THE BUY VERSUS LEASE DECISION FOR TIMBERLANDS

W. David Klemperer and Brian J. Greber

Abstract. --This paper illustrates decision guidelines for forest products firms deciding whether to buy or lease timberlands. Analyses include factors such as tax rates on ordinary income and capital gains, lease payments, interest rates, inflation, land costs, rates of land value-increase, and costs of debt.

With rising land values, many forest products firms have found forest land leasing an affordable alternative to purchasing land. Although the non-industrial private forest (NIPF) area under lease or management contracts in the South has declined by 30 percent since 1970, the leased area is still significant: about 4.7 million acres in 1984 (Meyer and Klemperer 1984, Siegel 1973).

Forest products firms are interested in developing economic decision guides for choosing between leasing or buying forest land for timber production--a topic which this paper addresses.

APPROACH

We assume that leased land is bare and would be reforested immediately by the firm (lessee), timber is clearcut at rotation-end, and land is returned to the owner in its initially bare condition. Originally existing timber, if any, is assumed to be sold and harvested immediately under a separate contract. To place bare land purchase on the same time horizon as leasing, we assume land sale after a period equal to the lease contract length (here, one rotation).

If the firm aims to maximize its value, it should choose the alternative with the greatest present value, using its weighted average cost of capital for projects of similar risk and debt structure (Clark et al. 1973). We will assume identical forest management income and costs on purchased or leased land. Thus, the crucial variables are the costs and incomes unique to buying or leasing.

1Department of Forestry, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. The authors are indebted to Richard D. Meyer for research assistance and to the U.S. Forest Service, Southern West Experiment Station for financial support.

2Includes Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, Louisiana, Arkansas, Oklahoma, and Texas.

3The weighted average cost of capital is E(q) + D(e), where E and D are proportions of equity and debt, q is the alternative rate of return on equity capital with the same debt/equity ratio as the buying or leasing ventures, and e is the after-tax interest rate on borrowed capital (see Weston and Brigham 1978).
The present value of unique leasing costs is the discounted value of tax savings from deductibility of lease payments from taxable ordinary income minus the present value of lease payments (net values are always negative). The net present value of costs and revenues unique to buying land is the discounted after-tax land sale income minus the initial bare land purchase price. The firm can choose the alternative with the least negative present value of unique costs, if such costs can be offset by net timber management income.

For all cash flows affected by capital gains taxes, present values are computed in nominal terms (including a projected inflation rate) in order to model inflation-induced increases in capital gains taxes which reduce present values. Other assumptions are that forestry is the most profitable use for lands in question, only timber income and costs are considered, state income taxes and other forest taxes beyond annual property taxes are omitted, the firm pays all timber management costs and property taxes, and leasing and buying have the same risk. Lease payments will be annual and indexed to the inflation rate (e.g., the consumer price index), the first payment due immediately and the last payment due one year before contract end.

BUY VS. LEASE PRESENT VALUE EQUATIONS

Notation

Throughout the analysis, the following notation is used. Interest rates are in decimal form, and the base year for constant dollar values is the year the lease begins.

\[ n = \text{contract life in years (here equal to one rotation).} \]

\[ H = \text{harvest income in year } n, \text{ in constant dollars.} \]

\[ M = \text{annual costs per acre (management, ad valorem tax, etc.) occurring from years 1 to } n, \text{ in constant dollars.} \]

\[ P = \text{initial annual lease payment. First payment is due immediately, last payment due one year before contract end. Payment increases annually at the inflation rate.} \]

\[ R = \text{reforestation costs per acre in real dollars occurring in year 0.} \]

\[ m = \text{a factor by which to multiply the initial lease payment to compute the firm's after-tax present value of annual lease payments, where:} \]

\[ m = \frac{(1 + r)^n - 1}{r(1 + r)^n} \]

Since payments rise at exactly the inflation rate, they may be discounted as fixed real payments with
a real interest rate. The term \( (1-t) \) reflects
deductibility of payments for income tax purposes.

\[
t = \text{ordinary income marginal tax rate}
\]

\[
c = \text{capital gains tax rate}
\]

\[
f = \text{anticipated annual inflation rate}
\]

\[
i = \text{nominal, after-tax, risk-adjusted interest rate for the timber}
    \text{production investment, where } i = r + f + rf.
\]

\[
r = \text{real, after-tax, interest rate for the timber production}
    \text{investment: equal to } [(1 + i)/(1 + f)] - 1.
\]

\[
g = \text{anticipated annual real rate of stumpage price}
    \text{increase above inflation.}
\]

\[
L = \text{current purchase price per acre of bare land.}
\]

\[
v = \text{nominal annual rate of increase in land value (real}
    \text{rate is } [(1 + v)/(1 + f)] - 1).
\]

**Net Present Value of Timber Income**

For both land leasing and purchase, the net present value of timber in-
come, excluding costs unique to leasing and buying, is:

\[
H(1 + f)^n (1 + g)^n - c [H (1 + f)^n (1 + g)^n - R]
\]

\[
\frac{(1 + i)^n}{(1 + i)^n - R - M(1 - t)} \frac{(1 + r)^n - 1}{r(1 + r)^n}
\]

