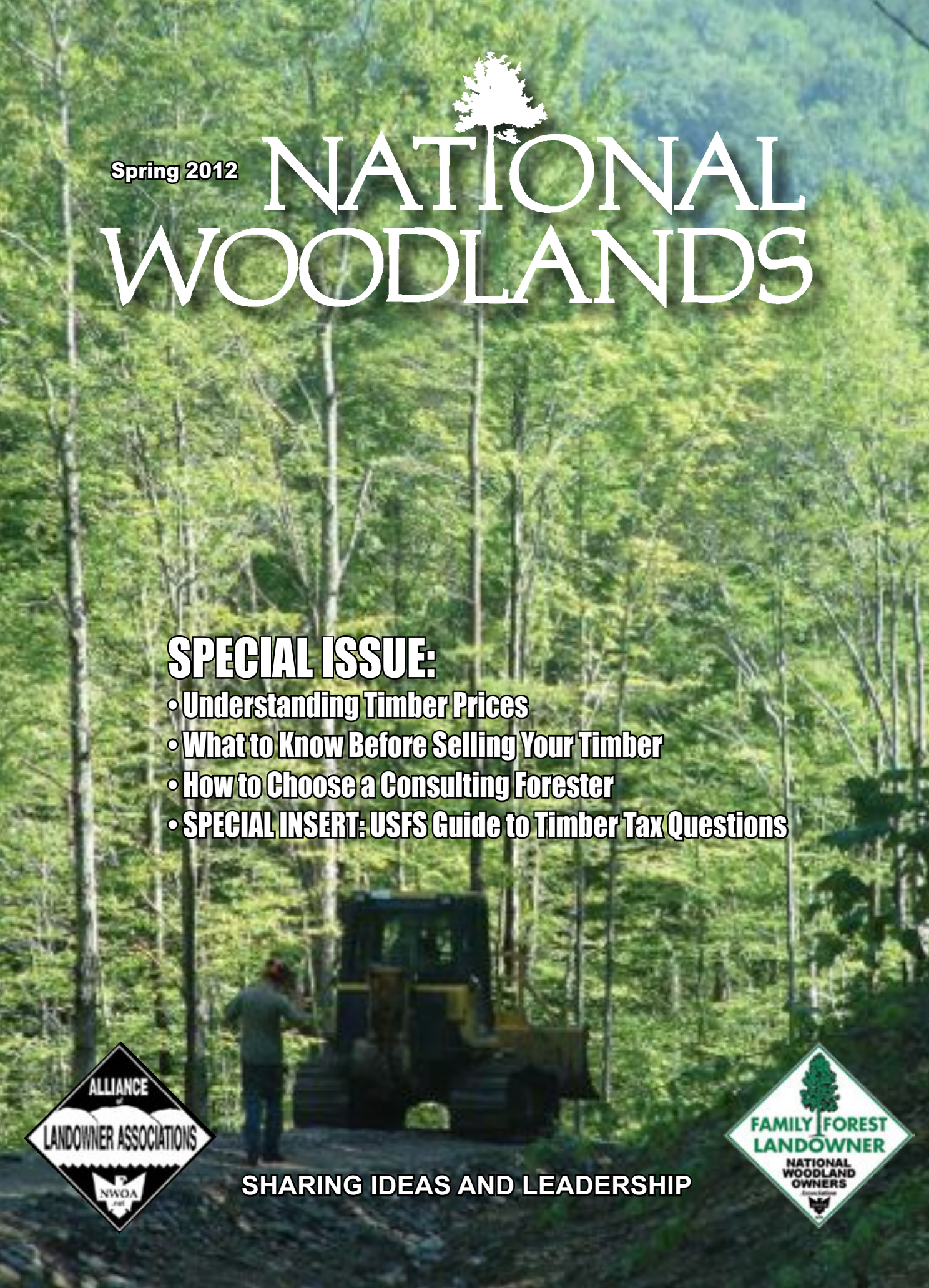

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When to Cut Your Woodlot: Maximizing the Economic Reurns

James Jeuck *and* **Robert Bardon***

The question of when it is optimal to harvest and start the next crop is tricky for most woodland owners. Not to downplay other important objectives, this key decision has such long-term effects on future forest activities and inter-generational income, it should be given a high priority in your woodland planning.

