65	—	—	55.34														



THE FOREST SERVICE of the U. S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.