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VALUING STANDS OF PRECOMMERCIAL TIMBER

Land opportunity cost plays an important role in this tricky valuation problem.

PRECOMMERCIAL TIMBER HOLDINGS pose a difficult valuation question. The stands of trees have value, but, by definition, they have no current potential for conversion to timber products. The value is intrinsic and is equal to the discounted cash flows (DCF) expected from future timber harvests. Precommercial timber's value changes with its temporal progression towards mature commercial timber. This value is affected by the sunk cost of stand establishment and the opportunity cost of holding land to grow trees.

ILLUSTRATION:

Valuation of precommercial timber usually involves DCF techniques and projection of future forest yield, or the compounding of past production costs. This article describes the standard DCF analytical framework, but illustrates that precommercial timber will be undervalued unless land opportunity cost is considered. The analysis shows that a precommercial timber stand represents much more than compounded out-of-pocket production costs or discounted timber harvest revenue.

The valuation of precommercial timber is an important forestry valuation problem. Nearly one fourth of the nation's commercial timberland is in precommercial timber stands. These precommercial stands are located primarily in the eastern United States. In the southern United States, for example, approximately 30 percent of timbered acres contain precommercial timber.(n1)

SELLER'S VALUE VERSUS BUYER'S VALUE

Two common methods are often used to value precommercial timber: one determines "seller's value" and the other "buyer's value."(n2) The seller's value is calculated by compounding all production costs at some specified interest rate (usually the historical market rate over the time period involved). The buyer's

value is calculated by discounting projected timber sale revenues back to the present (often using the current market interest rate or an estimate of expected interest rates over the projection period). Because the techniques involve either compounding or discounting money flows over the long time periods common for forestry investments, the choice of an interest rate is crucial to the valuation process.

Buyer's value calculations and seller's value calculations often use different interest rates. Even when identical interest rates are used, inconsistent valuation results may occur.⁽ⁿ³⁾ However, these inconsistent values are calculated only when the wrong interest rate is used in the calculation. The appropriate interest rate is the internal rate of return (IRR) of the timber investment. When the interest rate used for compounding and discounting equals the IRR, the buyer's value equals the seller's value at every stand age.⁽ⁿ⁴⁾

The following discussion ignores inflation. Standard computational techniques could have been used to account for inflation; however, they would unnecessarily complicate the discussion.

ILLUSTRATION OF BUYER'S VALUE AND SELLER'S VALUE

Exhibit 1 is an example of the amount and timing of typical cash flows generated by a southern pine plantation.⁽ⁿ⁵⁾ Annual expenses during Years 1 to 25 equal annual revenues. This is a reasonable assumption that eliminates a complication of calculation that does not affect the analysis. Exhibit 1 also assumes that between Year 0 and Year 25 there are no intermediate costs or intermediate harvest revenues. These assumptions simplify the graphical descriptions that follow and do not alter the analytical results. The concepts that will be elucidated work equally well with plantations or naturally regenerated stands. (For naturally regenerated stands the establishment costs would be simulated from comparable establishment costs for stands of similar forest type and stocking. However, the Internal Revenue Service would probably not accept such a simulation.⁽ⁿ⁶⁾)

Exhibit 2 illustrates the concept of buyer's value and seller's value for a 12-year-old stand of precommercial pine on a plantation. If the \$150 of establishment costs are compounded at 8 percent to Year 12, the acre of precommercial pine has a seller's value of \$377.73. However, discounting the \$2550 of net harvest revenue at 8 percent interest produces a buyer's value of \$937.63. The \$559.90 difference represents the inconsistency described above. The inconsistency occurs whenever the interest rate used to compute buyer's value and seller's value is other than the IRR of the underlying timberland investment.

The IRR of this plantation investment can be easily calculated as 12 percent ([Multiple line equation(s) cannot be represented in ASCII text]). When buyer's and seller's values are computed using 12 percent as the rate for either compounding or discounting, they are identical throughout the holding period. The value of the 12-year-old precommercial pine plantation in the example is \$584.40.

The lowest value the seller will accept, in order to recoup planting costs at his 8

percent alternative rate of return, is \$377.73. If the buyer also has an 8 percent alternative rate of return, he will pay no more than \$937.63. The negotiating range is the \$559.90 difference between the buyer's and seller's values. If the buyer's value had exceeded the seller's value, no negotiating range would exist.