Similar to other investment tools, the basic principal of financial maturity of a timber stand allows you to determine the best time to harvest and replant. Financial maturity occurs when the rate of value increase of your timber equals the interest rate of another investment. So long as the value of your timber increases at a faster rate than money invested elsewhere, it should continue to grow. When the alternative investment equals or exceeds the rate of value increase, it is time to think about thinning or final harvest.

The example in this article works for trees or even-aged stands of softwoods and hardwoods with Form Class 78, but similar data can developed for most species and U.S. regions. We guide you through:

- How a tree's (or even-aged stand's) financial value changes over time;
- what measurements are necessary; and
- the determination of the current rate of value increase for your timber to compare other investment opportunities.

The rate of value increase changes over time: Its biology… and markets

Trees have predictable volume growth rates over their lives. After several decades of vigorous development (Fig. 1, a), growth rates level out (Fig. 1, b), and eventually decline with increasing age (Fig. 1,c). While large volumes of wood growth continue after this peak (often for decades and hundreds of years), the rate of volume growth slows each year. At the same time, the market value of your timber increases as it moves from one product class to the next in stair-step fashion seen in Fig. 2. Each step represents a large increase in the value of these different products.

Pine pulpwood moving into chip-n-saw may see 150 percent increase in value and over 250 percent increase moving into sawtimber. These two factors, fast biological growth and strong market value, continue to increase the rate at which your timber value increases. It is important to track this rate as your timber gets older.

As your timber matures, eventually the value of the next year's growth will fall below the rate of an alternative investment marking financial maturity of your stand. You may continue to grow the timber for other values but be aware that the return rate on your investment decision to grow timber is diminishing .

Finding if your stand is financially mature

Our approach to estimate the volume growth of trees is expressed as percent annual compound interest, similar to any investment strategy. Volume growth and product class changes are converted to value growth rates through tables based on assumptions covering a wide range of tree growth rates and site productivity. This requires some knowledge of basic tree measurements and price data that may require seeking a professional forester for some help. Don't be afraid to ask for help, for once you see how to make these measurements you can purchase the tools and do it on your own. The steps out outlined as follows.

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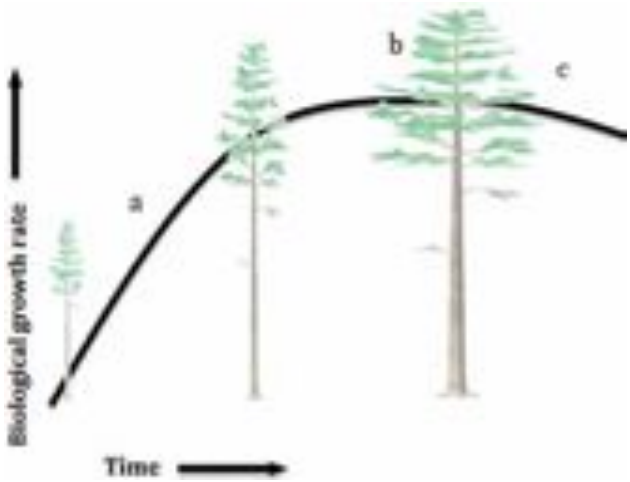


Step 1: Estimate volume growth expressed as a percent annual compound interest

Estimating volume growth expressed as a percent annual compound interest requires information on the site productivity, and averages of tree age, diameter, and diameter growth. Several pieces of this information may already be available in your forest management plan or can obtained from the forester who put the plan together. If the data is unavailable you can collect the data by sampling several of the most vigorous, tallest, and straightest "crop" trees in your stand. Tools needed are an increment borer and a tree diameter measurement tool such as a d-tape. From these trees collect the following information:

