

EMERGING ISSUES IN FOREST ECONOMICS

Edited by

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Impact of Mergers and Acquisitions on the Forest Products Industry:

An Event Study of Stock Market Returns

Bin Mei and Changyou Sun¹

Abstract

The forest products industry in the U.S. has witnessed an unprecedented period of mergers and acquisitions (M&A) in the past decades. In this study, 57 major M&A events in the forest products industry were assessed by event analysis. By focusing on firm-level performance, financial data from the capital market were used to measure the impact of M&A events on the performance of firms. The abnormal returns implied capital market reacted positively to M&As in U.S. forest products industry as a whole, leading to a significant enhancement of the firms' market value. However, the acquiring firms experienced no significant response from the capital market. The results from cross-sectional regressions indicated that the position of a firm in the M&A event explained most of the variations of the cumulative abnormal return. The risk analyses for the acquiring firms in the selected 14 M&A events showed that the risk for most of them has experienced limited changes after the M&A events.

Keywords: abnormal return; Capital Asset Pricing Model; risk

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1. Introduction

Mergers and acquisitions (M&A) have been occurring frequently in the forest products industry over the last few years. M&A increased from 1995 to 1997, 26.9 to 36.9 percent based on an annual dollar increase (Diamond, et al. 1999). A widespread concern has been whether these changes of ownerships have improved their financial performance.

Event analysis (event study) is a standard methodology in financial economics to determine the impact of specific financial decisions on shareholder returns and expected firm profitability. The theoretical basis for the event analysis is based on the assumption that individual stock returns over time can be predicted to some degree. Researchers then observe the actual stock returns over the period of interest and compute the difference between the returns predicted and observed. Though stock returns are subject to some degree of "noise" or random statistical fluctuation, the event analysis is looking for returns that exceed this normal level of variation. If the difference is determined to be statistically different from zero, it may be concluded that the event under study did impact stock returns and reflect an investor reaction to the event (Wells 2004).

Event analysis methodology provides management researchers a powerful technique to explore the strength of the link between managerial actions and the creation of value for the firm (McWilliams and Siegel 1997). It has been applied to a variety of events such as corporate acquisitions (Knapp 1990), food safety issues (Salin and Hooker 2001), and forest policy and regulation (Zhang and Binkley 1995).

2. Methodology

2.1 Abnormal returns

To calculate the abnormal returns, first, it is necessary to evaluate the "normal" stock returns for those firms, had the event not occurred. Several methods are available for estimating returns, including mean-adjusted model, the market–adjusted model, and the market model. Because the market model incorporates a risk adjustment component to the estimate of returns, researchers usually rely on this model to refine their predicted returns over the event window in question. A market model assumes a stable linear relation between the market return for security i as follow,

(1)
$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

where R_{it} and R_{mt} are the rate of returns on security *i* and the market portfolio over the estimation window, respectively, and ε_{it} is the zero mean disturbance term. In this study value weighted S&P 500 Index is chosen as the proxy of the market portfolio.

Using estimation window (i.e., nonevent period) data (Figure 1), we get the estimate of the regression parameters of (1), i.e., $\hat{\alpha}$ and $\hat{\beta}$. Then, for a firm *i* and event window *t*, $t = T_1 + I$, ..., T_2 , the abnormal return is:

(2)
$$AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt}$$

Since the daily returns are in continuous form, for a individual stock *i* through the window period T_1 to T_2 , the cumulative abnormal returns (*CAR*_{*it*}) can be constructed as,

$$(3) \qquad CAR_{it} = \sum_{t=T_1}^{T_{2_t}} AR_{it}$$



Figure 1. A comparison of estimation window, event window, and post-event window along a time line for event analysis Source: MacKinlay (1997).

If the event had no impact on the returns for the security, then the expected value of CAR_{it} should be zero. When the estimation window is large (so that CAR_{it} has a normal distribution), the test statistic for the hypothesis that $CAR_{it} = 0$ is a familiar Student's *t*-statistic. The variance of CAR_{it} is generally assumed to be the same as that of the estimation window and asymptotically calculated as (MacKinlay 1997)

(4)
$$Var(CAR_{it}) = (T_2 - T_1 + 1)\sigma_{\varepsilon_i}^2$$

where $T_2 - T_1 + I$ is the total number of days in the event window.

As tests with one event are unlikely to be useful researchers then aggregate CAR_{it} across firms to obtain the average cumulative abnormal returns,

(5)
$$\overline{CAR}_t = \frac{1}{N} \sum_{i=1}^N CAR_{it}^2$$

where *N* is the number of observations included in the sample. This aggregation assumes that there is no overlap in the event windows of the firms included in the aggregation, i.e., there is no clustering. With the assumption that \overline{CAR}_t is asymptotically normally distributed, the variance of the average cumulative abnormal returns for the sample firms can be expressed as follows:

(6)
$$Var(\overline{CAR}_t) = \frac{1}{N^2} \sum_{i=1}^{N} Var(CAR_{it})$$

Finally, the statistical significance of the average effect of an event on the market value of firms is tested by calculating the *z*-statistic as

(7)
$$z = \frac{\overline{CAR_t}}{\sqrt{Var(\overline{CAR_t})}} \sim N(0, 1)$$

This distributional result is asymptotic with respect to the number of securities and the length of the estimation window (Campbell, et al. 1997). Parametric tests and nonparametric tests are used to check the robustness of the conclusions (MacKinlay 1997). In this study, model (1) is estimated on a 300-day estimation window. Then, *CAR* are evaluated over four different event window, i.e., (-3, 3), (-7, 7), (-10, 10), and (-15, 15), respectively. The choices are consistent with prior studies of capital market responses (Lepetit, et al. 2004).

² Equation (5) is equivalent to
$$\overline{CAR}_t = \sum_{t=T_1}^{T_2} AR_t$$
, since $\sum_{t=T_1}^{T_2} AR_t = \sum_{t=T_1}^{T_2} \sum_{n=1}^{N} AR_{it} = \frac{1}{N} \sum_{t=T_1}^{N} AR_{it} = \frac{1}{N} \sum_{t=T_1}^{N$

2.2 Cross-sectional regression

In cross-sectional regression, multiple factors are considered collectively. Insights can be gained by examining the association between the magnitude of the abnormal returns and the characteristics specific to the event observations. The basic approach is to run a cross-sectional regression of the abnormal returns on the characteristics of interest.

Given a sample of *N* abnormal return observations and *M* characteristics, the regression model is:

(8) $CAR_{j} = \delta_{0} + \delta_{1}x_{1j} + \dots + \delta_{M}x_{Mj} + \eta_{j}$

where x's are factors specific to the event observations, δ 's are coefficients correspondingly, and η_i is the mean zero error term.

By avoiding cluster when identifying M&A's, the η_j 's are assumed to be cross-sectionally uncorrelated and homoskedastic, and inferences can be conducted using the usual OLS standard errors. In this study, the cumulative abnormal returns (*CAR_{it}*) for M&A's were regressed on the return of assets (ROA), the scale of the company (Scale) with a value equal to 1 if the total assets were larger than 100 million US dollars and 0 otherwise, the transaction size (SOT) as the natural logarithmic value of the ratio of the transaction cost divided by the total assets, and the status in M&A's (BS) with value 1 indicating the acquiring side, while 0 on the target side. *2.3 Risk analysis*

Risk is the other side of the coin of market reaction to M&A's in forest products industry. Investors require higher expected returns in exchange for bearing risk. Statistical estimates of systematic risk (or the volatility of returns) before and after the events can evaluate M&A's impacts from another perspective.

Financial market measure of systematic risk is derived from the Capital Asset Pricing Model (CAPM). Using the CAPM, two regressions will be estimated for each firm: one before the M&A event and the other after the M&A event. A Chow test can be used to determine if there are statistically significant changes (Salin and Hooker 2001).

3. Data

M&A events in forest products industry were searched from major news service including PR Newswire, Business Newswire, the New York Times, Bizjournals and other major daily news outlets. Industry publications such as the *Pulp & Paper 2002 North American Fact Book* (Rudder 2002) were also used for reference. The date of event was defined as the first mention of the activity. Daily returns and S&P 500 index were collected from the Center for Research in Security Prices (*CRSP*). Total assets, return of assets were obtained from *COMPUSTAT* for each sample firm based on the fiscal year-end data preceding the event.

Initially a large number of M&A events were observed in the period between January 1, 1990, and December 31, 2004. According to the financial data availability several were dropped. In order to avoid clustering, another group of events that took place close in calendar with other events were also abandoned. Thus, the final sample comprised 57 events representing 50 unique participants, with 43 firms on the acquiring side and 41 firms on the target side³ (table1). In cross-sectional regression, some observations were dropped due to no disclosure of the transaction cost. All the values of transactions in the sample exceed US\$ 100 million. For risk analysis, 14 M&A events were chosen whose transaction costs are more than 1 billion US dollars. Risk 50, 100 and 150 days before and after the M&A event were compared respectively.

³ Particular firms may be observed more than once in the 57 M&As, such as International Paper.

No	Date	Acquiring side	Target side	Cost
1	3/1/1990	Georgia-Pacific	Great Northern Nekoosa	3.8
2	7/17/1995	Kimberly-Clark	Scott Paper	9.4
3	10/11/1995	Sappi Ltd	Scott Paper (S.D. Warren)	1.6
4	2/1/1996	International Paper	Federal Paper Board	3.6
5	2/28/1996	Weyerhaeuser	Cavenham Forest Industries	0.5
6	3/6/1996	R-H timber	IP Timberlands LTD	0.905
7	4/3/1996	Noranda Forest	Pentair (Pointe Paper)	0.2
8	5/1/1996	Willamette Industries	Cavenham Forest Industries	1.6
9	6/1/1996	Georgia-Pacific	Domtar of Canada	0.35
10	8/7/1996	Plum Creek	Riverwood International	0.54
11	10/1/1996	Mead	Boise Cascade	0.65
12	12/18/1996	Alliance Forest Product	Kimberly-Clark	0.6
13	5/5/1997	James River	Fort Howard	3.4
14	6/1/1997	St. Laurent Paperboard	Chesapeake (kraft mill & 4 box plants)	0.508
15	7/9/1997	Consolidated Papers	Repap Enterprises (coated paper mill)	0.674
16	7/18/1997	Rock-Tenn	Waldorf (two boxboard mills)	0.414
17	8/1/1997	Wausau Paper Mills	Mosinee Paper	0.442
18	1/30/1998	Plainwell	Pope & Talbot (tissue business)	0.147
19	3/23/1998	Donohue	Champion International (newsprint mills)	0.45
20	3/31/1998	Georgia-Pacific	CeCorr	0.282
21	4/9/1998	International Paper	Weston Paper and Manufacturing	0.232
22	4/29/1998	Bowater	Avenor	2.47
23	5/6/1998	Jefferson Smurfit	Stone Container	6.45
24	6/10/1998	Graphic Packaging	Fort James (boxboard mill & packaging)	0.83
25	6/18/1998	International Paper	Mead (Zellerbach distribution)	0.263
26	9/21/1998	Abitibi Consolidated	Stone Container (newsprint mill)	0.25
27	9/30/1998	Weyerhaeuser	Bowater (uncoated free-sheet mill)	0.52
28	2/13/1999	Chesapeake	Field Group	0.355
29	3/16/1999	International Paper	Union Camp	7.9
30	4/1/1999	Caraustar Industries	International Paper (boxboard mill)	0.108
31	4/27/1999	ACX Technologies Inc.	Fort James (paperboard packaging)	0.83
32	5/25/1999	Georgia-Pacific	Unisource Worldwide (paper distribution)	1.24

Table 1. The announcement dates, parties, and transaction payments for the major mergers and acquisitions in the U.S. forest products industry from 1990 to 2004

No.	Date	Acquiring side	Target side	Cost
33	6/26/1999	Georgia-Pacific	Chesapeake (Wisconsin tissue mills)	0.73
34	7/1/1999	Weyerhaeuser	MacMillan Bloedel	2.45
35	8/18/1999	Sonoco Products	Graphic Packaging (flexible packaging)	0.105
36	8/24/1999	Rayonier	Smurfit-Stone Container (timberlands)	0.725
37	10/4/1999	Westvaco	Temple Inland (bleached board mill)	0.625
38	11/29/1999	Westvaco	Mebane Packaging	0.2
39	2/11/2000	Abitibi Consolidated	Donohue	4.9
40	2/22/2000	Stora Enso	Consolidated Papers	4.8
41	4/25/2000	International Paper	Champion International	9.6
42	7/18/2000	Plum Creek	Georgia-Pacific (Timber Co.)	4
43	8/30/2000	UPM Kymmene	Repap Enterprises	0.911
44	10/13/2000	Georgia-Pacific	Fort James	11
45	2/21/2001	Sweden's SCA	Georgia-Pacific (tissue division)	1.6
46	4/2/2001	Bowater	Alliance Forest Products	0.77
47	4/18/2001	FiberMark	Rexam Decorative Speciatis International	0.14
48	6/4/2001	Domtar	Georgia-Pacific (four paper mills)	1.65
49	7/5/2001	Premdor	Masonite	2.5
50	8/3/2001	Premdor	International Paper (wood panel division)	0.5
51	8/15/2001	Georgia-Pacific	Plum Creek Timber	4
52	8/29/2001	Westvaco	Mead	10
53	1/21/2002	Weyerhaeuser	Willamette Industries	7.8
54	5/13/2002	Sappi Ltd	Potlatch (coated papers business)	0.48
55	7/24/2002	Smurfit Stone	MeadWestvaco (container business)	0.375
56	8/14/2002	Bain Capital Inc	Georgia-Pacific (Unisource Worldwide)	0.825
57	4/21/2004	International Paper	Box USA	0.4

Table 1. The announcement dates, parties, and transaction payments for the major mergers and acquisitions in the U.S. forest products industry from 1990 to 2004 (continued)

Unit: \$ billion for transaction costs.

Source: Compiled by the authors from various publications.

4. Empirical Results

4.1 Results from abnormal returns

The CAR_t for the 84 observations as a group and the test for significance of the effect were presented in Table 2. The results indicated that the $\overline{CAR_t}$ s to the firms involved in M&A announcements were positive and significant at the 5% level at the end of the 15-day event window. The $\overline{CAR_t}$ s at the end of 21-day event window and 31-day event window were significantly positive at the 1% level as well. Thus, we should reject the null hypothesis that the aggregated abnormal return for the entire sample of firms during the event period equaled zero except for the 7-day event window. The sign tests were consistent with our results.

Event window	Average cumulative abnormal returns	z statistic	Sign test(θ)
	All observations $(N = 84)$		
7 days: (-3, 3)	1.9%	1.19	0.87
15 days: (-7, 7)	5.2%	2.20^{b}	2.62^{a}
21 days: (-10, 10)	12.1%	4.36 ^a	2.74 ^a
31 days: (-15, 15)	17.9%	5.32 ^a	3.93 ^a
	Acquiring side $(N = 43)$		
7 days: (-3, 3)	1.0%	0.69	0.46
15 days: (-7, 7)	0.1%	0.03	0.15
21 days: (-10, 10)	0.2%	0.04	0.15
31 days: (-15, 15)	0.9%	0.16	0.15
	Target side $(N = 41)$		
7 days: (-3, 3)	2.9%	1.53	0.78
15 days: (-7, 7)	10.5%	3.83 ^a	3.59 ^a
21 days: (-10, 10)	24.6%	7.63 ^a	4.53 ^a
31 days: (-15, 15)	35.8%	9.14 ^a	5.47 ^a

Table 2. The average cumulative abnormal returns for N observations as a group over an event window for the selected M&A events in the forest products industry from 1990 to 2004

Note: The *z* value reported is from the 2-tailed test; ^a significant at the 1% level; ^b significant at the 5% level.

For the 43 observations on the acquiring side as a sub-group, the CAR_t s at the end of the event windows were slightly positive. However, none of the $\overline{CAR_t}$ s from the four event windows was significantly different from zero at the 5% level. The sign tests showed the same results. We could not reject the null hypothesis that the aggregated abnormal return for the acquiring firms during the event period equaled zero. Our results were consistent with former studies about M&A (Dodd 1980; Halpern 1983; Choi and Russell 2004).