(1)

The first term in (1) is the after-tax present value of future harvest income
after capital gains taxes. The second term is the initial reforestation
cost, and next is the after-tax present value of annual costs assumed to
remain fixed in real terms (but rising at the inflation rate in current
dollars). The net present value of timber income, (1), must be sufficient
to offset negative present values of costs unique to leasing or buying for
either to be a viable alternative.
Net Present Value of Costs Unique to Leasing

Given some fixed real lease payment (rising in current dollars at the inflation rate), the after-tax present value of these costs (a negative number) to the firm is:

\[ P_m \]  

The analysis reflects the common practice of indexing lease payments only to the inflation rate.\(^4\)

Net Present Value of Costs Unique to Buying Land

Present value of revenues minus costs unique to land purchase is:

\[
\frac{L(1 + v)^n - c(L(1 + v)^n - L)}{(1 + i)^n} - L
\]  

(3)

where the first term is present value of gross land sale income minus capital gains taxes, and the second term is land purchase cost. The result may be positive or negative.

EXAMPLES OF APPLYING DECISION GUIDES

Here we apply the foregoing decision rules to hypothetical slash pine lands in Florida, given the following assumptions:

* Cut pulpwood only, no thinnings.
* Lease contract length and rotation is 20 years.
* A current stumpage price of $28/cord yields a harvest revenue for site index 60, base age 25, of $694/acre (24.8 cords/acre, age 20), and $1006/acre for site 70 (35.93 cords/acre, age 20)\(^5\).
* Regeneration cost is \( R = \$120 \) per acre (chop, burn and plant).

---

\(^4\)In setting a minimum acceptable lease payment for a landowner, or maximum for the firm, anticipated real stumpage price-increases can be accounted for with \( g \) in equation (1). The landowner would set the minimum acceptable lease payment (or the firm would set its maximum) so that the present value of lease payments would be equal to equation (1). The greater the anticipated rate of real stumpage price-increase, the greater the lease payment would be. Lease payments are determined as follows: Equation (1) = \( P_m \). Then, the initial payment (minimum for the landowner or maximum for the firm) would be Equation (1)/\( m \).

\(^5\)Yields from Bailey et al. (1982), assuming 85 cubic feet per cord.
• Annual cost paid by firm is \( M = \$3/\text{acre} \).

• Anticipated inflation is 6%/year.

• Stumpage prices and all costs remain fixed in real terms and increase in nominal terms at 6%/year (\( g = 0 \)).

• Firm pays a corporate income tax rate of 46% and a 28% capital gains tax rate (\( t = .46, c = .28 \)).

• Current bare land purchase prices are assumed at $300/acre for site 60 and $400/acre for site 70.

The above are only hypothetical values to illustrate application of the decision guides. Each firm would have to compute present values based on inputs appropriate for a given situation.

For site index 60 lands, Table 1 shows the relevant present values for the buy versus lease decision, given the foregoing assumptions and nominal interest rates from 8% to 13% (real, 1.9% to 6.6%), initial annual lease payments from $2 to $22 per acre, and nominal land value-increases from 6% to 14% per year (real from 0 to 7.5%). For any required lease payment and projected rate of increase in land value, the best alternative is that with the least negative present value of costs, providing costs can be offset by present value of timber revenues in row 1. For example, given 8% nominal interest, a $10 initial lease payment, and nominal land values rising at an expected 6% per year, leasing would be preferred. With land values rising at 9% annually, buying is preferred.

At 13% interest in Table 1, net present value of timber income (row 1) is not sufficient to offset either buying or leasing costs, so neither could yield the firm’s required rate of return. At 12% interest, the only relevant lease choices are where real lease payments are substantially below $6/ac. For buying to be considered at 12% interest, expected nominal land value-increase would have to substantially exceed 9%/year.

As shown in Table 2, site 70 lands have the potential to support higher lease payments than site 60. In addition, the higher $400 per acre land cost creates different present values of purchase costs (higher cost at low rates of land value-increase, but greater benefits from high rates of land value-increase, compared to Table 1).