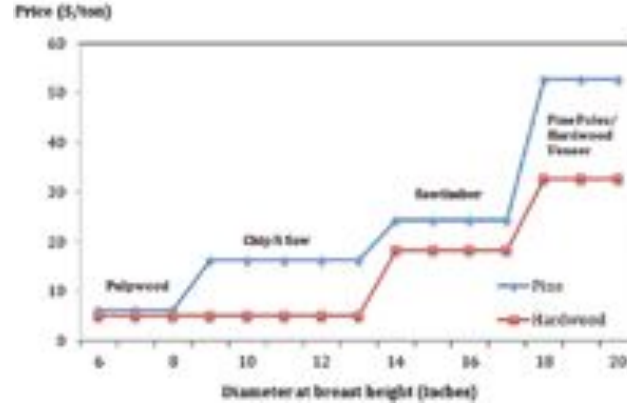
- **Average dbh (nearest inch):** measured by diameter tape or Biltmore stick.
- **Average tree age:** measured by increment borer cores extracted at dbh and counting the number of rings from the center of the trees.
- **Average of last 10-year diameter growth (nearest inch):** measuring the outer-most 10 growth rings for each core (above) measure gives radial growth for the past 10 years. Multiply these by 2.1 for diameter growth.
- **Site index (SI) for the stand of trees:** SI estimates the productivity of a stand based on soil type and other factors of trees. Your forest management plan should have this information for each management unit or a professional forester can help you obtain this directly in the field from tree height and age.

With these averages for your trees or stand you may determine the growth rate in percent annual compound interest from Table 1 below. Bear in mind, these growth rates are based upon merchantable volume growth only. This information alone is greatly important in forest management decisions. A 5 percent volume growth rate typically marks the lower threshold for "vigorously" growing timber often signaling a profession that, biologically speaking, thinning or regeneration may need to be scheduled. Converting this to value growth rates helps place this into an economic framework.

Step 2: Estimating value growth expressed as a percent annual compound interest

Usually, inflation and relative scarcity of large tree cause sawtimber prices to increase over time. Despite the current recession, 2011 sawtimber stumpage is still higher than 1991. To include the value associated with volume growth, one needs price information for the end and beginning of

Figure 2. Stumpage of various timber product classes in North Carolina Q2, 2010. This represents a statewide average based on Timber Mart South given in dollars per ton. (Note: value based on tons was used for comparing value changes. Selling higher value timber products—sawlogs, veneer, and poles—on a tonnage basis is not recommended over selling on a recognized board foot volume method).



An Alternate Approach

Another way of thinking about it: comparing growth per acre with value growth percent

Two ways to look at value growth of a stand of trees are value growth per acre and value growth percent. When land is limited, managers sometimes try to maximize value and growth per acre. A stand might be scheduled for harvest when it no longer produces, for example, 500 board feet (or its economic equivalent, depending on markets, say $60) per acre per year. You should compare this per-acre amount with other income opportunities, such as crops.

Money is more limited than land in most investment situations. Managers therefore try to maximize return per dollar. To do this, value growth of trees (or stands) is more usefully expressed as percent, to compare with rates of return possible through alternative investments. When a stand's stumpage value (the capital tied up in a stand) could earn more in alternative investments (a higher percentage), then the stand is financially mature.

These two methods of evaluating the adequacy of timber growth can lead to quite different answers. For example, a stand containing 5,000 board feet per acre and growing 500 board feet per acre per year is returning 10 percent. Ten years later, the same stand should contain 10,000 board feet because each year's growth has been automatically reinvested (tax free). However, the stand is now returning only 5 percent (500 on 10,000), even though the volume growth rate has remained constant. After converting percent volume growth to value growth, the investor with more attractive alternatives elsewhere would prepare to market this financially maturing timber stand.

Table 1. 10-year tree volume growth expressed as a percent annual compound interest. (This table was built using estimates of annual percent board foot volume growth rate expected of a stand of trees with Form Class 78 during a 10-year period. This is based on the average age of the trees, site productivity, and measured 10-year diameter growth at dbh.)