For the 41 observations on the target side as another sub-group, the \overline{CAR}_t at the end of the event windows were significantly positive at 1% level except for the 7-day window. The sign tests showed similar results. We should reject the null hypothesis that the aggregated abnormal return for the target firms during the event period equaled zero. Our results were consistent with former studies about M&A (Halpern 1983).

Overall, capital market reacted positively to M&A in U.S. forest products industry as a whole, leading to a significant enhancement of the firms' market value. Considering the results of acquiring firms, the evidence appeared to be broadly consistent with value maximization strategies. First, in many of the M&A the acquiring firm had already had some share ownership of the target firm. Any gains from the merger may had already been reflected in the acquiring firm's stock price when the prior share ownership was obtained; hence non-positive gains in the current merger could still be consistent with value maximizing merger theories. Second, if the target firm was very small relative to the bidder, which was most the case in our study, the impact on the abnormal performance of the latter of a profitable merger may be swamped by random noise over the measurement period. Yet, target firms experienced positive response from the capital market during the period of M&A announcements in U.S. forest products industry. That was possibly because the target firms' shareholders had been given an enticement

to accept the acquisition, so they earned abnormal returns regardless of the motivation for the acquisition.

4.2 Results from cross-sectional regression

The performance of M&A transactions was a set of complex matrices that consisted of various factors. In implementing M&A transactions, there was no single important factor with respect to achieving the best performance. Rather, multiple factors in general were intercorrelated, and the existence of one factor may result in different outcomes. Thus, the outcomes obtained from the examination of several factors simultaneously will benefit future M&A leaders in the forest products industry.

Table 3 reported the OLS regression results for four event window CAR measurements. The status of the company in the M&A transaction was the factor that contributed most to explaining the variations of the CAR except for 7-day event window. This was consistent with previous abnormal return analysis. The negative sign proved our results in the analysis of the abnormal returns that the stock market responses more positively to the target firms than the acquiring firms. The coefficients of return of assets were negative for each event window, yet none of them was significantly different from zero. The relative transaction size was not significant except for 7-day event window. The coefficients of scale were positive for 7-day and 15-day event window, while negative for 21-day and 31-day event window, but not significant either.

Given the complication of these M&A events and the equity market, the model had a relatively good fit. For 7-day, 15-day, 21-day, and 31-day event windows, the R^2 ranged from 0.082 to 0.484, while the value around 0.10 was reported in previous studies (Asquith, et al. 1983). The *F*-statistics were also significant at the 5% level for 7-day event window and significant at the 1% level for the other three event windows.

4.3 Results from risk analysis

By comparing beta 50 days prior and after the M&A event, 2 out of the 14 observations in our study had experienced significant risk changes at the 5% level, and 3 significant at the

	7-day CAR		15-day CAR		21-day CAR		31-day CAR	
	Coeff.	<i>t</i> -value	Coeff.	<i>t</i> -value	Coeff.	<i>t</i> -value	Coeff.	<i>t</i> -value
Constant	-0.017	-0.55	0.110^{a}	3.01	0.322 ^a	6.79	0.412 ^a	6.46
ROA	-0.001	-0.55	-0.001	-0.41	-0.002	-0.56	-0.005	-0.81
Ln (SOT)	0.014^{a}	2.71	0.008	1.22	-0.010	-1.17	-0.009	-0.45
Scale	0.045	1.65	0.001	0.12	-0.063	-1.47	-0.041	-0.71
BS	-0.020	-0.99	-0.122 ^a	-5.01	-0.264 ^a	-8.38	-0.352 ^a	-8.33
Adj. R^2	0.082		0.257		0.479		0.484	
F-statistic	2.83 ^b		8.07^{a}		19.82 ^a		20.21 ^a	
Obs. No.	83		83		83		83	

Table 3. Results from the cross-sectional regressions of cumulative abnormal returns on the characteristics of selected firms by different event windows

Note: ^a significant at the 1% level; ^b significant at the 5% level; ^c significant at the 10% level.

Voor	Acquiring firm	Days	prior to e	vent	Days after event		
I Cal		50	100	150	50	100	150
1995	Kimberly Clark	0.993	0.935	0.936	1.681	0.750	0.544
1996	International Paper	0.294	0.988	1.168	0.200	0.422	0.467
1997	James River	0.829	0.745	0.575	1.160	0.730	0.888
1998	Jefferson Smurfit	0.293	1.061	1.075	1.542 ^b	1.505	1.400
1999	International Paper	1.000	0.284	0.617	-0.055	-0.291	0.074^{b}
1999	Georgia Pacific	0.357	0.434	0.447	-1.431 ^c	-0.249	0.127
2000	International Paper	1.013	0.973	0.900	0.024 ^c	0.084^{b}	0.199 ^b
2000	Georgia Pacific	0.392	0.371	0.532	0.568	0.706	0.730
2000	Weyerhaeuser	0.358	0.379	0.469	0.201	0.460	0.345
2000	Plum Creek	0.035	0.225	0.236	0.179	0.123	0.247
2001	Georgia Pacific	0.612	0.726	0.770	1.357 ^b	1.302 ^a	1.266 ^c
2001	Domtar	0.600	0.339	0.341	1.960	0.687	0.647
2002	Weyerhaeuser	0.821	1.113	1.045	0.915	0.823^{b}	0.820
2002	Westvaco	0.736	0.812	0.721	1.418 ^c	1.328 ^b	1.196 ^b

Table 4. A comparison of firms' risk and beta values before and after the M&A event using the Capital Asset Pricing Model and Chow test

Note: ^a significant at the 1% level; ^b significant at the 5% level; ^c significant at the 10% level.

10% level. For 100 days prior and after M&A event, 3 out of 14 had risk changed significantly at the 5% level, and 1 significant at the 10% level. For 150 days prior and after the M&A event, also 3 out of 14 had risk changed significantly at the 5% level, and 1 significant at the 10% level (Table 4). Overall, the risk for most of the forest products firms under consideration had not changed much after the M&A events, especially in the short run. Part of the reasons might be that these individual firms have been large and mature.

5. Conclusions

The M&A trends have maintained in the forest products industry in the last few years. This study examined the response of the stock market to these M&A events and the relationship between the stock market response and the characteristics of the M&A observations by event analysis. The results suggested that these M&A events were associated with significant increases in market valuation of firms and, at least temporarily, created value for the firms' stockholders. This, therefore, indicated a perception among investors that M&A initiatives announced were likely to be associated with future benefit streams for firms. Yet, it should also be noted that the analyses in this study focused on the average cumulative abnormal returns on these selected firms as a group. It is always possible that an individual firm might lose its value because of the M&A event involved.

It could be concluded from the cross-sectional regressions that the relative transaction size and the firm's position in the M&A are significantly positive-related to *CAR* measurements. Considering the complex structure of the equity market, other factors beyond the specification in this study may be worthy of more analysis in the future. In addition, the risk analysis for the acquiring firms in the selected 14 M&A events revealed that the risk for most of them had experienced limited changes after the M&A events.

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Recent Mergers and Acquisitions of Vertically-Integrated, American Forest

Products Companies: Has Shareholder Value Been Created?

Tony Cascio¹

Abstract

Event study methodology was used to test the null hypothesis of no shareholder value creation from the mergers and acquisitions of nine vertically-integrated American forest products companies within the last ten years. The concept of market efficiency dictates that the reaction of financial markets to new information should be both quick and lasting. Short-term event study methodology tests the first characteristic, while long-term event study methodology can be used to test the latter. A net creation of \$4.7B of market value upon the announcement of the nine mergers and acquisitions was identified by the use of short-term event study methodology. Seven of the nine combinations displayed a creation of value. When the results are viewed separately for shareholders of the target and acquiring firms, we found that target firms enjoyed a statistically significant, nearly 15% average return attributable to the merger announcements. The returns to acquiring firms averaged a statistically insignificant 0.34%. In the aggregate, the return for this sample of firms was a statistically significant 7.66%. These results are consistent with the findings from previous research on merger and acquisition announcements. The calendar-time portfolio approach was used to estimate long-term post merger performance. Three year mean abnormal returns of -5.11% and -10.93% were found, when benchmarking performance based on firm size and risk, respectively. For both of these benchmarks, the abnormal returns were strongly insignificant. These findings are both consistent with previous research, and in keeping with the tenets of market efficiency.

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A Rationale for Risk Management in Forest Businesses

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Abstract

Hedging activities are designed to reduce the volatility of firm value or cash flows. The largest publicly-traded forest corporations make extensive use of hedging, including insurance and derivative contracts. In 2002 alone, 17 of the 19 largest publicly-traded forest industry firms utilized financial derivatives with a notional value exceeding \$8.2 billion. Are forest industry corporations risk-averse? Why do these firms expend resources to reduce risk? Risk is costly to firms because of the indirect effects on shareholder income. These effects are realized principally through financial distress costs, taxes, managerial compensation programs, agency costs, the crowding out of promising investments, and the comparative advantage of providing real services. This research details examples of each in the forest products industry and discusses potential opportunities to expand and to reduce the use of financial contracts in the forestry sector.

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West Virginia Forest Landowners: A Look at Their Characteristics and Forest Management Decision

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Abstract

Nonindustrial private forest (NIPF) landowners play an important role in sustaining the hardwood resources of West Virginia since they control the majority of the state's timberland base. No comprehensive description of the state's NIPF landowners has been done since the 70s. An updated and comprehensive survey is needed to have a better understanding of West Virginia's private forest landowners and timberland resource base. Thus, a survey of West Virginia forest landowners in the fall of 2005 was conducted to characterize the state's NIPF landowners and their forest lands and to provide an insight into their forest management decisions. Preliminary results of the survey indicate that aesthetic enjoyment and place of residence were the two most important reasons for forestland ownership. Most landowners are not actively managing their forestland. Less than 13% of the respondents have conducted any type of forest management plan. Landowner participation in educational and forestry assistance programs has been minimal with only 3% attending educational programs; less than 20% were aware of the forestry assistance/incentive programs, and only 25% of those aware had ever used any of the programs.

Key words: NIPF landowners, landowner survey, Appalachian hardwoods, landowner characteristics.

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1. Introduction

West Virginia is the third most heavily forested state in the United States with 12 million acres of forestland, which is approximately 78% of the state's total land area (Childs, 2005). West Virginia is also the second leading hardwood state in the nation making it an important hardwood resource base. The contribution of wood-related industry to the state's economy cannot be overemphasized. For example, while employment in most of the other industries like mining, primary metals, stone-clay-and glass, and chemicals fell during the 1980 and 2004 period, employment rose from 6.5 thousand to 11.8 thousand for wood products and furniture industries in that same period (Childs, 2005). Eastern hardwoods will play an even more important role as Southern forests continue to have less intensive forms of management and low rates of growth of hardwood timber (Haynes, 2002).

In terms of forestland ownership, 76% of the state's forestland is owned by nonindustrial private forest (NIPF) landowners (Birch, 1996). Due to this significant proportion of ownership, actions of this landowner group will have a significant impact on the availability of hardwood to the state and to the nation as a whole. Many studies have been carried out linking NIPF landowner characteristics with their forest management decisions (e.g., Greene & Blatner, 1986; Romm et al., 1987; Kuuluvainen et al., 1996; Conway et al., 2003; Elwood et al., 2003). Even though NIPF landowner characteristics have been a topic of extensive studies in other regions, there is very little information about the NIPF owners in the Eastern U.S., and more so in West Virginia. There have been few studies on characterizing landowners' participation in Forest Stewardship Program and evaluating the effectiveness of this program in the state (e.g., Magill, 2003; Jennings et al., 2003; Egan et al., 2001). A detailed study on the characteristics and the management decisions of NIPF landowners in West Virginia have not been conducted since 1978 (Birch and Kingsley). A comprehensive survey of NIPF landowners was thus needed to have a better understanding of the state's NIPF landowners' characteristics and their forest management decisions. This paper presents preliminary findings of a statewide survey carried out in the fall of 2005. The study was conducted to characterize the state's NIPF landowners and their forestlands and to provide an insight into their forest management decisions.

2. Methods

The study population was made up of nonindustrial private landowners of West Virginia. Since we intended to characterize all NIPF landowners of the state regardless of ownership size, the study population included all landowners irrespective of the size of their landholdings.

The data for the study was collected from a mail survey conducted in the fall of 2005 to 2,100 randomly selected NIPF landowners. Names and addresses of landowners were obtained from the State Tax Assessor's Office. Dillman's (2000) Tailored Design Method was used to design the survey. A total of three mailings (i.e., initial mailing and two follow up mailings) were sent in order to increase the number of responses.

The survey instrument was developed with the aim of collecting comprehensive statewide information on NIPF landowners' characteristics and behavior towards forest management. The survey was divided into six sections: 1.) property information (i.e., ownership size, forest composition, time of parcel acquisition, mode of parcel acquisition, and residence information); 2.) landowner objectives; 3.) forest management and investment (i.e., who manages the forestland, preparation of forest management plan, effect of tax on their management decisions, estimates of their forestland and timber value, perceived risks in timber

management, problems typically encountered by owners in their forestland property, and forest management activities); 4.) harvesting and sale (i.e., timber harvest information, reasons for harvesting, use of assistance from professional foresters during the harvest, reasons for not harvesting, and plans for future harvest); 5.) use of forestry assistance/incentive and educational programs; and 6.) demographics (i.e., membership to forestry-related organization, age, gender, ethnic background, education, profession, and annual household income). Data from completed questionnaires were entered and compiled in MS Excel. Summary statistics were computed for the variables collected in the survey using SAS.

3. Results

3.1 Survey Response Rate

Of the 2,100 questionnaires that were initially mailed out, about 216 were returned due to undeliverable addresses and deceased landowners. Moreover, about 611 questionnaires were returned either because the landowners did not own any timberland property in West Virginia or have already sold their timberland property at the time of the survey. Thus, the effective sample size was reduced to 1,273. The survey resulted in 244 usable responses or 19% response rate.

3.2 Property Information

Majority of the respondents (55%) owned a single parcel of forestland (Figure 1). However, there are also a few (2%) who owned over 100 parcels. Hardwood forest was the dominant forest type, averaging approximately 3,455 acres (Table 1). Although pine forest type was the second largest forest type reported by the respondents, it only averaged 271 acres. The average ownership size was approximately 4,114 acres with a median of 43 acres. Majority of the respondents (78%) acquired their first forest property between 1950 and 1999 (Figure 2). Over 20% of the respondents have acquired their first forestland property in the last 5 years.



Figure 1. Distribution of NIPF respondents by number of parcels of forestland owned, West Virginia, 2005.

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Forest Type	Mean	Std Dev	Minimum	Maximum	Median	Range
Hardwood Forest	3,454.82	28,796	0	341,250	20	341,250
Pine Forest	270.92	2,803	0	30,000	0	30,000
Mixed Forest	244.24	3,310	0	50,000	0.25	50,000
Others	247.54	3,360	0	50,500	0	50,500
Total Forest	4,113.86	35,175	0.5	375,000	43	375,000

Table1. Forest ownership size (in acres) according to forest type of the NIPF respondents in West Virginia, 2005.

*Forest type acres do not add up to total acres reported because some landowners did not report breakdown of ownership by forest type.

Most of the timberland properties were acquired through purchase (69.67%). About 23% of the landowners had gained ownership through inheritance and 4.51% as gift (Figure 3). While majority of the landowners (76%) have still retained their first forestland acquisition, the results also indicate that there have been changes in forest acreages among landowners in West Virginia (Figure 4). About 24% of the landowners have had changes in the size of their forestland ownership. Of these landowners, 45% had acquired more forest acreage through the years by buying more properties (Figure 5). However, majority of the landowners (55%) had fewer acreage now compared to the time when they first acquired their forestland. These landowners



Figure 2. Distribution of NIPF respondents by year of first forest parcel acquisition, West Virginia, 2005.



Figure 3. Mode of forestland acquisition by NIPF respondents in West Virginia, 2005.



Yes 24% No 76%

Figure 4. Change in forestland ownership of NIPF respondents since initial acquisition, West Virginia, 2005.

Figure 5. Direction of change in forest ownership size among NIPF landowners in West Virginia, 2005.

have either sold their property, have built homes on the property, or have bequeathed their property.

