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Introduction to forestry investment analysis: Part I. Basic investment characteristics and financial criteria

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INTRODUCTION TO FORESTRY INVESTMENT ANALYSIS

Part I: Basic Investment Characteristics and Financial Criteria

Calculate ROI Under Differing Management Strategies

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Many forest landowners consider their forest to be an investment. Some of these landowners, however, and many new timberland investors, may not fully understand the basic ingredients that make up a forestry investment. Like all investments, forestry involves costs and revenues, and rates of return can be calculated. These rates of return can be compared with interest rates earned for other investments, but forest landowners should be sure to understand the unique characteristics of a forestry investment. Most of the cash flow from a forestry investment will result from timber sales. Timber sale revenue, of course, is a function of current stumpage prices, but also it is a function of the amount of wood removed from an acre. This is called forest yield.

Forest Yield or Return from the Forest

Yield is just that, what the forest yields in timber products. Pulpwood is usually expressed in cords (a 4 x 4 x 8 foot rick of wood) and sawtimber in board feet (a 1 inch x 1 foot x 1 foot board contains 1 board foot). Since it is the amount of timber you expect from a forest, yield (and stumpage price) also reflects the revenue you expect to receive from timber. Computer models and tables can provide expected yields for a forest site. Two key elements affect the timber yield you can expect from your forest: site index and stocking.

Site index describes the quality of forestland for growing trees (soil productivity). Site is always in reference to a particular tree species; for example, loblolly pine sites or white oak sites. Few species grow equally well on the same site. Specifically, site index is the average total height of the dominant trees in a forest stand at an index age.

In the South, for instance, an index age of 50 years is commonly used for natural pine stands and 25 years for pine plantations. If forestland has the capacity to grow dominant loblolly pines to an average total height of 90 feet in 50 years, it is classified as "site index 90 land for loblolly pines, base age 50." Site index is important because of its dramatic impact on timber yield at harvest. On Virginia's coastal plain, loblolly pine yields by site index for a 20-year-old stand with 700 trees per acre are in Figure 1.

Fig. 1

Site Index (base age 25)	Yield (cords per acre)
50	22.6
60	34.5
70	52.9
80	80.9

Because site quality has such a major effect on timber yield, it should be a key element in pricing any forest tract. Higher site index land is worth more than lower site index land for timber production. If your forest management capital is limited, the highest site index areas of your forest should receive investment priority since they provide maximum timber production.

Stocking is a measure of how many trees are in a forest stand relative to how many are needed to attain your objectives. There are two common measures of stocking: trees-per-acre and basal area. Basal area is the cross-sectional area of trees at breast height (4fi feet above the ground) per acre, measured in square feet. Or, in plain English, basal area is the square foot area of the top of all the tree stumps on an acre of land if all the trees were to be cut 4fi feet above the ground.

To meet your objectives, your forest stand should be fully stocked, not understocked or overstocked. In the South, as a rule of thumb, the basal area of the forest

stand should approximate the 50-year site index of the land. Using this rule, site index 90 land should have a stocking of about 90 square feet of basal area per acre.

Trees-per-acre is a vague measure of stocking, unless you have an idea of tree size and how the trees are spaced in the stand. But it has the great advantage of being easily understood.

Stocking has little effect on total yield of your forest stand if you are only interested in cubic feet of wood produced. Stocking has a great impact, however, on the timber products available at harvest. You need a properly stocked stand to grow sawtimber. For example, for a 30-year-old loblolly pine stand, stocking differences can account for over 5,000 additional board feet (Fig. 2).

Fig. 2

Trees Per Acre	All Trees As Pulpwood (Cords)	Sawtimber (Board Feet)	Pulpwood (Cords)
500	52.6	7,523	32.5
600	52.7	5,551	37.2
700	52.6	4,090	40.6
800	52.2	3,011	43.0
900	51.7	2,214	44.6
1,000	51.7	1,628	45.6

Most forest landowners will need a forester to appraise stocking levels. Timberland investors would be wise to consider existing stocking levels when purchasing tracts of timber.

Forest Investment Characteristics

To start with, you cannot invest in timber without investing in land. So when you consider a timberland investment, you are considering a timber and a land investment. Both values tend to increase with inflation. Southern pine sawtimber prices and timberland have tended to outpace or at least equal inflation.

Another characteristic of timberland investments is the long time period often involved. A full growing cycle for southern pine is 25 to 35 years. You may be able to buy an established forest, say 20 years old, and quickly earn harvest revenue. A large timberland purchase may include timber of many ages, allowing periodic or annual harvest revenues. Small forests, however, may only provide occasional income, through thinnings and major harvests every few decades.

When buying timberland, carefully consider the age structure of the forest because it will dictate the cash flow from your investment. Small timberland investments are likely to produce infrequent income and, especially when the forest is young, timberland can be a moderately illiquid investment. Since the timing of timber revenue is very predictable, however, careful planning can minimize cash flow problems.