CONCLUSION

Our numerical examples only illustrate approaches to evaluating the buy versus lease decision and should not suggest typical lease payments or present values. Each specific case would require separate computations using a range of likely inputs. In addition, different lease arrangements would require changes in present value formulas to account for factors such as regeneration lags, requirements that firms reforest at contract-end, lease payments indexed to average stumpage prices rather than the consumer price index, payment of state income taxes or yield taxes, thinnings, or differences in the responsibility for tax payments.
Table 1. **Per Acre Present Values Required for Buy versus Lease Decision, Site Index 50.**

(Bare land purchase price of $300/acre)

<table>
<thead>
<tr>
<th>Nominal Interest Rate*</th>
<th>8%</th>
<th>10%</th>
<th>12%</th>
<th>13%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Net present value of timber income, $/ac. (common to leasing and buying; equation (1))</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$204</td>
<td>$101</td>
<td>$30.5</td>
<td>$4.30</td>
<td></td>
</tr>
<tr>
<td><strong>LEASE:</strong></td>
<td>After-tax net present value of lease payments, $/ac.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(equation (2))</td>
<td>$2</td>
<td>$-18.2</td>
<td>$-15.5</td>
<td>$-13.5</td>
</tr>
<tr>
<td>$6</td>
<td>$-54.6</td>
<td>$-46.6</td>
<td>$-40.4</td>
<td>$-37.8</td>
</tr>
<tr>
<td>$10</td>
<td>$-91.0</td>
<td>$-77.7</td>
<td>$-67.3</td>
<td>$-62.9</td>
</tr>
<tr>
<td>$14</td>
<td>$-127</td>
<td>$-109</td>
<td>$-94.2</td>
<td>$-88.1</td>
</tr>
<tr>
<td>$18</td>
<td>$-164</td>
<td>$-140</td>
<td>$-121</td>
<td>$-113</td>
</tr>
<tr>
<td>$22</td>
<td>$-200</td>
<td>$-171</td>
<td>$-148</td>
<td>$-138</td>
</tr>
<tr>
<td><strong>BUY:</strong></td>
<td>After-tax net present value of land purchase cost, #/ac.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(equation (3))</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6%</td>
<td>9%</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>Percent nominal annual increase in land value #</td>
<td>$-133</td>
<td>$-185</td>
<td>$-219</td>
<td>$-233</td>
</tr>
<tr>
<td>$-22.3</td>
<td>$-108</td>
<td>$-166</td>
<td>$-188</td>
<td></td>
</tr>
<tr>
<td>+355</td>
<td>+153</td>
<td>+16.5</td>
<td>-35.1</td>
<td></td>
</tr>
</tbody>
</table>

* Given the 6% projected inflation, corresponding real interest rates are 1.9%, 3.8%, 5.7% and 6.6%.

** Initial payment is increased annually by the inflation rate, but remains constant in real terms.

# Corresponding real rates are 0%, 2.8%, and 7.5% per year.
Table 2. *Per Acre Present Values Required for Buy versus Lease Decision, Site Index 70.*

(Bare land purchase price of $400/acre)

<table>
<thead>
<tr>
<th>Nominal Interest Rate*</th>
<th>8%</th>
<th>10%</th>
<th>12%</th>
<th>14%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net present value of timber income, $/ac. (common to leasing and buying; equation (1))</td>
<td>$359</td>
<td>$208</td>
<td>$105</td>
<td>$35.0</td>
</tr>
<tr>
<td><strong>LEASE:</strong> (equation (2))</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial lease payment/acre</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$5</td>
<td>$-45.5</td>
<td>$-38.9</td>
<td>$-33.6</td>
<td>$-29.5</td>
</tr>
<tr>
<td>$10</td>
<td>$-91.0</td>
<td>$-77.7</td>
<td>$-67.3</td>
<td>$-59.0</td>
</tr>
<tr>
<td>$15</td>
<td>$-136</td>
<td>$-117</td>
<td>$-101</td>
<td>$-88.5</td>
</tr>
<tr>
<td>$20</td>
<td>$-182</td>
<td>$-155</td>
<td>$-135</td>
<td>$-118</td>
</tr>
<tr>
<td>$30</td>
<td>$-273</td>
<td>$-233</td>
<td>$-202</td>
<td>$-177</td>
</tr>
<tr>
<td>$40</td>
<td>$-364</td>
<td>$-311</td>
<td>$-269</td>
<td>$-236</td>
</tr>
<tr>
<td><strong>BUY:</strong> (equation (3))</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial nominal increase in land value #</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6%</td>
<td>$-178</td>
<td>$-246</td>
<td>$-293</td>
<td>$-325</td>
</tr>
<tr>
<td>9%</td>
<td>$-29.7</td>
<td>$-143</td>
<td>$-221</td>
<td>$-274</td>
</tr>
<tr>
<td>14%</td>
<td>$+473</td>
<td>$+205</td>
<td>$+21.9</td>
<td>$-104</td>
</tr>
</tbody>
</table>

* Given the 6% projected inflation, corresponding real interest rates are 1.9%, 3.8%, 5.7% and 7.5%.

** Initial payment is increased annually by the inflation rate, but remains constant in real terms.

# Corresponding real rates are 0%, 2.8%, and 7.5% per year.
In any case, as long as present value formulas properly reflect contract arrangements, the general buy vs. lease evaluation would be the same: choose the alternative with the maximum present value, or net present value of timber management revenues minus net present value of costs unique to buying or leasing.

Although not discussed here, the landowner could also estimate which has the greatest present value: leasing the land, selling, or managing it. Computations would be analogous to those discussed for the lessee and could form the starting point for negotiations between landowner and firm.

LITERATURE CITED