Majority (80%) of the NIPF landowners reside in West Virginia while 19% of the landowners were absentee landowners (Figure 6). Absentee landowners were mostly from adjoining states (e.g., Maryland, Kentucky, Ohio, Pennsylvania, Virginia) but there were also a few landowners who live in other states such as Florida and California.



Figure 6. Distribution of NIPF respondents by place 0f residence, West Virginia, 2005.

3.3 Landowner Objectives

Landowners were presented with 9 possible reasons for owning their forestland: timber for sale, wood for personal use, wildlife, recreation, aesthetics, residence, land investment, water quality, and non-timber forest products (NTFPs). They were then asked to rank these objectives by level of importance. Aesthetics ranked the highest as a reason for owning forestland among the respondents, followed closely by residence, recreation, and wildlife (Table 2). Land

Objectives	Very Important (%)	Important (%)	Not very important (%)	Not at all Important (%)	Total (%)
1. Timber	17.43	12.84	14.22	55.50	100.00
2. Wood	14.69	16.11	21.80	47.39	100.00
3. Wildlife	40.00	20.91	12.27	26.82	100.00
4. Recreation	43.46	23.83	12.62	20.09	100.00
5. Aesthetics	47.06	18.14	12.25	22.55	100.00
6. Residence	44.55	14.22	9.00	32.23	100.00
7. Land Investment	30.70	21.86	20.00	27.44	100.00
8. Water Quality	26.96	24.02	13.24	35.78	100.00
9. NTFPs	4.37	10.19	11.65	73.79	100.00

Table 2. The relative importance of reasons for owning a forestland for NIPF respondents, West Virginia, 2005.

investment and water quality were also perceived to be more important reasons than timber for sale. Timber for sale and wood for personal use only ranked 6th and 7th, respectively. Non-timber forest products were perceived to be the least important reason for forestland ownership.

3.4 Forest Management and Investment

Majority (71.72%) of the respondents managed their forestland on their own while 17% had no one to manage their forestland (Figure 7). Only about 8% of the respondents had sought

the help of professional foresters. Of these landowners, majority sought the help of consulting foresters. With respect to landowners having a written forest management plan, majority of the landowners (88%) did not have a written forest management plan (Figure 8). Of the landowners



Figure 7. Distribution of the respondents according to the manager of the forestland, West Virginia, 2005.



Figure 8. Percentage of NIPF respondents with a written forest management plan, West Virginia, 2005.

who had a written forest management plan, 71% confirmed of following the prescribed treatments in the management plan. Of those without a management plan, 45% were interested in having a written forest management plan for their property (Figure 9).



Figure 9. Percentage of NIPF respondents interested in having a written forest management plan, West Virginia, 2005.

Respondents were also asked how taxes affected their forest management decisions. Over half of the respondents (66%) responded that taxes have no influence in their forest management decisions (Table 3). For some landowners, taxes did have an influence in their decision to manage their forestland. For example, 17% of the respondents said that taxes promoted harvesting mature timber while 14% of these landowners thought taxes made them think about selling the property and promoted forest management activities. Of the various tax programs available, property tax was considered by the respondents to have the most effect on the management and use of their timberland property (Figure 10).

Effect of taxes	Yes (%)	No (%)	Total (%)
Promote harvesting of mature timber	16.74	83.26	100.00
Promote timber harvesting regardless of whether the timber is mature or not		98.28	100.00
Make me think about selling the property		86.27	100.00
Promote conservation of the property to other land uses (agriculture, real estate, etc.)	7.73	92.27	100.00
Promote forest management activities		86.27	100.00
Promote subdivision of the property into smaller tracts		94.42	100.00
Discourage investments in forest management activities		94.42	100.00
Have no influence whatsoever		34.33	100.00
Others	1.72	98.28	100.00

Table 3. Perceived effect of taxes on the management and use of the forestland by NIPF respondents, West Virginia, 2005.



Figure 10. Distribution of NIPF respondents by tax programs affecting forest management decisions, West Virginia, 2005.

Landowners were also asked whether they have had their forestland and timber appraised. This was done to determine whether landowners have any idea of what their land and timber are worth. The results of the survey indicate that only 8% of the respondents have had their forestland value appraised (Figure 11). In terms of timber value, only 9% of the respondents have had appraisals done (Figure 12). Around 25% of the landowners who had not appraised their timber interested in having their timber appraised were (Figure 13).



Figure 11. Percentage of NIPF respondents who have had their forestland appraised, West Virginia, 2005.



Figure 12. Percentage of NIPF respondents who have had their timber appraised, West Virginia, 2005.

In terms of the landowners' perception about the risks involved in timberland investment relative to other investment alternatives (e.g., Savings account, Stocks, Bonds), the majority (71%) did not think of timberland investment as more risky compared to other alternatives (Figure 14). Only 15% of the respondents perceived timberland investment as a more risky investment alternative.



Figure 13. Percentage of NIPF respondents interested in having their timber appraised, West Virginia, 2005.



Figure 14. NIPF respondents' perception of timberland investment as riskier than other potential investments (e.g., bank savings account, certificate of deposit, stocks, bonds, mutual funds), West Virginia, 2005.

Typical problems encountered by landowners in their forest property were also looked at. The most common problems reported by landowners were trespassing, poaching, trash dumping, and deer (Figure 15).



Figure 15. Problems encountered by the NIPF respondents in their forestland, West Virginia, 2005.

Respondents were also presented with a list of forest management activities (i.e., timber harvesting, tree planting, herbicide application, fertilization, thinning, road construction or

maintenance, survey, access control, grapevine control, timber stand improvement, wildlife habitat improvement, recreation improvement, and other activities) and were asked to report which of these activities they have carried out in their forestland in the previous year. Less than 13% of the respondents have conducted any type of forest management activity in 2004. Road maintenance, timber harvesting, wildlife habitat improvement, and recreation improvement were among the most practiced activities (Figure 16).



Figure 16. Forest management activities carried out by NIPF respondents, West Virginia, 2005.

3.5 Harvest and Sale

Only 21% of the respondents had harvested timber within the past five years (Figure 17). The major reasons identified by the respondents for timber harvesting were: to remove mature timber, to improve the quality of the remaining trees, to take advantage of good timber prices, and to salvage the value of timber or timber products that were damaged. In terms of the reasons for not harvesting, majority of landowners (48.46%) indicated that they were simply uninterested (Figure 18). Other reasons for not harvesting included the lack of knowledge on how to sell, timber was not mature enough, or timber prices were too low.



Figure 17. Distribution of NIPF respondents who harvested timber between 2000-2004, West Virginia



Figure 18. Reasons of NIPF respondents for not harvesting timber, West Virginia, 2005.

Landowners who were not interested in harvesting were asked whether they have any plan to harvest in the future. The majority (52%) said that they have no plan to harvest (Figure 19). However, approximately 34% are considering harvesting in the future.



Figure 19. Future timber harvest plans of NIPF respondents, West Virginia, 2005.

3.6 Use of Forestry Assistance/Incentive and Educational Programs

The results of the survey indicate that NIPF respondents have low level of awareness about the forestry assistance or incentive and educational programs that are available to them. Only 18% of the respondents were aware of one or more of such programs (Figure 20) and only 25% of those respondents actually used any of these programs (Figure 21). The forest stewardship program was the most common program used by the respondents. Other programs that were utilized include the Conservation Reserve Program, Forestland Enhancement Program and Timberland Tax Incentive Program. In terms of attendance in educational programs, an even smaller percentage (3%) of the respondents attended educational programs offered by the different organizations in the state (e.g., West Virginia University Extension Service, USDA Forest Service, West Virginia Forestry Association, West Virginia Division of Forestry) (Figure 22).



Figure 20. Distribution of NIPF respondents who were aware about existing forestry assistance/incentive programs, West Virginia, 2005.



Figure 22. Distribution of NIPF respondents who have attended forestry educational programs, West Virginia, 2005.

3.7 Demographics

The study also collected demographic characteristics of the survey respondents. Around 6% of the respondents were members of forestry-related organizations (Figure 23). Majority of NIPF landowners were male (81%) (Figure 24). The average age of the respondents was 59 years (Figure 25) and most of them were high school graduates and above (Figure 26), and Caucasian (94%) (Figure 27). Majority of the forestland owners were either professionals (39%) or retired people (31%), while farmers comprised only about 3% of the respondents (Figure 28). Most (47%) of the respondents were from the middle income group (i.e., between \$20,000 and 60,000 per year) while there were about 25% of the respondents in the higher income (i.e., above \$100,000) (Figure 29).



Figure 21. Distribution of NIPF respondents who used one or more forestry assistance/incentive programs, West Virginia, 2005.



Figure 23. Membership of NIPF respondents in forestry-related organizations, West Virginia 2005.



Figure 24. Distribution of NIPF respondents by gender, West Virginia, 2005.



Figure 25. Distribution of NIPF respondents by age, West Virginia, 2005.



Figure 26. Distribution of NIPF respondents by educational level, West Virginia, 2005



Figure 27. Distribution of NIPF respondents by ethnic background, West Virginia, 2005.



Figure 28. Distribution of NIPF respondents by occupation, West Virginia, 2005.



Figure 29. Distribution of NIPF respondents by annual household income, West Virginia, 2005.

4. Summary and Conclusion

This study presents the preliminary findings of a forest landowner survey carried out in the fall of 2005. The findings of the survey are important in providing a better understanding of the state's NIPF landowner characteristics and their forest management decisions. West Virginia NIPF landowners are similar in many aspects to their counterparts in other regions of the country.

The results of the survey showed that NIPF respondents consisted mainly of the small forest landholders with a median forestland ownership of 43 acres. Hardwood forest dominated the respondents' forest landholdings with more than 83% of the total forestland owned in hardwood forest. Thus, landowners in West Virginia have the potential to be an important source of hardwood resources not only for the state but for the nation as a whole.

Landowners in West Virginia own their forestland mainly for non-timber benefits (i.e., aesthetics, residence, recreation, wildlife, land investment, and water quality) rather than for timber production. This is not surprising as previous studies have also shown that NIPF landowners are placing greater emphasis on non-timber benefits over timber benefits of forest ownership (e.g., Haymond, 1988; Birch, 1996; Rickenbach et al., 1998; Erickson et al., 2002; Belin, 2005). The results also suggest that most landowners are not actively managing their forestland. Less than 13% of the respondents have conducted any type of forest management activity. This behavior is also true for landowners in other regions. For example, Arano and Munn (2006) also reported that NIPF landowners in Mississippi are not managing intensively. Even earlier studies on NIPF landowners have indicated how these landowners often managed less intensively (e.g., Adams et al., 1992; Kurtz et al., 1993; Alig and Adams et al., 1995). This behavior can be partly attributed to the small holdings owned by many of the landowners in the state. Approximately 97% of the respondents have forest holdings that are 100 acres or less. Landowners with smaller holdings tend to have limited management options (Conner and Hartsell, 2002) and managing smaller holdings may not be viewed as a practical undertaking for these landowners (Wicker, 2002).

Majority of the respondents managed their forestland on their own. Few respondents have sought the help of professional foresters. In addition, only 12% of the respondents had written management plan. This is typical of private forest landowners in the Northern United States (e.g., Birch 1997).

In terms of timber harvesting, only 21% of the landowners had harvested timber in the past five years. Although some landowners have expressed interest towards a future timber harvest, majority (52%) of them are still not interested. This lack of interest in timber harvesting coupled with less intensive forest management practices may have a critical impact on the overall hardwood supply in the state.

In order to encourage landowners to be more actively involved in managing their forestlands, the state offers several forestry assistance/incentive and educational programs to these landowners (e.g., Forest Stewardship Program, Forest Land Enhancement Program). However, the respondents indicated low level of awareness and participation in the various kinds of forestry assistance/incentive and educational programs that were being offered in the state. This does not present a very encouraging scenario as to the effectiveness of these programs in reaching their constituencies and poses a real challenge for the state to come up with more effective programs. A number of studies (e.g., Brunson et al., 1996; Bliss et al., 1997; Egan,

1997; Rickenbach et al., 1998; Belin et al., 2005) have suggested the need for a broader type of assistance package covering broad array of topics for forest management not just timber management in order to increase the interest of the NIPF landowners in attending the various forestry assistance/incentive and educational programs. Given that these landowners are not just interested in producing timber, such type of assistance package may attract more landowners.

In terms of demographic characteristics, West Virginia NIPF respondents also mirror their counterparts in other regions of the country. For example, majority of the NIPF respondents are male, Caucasian, of older age, highly educated, relatively well-off, and most live on or near their property. Such characteristics are similar in many aspects to those reported in other studies (e.g., Birch, 1996; Rickenbach et al., 1998; Belin et al., 2005).

This study presents preliminary information on West Virginia's landowner characteristics and management intentions. Such information is needed because effective private forestry programs rely on published behavior of these owners and descriptions of the conditions of their forest properties. However, further analysis on the relationship between their characteristics and their management decisions are needed to better understand them and their decision pattern.

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Alabama's Changing Family Forest Owners: 1994-2004

Yi Pan¹, Yaoqi Zhang

Brett J. Butler²

Abstract

Family forest owners in Alabama now control 67% of the State's forestland. The composition and characteristics of these family forest owners has changed substantially over the past decade and will continue to change. This paper examines the change of family forestland owners in the past decade in terms of age, income, education and management objective and management intensity.

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Forest Management Under Fire Risk When Carbon Sequestration has Value

Stephane Couture and Arnaud Reynaud

Abstract

In this paper, we develop a multiple forest use model to determine the optimal harvest date for a forest stand that produces both timber and carbon benefits under a risk of fire. The preferences of the representative non-industrial private forest owner are modelled though an expected utility specification. We introduce saving as a decision of the forest owner at anytime. The problems of forest management and saving decisions are simultaneously solved using a stochastic dynamic programming method. A numerical programming method developed is used to characterise optimal management policies over a grid of parameters. We apply this framework to model the behaviour of a representative forest owner located in the South-Western of France. The stopping methodology is used to determine the optimal rotation period. Numerical illustrations indicate that higher risk will decrease the optimal rotation period while higher carbon prices will increase the optimal harvesting age. We find that increased relative risk aversion accelerate the optimal length of the rotation period. Finally, the frontier of carbon price/risk space to maintain the same rotation age is shown to be affected by risk aversion.

Evaluating Planning Alternatives Concerning Financial Revenues, Carbon

Sequestration, and Potential Biofuel Production for Loblolly Pine Plantations

in East Texas

Drs. Ching-Hsun Huang and Gary D. Kronrad

Abstract

Global concern over increasing carbon dioxide (CO₂) concentrations in the atmosphere, which may lead to possible future climate changes, have generated interest in offsetting CO₂ emission by storing carbon in forests and utilizing forest biomass as renewable energy to replace fossil fuels with biofuels. Options for the sequestration of carbon and substitution of bioenergy for fossil fuels need to be examined from economic and biological perspectives. In order to provide useful and timely information concerning carbon sequestration and potential biofuel production, this study investigated loblolly pine and determined the financially optimal management regimes (maximizing land expectation value) and biologically optimal management regimes (maximizing mean annual increment), the amount of carbon stored in long-lived wood products, the available forest logging residue that can be used for biofuels, and their potential energy values. Results indicate that for average sites the biological optimum management regime would annually sequester 0.17 more tons of carbon in long-lived wood products and produce 0.23 more tons of biomass suitable for bioenergy production per acre (energy value of 2.93 GJ/ac/yr) than those of the financially optimal management regimes is \$20.80 per acre per year.

Supply of Electricity and CO₂ Displacement from Logging Residues

Jianbang Gan¹

Abstract

Timber harvest residues are a potential source of biomass that could be used for producing bioenergy and consequently displacing CO₂ emissions from burning fossil fuels. This study estimates the supply curves of electricity generated and CO₂ emissions displaced by substituting coal with logging residues in electricity generation. According to the 2002 Forest Inventory and Analysis data, approximately 35.5 dry million tonnes of logging residues could be recovered annually in the U.S., which could generate about 66 TWh of electricity and displace some 17 million tonnes of carbon. About 82% of the electricity could be produced at a cost of \$50/MWh or lower; nearly 80% of the carbon displacement could be achieved at less than \$70/t C. The South and Northeast regions would be most cost-competitive for such operations.