When acquired, bare land often requires a large initial expense for forest establishment. Annual management costs and property taxes, however, are likely to require only small cash payments. Again, these cash flows are very predictable and easy to include in an investment analysis. Current tax laws enhance forestry investments and help reduce the impact of early expenses. Forest regeneration expenses, for example, can qualify for an investment tax credit and deductions over seven tax years.

Another unique quality of timberland is that it can be an enjoyable investment, providing hunting and other outdoor recreation for you and your family. Although such benefits are not easily included in investment appraisals, they can be a very important part of timberland investment decisions.

Compounding and Discounting

Forestry investment analysis starts with compounding and discounting. These terms simply refer to moving money through time while taking interest into account. For example, if you place $100 into a savings account earning 4% interest, how much will be in the account in one year, in five years? You probably multiplied $100 times 0.04 to come up with $4.00 interest, and added that to $100 to come up with $104 in the account at the end of one year. Or, you could have skipped a step and multiplied $100 by 1.04 to obtain $104.00. How about the 5-year question? Compound interest means you earn interest on interest, so you expect 4% more on $104 in the second year, and so on. In formula form, this can be accomplished by multiplying the $100 by a series of 1.04's. Or in this case, after five years the account will contain $100 $(1.04)^5 = \$121.67$.

Compounding means to move a sum of money into the future like we just did. Discounting means bringing it back to the present considering interest. If you are promised $121.67 in 5 years and use a 4% interest rate, the sum is worth $100 today. This is discounting.

The two basic forestry investment analysis formulas that we used above are:

To compound money

$FV = PV(1+i)^n$

To discount money

$PV = FV/(1+i)^n$

where

PV=present value, or value today

FV=future value

n=number of compounding periods

i=discount rate or interest rate, expressed as a decimal

All of finance comes down to these two basic formulas. Formulas also exist to compound or discount cash flow series (like a series of car payments), but

they are just shortcuts from having to use the formulas above multiple times.

Financial Criteria

Net Present Value (NPV) is one of the most common criteria used to evaluate forestry investments. It is nothing more than all of the cash flows discounted to the present at a specified interest rate. It is the value today of an investment at a specified interest rate. NPV is stated in dollars. If an investment has a net present value of $600 per acre at an 8 percent interest rate, this means the investment will produce an 8 percent rate of return plus the equivalent value of $600 at the beginning of the investment. If the NPV is negative, you are not earning the specified interest rate. Net present values are very dependent on the interest rate used. The average investor needs to be aware of net present value, but probably has a better understanding of the straightforward rate of return method for evaluating investments.

Rate of Return (ROR) is the interest rate earned by the invested money. It is equivalent to the interest rate paid on a savings account or the yield of a bond. Usually a forester will calculate the rate of return using a computer or a financial calculator. The calculation involves finding the interest rate earned by the investment's cash flow. This will produce an NPV of zero; that is, you earn exactly that interest rate, no more, no less. Rates of return may or may not include inflation. In an investment analysis, the term real indicates that inflation has been removed. The rate of return earned by an investment may be stated in real terms or in market (or nominal) terms. That is, the rate of return will include inflation (market interest rate) or will be net of inflation (real interest rate). If the interest rate for an investment is not specified as real or inflated, the stated rate of return usually includes inflation. If the analysis includes an allowance for inflation, the term real rate of return is almost always used. Inflation is discussed in Part II of this article.

Be wary of the stated rate of return on a timberland investment if the interest rate earned can't be distinguished as real or market. If inflation is 5 percent annually and one investment has a market rate of return of 7 percent and a second investment has a real rate of return of 3 percent, you might be tempted to take the higher return. But the first investment only returns about 2 percent in real terms. The second investment has the higher real return. All you need to remember about an investment's rate of return is that it is an interest rate, just like any other interest rate, and that it can be directly compared with the interest rates of other investments.

Equivalent Annual Income (EAI) can also be calculated by a forester. At a specific interest rate, EAI represents the annual income equivalent to the net present value (NPV) of a full rotation of timber. For example, if a 25-year rotation has a NPV of $3,500 at 4% interest, EAI at 4% can be calculated as $224.04. In plain English, $224.04 paid annually over 25 years is exactly equivalent to a cash payment today of $3,500 at 4% interest. Forest landowners may find this criterion useful when comparing agricultural crops to forestry investments.

Bare Land Value (BLV) or land expectation value is the value of bare forestland in permanent timber production. It is a special NPV calculation that obtains the value today of all future timber rotations on a piece of bare land. Since it is a type of NPV calculation, it is very dependent on the interest rate used. If BLV was calculated at $600/acre at 4% interest, you could pay $600 for the bare land and would earn exactly 4% if you put the land into perpetual timber production. If you paid less than $600/acre for the land, you'd earn more than 4% on your investment. Vice versa, if you paid more than $600/acre.