Forest management plans are required for sound forestry investment. Professionally prepared plans will list by year all scheduled activities and related costs and revenues. Thus an IRR can readily be calculated, as can an equitable valuation of precommercial timber.

LAND OPPORTUNITY COST

Whether the opportunity cost of land should be included as a production cost in timberland investments is a question forest economists have long argued.⁽ⁿ⁷⁾ Land opportunity cost is the foregone opportunity to put land devoted to tree growing to its next best alternative use. If the land is devoted to forest production due to absolute restrictions from family inheritance or law, for example, then one might argue that land opportunity cost is irrelevant. However, in most values of precommercial timber, the underlying land presumably does have an alternative use. Consequently, income from that alternative use should be included as a production cost in determining the value of precommercial timber. In fact, land value should be included in any timberland investment analysis, except under very unusual circumstances.⁽ⁿ⁸⁾

The omission of land opportunity cost as a production cost has caused many stands of precommercial timber to be undervalued. Returning to the example, assume a land value of \$400 for the one-acre pine plantation. If land value remains constant over the twenty-five-year investment period, the initial investment becomes \$550, and the net harvest and land value becomes \$2950. The IRR of the pine plantation investment declines to 6.95 percent ([Multiple line equation(s) cannot be represented in ASCII text]). If all investment flows are discounted or compounded at 6.95 percent, the seller incurs an annual land rent opportunity cost of \$27.80 (6.95 percent of \$400.00). When seller's value is calculated, this annual opportunity cost should be included in the calculation.

ILLUSTRATION:

Exhibit 3 illustrates the effect of a \$400 per acre land opportunity cost. The value of the stand of precommercial timber is higher at all stand ages, except, of course, at final harvest age. At age 12, the inclusion of the \$400 per acre land opportunity cost causes the value of the precommercial timber to increase from \$584.40 to \$831.78, a 42 percent increase. An \$800 per acre land opportunity cost (also illustrated in Exhibit 3) results in a 61 percent increase of stand value to \$939.51 per acre. (The IRR in the \$800 land cost example is 5.17 percent and the annual land rent opportunity cost is \$41.36 per acre.)

INCREASING LAND VALUES AND THE VALUE OF PRECOMMERCIAL TIMBER

Constant land values throughout a typical forest rotation are not the usual case. However, the prior example can be used to show the implications of an increase in land value from \$400 to \$800 per acre over the twenty-five-year period. (Although land values increase, the example assumes that Exhibit 1 values

(annual flows) are unchanged by inflation.)

The IRR of the investment in the one-acre plantation can be calculated as before, with the values adjusted for the 100 percent increase in land value. The IRR is 7.495 percent, calculated as ([Multiple line equation(s) cannot be represented in ASCII text]). Land increases 2.81 percent annually during the twenty-five-year period, calculated as ([Multiple line equation(s) cannot be represented in ASCII text]).

The calculation of annual land "opportunity rent" cost is a bit more complicated and is explained in the Appendix. The value of a precommercial timber stand, when land values are rising is the sum of all costs and revenues in the cash flow compounded to the stand age plus the future value of the annual opportunity rent payments. The equations in the Appendix show that the value of a 12-year-old precommercial pine plantation in this example is \$751.44.

The dotted line curve in Exhibit 3 illustrates the values of the pine plantation when land values increase from \$400 to \$800. Why is the precommercial timber value less when land is increasing in value than when land value is constant? In the example, with increasing land values the per acre value of the 12-year-old plantation was \$751.44. When the land value was a constant \$400 per acre, the value of the 12-year-old stand was \$831.78. Intuition suggests that the precommercial timber value for the scenario with increasing land value should exceed the value in the \$400 per acre constant land value scenario. After all, land value in the increasing scenario is greater at all ages.

However, the positive impact of increasing land value on the total investment is reflected in the higher IRR and consequently lower annual land rent "payment." Thus, land rent opportunity cost and the value of land appreciation net out to a lower precommercial timber value.