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The Timber Harvesting Behavior of Family Forest Owners in the Southeastern United States

Brett Butler¹

Abstract

Theoretical and empirical models were developed to increase our understanding of the timber harvesting behavior of family forest owners of the southeastern United States. Family forest owners were modeled as utility-maximizers who made harvesting decisions by balancing amenity and profit values. To test the theoretical model, data from forest inventories and landowner surveys conducted by the USDA Forest Service were used to estimate biophysical and socioeconomic variables. Separate logistic regression models were generated for all family forest owners and profit, multiple-objective, and amenity oriented groups. Stand structure variables, such as basal area and volume, were the most significant predictors of timber harvesting among the variables tested. Other significant variables were stumpage values, the importance of timber production as an ownership objective, and whether owners lived within one mile of their forestland. Softwood sawtimber stumpage value, whether owners lived within one mile of their forestland, their incomes, whether they had management plans, and whether their forestland was managed by a professional forester were significant variables in the harvesting model for the profit group. Basal area, softwood sawtimber stumpage value, the importance of timber production as an ownership objective, whether owners lived within one mile of their forestland, and slope were significant for the multiple-objective group model. For the amenity group model, softwood pulpwood stumpage value and owners' incomes were significant variables. The results of the models were aggregated and implications for the region's timber supply were assessed for different scenarios.

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Using Landowner Perception to Facilitate Forest Management on Private Lands: Experience Based Constructs from East Tennessee

Miriam L. E. Davis and J. Mark Fly

Abstract

Using examples taken from a case study of private forest landowners in East Tennessee, this session explores how landowners' personal experience of their forestland can inform professional practice relative to the private landowner population. By asking landowners about their direct personal experiences with forestland, and allowing them to describe those experiences in their own language, we allow them to reveal what is meaningful without the limits of preconceived notions or categories, as well as how they conceptualize these meanings. In so doing we open up avenues for dialogue between professionals and landowners by finding both shared and unshared understandings.

Using these methods in East Tennessee with landowners who are both actively and not actively managing ("non-participant") their forestland, themes describing how landowners experience their land reveal similarities and differences which can be used in professional practice with each population. For actively managing forest landowners the focus of their experience is on the land and its degree of naturalness. These landowners are keenly aware of the integrity with which resources are used and mis-used. For non-participant forest landowners the focus of their experience is on the self. These landowners are connected to their land primarily as a vehicle for connecting them with other people, with nature, and with special places. The details and benefits of examining how landowners experience their forestland will be discussed, as well as the implications of these and additional findings for professional practice.

NIPFs in the Southeast: Are They All the Same?

Indrajit Majumdar¹, Lawrence D. Teeter²

Brett J. Butler³

Abstract

The names used to describe the family forest owners have changed over time, but the inclination to treat/analyze them as a homogeneous class has been fairly common. This study characterizes the family forest owners in the three Southeastern states of Alabama, Georgia and South Carolina based on their feelings about forest stewardship and their stated reasons for owning forestland. Our study, using multivariate cluster analysis procedures, suggests that the family forest owner 'group' is in fact a diverse set of owners who can be grouped into three attitudinal types namely *multiple-objective, non-timber* and *timber* oriented. The *multiple-objective* ownership type was found to be the largest group (533 owners, 49.1%) with almost every 1 out of 2 family forest owners in the sample population belonging to this category. Owners belonging to the *timber* (319 owners, 29.4%) cluster had only timber management and land investment as strong motivating factors behind their forestland ownership, while owners belonging to the *non-timber* (233 owners, 21.5%) cluster value the non-consumptive uses of their forestland such as aesthetic values, biodiversity, recreation and privacy.

Keywords: family forest, cluster analysis, landowner motivation.

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Introduction

Forests and forestry have played a significant role in the economic development and psyche of the South. Forests, which in pre-settlement times occupied nearly all of the land area of the South, now occupy only 56 percent ((Economic Research Services of the USDA Forest Service 2002) <u>http://www.ers.usda.gov/Data/MajorLandUses/MLUsummarytables.pdf</u>). Also, the changing composition and use of these forests have important implications for their timber and non-timber outputs. Some of these changes have resulted from forest conversions to agriculture, and subsequent reversions back to forest (Healy 1985) and permanent conversions of forest to urban land. Other changes occurred as fiber demand increased over time and harvested lands were replanted with pines. More recent is the recognition that forests provide significant amenity and recreational values, which may lead to reductions in harvest by non-industrial private forest landowners (Lee 1997).

While forests provide both market and amenity outputs, these outputs are not necessarily complementary. The dominant market output is timber, the harvest of which often conflicts with production of high-quality amenity benefits. Thus, the values held by private landowners for amenities play a role in influencing private forest management by changing the harvest date or amount of timber produced from any given stand.

With the unprecedented recent growth in the number of private forest landowners there is an increased need to research and investigate the motives of these landowners to manage their land for timber and/or non-timber use. Three broad categories of ownership constitute what we consider private forestlands: family owned or individual owners, industrial ownership, and Timber Investment Management Organizations (TIMOs) or Real Estate Investment Trusts (REITs). While of these latter two are considered to be primarily in the business of forestland management for profit and invariably their management actions focus on timber harvests, the objectives of the former, individual forest land owners, still remain largely unknown. The individual and family forest landowners hold 42% of the nation's timberland (261.6 million acres) and 59% (127.6 million acres) in the South (Butler and Leatherberry, 2004). Given their numbers it is important to study their diverse objectives, goals and intentions for managing their lands for timber and/or non-timber purposes.

Substantial research has been done over the past few decades focusing mainly on ways to motivate the family forest landowners to practice active forest management to boost timber supply. The relationship between harvesting decisions and the characteristics of landowners (Binkley 1981) has been the focus of most studies on private forest management behavior. Pattanayak et al. (2002) reported that timber supply is a function of the endogenous distribution of forest inventory which is correlated with ownership type and management characteristics. However, the relationship between forest amenity characteristics and private forest harvest has not been well established. One feature of all of the studies, with some exceptions (Finley et al. 2006; Butler 2005; Kluender and Walkingstick 2000; Finley 2002; Green and Blatner 1986; Gramann et al. 1985; Young and Reichenbach 1987) is to consider individual private landowners as a homogeneous, single group with similar motivations. In reality, the validity of this assumption is questionable.

This article tests the hypothesis that family forest landowners form a heterogeneous group with differing motivations and goals for forest management, and that even when they face the same market environment their actions differ.

Literature Review

Using data from a survey of 146 Finnish landowners in Southern Finland, Kuuluvainen (1996) employed K-means cluster analysis to empirically identify four groups of non-industrial private forest landowners (NIPFs) based on their objectives as *multiobjective owners*, *self-employed owners*, *recreationists* and *investors*. Lewis (1979) and Kurtz and Lewis (1981) utilized Q-methodology to construct a taxonomy of family forest owners in the USDA Forest Service Eastern Ozarks region of Missouri and identified four attitudinal types which were identified and described as *timber Agriculturists*, *timber conservationists*, *forest environmentalists* and *range pragmatists*.

More recently, a survey of and subsequent cluster analysis of 866 family forest owners in Arkansas identified four distinct groups of family forest owners: *timber managers, resident conservationists, affluent weekenders* and *poor rural residents* (Kluender and Walkingstick 2000).

Kittredge (2004) suggests that market segmentation may provide a superior approach to outreach compared with the traditional methods that assumed a single more homogeneous group of family forest owners. Market segmentation allows the audience to be broken down into relatively homogeneous similar classes, and the needs and desires of each class can then be ascertained. With the ownership class identified, certain groups can be chosen as priority targets for specific outreach programs. For example, Broderick et al. (1996) grouped family forest owners in Connecticut based on their intentions concerning forest stewardship planning. The groups consisted of those who intended to sell their land (*sellers*), those who had a stewardship plan or had protected their land (*planners*), those who intended to develop a stewardship plan (*intenders*), and those who showed little inclination towards stewardship planning (*non-intenders*). Finley et al. (2006) used segmentation analysis to delineate the private forest owners in Massachusetts into four segments and named them as *general cooperators, conservation cooperators, neutralists* and *non-cooperators*. Each of the segments represented distinct levels of interest of the private forest owners within a segment to cooperate for certain forest activities with other owners outside the boundary of their individual forest property.

Kendra and Hull (2005) used cluster analysis to group family forest owners who had recently purchased forestland in rapidly growing counties in Virginia. In this case, the typology was based solely on the owners' responses to survey items measuring forest ownership motivations. The resulting six types were then described on the basis of demographic, land ownership and management characteristics and labeled as *absentee investors, professionals, preservationists, young families, forest planners,* and *farmers.* This study serves as a very recent example of a typology of family forest owners for which the classification was based on purely psychological variables. Though this study is significant in exploring the motivations of new owners and their reasons for acquiring forestland it fails to validate the results due to the absence of data on any of the past actions of the owners and as such the connection between landowner attitudes and their probable management actions in the future could not be made. Summarizing this section on the review of past studies, we see a lot of variation regarding their motivations and the management strategies they employ. Emphasizing the diversity of family forest owners in the South, Wicker (2002) stated, "available research information is insufficient to define an average private southern forest landowner."

Landowner Model

A typical rational forest landowner is assumed to maximize his utility from his forest holding by equating his preferences for timber and non-timber values to the total capacity of the land to provide these two benefits given resource and budget constraints. Based on Vincent and Binkley's (1993) model for a single stand, the optimal point where the landowner will maximize his utility depends on the interplay of the production trade-offs (the combinations of timber and non-timber units that the stand can produce) and the consumption (psychic) trade-offs which are determined by the landowners' perception of the relative value of timber and non-timber products of the forest. Binkley argues that for a single stand, unless the relative price line is either 'too' steep or 'too' flat, the multiple use option is always superior and rejects the possibility of a corner solution where the landowner chooses either to produce *only* timber or only non-timber. We support Vincent's and Binkley's argument that the most plausible option for family forest landowners in general is to practice multiple-use forest management in absolute terms. We argue, however, that based on the psychic price (value) that individual landowners' perceive from non-timber benefits, which typically do not have any market price, the slope of the relative price (value) line can differ to such a degree that it may be possible to group/classify landowners' based on their motivation to manage for either *mainly* timber or *mainly* non-timber or both.

To illustrate our point consider three family forest landowners' A, B and C who own single forest stands where each stand can produce two products, timber (T) and Non-timber (NT). We assume a strictly concave production possibilities frontier (PPF) for each of the three landowners consistent with the usual microeconomic assumption of increasing opportunity costs as one produces more units of a product (see Figure 1). The landowners maximize their utility at the tangential point between the PPF and the relative price (value) line such that landowner A produces A_T and A_{NT} , landowner B produces B_T and B_{NT} and Landowner C produces C_T and C_{NT} quantities of timber and non-timber (Figure 1). The object of this paper is to test the validity of the existence of similar family forest landowner groups in the Southeast as represented by landowners A, B or C using multivariate statistical techniques.



Figure 1 Landowner Behavior Model

Data and Methods

This study is based on an analysis of National Woodland Owner Survey (NWOS) data on the family forest owners in three Southern states: South Carolina, Georgia and Alabama. NWOS is conducted under the Forest Inventory and Analysis (FIA) program of the United States Department of Agriculture (USDA) Forest Service (USFS). The data used in this study was collected during the period 2002-2004.

The NWOS used a self-administered questionnaire distributed to family forest owners by the U.S. Postal Service as the primary survey instrument with telephone interviews conducted sometimes to augment response rates (Butler et al 2005). The questionnaire included 30 questions concerning:

- Forest land characteristics
- Ownership objectives
- Forest use
- Forest management
- Sources of information
- Concerns and issues
- Demographics

The questions in the survey were prepared using a comprehensive questionnaire review process which included expert reviews, pretesting of the survey instrument at several forest land-owner conferences and professional meetings, input from state forestry agencies, expert opinion and review by the clearance office of the USDA forest service [⁴].

Data

The total number of private landowners responding to the NWOS during the survey period in South Carolina (SC), Georgia (GA) and Alabama (AL) was 1854 (SC=753, GA=813 and AL=290). Out of these private owner responses, we discarded forest industry (FI) + TIMOs + REITs since we were interested in exploring the diverse set of motivations of the family forest owners. We assumed that the motivations of FIs, TIMOs and REITs were to generate profit from timber management. We also excluded all owners with parcel sizes less than 25 acres due to the economic inefficiencies associated with managing such smaller parcels for timber, and assumed that a rational owner with the aim of maximizing his utility from the forestland had to be motivated mainly by the non-timber amenity values of the forest for a parcel smaller than 25 acres. This resulted in reducing the number of respondents included in the analysis to 1339 from 1854.

Statistical Methods

This study is related to the identification of family forest landowner groups based on their similar motivations to manage their land and the attached values and interests of these owners in their forestland. The questions that form the basis for identifying the landowner typologies consist of NWOS questions, each emphasizing the perceived importance of various benefits that may be important to the forest owners. All questions were rated by the respondents using an ordinal Likert-type scale of 1-7 where 1 reveals the strongest motive corresponding to 'Very

^[4] For a detailed description of the development and implementation of the survey instrument (NWOS) read 'Design, Implementation, and Analysis Methods for the National Woodland Owner Survey' (Butler et al 2005).

Important' and 7 reveals the weakest motive corresponding to 'Not Important' for owning the land.

Principal Components Analysis (PCA) is the most important statistical routine for dimensional reduction and seeks to transform a larger set of correlated variables into a smaller set of uncorrelated variables or factors without losing much information. PCA with varimax rotation was used to reveal the latent constructs (factors) of forest owner motivations based on the 8 questions mentioned above by utilizing the variance-covariance matrix of responses. Two factors were identified as economic and non-economic with the former denoting a strong timber interest related to timber harvests and land investment and the latter denoting the non-timber amenity values (biodiversity, aesthetics, recreation) of the forest perceived as the most important reasons for owning the forestland by the landowner. The overall Kaiser-Meyer-Olkin (KMO) ⁵ measure for factor suitability was 0.72 confirming the factorability of the indicator variables (NWOS questions). The two factors together explained 55% of the variance in the responses to the reasons for owning forestland by the landowners. Reliability analysis was conducted by computing Cronbach's alphas for each factor which ranged from .64 to .72, suggesting internal consistency for each of the factors extracted. Finally, a scores matrix of the order N \times 2 where N (1339) denotes the total number of NWOS respondents with a score on each of the 2 factors was computed by taking each respondents standardized score on each variable, multiplied by the corresponding factor loading of the variable for the given factor, and summing these products. The factor scores describing owner motivations to manage their forestland were used as criterion variables for the cluster analysis.

Cluster Analysis

In order to get meaningful groups of family forest owners based on their motivations for owning and managing their forestland, NWOS data was subjected to clustering analysis using the factor scores on the two factors extracted for each respondent. Since all the clustering routines available through various mathematical software packages are biased towards identifying clusters with certain characteristics, once the data are input it is necessary to identify the algorithm which gives the best interpretable results and then test cluster validation. As a first step to clustering, the SAS procedure CLUSTER explored various hierarchical methods such as single linkage, complete linkage, average linkage, centroid and Ward's method (SAS 2004, p. 955) to determine the best method for clustering the data. The hierarchical clustering method is exploratory in nature and assumes no *a-priori* information about the number of clusters. To get landowner clusters of reasonable proportions and exclude the possibility of producing groups that were too small, Ward's minimum variance method was used. This method is based on leastsquares criteria and minimizes the within-cluster sum of squares, thus maximizing the withincluster homogeneity. The 'agglomerative dendrogram' that provides a visual representation of the step-by-step hierarchical clustering process wherein at each step the two closest clusters are merged into one bigger cluster, was not very useful to evaluate the cluster solution owing to the cumbersome interpretation of a large number of observations (respondents). Based on some of the most widely used statistics like root-mean-square standard deviations (RMSSTD), semipartial R-squared (SPR) and R-squared (RS) a three cluster solution was found to be appropriate and supported our initial hypothesis.

^{[5}]KMO is a measure of sampling adequacy and evaluates the appropriateness of the correlation matrix for factoring. KMO values should be greater than 0.6 for a satisfactory factor analysis (Tabachnik & Fidell 2001).