The interest rate (or discount rate) used in the investment analysis will affect the net present value and bare land value. The investor specifies the interest rate used in the analysis. It should be the rate of return he could obtain from his best alternative investment such as a certificate of deposit from a bank. This is why it is often called an alternative rate of return. An investor's alternative rate of return is not always easy to estimate. A main advantage of the rate of return approach is that an alternative investment rate does not have to be estimated.

A Simple Example

Consider the example of a landowner deciding whether to regenerate 40 acres. His alternative rate of return is 4% (net of inflation and taxes). The investment is outlined in Table 1.

The NPV of this investment is the cumulative value of all the cash flows, each discounted at 4%. Note annual management costs and property taxes represent an annual series, which is discounted using a specialized formula. Each $2.50 payment could be individually discounted and the result would equal $40.82.

If the NPV equaled zero, the investment would earn exactly the interest rate used in the calculation. An investment is acceptable if the NPV is equal to or

Table 1. Cash flow from a typical forestry investment (per acre).

Item	Year Incurred	Amount
Establishment Cost	0	-$160.00
Annual Management & Tax Cost	14-27	-2.25
Thinning Revenue	16	97.50
Thinning Revenue	22	156.00
Harvest Revenue	27	1,287.00

greater than zero. In this case, the investment would earn a 4% rate of return PLUS $363.41. This means you would earn at least the interest rate you used in the calculation.

Rate of Return (ROR) is the interest rate earned by the investment. ROR is the average rate of capital appreciation during the life of an investment. ROR is usually calculated with a computer program. The program calculates NPV at various interest rates until the NPV equals zero. Recall, the ROR is the interest rate that makes NPV equal to zero. The program accomplishes its task via a series of guesses. Higher interest rates make NPV decrease. So if NPV turns negative the ROR would be less than the interest rate used to calculate NPV. In this case, a second guess might be 8% for ROR. Table 2 calculated with an 8% interest rate produces a NPV of $30.93. So we know now ROR is greater than 8%. A good third guess would be 9% for ROR. At 9% the NPV becomes -$11.46. By numerous calculations, we find NPV essentially equals zero at 8.7%. Table 3 illustrates NPV being recalculated at 8.7%.

At 8.7% interest rate, NPV is -0.23 (close enough to zero for our calculations as we only need ROR to two decimal places; the actual ROR is 8.704%).

Equivalent Annual Income (EAI) was calculated as $22.25. At 4% interest, a landower should be indifferent between $363.41 today and $22.25 per year for 27 years. The values are equivalent.

Bare Land Value (BLV) is the value of bare land put into perpetual forest production. The calculation involves compounding all costs and revenues to the end of a single rotation. This compounding includes establishment cost, but it does not include land cost (land value is what is being calculated). This net future value is assumed to occur at the end of every rotation to form a perpetual series. Then another specialized formula can be used to convert this net future value to BLV.

BLV is $556.37. This represents the maximum amount that could be paid for the land for forestry uses—if the required interest rate of 4% must be earned and the timber values assumed are those actually expected for the property.

We have examined four common forestry investment criteria: NPV, ROR, EAI, and BLV. Only the ROR criterion requires no interest rate assumption; it actually is the interest rate. That makes ROR a very popular criterion. However, the other criteria have advantages. BLV considers all future costs and revenues. EAI makes sense when comparing, for example, an annual crop like soybeans to timber production. NPV will produce very consistent results, given the proper interest rate. A forest landowner likely will

Table 2. Calculation of net present value (i=4%).

Item	Year Incurred	Amount	Formula	Discounted or "Present" Value
Establishment Cost	0	$160.00	—	-$160.00
Annual Management & Taxes	1-27	-2.50	$\frac{(1.04)^{27}-1}{(.04)(1.04)^{27}}$	-40.82
Thinning Revenue	16	97.50	$1/(1.04)^{16}$	52.05
Thinning Revenue	22	156.00	$1/(1.04)^{22}$	65.83
Harvest Revenue	27	1,287.00	$1/(1.04)^{27}$	446.35
			Net Present Value	$363.41

Table 3. Calculation of net present value (i=8.71%).

Item	Year Incurred	Amount	Formula	Discounted or "Present" Value
Establishment Cost	0	$160.00	---	-$160.00
Annual Management & Taxes	1-27	-2.50	$\frac{(1.087)^{27}-1}{(.087)(1.087)^{27}}$	-25.71
Thinning Revenue	16	97.50	$1/(1.087)^{16}$	25.66
Thinning Revenue	22	156.00	$1/(1.087)^{22}$	24.89
Harvest Revenue	27	1,287.00	$1/(1.087)^{27}$	135.33
			Net Present Value	$0.17