ILLUSTRATION:

To illustrate the limiting case, assume the unlikely scenario of the land value increasing from \$400 to \$6,800 per acre. In this case the IRR of the investment is 12 percent, calculated as follows:

[Multiple line equation(s) cannot be represented in ASCII text]

Land appreciation equals 12 percent annually, calculated as follows:

[Multiple line equation(s) cannot be represented in ASCII text]

Since $i = j$ (see Appendix), the factor to calculate the future value of annual land opportunity rent payments becomes zero and the precommercial timber value equals the scenario with no land cost. Thus, increasing land value serves to temper the cost of holding land.

SUMMARY

Valuation of precommercial timber is a tricky problem. DCF techniques produce inconsistent results unless the IRR is used as the discount rate. Even when the IRR is used as the discount rate, land opportunity cost must be included in the

valuation. Inclusion of this opportunity cost usually raises the value of precommercial timber. Truly consistent valuation requires inclusion of land opportunity cost prior to calculation of the IRR used for discounting purposes.

APPENDIX ANNUAL LAND OPPORTUNITY RENT WHEN LAND VALUES ARE RISING

The annual land opportunity rent payment is calculated in two stages. First, the beginning land opportunity rent payment is defined as:

$$P = LV (i - j)$$

where

P = land opportunity rent payment,

LV = land value at beginning of rotation,

i = interest rate used for compounding and discounting (equals IRR), and

j = annual percentage change in land value.

Second, to find the future value of the annual land rent payments at any year in the rotation, the standard formula for the future value of a geometric series of cash flows⁹ is used:

$$FV = p [(1 + i)^n - (1 + j)^n] / [i - j]$$

where:

FV = the future value of the annual land opportunity rent payments,

n = age of the precommercial timber, and P, i, and j are defined as above.

Obviously, the two relationships can be simplified to:

$$FV = LV [(1 + j)^n - (1 + j)^n]$$

The value of the precommercial timber is given by the value of all costs and revenues in the cash flow compounded to the stand age plus FV.

In the example:

i = 7.495 percent,

j = 2.81 percent, and

LV = \$400.00

The value of a 12-year-old precommercial pine plantation in this example is given by:

Value @ age 12

$$= \$150.00 (1.07495)^{12} + \$400.00 [(1.07495)^{12} - (1.0281)^{12}]$$

$$= 5751.44$$

EXHIBIT 1
EXAMPLE OF CASH FLOWS OF A ONE-ACRE INVESTMENT
IN A SOUTHERN PINE PLANTATION

Year	Item	Per-Acre Cash Flow
0	Site preparation and planting	(\$150.00)
1-25	Annual property tax and management fee	(\$53.50)
1-25	Annual hunting lease revenue	\$3.50
25	Net pulpwood harvest revenue	\$2,550.00

GRAPH: EXHIBIT 2 SELLER'S AND BUYER'S VALUE FOR THE ONE-ACRE SOUTHERN PINE PLANTATION EXAMPLE

GRAPH: EXHIBIT 3 VALUE OF PRECOMMERCIAL PINE PLANTATION BY AGE WITH AND WITHOUT LAND OPPORTUNITY COST

(n1) USDA Forest Service, An Analysis of the Timber Situation ;n the United States 1952-2030, USDA Forest Service Forest Resource Report No. 23 (Washington, D.C.: Government Printing Office, 1982): 360-362.

(n2) B. Foster, "Evaluating Precommercial Timber," Forest Farmer 46 (November-December 1986): 20-21.

(n3) Foster.

(n4) Foster.

(n5) T.J. Straka and W.F. Watson, "Basic Forestry Investment Analysis for Timberland Owners," Forest Farmer 48 (November-December 1988): 6-8.

(n6) Foster.

(n7) D. Haley, "The Importance of Land Opportunity Cost in the Determination of Financial Rotations," Journal of Forestry 64 May 1966): 326-399.

(n8) W.A. Leuschner, Introduction to Forest Resource Management (New York: John Wiley and Sons, 1984), 64-65.

(n9) S.H. Bullar. T.A. Monaghan. and T.J. Straka. Introduction to Forest Valuation and Investment Analysis. Mississippi Cooperative Extension Service Publication 1546 (Mississippi State 1986), 90-92.

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