Using a non-hierarchical (K-means) method to sort the observations to the nearest centroid through the procedure FASTCLUS [⁶] in SAS we found similar results compared to the hierarchical method. The results discussed in the next section were obtained by the non-hierarchical clustering routine. 254 incomplete observations (no response on at least one of the 8 questions on reasons for owning forestland from Item 9 of the NWOS) were excluded from the cluster analysis and this resulted in reducing the number of observations to 1085 from 1339. The three clusters were named *timber* (319 owners or 29.4% of all owners), *non-timber* (233 owners or 21.5% of all owners) and *multiple-objective* (533 owners or 49.1% of all owners). The socio-demographic and forest characteristics of the three types of family forest owners are described in Table 1.

Characteristic	Multiple-	Timber	Non-timber
	objective		
Mean age (yrs)	61.5	64.2	62.2
Men (%)	74.1	66.1	75.9
Mean duration of ownership (yrs)	28.6	31.2	22.4
Income (1000\$)	79.4	78.3	71.4
Education	4.2	4.3	3.8
Retired (%)	36.7	42.9	45.5
Mean forest area	1345.3(350) ^b	1857.9(333)	$384.5(97)^{a}$
$(ac)^*$			
Farm area $(ac)^*$	444.7(160)	411.6(150)	229.7(100)
Management plan	32.1 ^b	25.7	10.3 ^a
(%)			
Site preparation	47.8 ^b	43.3 ^b	12.9 ^{a,c}
(%)			
Harvest (%)	89.3 ^b	86.2 ^b	56.6 ^{a,c}
Leased (%)	44.1 ^b	52.3	19.7 ^a
Inherit (%)	49.3	56.7 ^b	27.5 ^c

Table 1 Socio-demographic and forest characteristics of family forest owners by cluster

Note: ^a, ^b and ^c represent statistically significant separation with the mean for *multiple-objective*, *non-timber* and *timber* group of owners at 0.05 level of significance based on Tukey's studentized range test.

^{*}Values in parentheses refer to the median.

Multivariate analysis of variance (MANOVA) and analysis of variance (ANOVA) were conducted to compare the differences in the means of the profiling variables (Table 1) between the three groups of family forest owners. For MANOVA statistical differences were determined based on Wilk's lambda [⁷] and this test confirmed the presence of three statistically distinct owner groups based on the landowner responses to emphasize the importance of various reasons

^{[&}lt;sup>6</sup>] FASTCLUS in SAS uses a nearest centroid sorting iterative method where a set of points known as cluster seeds is selected as the first guess of the mean of the clusters and each observation is assigned to the nearest seed to form temporary clusters, the seeds are then replaced by the seeds of the temporary clusters in an iterative manner until no further changes occur in the clusters (for detail see SAS 2004).

^[7] MANOVA results using SAS revealed significant multivariate effect for landowner groups, Wilk's lambda = 0.69, F (26, 342) = 2.70; p < 0.001.

for owning their land (question # 9 of the NWOS). Pairwise comparison using Tukey's studentized range test (see Table 1) revealed some statistical differences in forest acreage, whether owners had inherited their land, had performed harvest, leased their land, had a management plan or had done some site preparations in the past across the three owner groups. For example owners belonging to the *timber* and *multiple-objective* clusters tended to own the largest tracts of forest land compared to owners within the *non-timber* cluster who owned the smallest sized tracts on average possibly reflecting economies of scale associated with larger tracts (Kline et al. 2000). The *timber* cluster owners were also found to have strong linkages to farming and owned on an average 412 acres of farmland. Respondents classified as either *timber* or *multiple-objective* owners had strong financial interest and on an average owned more farmland acres than the *non-timber* group possibly to supplement their timber income through farming. Responses reveal that the *non-timber* cluster owners were the least educated and least wealthy in comparison to the *multiple-objective* cluster owners and the *timber* cluster owners.

The majority of the *non-timber* type of owners was retirees though the mean age of all the owners across all ownership types was greater than 60 years, suggesting that the family forests are going to change hands and new owners are going to replace the present surveyed owners shortly. It remains to be seen whether these new owners will have similar motivations as their predecessors or if they will act differently. The longest average tenure of forestland ownership lies with the *timber* cluster owners reflecting that profit motivated owners generally have managed the same forestland for a longer time as compared to owners in other clusters. It also reflects that timber management is a long term decision of the owner belonging to the *timber* cluster when compared to maintaining forestland primarily for non-timber uses by the owners of the non-timber cluster. There was a stark contrast in the percent of owners belonging to the timber cluster (52.3%) who had leased their land relative to owners within the non-timber cluster (19.7%). Further empirical evidence amongst the single ownership objective groups (timber and non-timber) as expected reflected the difference in the behavior related to timber management with a sharp difference in the percent of owners within each group who had written management plans, did timber harvests in the past and had prepared their land to plant new trees within the last 5 years. The majority of owners classified in the timber cluster had inherited their forest property while the non-timber owners were least likely to have inherited their forestland. This coupled with the fact that these owners have the maximum tenure show that *timber* motivated owners have high legacy values relative to the *non-timber* type of ownership. However, owners belonging to the *multiple-objective* ownership class had stronger preferences for both timber and non-timber products relative to the other two owner types.

Cluster validation

While classification procedures using cluster analysis have been applied to family forest owners in a number of studies (Kurtz and Lewis 1981, Marty 1983, Kluender and Walkingstick 2000, Kittredge 2004, Kendra and Hull 2005), none of the studies reported results of any empirical cluster validity test. Based on the 5-step cluster validation technique as suggested by Lattin et al. (2002) we performed a validation test on the NWOS clustering results. According to this technique at the first step the data were randomly split in the ratio 1:1 using the RANSPLIT macro in SAS. The two samples thus formed are referred to as the calibration and the validation samples. At the second step the calibration sample was used for hierarchical cluster analysis and the appropriate number of clusters and their centroids were determined. In the third step the cluster centroid from the second step was used to assign each observation from the validation sample to the nearest centroid using non-hierarchical cluster analysis and the cluster solution was saved. In the fourth step the validation sample was used to perform a similar hierarchical cluster analysis as in the second step and the results were saved in a SAS database. Finally the cluster solutions obtained from the step-3 and step-4 were compared and a confusion matrix (Table 2) depicting the percent of observations in each of the three cluster groups incorrectly classified into another group was created. As can be seen, the percent-misclassification was pretty low and most of the observations that were clustered at both step-3 and 4 of the validation routine also were found to be in the same cluster group with the percent of correct classification for each of the three types of landowner to be above 95% (see table 2).

Table 2 Confusion matrix for cluster validation							
	Multiple-objective	Timber	Non-timber	% Misclassification			
Multiple-objective	322	*	8	2.4			
Timber	5	181	*	2.7			
Non-timber	*	2	189	1.05			

* Denotes null or 0 number of observations

Conclusion

Our study supports the presence of three groups of family forest owners in the three Southeastern states of AL, GA and SC as discussed in the theoretical model on landowner behavior above and also as reported by Butler (2005) in his study of family forest owners in five southeastern states. It also emphasizes the need to differentiate family forest owners into smaller homogeneous entities. Contradictory to Kendra and Hull's (2005) recent study on new owners in Virginia, the bulk of landowners in our study were found to be motivated strongly by the profit motive either through timber harvests as a source of income generation or choosing forestry as a better land investment option. As reported above, landowners have different objectives and motivations for managing their forestland and identification of those may be critical to developing better informed policy prescriptions. Policies can be targeted towards each owner group according to their needs and interests and thus policy implementation can be made more efficient. For example, timber harvests for owners within the non-timber group may be for wildlife habitat or to maintain a healthy forest which is quite different than for economic reasons. The *multiple-objective* ownership type was found to be the largest group with almost every 1 out of 2 family forest owners in the sample population belonging to this category. These owners derive utility from both economic and non-economic uses of the forest and also potentially could be the ones targeted by policy makers and resource managers to enhance their production of timber or non-timber outputs since they are not devoted to any single management objective unlike owners in the *timber* and the *non-timber* clusters.

The above work is by no means complete and further analyses of the data by integrating the detailed forest characteristics, which complement the ownership NWOS data, along with linkages to the socio-economic Census data, could produce important information on family forest owner behavior. Also a large number of observations (223) excluded from the analysis due to incomplete responses warrants a closer look to check if there are enough similarities amongst them to be classified as a separate cluster or not. This group could represent owners who are

undecided or who don't know the reasons for owning their forestland and are only interested in passive ownership of their forestland. Such owners were identified and termed as *passive* owners in a study of NIPF owners in western Oregon and western Washington by Kline et al. in 2000. Finally, the average age of family forest owners is in the sixties and it remains to be seen if the future change of ownership will be associated with changing owner attitudes and motivations or not. This also suggests the dynamic nature of human behavior and one on which studies need to be updated from time to time.

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Monetizing the Bare-Land Component of Timberland: Assessment of Opportunities and Agency Issues

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Abstract

Timberland owners have used a number of approaches for monetizing the bare- land component of their timberland without losing the right to grow and harvest timber, including, among others: selling a working-forest conservation easement, selling recreational rights, and selling the surface while retaining cutting rights. In this paper, I will address the latter approach, with an emphasis on the opportunities and challenges associated with alternative structural elements adopted in the arrangement. Institutional investors are accustomed to having various contracting alternatives to modify the attributes of their portfolio assets. Monetizing the bareland component of timberland provides these investors with the opportunity to modify such attributes as the timber-to-land value ratio, capital at risk, and investment duration.

Some of the structural elements to be assessed will be: retaining term versus perpetual cutting rights, the presence versus absence of a periodic payment to the bare-land owner, inclusion versus absence of a timber-income-based payment to the bare-land owner, and the presence versus absence of a buyback option for the bare-land seller. The primary criterion to be used in assessing these structural elements will be relative agency costs.

Financial economists developed agency theory to analyze the conflicts of interest (and the associated costs) between various groups of principals and agents. Previous applications to forestry have focused on those agency costs which result from separation of timberland ownership from forest management. In this application, the separation of land ownership (the principal group) from cutting-right ownership (the agent group) will result in varying degrees of anticipated conflict of interest.

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Current Rates of Return for Institutional Timberland Investment

Jack Lutz¹

Abstract

Institutional-type timberland investments were historically touted as producing rates of return of about 8% net of inflation. Our discussions with market participants suggest the rate of return for pure timberland investments is now lower, for a number of reasons. The increasing number of timberland investment management organizations (TIMOs), timber real estate investment trusts (REITs) and wealthy individual investors has increased the efficiency of timberland markets, lowering the liquidity risk. More investors can participate in very large transactions, thereby reducing the wholesale to retail discount. Demand for timberland investment, resulting in competition and higher prices for timberland transactions. The downward pressure on returns is offset in part by a fuller realization of non-timberland values of some parcels and by the use of debt in transaction financing. Other attributes of timberland returns (such as poor correlation with other investment assets) can make timberland an important component of an investment portfolio even if returns do not remain at historic levels.

Keywords: Timberland, Investment, Rates of Return, Liquidity Risk, HBU

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Introduction

For years, timberland was widely marketed as producing real returns in the 8-10 percent range. The large volume of cash available for a limited number of large timberland transactions has led to some hefty prices being paid for timberland in recent years. Discussions with investment managers, their clients and investment consultants suggest that expectations for timberland returns *for pure timberland* are being lowered. Some now talk about 8 percent alone, with no upper end of a range. Some have suggested 7 percent is a good return to expect. Timberland investors are receiving higher returns, but these returns are being generated by more than pure timberland.

Historical Returns

Timberland was historically touted as producing (or *capable of producing*) 8% real returns. Some analysis has summed component parts of the returns: biological growth contributes, say, 3% to the return, in-growth contributes some more, and high-quality management contributes a few hundred basis points more. Table 1 shows the range of components and their contribution to returns found on some TIMO web sites.

	Contribution to			
Component	Returns			
	Low	High		
Growth and Ingrowth	5.00%	7.00%		
Real Timber Price Appreciation	1.00%	3.00%		
Acquisition and Disposition Strategy	1.00%	2.00%		
Professional Management	agement 2.00%			

 Table 1. Timberland Return Components and Their Contribution to Returns

Sources: Various TIMO web sites

Such analysis usually supports the historical 8 percent figure. However, these contributions assume a "normal" acquisition price for a property. Biological growth does not increase automatically with an increasing purchase price for a given property: a higher purchase price means the return from biological growth will be less than for a lower purchase price.

Some analysis has summed the risk-free rate, real estate premium and timberland premium to determine an appropriate required rate of return. One example in Forest Research Group files suggests a real estate risk premium of 1-2 percent and a liquidity risk premium of an additional 1-2 percent for large timberland properties. Added to a base risk free rate (in the mid-1990s) of 6 to 6.5 percent, this analysis indicated a required rate of return for timberland of 8 to 10.5 percent. In late February and early March of 2006, long-term Treasury bonds were yielding 4.50-4.75 percent. This suggests the current required rate of return for timberland should be 6.50 to 8.75 percent.

In theory, the current required rate of return for timberland should be even less than that. Twenty years ago there were only a half-dozen TIMOs, no timber REITs and no Canadian income funds. Even as recent as ten years ago there were still only 8-10 TIMOs in existence and only a couple of the TIMOs could handle large transactions. Today there about 30 TIMOs, REITs, income funds and soon-to-be-TIMOs looking for timberland to buy, and most of them appear capable of handling large transactions—note Forest Capital Partners' acquisition of the Boise Cascade lands. This list does not include a dozen or more wealthy individuals active in the asset class. This means timberland is much more liquid than it was twenty, and even ten, years ago.² Since timberland is more liquid, the liquidity premium should be lower. Should the "timberland" premium be eliminated entirely? Are large timberland parcels any less liquid than large real estate parcels? How many potential buyers are there for landmark buildings such as the Sears Tower or the Hancock Tower(s)? If we eliminate the liquidity premium entirely, we are looking at a required return for timberland of 5.50 to 6.75 percent.

The 8 percent real return is supported by the NCREIF Timberland Index and theoretical returns calculated by the Wilson model (more widely known as the John Hancock Timber Index). Figure 2 shows real returns over the past 45 years have averaged just under 9 percent. The real NCREIF returns alone have averaged about 12.6 percent since 1987.



Figure 2. Actual and Theoretical Timberland Returns for the US

How can timberland returns be lower if the NCREIF index is doing so well? The NCREIF index includes the sales and partial sales of properties. The sale of higher and better use (HBU) land (see below) at higher-than-timberland prices is included in these returns.

Recent Returns

Discussions with industry participants indicate that many believe expected timberland returns are lower now than they have been in the past. The vast quantity of money chasing a limited number of properties has resulted in transaction prices that can be significantly higher than a few years ago.

² Note that the investment vehicle may reduce liquidity for investors. While their timberland may be more liquid, investors in a pooled fund will face restrictions on their ability to cash out of that fund.

Three recent transactions in the Northeast and Lake stand out: \$590/acre in for about 250,000 acres in Maine \$530/acre in for about 650,000 acres in Michigan \$800/acre in Michigan—deal not completed

There has been a continuous chorus of "How could they pay that much?" after large timberland transactions since early 2002. I have heard representatives from almost every TIMO wonder out loud how everyone else is paying so much—but their own winning bid on another transaction was entirely reasonable. The winning bidder sometimes pays 10-25 percent more than the next highest bidder, and most of the rest of the bidders are clustered in a pack. But, it is never the same buyer paying the perceived high price. An unsuccessful bidder in one sale will be the winner in the next.

Investors and their consultants tell us they are still being promised returns of 8 percent (real). How can such returns be realized if timberland returns should be lower?

HBU Returns

As little as ten years ago, timberland investors put little additional value on non-timber assets. Spectacular lakes or viewsheds or conservation lands might be sold off, but the intention of an acquisition was to produce timberland returns. Now, investors are placing a high value on those parts of the property that have a higher value for uses other than tree-growing—the HBU land.

If the total return on an investment is to be 8 percent and timberland is earning 7 percent, what return is required on the HBU portion to achieve the 8 percent total return? Table 2 provides this calculation for a hypothetical transaction. If HBU acres account for 10 percent of the area, then the implied HBU return is 12.5 percent. The table also shows that the HBU return would need to be 17 percent if the timberland return was only 6 percent.