Age of trees (site index)	20 to 50 years (Site Index: 60-80) (moderate sites)					20 to 50 years (Site Index: 90+) (best sites)					50+ years (Site Index: Any)				
Past 10-year DBH growth (in)	1"	2"	3"	4"	5"	1"	2"	3"	4"	5"	1"	2"	3"	4"	5"
Stand's average DBH															
6"	8	12	15	18	20	10	14	17	19	23	--	--	--	--	--
8"	5	8	10	13	15	7	9	12	15	17	--	--	--	--	--
10"	5	6	9	10	12	6	8	10	14	14	--	--	--	--	--
12"	4	6	7	9	10	5	7	9	11	12	2	4	6	7	9
14"	4	5	7	8	9	5	7	8	10	11	2	3	5	6	7
16"	3	5	6	7	8	5	6	8	8	10	1	3	4	5	6
18"	3	4	5	6	7	5	6	7	8	9	1	2	4	5	6
20"	3	4	5	6	7	4	5	6	7	8	1	2	3	4	5
22"	3	4	5	5	6	4	5	6	7	8	1	2	3	4	5
24"	3	4	4	5	6	4	5	6	6	7	1	2	3	3	4

***Example 1** (in yellow): Use left column to enter appropriate DBH. Use top headings to enter age, site index, and DBH growth. Information for a stand of second growth yellow poplars, western NC: The average age of dominant and co-dominant trees is 30 years, the site index is 80, the average DBH of the co-dominant and dominant trees is 16" and the average 10-year diameter growth is 3 inches. The 10-year tree volume growth expressed as a percent annual compound interest is increasing at 6 percent.*

the current 10-year growth period. For North Carolina, this price information is available online from Extension Forestry at *http://www.ces.ncsu.edu/forestry/resources/price_report.php*. You may need to get this information from your local Extension Office, County Ranger, or professional forester. From it, a simple price ratio is calculated using the following equation:

Price ratio = y_(n+10)/y_n

Where,

y_(n+10) = stumpage price at the end of the 10-year period.

y_n = stumpage price at the start of the 10-year period.

For example: Hardwood sawtimber sold at $126/MBF ten years ago. Today, it is selling at $190/MBF. The 10-year price ratio is:

Price ratio = $190/$165= 1.5

This price ratio is use along with the volume growth data in Table 2 to determine the value growth of trees as expressed as percent annual compound interest. This interest rate correctly compares with other investments for determination of your timber's financial maturity.

Conclusion

Percent growth is one technique for deciding the optimal economic harvest time (thin or harvest) for a financially mature stand of trees or woodlot. Still, this is only a guide. Market fluctuations alone, such as in the past 5 years can offset several years' growth, currently making it appear as a poor investment. If you do decide to wait and continue to enjoy your woodlands while markets rebound, you are still increasing the stand's value through biological growth. Most stands can be managed many years beyond strict financial maturity before stagnation or potential catastrophe begins to force regeneration or a timber sale. Your financial return may not be as big, but it's money when you need it. When you do decide to cut, professional advice and assistance are always recommended.

Table 2. Value growth of trees expressed as percent annual compound interest.

price ratio	Percent annual volume growth (From Table 1) 1	2	4	6	8	10
1	1	2	4	6	8	10
1.2	2.8	3.8	5.8	7.8	9.8	11.8
1.5	5.1	6.1	8.1	10.1	12.1	14.1
1.8	7.1	8.1	10.1	12.1	14.1	16.1
2.2	9.2	10.2	12.2	14.2	16.2	18.2
2.6	11.0	12.0	14.0	16.0	18.0	20.0
3.1	13.0	14.0	16.0	18.0	20.0	22.0

Example 2: As an example, the price ratio of 1.5 (50 percent increase in 10 years, or 4 percent annual compound interest rate) is applied to the example from Table 1. growing at 6 percent gives a value growth rate of 10.1 percent per year. If other investment opportunities had alternative rates of returns greater than this, it would make financial sense to harvest at this point. However, if alternative rates of return are less than 10.1% and there is no pressing need to harvest, it may be prudent to continue to grow the stand.