	Component Return	Component Area		Component Value	Total Value		Component Return	Component Return
		Acres	%	\$/Acre	\$/Acre	%		
Timberland	7.00%	225,000	90.00%	\$1,000	\$225,000,000	81.8%	7.00%	6.00%
HBU	x%	25,000	10.00%	\$2,000	\$50,000,000	18.2%	12.50%	17.00%
Total	8.00%	250,000		\$1,100	\$275,000,000		8.00%	8.00%

Table 2.	Calculation o	f Weighted	Average Re	eturn for	Timberland/HB	U Investment

Data provided by Eastern Appraisal and Consulting, Portland, Maine, indicates that discount rates of about 9 percent were commonly being applied to *developed* commercial real estate investments in late 2005. A complicated subdivision and development program for a large rural property might call for a discount rate of 15 to 20 percent. The HBU return of 12.5 percent for a timberland property that is otherwise earning 7 percent falls between the return for developed properties and the return for complicated rural subdivisions and so we will call it reasonable. However, the required HBU return when the timberland is only producing 6 percent returns is getting a little high.

The required HBU return varies with the proportion of HBU acres and their value. Table 3 shows how the HBU return varies with different assumptions. As the portion of HBU lands increases, the required return for those lands decreases. Note that higher HBU per-acre values require lower returns.

	Component Area		Component Value	Total Valu	he	Component Return	Component Return
	Acres	%	\$/Acre	\$/Acre	%		
Timberland	225,000	90.00%	\$1,000	\$225,000,000	81.8%	7.00%	6.00%
HBU	25,000	10.00%	\$2,000	\$50,000,000	18.2%	12.50%	17.00%
Total	250,000		\$1,100	\$275,000,000		8.00%	8.00%
	Componen	t Area	Component	Total Valu		Component	Component
	componen	t Alea	Value		JC	Return	Return
	Acres	%	\$/Acre	\$/Acre	%		
Timberland	212,500	85.00%	\$1,000	\$212,500,000	73.9%	7.00%	6.00%
HBU	37,500	15.00%	\$2,000	\$75,000,000	26.1%	10.83%	13.67%
Total	250,000		\$1,150	\$287,500,000		8.00%	8.00%
	Componen	t Area	Component	Total Valı	Ie	Component	Component
	oomponon		Value	i otar i an		Return	Return
	Acres	%	\$/Acre	\$/Acre	%		
Timberland	200,000	80.00%	\$1,000	\$200,000,000	66.7%	7.00%	6.00%
HBU	50,000	20.00%	\$2,000	\$100,000,000	33.3%	10.00%	12.00%
Total	250,000		\$1,200	\$300,000,000		8.00%	8.00%
	Componen	t Area	Component	Total Valu	le	Component	Component
	oomponon		Value	i otar i an		Return	Return
	Acres	%	\$/Acre	\$/Acre	%		
Timberland	187,500	75.00%	\$1,000	\$187,500,000	60.0%	7.00%	6.00%
HBU	62,500	25.00%	\$2,000	\$125,000,000	40.0%	9.50%	11.00%
Total	250,000		\$1,250	\$312,500,000		8.00%	8.00%
Component Area		Component	Total Value		Component	Component	
	componen	() li ou	Value			Return	Return
	Acres	%	\$/Acre	\$/Acre	%		
Timberland	225,000	90.00%	\$1,000	\$225,000,000	75.0%	7.00%	6.00%
HBU	25,000	10.00%	\$3,000	\$75,000,000	25.0%	11.00%	14.00%
Total	250,000		\$1,200	\$300,000,000		8.00%	8.00%

 Table 3. Calculation of Weighted Average Return for Timberland/HBU Investment with Changes in Assumptions

Other Return Enhancers

Leveraged investments were very rare among institutional investors ten years ago, but are becoming more common. Incorporating debt into the financing package can increase returns to the equity investors. Of course the requirements to meet debt payments increases the investment risk (to some extent), and the required return should be adjusted accordingly. Some industry participants think that investors looking for "pure" timberland investments should look in the international arena. The competition for such timberlands is less developed and there are fewer HBU opportunities.

Stumpage Market of Central Georgia: Identifying Driving Factors and

Market Risk from Bid Transactions

Tim Sydor and Brooks C Mendell¹

Abstract

Stumpage prices in a given timber market is driven by the demands and preferences of buyers and sellers. The majority of these preferences are often unobserved, but some may be approximated and quantified by various characteristics that accompany bid sales. Accounting for observed characteristics of timber transactions may improve our understanding of stumpage market fluctuations and reduce our exposure to market volatility. A hedonic price model is developed for the pine sawtimber stumpage market in Central Georgia. An allocated pine sawtimber price per ton is regressed against observed characteristics of the tract and factors quantifying product size, volumes, and distributions on the tract. Results suggest that both size of the product and its total volume can be associated with higher stumpage prices. Other significant factors include product distribution, with preference given to higher grade products and timber quality. The model explains the effects of the observed characteristics on stumpage prices. As a result, accounting for these effects, thereby providing a perspective on the true price volatility with respect to general market fluctuations.

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Tools for Assessing Risk and Asset Prominence within a Portfolio of Timberland Investments

Tony Cascio¹

Abstract

We apply modern portfolio theory to assess sub-regional timberland assets within the US South. First, we develop a unique set of synthetic timberland returns for 22 sub-US South regions, for a 19 year time horizon. We then develop a measure to reflect the persistence of a timberland asset within a portfolio across a range of required portfolio risk levels. This measure also recognizes the important fact that timberland investments are not unlimited in availability, which must be considered when an optimal portfolio is constructed. Monte Carlo simulation is utilized to assess two forms of risk within a portfolio of timberland investments. Value at risk (VAR) of a hypothetical ten year, regionally-diversified timberland investment is estimated. Finally, we estimate the impact upon portfolio risk of not rebalancing a timberland portfolio periodically over a typical timberland investment lifetime.

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Multiple Product Subregional Timber Supply (MP SRTS) Projections

For the South

Robert Abt and Frederick Cubbage¹

Abstract

The SubRegional Timber Supply (SRTS) Model has been developed for more than a decade. It uses USDA Forest Service Forest Service Forest Inventory and Analysis (FIA) data and economic supply and demand framework to project timber inventory, supply, and price into the future. SRTS has been applied widely throughout the U.S. to a variety of timber and other applications such as climate change, forest structure and wildlife habitat, and industry location decisions. The model currently can incorporate multiple products, endogenous timber price effects on reforestation and land use change, and the new Southern Annual Forest Inventory (SAFIS) data. Current projections in 2006 with low timber demand and low prices indicate that southern softwood and hardwood inventories are apt to be sustainable at current levels for a decade or more. Increased demand and reduced land area scenario results indicate that there will be increased total inventory due to lower demand, but slight price increases in key timber supply units in many regions of the South due to less timberland and less inventory in those areas.

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Timber Supply Modeling and SRTS Development

Timber supply and projections have been enduring topics for more than a century. Our sophistication in making these projections has increased from aggregate analyses made in the 1930s, such as the federal Copeland report, to the periodic "timber trends" and "South's forests" reports led by Les Josephson and Dwight Hair with the USDA Forest Service in the 1950s to the 1970s. Those early reports were essentially "accounting" models that aggregated the national and regional Forest Service Forest Inventory and Analysis (FIA) data by management type and region. They used stand table projection methods to project regional timber supply into the future.

The Renewable Resource Planning Act (RPA) was passed in 1974, and mandated long-term projections of timber supply and demand for national forestry planning. This passage corresponded with the development of better integration of economic theory and computer applications to make timber supply projections. These RPA and regional economic modeling efforts have been led by Richard Haynes and Darius Adams in the Pacific Northwest from the 1970s until 2006, with the inventory aggregation and projection methods being led by John Mills there using the ATLAS model.

In the 1990s, a need for more detailed regional timber supply forecasts was recognized in the South, and we began to develop models at NC State University in cooperation with the USDA Forest Service in Research Triangle Park, North Carolina. These efforts over the last decade led to the development of the SubRegional Timber Supply (SRTS) model. SRTS initially combined the regional timber supply and demand framework developed by Adams and Haynes; a timber inventory model developed by Fred Cubbage and Dale Hogg at the University of Georgia; and an economic supply and demand framework developed by Robert Abt at NC State University. SRTS research was initially supported the Southern Forest Resource Assessment Consortium (SOFAC), which is a timber supply modeling consortium focused on southern models and applications.

Since about 1995, Abt has led the SRTS development and applications with various students and research professors. SRTS has been operational as a single product/volume projection model from about 1995 through 2004, and was applied using two species groups and five management classes. SRTS uses the stand table projection method to project timber inventories through age classes and remove harvests from those age classes. Aggregate region-wide growth equations and removal equations are determined based on a regression across ten-year age classes and the five forest management types—pine plantation, natural pine, mixed pine-hardwood, upland hardwoods, and bottomland hardwoods. Forest projections are made using the current: (1) forest area, (2) inventory, (3) growth, and (4) removals as the input basis. A comparative statics economic modeling approach is used by region and species group. Supply and demand "curves" are presumed to intersect at the current inventory levels. The market simulation framework applies user-supplied price and inventory shift elasticities. Supply shifts are based on the inventory change by product. Demand shifts are user specified.

SRTS has been used to make projections for softwood and hardwood timber inventory, supply, and price by regional breakdowns, usually as USDA Forest Service FIA survey units or other

areas. The minimum region size is determined by the FIA sampling structure and the need for detailed inventory data. Since 2000, Abt and others have expanded the modeling capabilities to include endogenous price effects on reforestation and land use change.

SRTS has been applied both in the U.S. South (Abt et al. 2000, Bingham et al. 2003) and Northeast (Sendek et al. 2003) to examine timber supply and prices. It also has been used in applications to global climate change and potential timber market impacts (Murray et al. 2003) and to examine the influence of nonmarket values on timber market decisions by nonindustrial private forest landowners (Pattanayak et al. 2004). Prestemon and Abt (2004) used the SRTS model in the Southern Forest Resource Assessment (SOFRA) regional effort, and Abt and others used the model to analyze the impacts of wood chip mills on timber supply in North Carolina (Schaberg et al. 2005). The model has also been used for state level timber inventory and forest structure, wildlife habitat and species analyses, forest industry wood basin studies, plant location and closing decisions, timberland investment decisions, and analysis of exogenous shocks, such hurricanes, mill capacity changes, or demand shifts.

This paper summarizes the status of the model as of 2006, and includes relevant southern timber supply projections based on current FIA data and updated timber supply assumptions.

Models and Current Projection Scenarios

SRTS/SOFRA

The inputs to SRTS are the keys to the model results. The most complete recent SRTS runs using the old single products SRTS model are described above briefly and in detail in Abt et al. (2000). SRTS runs were made for the Southern Forest Resource Assessment (SOFRA) analysis during 2000 to 2003 (Prestemon and Abt 2004), which projected timber inventory and price indexes to 2040 using the single product SRTS model. This SOFRA baseline run essentially assumed a high demand level, with a 1.5% increase in timber demand annually, which was based on the previous RPA projections. Based on surveys of state and industry forestry leaders, the SOFRA analyses also included a high productivity rate increase for forest management intensity, of a 75% increase in average productivity for forest industry lands and a 37.5% increase for nonindustrial private forest (NIPF) lands by the end of the projection period. This led to a substantial increase in the area of forest plantations, from about 32 million acres at the start of the projection period in 1995 to 52 million acres by 2040.

As one would expect based on economic theory, the South-wide SOFRA base projections led to increases in softwood inventory, growth, and removals (Figure 1). Removals did increase faster than growth, so softwood timber prices continued to increase, which drove the increase in plantation acres. South-wide hardwood inventories remained at a high level for the projection period, but began to decline slightly in about 2025, and continued until the end of the projection period. Increased harvests prompted hardwood timber prices to increase slowly throughout the

projection period, from 1995 to 2040. These aggregate South-wide results differed considerably by state and survey unit, with some areas—such as the southern coastal plain—usually having more softwood timber and the piedmont and mountains areas usually having increasing hardwood timber inventories.

Post SOFRA Changes

Since the SOFRA effort, the forest industry experienced a major recession along with much of the rest of the U.S. economy. Thus the high demand and high timber price scenario that formed the baseline assumptions for SOFRA have appeared to be less realistic each year. SOFRA included several sets of projections. Even the low demand scenarios in SOFRA, however, assumed some increase in demand (Figure 2). During the last five years pulp demand in the South decreased and is now recovering, largely due to increases in OSB and other reconsitutued products. Thus plantation investments have dropped significantly. Furthermore the sale of most of the forest industry land in the South to Timber Investment management Organizations (TIMOs) (Clutter et al. 2006) has cast further doubt on the assumption of high levels of timber management intensity. There are still large pine plantation productivity gains based on prior investments, so the softwood supply curve has shifted out. However, low timber prices and market weakness have led to far less investments in timber growing than in the decade of the 1990s.



Figure 1. SRTS Southern Softwood Inventory Projections – SOFRA Base, 2002 (1.5% demand increase per year)

MP SRTS

To improve our modeling of these dynamic changes in southern timber markets, we developed the Multiple Product SRTS (MP SRTS) modeling approach. MP SRTS is an extension of SRTS that allows tracking and harvesting of multiple products in the same economic supply and demand framework. The economic module finds the market clearing product price given the location of aggregate demand and sub-region and owner supplies. Growth by the five forest management classes is still handled through aggregate region-wide regressions, only it is now applied to five-year age classes. This greater number of age classes allows the model to represent diameter distributions better, which is needed for multiple products formulation. The model still grows volume through the age classes, and then relates this volume to product classes, which can be specified by the user. Demand by product is assumed to be independent. An embedded goal program reconciles the product mix request by owner and region from the market model and the historical harvest across age classes embedded in the FIA data. As with SRTS, the model finds and allocates timber removals (harvest) each year, updates the results with annual internal accounting, and then runs the projections for another year. A typical input set is shown in Table 1 and explained below.

Inventory parameters	Growing stock, growth, removals and diameter
	distributions for product classes
Species Group	Softwood or hardwood (hardwood can be split into
	Soft Hardwood, Hard Hardwood)
Owner	Industry/Corporate/TIMO, Nonindustrial Private
Management Type	plantation, natural pine, mixed pine/hardwood,
	upland hardwood, bottomland hardwood
Age Class (5 year)	0, 1-5, 6-10, 1-15,36-4040+ etc.
	(oldest age class varies by management type)

Table 1.	Typical MP	SRTS Inputs	Used for 20	006 Southern	Timber .	Analysis
	21	1				2

MP SRTS requires a demand shift assumption for each product. Products are defined by species group, diameter class, and percentage degrade to pulpwood. Either harvest, demand, or price can be specified and the market module will find the equilibrium solution for the other two parameters. The MP SRTS model uses the latest FIA data as the starting point. We have not used SRTS to update the data to a single year, since in the absence of accurate removal data, this may introduce more bias than using old data. This problem should be less important as the annual SAFIS data come on line.

Demand is modeled at the aggregate level, i.e. whatever regions are included in the model are assumed to face the same demand curve. Given inventory shifts by product, region and owner, the solution for equilibrium price simultaneously determines harvest shifts across regions and owners.

The objective function for the goal program was to harvest across management types and age classes, by owner and region, to get the projected target mix, while harvesting consistent with historical harvest for this region. The "consistent with historical" requirement is relaxed if the requested mix is significantly different from starting point. Thus the goal program activities are harvest level by management type and age subject to product mix and harvest distribution goals.

For partial harvests, the goal program defines a stocking target (volume per acre) for each cell. The default is the starting volume/acre by region, owner, management type, and age class. If the current stocking is greater than the target, then harvest is considered thinning until the target is reached. The remaining harvest is considered to be clearcut. Under most circumstances, this maintains average stocking near target levels throughout the projection.

For the inventory module in MP SRTS, FIA growth per acre is modeled as a function of physiographic region, owner and age. The shape of the growth curve varies by physiographic region, management type and owner. For pine plantations, the level of the growth curve is calibrated to match the mean of the local region/owner data. For plots with missing ages, age is estimated using a regression on age and plot characteristics.

Multi-Product SRTS is essentially a simulation framework that allows the user to use a simple market mechanism to explore market and inventory responses to various supply and demand scenarios. Most of the "work" in developing a model run is accessing and summarizing the starting inventory data. This has been make more challenging by recent decisions by the Forest Service to limit distribution of ownership data. There have also been challenges associated with calculating growth and removals during the transition from periodic to annual inventories.

Accurate "forecasts" using the model would require estimates of supply and demand elasticities specific to sub-regions, owners, and products. Since these are generally not available, using results from aggregate southwide studies allows us to explore the basic economic implications at a detailed level, but they do not reflect many factors that might be unique to a particular region. Though the detailed regional results are likely to be wrong, they will no doubt be less wrong than inventory projections that ignore economic interactions completely.

Recent Projection of a Base Model

In 2004, we used MP SRTS to project timber inventory, price, and harvest from 1995 to 2040, to match the SOFRA runs described before. These results with the lower demand indicated that softwood timber inventories actually increased from the SOFRA runs (Figure 2). In the 2002 SOFRA analysis, southern softwood inventory increased from 88 billion cubic feet to 115 billion cubic feet over the projection period, while it increased to more than 120 billion cubic feet using the 2004 data set. Essentially, the inventory was driven by existing pine plantations, and lower removals allowed inventory to increase.

In 2006, we made a set of base runs for MP SRTS with the low demand economic assumptions, to make short run projections by forest survey unit, from 2002 to 2020. We used the new FIA

data that was available in March 2006 for all states except Florida, Mississippi, and Oklahoma. We held plantation acres constant at 2006 levels of about 32 million acres, since we have not even reached replacement planting levels in recent years. The timberland area was reduced based on SOFRA land use projection. Demand for all products was assumed to increase at 0.5% per year.

The aggregate effect of these short run projections was that South-wide hardwood inventory was level throughout the projection period. South-wide pine inventory increased as it did with the 2002 and 2004 FIA data, but varied considerably among forest survey units and by product class.

For pine, pulpwood inventory increased in the South Carolina coastal plain, Alabama central, Louisiana southeast and southwest forest survey units. It also increased in other units that only have trivial pine components, including the Florida south, Louisiana south, and Mississippi delta.



Figure 2. SRTS Southern Softwood Inventory Projection, 2004 (0.5% demand increase)

Pine pulpwood inventory decreased in the North Carolina northeast; Tennessee; Georgia, Alabama, and North Carolina Piedmont; and the Georgia southeast forest survey units. Pine pulpwood harvest increases occurred in the South Carolina coastal plain, Alabama central, Louisiana southeast and Louisiana southwest units (Figure 3).

Pine pulpwood harvest decreased in the North Carolina northeast; Tennessee; Georgia, Alabama, and North Carolina piedmont; and the Georgia Southeast units.

Pine small sawtimber inventory trends were fairly similar. Pine sawtimber and large sawtimber had more widespread harvest declines except in the northern fringes of the South and in south Alabama (Figure 4, 5, 6).



Figure 3. 2006 SRTS Projected Pine Pulpwood Inventory Shift, 2002-2022



Figure 4. 2006 SRTS Projected Pine Small Sawtimber Inventory Shift, 2002-2022



Figure 5. 2006 SRTS Projected Sawtimber Inventory Shift, 2002-2022



(1) <30% decrease; (2) 10-30% decrease; (3) <10 difference; (4) 10-30% increase; (5) >30% increase

Figure 6. 2006 SRTS Projected Pine Large Sawtimber Inventory Shift, 2002-2022

For the hardwood inventory, the MP SRTS Projections for 2002 to 2022 found hardwood pulpwood inventory increases in the Mountains, Tennessee, Virginia, Florida North, and Arkansas. Hardwood pulpwood inventory decreases occurred in Mississippi, Alabama west, and North Carolina coastal plain forest survey units (Figure 7).

Hardwood sawtimber inventory increases occurred in the Mountains, Tennessee, northern Virginia, Florida north, Arkansas, and Alabama units. Hardwood sawtimber inventory decreases were projected for the North Carolina northeast, South Carolina northeast coastal plain, and Mississippi units (Figure 8).



Figure 7. 2007 SRTS Projected Hardwood Pulpwood Inventory Shift, 2002-2022

Conclusions

SRTS has become part of the evolving set of timber supply models that have been developed in the U.S. over the last several decades. In its construction, we have tried to develop an integrated package of aggregate timber inventory projections and economic theory that can utilize existing FIA data; allow upgrades through addition of various economic land use and price models; allow simulation of various alternatives; and provide reasonable and accurate results. MP SRTS is an extension of SRTS that provides more detailed analyses and more product breakdowns, but does require more modeling inputs and skill. The SRTS/MP SRTS models have provided a major increase in southern timber and forest modeling capabilities, as has been reflected in the widespread adoption and use of the model in public and private forest assessment efforts.



(1) <30% decrease; (2) 10-30% decrease; (3) <10 difference; (4) 10-30% increase; (5) >30% increase



We will continue to enhance these models and refine them for use by other modelers. This also will require adaptive management to the continually evolving FIA/SAFIS data base and its strict restrictions on use. We also will seek other applications as appropriate, such as carbon accounting modeling, fuel and wood energy harvests, forest industry restructuring/plant decisions, changing ownership impacts, and international competition/trade. We will consider tradeoffs between model complexity and user friendliness as we make such enhancements. Hopefully these continued efforts will continue to provide good information and data about Southern timber supply and future prospects by region, survey unit, and product class.

Acknowledgments

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Rapid Assessment of Timber Damage after Hurricane Rita

Weihuan Xu, Burl Carraway, Christopher Brown, Jin Zhu, and Dennis Jacobs¹

Abstract

This paper describes the details of the procedure, implementation, and results of a Rapid Damage Assessment Protocol (RDAP) that was used to assess timber damages from Hurricane Rita in 2005. The RDAP utilize the combination of weather data, historical hurricane damage information, aerial survey, ground plot survey, Forest Inventory and Analysis (FIA) data, and spatial interpolation technique to produce timber damage assessment. It is capable of producing high quality timber damage data in a short period of time, satisfying the urgent need for reliable data by government agencies as well as private entities on timber damage for disaster relief and salvage operations. Using the RDAP on East Texas, we were able to produce quality damage assessment within one week of the Hurricane. Two different approaches were used to estimate the total timber damage from the survey data. Using stratified sample average approach, the estimated total damaged timber volume was estimated to be 15.08 billion cubic meters, with an estimated damaged value of \$462.04 million. Using Universal Kriging geostatistical analysis approach with first order detrending and arcsin transformation for ratio data, the estimated total damaged timber volume was estimated to be 16.67 billion cubic meters, with an estimated damaged value of \$515.33 million. Comparing with stratified sample average approach, the geostatistical approach has the advantage of better accuracy with unique estimate damage rate for each FIA plot, and no need for artificial stratification for estimation. The RDAP have the potential to be adapted for evaluating future timber damages from hurricanes and other natural disasters.

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Patterns of Liability Insurance Coverage and Incidents Related to Hunting

and Fishing in Mississippi

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Abstract

Private landowners refrain to open their land for recreational users in the fear of being sued. This problem can be overcome by liability insurance. This study examined the decision of hunters, and anglers to purchase liability insurance and the actual bodily injuries and property damages in Mississippi during the hunting seasons from 2002/03 to 2004/05. Telephone survey was carried out, taking a random sample of adults who purchased Mississippi hunting and/or fishing license for the 2004/05 seasons. The survey revealed that 17.6% of hunting or fishing activities have been covered by liability insurance during 2004/05 seasons. Only 17 respondents reported incidents related to the recreational activity. It was concluded that the risk of landowners being sued is very low in Mississippi. Age, years of hunting and income was positively related to the purchase of liability insurance. This low risk can still be reduced by increasing the purchase rate of liability insurance.

Key Words: Incident, insurance, liability, recreation.

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Outdoor Recreation and Liability Insurance

Privately owned rural land plays a strategic role in meeting the increasing demand for public outdoor recreation. Unfortunately, non-industrial private forest landowners have been slower in response to the growing demand of outdoor recreation. Private lands are found on 66% of the United States and contribute 80% of wildlife habitats, thus they are important to animal production, recreational use, and society. Expenditures for wildlife-based recreation totaled \$101.2 billion dollars in the U.S. with most money spent on equipment and trip-related costs; 90% for consumptive uses and 89% for non-consumptive uses. Only \$3.2 billion was spent for land leasing or ownership, yet hunting was practiced most on private lands; 51% or on public and private lands combined; 30% (Benson 2001).

Jones et al. (2001) reported results from two surveys on Mississippi nonindustrial private landowners and the supply of fee hunting opportunities. The percentage of respondents that charged for hunting privileges was small, ranging from 8 to 14%, depending on year and region surveyed. Other studies also found that nonindustrial private landowners had similar low participation rate in providing fee access recreation (Zhang et al. 2006). The low supply of recreational services from private lands has been a concern among wildlife agencies and recreational users because the majority of federal and state funding for wildlife management comes from hunting and fishing license sales and from federal excise taxes on hunting and fishing license sales have taken significant steps to insulate landowners from liability when they grant free recreational access, liability remains a concern among landowners and a barrier to public access. Most states have adopted recreational use statutes, which limit the tort liability of landholders who make their land available for recreation. Studies indicate however, that the concern of landholders about legal liability for bodily injuries to recreational users is still a major barrier to recreational access on private rural lands (Wright et al. 2002).

Liability insurance provides a landholder with the means of shifting to an insurer the financial risk of liability arising from the use of the land by recreational users. Although insurance will not prevent a landholder from being sued, it does provide a landholder with two major benefits: 1) payment of damages to a third party for injuries that are covered by the insurance policy; and 2) an entity, the insurer, with a duty to defend the landholder against all actions brought against the landholder on any allegation of facts and circumstances potentially covered by the insurance policy, including groundless, false, or fraudulent claims (Noble 1991).

Though insurance can save the landowners from the financial burden of litigations, trend of insurance purchase have not been documented in the previous literatures. Natural resource agencies will be challenged to respond to such trends amidst a rapidly changing demographic context. The population of the United States continues to grow in number in racial, and ethnic diversity, and level of urbanization. It also continues to experience a shift in its age-structure, as the population grows older, and an increase in the variation in household composition (Murdock et al. 1992). In order to respond effectively, agencies will need current information on how such trends are likely to affect participation in wildlife-based recreation. This information can assist in the development of targeted strategies for responding to current trends in wildlife recreation use and demographic change. This paper provides analyses of the status of fishing and hunting license purchases among Mississippi recreation users using data from a statewide survey of the recreational users' population. The purpose of this study was to examine the extent of current fishing and hunting license purchases and identify socioeconomic and demographic factors that influence license purchases among Mississippi residents. We focused on two basic and related reasons: 1) actual damages and injury patterns in Mississippi during three hunting seasons 2002/03 to 2004/05. 2) Patterns in purchasing liability insurance in 2004/05 hunting season.

Pattern of Recreation Activities and Demographic Characteristics

The promotion of fee-based wildlife recreation on private lands encourages voluntary conservation and restoration of ecologically sensitive lands, with limited state and federal governmental involvement. Incentive-based federal programs, such as the U.S. Department of Agriculture's Conservation Reserve and Wetland Reserve Programs, have protected numerous acres of marginal lands within the state of Mississippi. Wildlife recreation on private lands can benefit many Mississippi stakeholders. Private landowners can derive additional income from hunting, fishing, and non-consumptive activities such as bird watching and nature tours. Landowners who improve wildlife habitat quality, and thereby increase game concentrations, increase the recreational value of their land (Jones et al. 2001). The net effects of landowner involvement in fee-based wildlife recreation are; more conserved and restored acreage without the use of traditional regulatory measures, additional income sources for landowners, and enhanced opportunities for outdoor enthusiasts.

Jones et al. (2001) carried out a research in Mississippi concerning the number of nonindustrial private landowners engaged in fee hunting, the amount and type of land dedicated to fee hunting by landowners, the various wildlife management practices these landowners implement, the costs and revenues associated with fee hunting, and various other issues related to fee hunting. Liability expense is the second largest category for landowners involved in fee hunting, managerial expense being the largest. Landowners engaged in fee hunting generally do not experience serious problems. Poaching and trespassing was the highest rated problem followed by accident liability. Respondents not engaged in fee hunting said that they chose not to involve because of loss of land control, loss of privacy, accident liability, damage to property, and poaching and trespassing followed successively. Over harvest of wildlife, financial gain not worthwhile, and not wanting wildlife hunted were other problems. The ratings of problems by two different groups indicate substantial difference between the actual and perceived problems.

Fee hunting provides monetary incentives to landowners for afforesting marginal agricultural land and protecting ecologically diverse forests and wetlands without the intervention of environmental regulations. Land-use planning by landowner cooperatives, economic development groups, and local communities can promote fee hunting on private lands as a viable alternative to development projects and agricultural production on marginal lands, thus protecting forests and emergent wetlands.

Accident liability is the second concern of landowners who are involved in fee hunting preceded by poaching and trespassing. Recreational use statutes do not protect the landowners involved in fee hunting from common tort. Insurance purchase can be a useful way to reduce the

liability. But very little information is available concerning the insurance purchased by recreationists and landowners involved in fee hunting. This article addresses insurance purchase issue and the different factors associated with it.

Since the early 1960s, research has consistently documented relationships between fishing and hunting participation and demographic variables. But relationship between insurance purchase and demographic variable has not been studied. Since hunters and anglers are the insurance purchasers, relationship between insurance purchase and demographic variables can be related to the trend in hunting and fishing participation. In general, gender, age, race, and place of residence have been shown to influence hunting participation (Floyd and Lee 2002). Generally, the influence of education and income on hunting participation is not as prominent or consistent as gender, age, race, and place of residence. Growing up in a rural setting is associated with an increased propensity to hunt, as are certain target characteristics (being male) and having a primary socializing agent i.e., a father who hunts (Stedman and Heberlein 2001).

Floyd and Lee (2002) reported that from their analyses of 1980, 1985, and 1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation data that largest effect on hunting was "whether or not the individual grew up in a rural area". In their analysis, rural residence was identified as the most important variable explaining the declining rates of hunting participation over the 1980 to 1990 time period.

Regarding the place of residence, 44% of hunters in 1997 lived outside a Metropolitan Statistical Area. In general, Caucasians are more likely to hunt than African Americans, or members of other major race and ethnic categories. Two percent of the African-American population and 3% of other racial groups (as defined by the U.S. Census) went hunting in 1996 (USDI and USDC 1997). These figures have remained nearly constant since 1985. Eight percent of the Caucasian population hunted in 1996 and 1991. The figures didn't change much in the 2001 survey (USDI and USDC 2002).

Methodology and Survey Design

The data for the study came from a telephone survey conducted by the Social Science Research Center at Mississippi State University. Data collection for this survey was done via telephone interviews with a simple random sample of adults who purchased a Mississippi hunting and/ or fishing license for the 2004/05 season and lived in a household with a telephone. All individuals under 18 years of age were excluded from this study, as were those with duplicate entries i.e. one who purchased more than one license. Of the 4,033 numbers dialed for this survey, 1,653 completed the interview, six interviews could not be completed during the time frame and 81 refused to participate, 1,116 were determined to be bad numbers, 55 could not participate because of communication problems, health problems, or were out of town for the duration of this study, and 638 numbers were not reached to start the interview, 310 were call backs that could not be completed during the time frame for this study. In addition, 174 said they had not purchased hunting and/or fishing license in the past three years.

Questions involved measuring fishing and hunting participation, insurance purchases, type of license purchased (resident and non-resident), rate of injury, type of land where the injury

occurred, property damages, recreational activity related to the injury, cost of license, total cost involved with injury, medical costs, claim limit per incident, type of land and selected socioeconomic and demographic characteristics. Data on insurance were obtained from items asking whether they purchased liability insurance in past three years. The six demographic variables are included in the analyses. The variables included are marital status, education, residence, income, gender, and years of hunting, race and ethnicity, age. There are 80 questions involved in the survey. The respondents hesitated to answer questions related to injuries. That is why information from all the questions could not be used for the analysis. Due to small number of respondents, variable associated with cost of injury, claim limit per incident and medical cost could not be involved in the regression model.

To examine the factors influencing a respondent's insurance purchase, logistic regression was used to examine the effects of years of hunting, race, marital status, education, place of residence, income, gender, age, type of license (resident or non-resident), residence sportsman license, residence all game license, non-residence all game license and other license purchases by the recreation user. Logistic regression was used since the dependent variable of insurance purchase to be analyzed was dichotomous. The logistic regression model to be estimated can be expressed as: Let *Yi* represent the insurance purchase status of a recreation user. Let *Yi* = 1 if the user says "Yea" and *Yi* = 0 if the user says "Nay". A binary logit model can be estimated with the following general form

$$Pr(Y_{i} = 1) = P_{i} = \frac{e^{\beta' x}}{1 + e^{\beta' x}}$$
(1)
$$Pr(Y_{i} = 0) = 1 - P_{i}$$
(2)

Where P_i is the probability of an insurance purchase, β is the set of parameters to be estimated associated with the independent variables (i.e. demographic and socioeconomic characteristics) (Greene 2003).

The dependent variable in the model represented a respondent's insurance purchase status. The independent variables included years of hunting, race, marital status, education, place of residence, income, gender, age, type of license (resident or non-resident), residence sportsman license, residence all game license, non-residence all game license and other license purchases by the recreation user. Selection of these variables was based on previous studies and their ability of improving the model's explanatory power that explains the effect of these variables on license purchase. Coding of the independent variables and their percentage in sample is shown in Table 1. In addition, years of fishing, total medical cost of the injury were used as explanatory variables, but they did not add any explanatory power to the model. Years of fishing were collinear with years of hunting. Other variables such as cost of insurance, claim limit per incident were also tried, but later decided to eliminate them because there were

Demographic Characteristics	Frequency	Percent in Sample
Gender (n= 1653)		
0 = Female	82	4 96
1 = Male	1571	95.04
Race and Ethnicity	10,1	
1 = Caucasian, 0 = others	1524	92.20
African-American	113	6.84
Other	16	0.97
Asian or Pacific Islander	0	0
American Indian or Alaska Native	0	0
Age (n = 1653)		
19-23	89	5.30
24-34	225	13.61
35-44	398	24.07
45-54	485	29.34
55-64	364	22.02
65 and older	92	5.56
Education $(n=1637)$		
1 = Never attended	3	0.18
2 = Grade school	39	2.38
3 = High school	109	6.65
4 = Grade 12 or GED	614	37.50
5 = College degree	423	25.80
6 = College 4 yrs or more	449	27.20
Income $(n=1289)$		
1 = Less than \$20,000	103	7.90
2 = \$20,000-60,000	588	45.61
3 = \$60,000-100,000	373	28.93
4 = \$Over 100,000	225	17.45
Population size $(n = 1564)$		
1 =A farm or ranch	199	12.72
2 = Rural but not a farm	575	36.76
3 = A town under 2500 population	127	8.12
4 = A town with 2500 to 10000	167	10.67
5 = A city of 10,000 to 50,000	313	20.01
6 = A city of 50,000 to 100,000	79	5.05
7 = A city larger than 100,000	104	6.64

Table 1 Demographic and socioeconomic characteristics of recreational users in Mississippi found through telephone survey during 2004/05 hunting season with codes used for logistic regression (N=1653)

only few respondents to answer the related questions. Resident and non-resident license purchasers were included in the model to see if that affects the rate of insurance purchase.

Results and Discussions

Descriptive Analysis of Purchase of Liability Insurance

Out of 17 respondents, only 1.1% reported any incidents related to the recreational activity. They said that they have not been involved in any lawsuits. The recreationists who are the landowners as well said that rate of property damage is very low. Among the respondents 97.4 % are hunters, 12.3% have hunted for 30 years, and 10.4% have hunted for 40 years. Caucasians are 92.2 % of the total sample, 6.8% are African-American. In the sample, 37.1% have passed grade and 45% of the respondents lie in the income group \$20,000 to \$60,000.

It was found that 17.6% of hunting or fishing activities have been covered by liability insurance during past three years (2002-2005). Very low rate of injury and property damage has an implication to the low insurance purchase rate in Mississippi. The low rate of insurance purchase is also due to the undeveloped business of fee access by private landowners. Review of cases by Wright et al. (2002) also showed that there is only one lawsuit related to recreational activity in the state of Mississippi. This is because fee access recreation is not developed in Mississippi. Private landowners are safer from being sued than what they really think of. Only 11% of landowners allow fee access recreational activities as mentioned in the previous literatures. Insurance purchase can be a way to reduce the risk of liability arising from injuries and property damages related to fee access recreational activities.

Sports club provided the highest insurance coverage, 45% in past three years. Members in the sports clubs are paying some money to the owners directly or indirectly, a percentage of their membership fee is allocated for insurance. This is because the landowners would not allow them on their land unless they buy the insurance. The cost of insurance was \$484/yr (n=33) in average, the least cost being \$25 and the highest being \$3700/yr. Average Claim limit per incident was\$ 550929.6/yr, least cost being \$25 /yr and the highest being \$500, 0000/yr (n=56). Average medical cost for injuries is \$6363.63/yr, least being \$1/yr and highest being \$70,000/yr (n=11). The respondents said that, most of the recreational activities were covered by the insurance purchased. The month of December accounted for most of the accidents (n=4). The number of incidents on the public land (n=8) and private land are about the same (n=9). For most of the injuries/damages insurance company paid the cost involved (n=12). Fee charge is not involved in the recreation activities; only four out of 17 respondents said that they are involved in fee charge. The equipment that directly involved in the accident is boat for most of accidents. This implies that most of the accidents are water related. This is in accordance with the finding by (Wright et al. 2002). The counties where accidents occurred were Washington, Warren, Claiborne, Clay, Grenada, Hinds, Holmes, Jefferson, Jefferson Davis, Kipper, Lowndes, Wayne, Wilkerson and Yazoo.

Comments by the respondents included that there is no need for liability insurance because accidents can be avoided by recreating safely. The respondents also said that they did not know that the liability insurance was available. This urges educational information to the recreationists about the insurance. Organizations like forest landowner's association also provide insurance in the state of Mississippi. Coverage can be extended on the farmer's liability insurance. Comprehensive liability insurance helps the farmers to keep themselves safe.

Logistic Regression Analysis of Purchase of Liability Insurance

The probability of insurance purchase is regressed against various independent variables to see their effect during the 2004/2005 hunting season. Likelihood ratio is 44.22 with 14 degrees of freedom which is significant at less than 1% level. Null hypothesis can be rejected in this case and conclude that at least one and perhaps all p coefficients are different from zero. The results of the regression are shown on Table 2. The likelihood of having purchased any type of insurance in the past three years is significantly associated with race, income, age, type of license and non-residence all game licenses.

Variable gender is not significant. Gender and race are the most consistent predictors for license purchases but gender is not a predictor of insurance purchase. The probability of insurance purchase increases with the Caucasian people. Lower rates of insurance purchases strongly suggests the need for strategies to encourage insurance purchase among ethnic minorities in the state of Mississippi.

People with higher income are more likely to purchase the insurance. Variable age is also positively related to insurance purchase revealing the higher insurance purchase rate with increasing age. Type of license i.e. resident and non-resident type is positively related to

Variables	Logit-coefficients	t-value
Intercept	-22.20	-51.42
Yrs. Of hunting	0.00	1.12
Race	1.34 ^a	3.36
Marital status	-0.14	-0.73
Education	0.03	0.59
Residence	0.00	-0.10
Income	0.10^{b}	1.56
Gender	-0.06	-0.20
Age	0.01 ^a	3.21
Туре	17.89 ^a	72.75
Residence sportsman	0.22	1.03
Residence all game	0.09	0.37
Non-Residence all game	18.36 ^a	65.50
Other	0.31	0.98

Table 2 Logistic regression analysis of insurance purchase on demographic and socioeconomic characteristics and user characteristics

^a Significant at 1% or better level

^b Significant at 10% or better level

insurance purchase, implying that recreation user out of state is more likely to buy insurance than users' inside the state. Place of residence (bigger tract) was hypothesized to be negatively

related to insurance because these people do not stay on the property. The respondents of our survey included landowners who are recreational users that is why there is no statistical significance of this hypothesis. It has practical significance for individuals who are recreation users as well as landowners.

Conclusions

Pattern of insurance purchase during the hunting seasons from 2002/03 to 2004/05 is not significantly different. The results indicated that about 17.6% of the sample interviewed purchased some type of insurance for hunting and fishing. Sports club provided the highest insurance purchase for its members. Promotion of fee hunting and liability insurance through sports club can be very effective. Age and Income of the users had significant impact on the rate of insurance purchase by the recreational users. It implies that, richer users are likely to buy insurance than poorer ones. Fee access recreation should be made available to lower income group people. Incentives from the government or landowner's association could be a way out for such people by making cheaper rates of insurance available.

Results indicated that only 1.1% users reported any injuries related to recreational activities. None of them reported any lawsuits. Respondents' ignorance about the insurance implies the lack of fee hunting opportunities. This low rate of insurance purchase exposes the recreational users and landowners to high risk of liability. It will in turn reduce the rate of participation in hunting and fishing. There are several practical and policy implications for this study. In the long run, the impact on funding to states generated through license purchase could be substantial. That is why it is recommended to increase public participation in fee access recreation and to increase purchase of liability insurance. This will improve the quality of hunting and fishing and reduce the burden on landowners. This in turn will benefit the state by increasing the license sales.

Extensive study regarding the liability coverage by different insurance companies can open to the public, an information regarding benefits of insurance companies. Research on costs related to the insurance can open some other roads for fee access recreation. As the type of license provided by the state wildlife agencies are standard, type of insurance can be standardized in some way rather than having many insurance companies. Insurance companies having differing coverage can create confusion on the users. This study surveyed a sample of recreation users; liability is the concern of landowners and not recreation users that is why study regarding the pattern of insurance purchase by landowners is recommended for future studies.

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Economic Impact and Visitor Preference of Off-Highway Vehicle Recreation:

Case Study at the Croom Motorcycle Area, Brooksville, Florida

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Abstract

Off-highway vehicle (OHV) recreation is a popular and fast growing forest-based activity. As such, it is necessary to understand the associated impacts to better manage for its use. While OHV use does generate negative impacts, such as sound pollution, adverse soil effects, and user conflicts, positive impacts also arise from this activity. This paper reports the findings of a study of OHV users who visited the Croom Motorcycle Area (CMA), a single use OHV recreation area, in the Withlacoochee State Forest, Florida. Specifically, this study focuses on the evaluation of economic impacts to Florida of OHV recreation at the CMA. Assessment of the economic impact was achieved through travel and equipment expenditure survey questions, combined with input-output models, that considered households as both exogenous and endogenous in order to generate type I and type II impact estimates. Type I impacts were evaluated at \$22.69 million, with type II impacts determined to be \$66.44 million.

Keywords: Nature based tourism; Public forests; Motorized recreation; Input-output analysis

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Introduction

Nature-based recreational activities on forested lands in the United States attract millions of participants yearly. Over 200 million people visited US Forest Service managed lands annually from 2000-2003 to participate in varied forms of recreation such as hiking, backpacking, skiing and off-highway vehicle (OHV) riding (USDA, 2005). One of the fastest growing forms of recreation over the last decade has been OHV recreation. Cordell, Betz, Green, and Owens (2005) in a study for the USDA, estimated that from 1999 to 2004 OHV recreation grew by over 15 million participants. This growth has been mirrored in Florida with an estimated 1.781 million participants as of 2004, ranking it fifth within the US and first within the southern US (Cordell et al, 2005). The enormous and growing popularity of OHV recreation has spurred many states into creating new OHV management policies to address the externalities that are created from this form of recreation. While OHV recreation does bring with it costs from ecological damage and user conflicts (Kay, 1981; Webb, Ragland, Godwin, & Jenkins, 1978; Sheridan, 1978; Dorrence, 1975; Kariel, 1990; Harrison, 1974 Vail & Heldt, 2004; Reed, 2005), it is important to recognize that it also generates substantial benefits which must be taken into consideration when making policy decisions.

OHV recreation produces substantial economic benefits to the communities and to the state in which the recreation activity takes place. OHV users spend money in traveling to their destination through the purchase of food, lodging, and other travel related expenditures. The equipment they require for their recreation also necessitates the outlay of thousands of dollars. These expenditures will benefit the local economies by increasing economic activity and employment. Studies using input-output models to capture the direct, indirect and induced impacts of OHV recreation to state economies have been undertaken on several occasions: OHV recreation generated about \$354 million in Colorado (Hazen and Sawyer, 2001), Okrant & Gross (2004) estimated that the contribution of OHV riding to New Hampshire's economy at \$318 million, and in Maine an impact of over \$200 million was estimated for OHV riding (Morris et al, 2005).

All impacts, whether they are positive or negative, result from the users who participate in a given form of recreation. In Florida OHV recreation policy is based on the State's ability to create recreation areas that will meet the demand for OHV riding, hence reducing the negative consequences that illegal and unmanaged riding has on land in Florida, while maintaining benefits. In order to make effective policy decisions in regard to OHV recreation, it is necessary for policy makers to understand the total economic benefits that are generated by this form of recreation.

This paper discusses the results of a study done by researchers at the University of Florida for the Florida Division of Forestry with the purpose of estimating the economic impacts of the Croom Motorcycle Area to the State of Florida. A regional input-output (I-O) model was used for this purpose.

Description Input-Output Models

Input-output (I-O) models consider inter-industry relations in a regional economy, as well as their interrelations with final demanded sectors (households, employees, government, and trade) in order to evaluate the impact that an industry or, as in the case of this study, an activity can have on the local economy (Millar & Blair, 1985).

Table 1 is a generalized accounting table that I-O models utilize. An assumption that is key in I-O models is that total outputs from a sector equals total inputs. The columns within the table represent inputs that industries require to produce a given level output. Reading down the columns gives the level of inputs that each sector receives from others. Industry sector S1 purchases Z_{11} from itself, Z_{21} from S2, H_{31} inputs from households and so on for total inputs of X_1 , the bottom row of table 1. Conversely, reading across the rows shows the outputs sold by a sector to the other sectors. Hence, sector S1 will sell Z_{11} to itself, Z_{12} sector S2, H_{13} outputs will be sold to households,

Tab	le 1	:	General	accountin	ng	tabl	e
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		Inputs						
Outpu	ts	Producing sector		Final demand sector				
		S 1	S2	H (3)	G (4)	E (5)	Total outputs	
ıcing r	S1	Z ₁₁	Z ₁₂	H ₁₃	G ₁₄	E ₁₅	X'1	
Produ Secto	S2	Z ₂₁	Z ₂₂	H ₂₃	G ₂₄	E ₂₅	X'2	
nts	H(3)	H_{31}	H ₃₂	T ₃₃	T ₃₄	T ₃₅	X'3	
tyme: ctor	G(4)	G ₄₁	G ₄₂	T ₄₃	T ₄₄	T ₄₅	X'4	
Pa Se	I(5)	I ₅₁	I ₅₂	T ₅₃	T ₅₄	T ₅₅	X'5	
Total	inputs	X_1	X_2	X ₃	X_4	X_5		

and so on for a total output of X'_1 , given the assumption stated above $X_2 = X'_2$. As such:

$$X'_1 = Z_{11} + Z_{12} + Y_1$$

where Y_1 is total final demand for S2 outputs, $Y_1 = H_{13} + G_{14} + E_{15}$.

Dividing the column entry by gross outputs will provide the trade coefficients, the amount of input from each sector needed for S2 to produce one unit of output. Duplicating this for each producing sector results in a series of equations that will form the coefficient matrix A, where:

$$A = \begin{bmatrix} a & 11 & a & 12 \\ a & 21 & a & 22 \end{bmatrix}$$

Solving for X, the vector of gross output, provides the final equation:

$$X=(I-A)^{-1}*Y$$

Where $(I-A)^{-1}$ in the Leontif inverse matrix and Y is the vector of final demand.

Households can be treated as either exogenous or endogenous with respect to the model. When households are treated as exogenous, type I (direct and indirect) multipliers and impacts are derived. Type II (direct, indirect, and induced) multipliers and impact are obtained by extending the Leontif inverse matrix to include additional spending of wage income by households. As such, type II multipliers and the associated impacts are greater due to the inclusion of this additional sector.

By changing Y, one can derive economic impacts from an I-O model. Essentially an activity or policy change can affect the final demand from various sectors. A change in Y will result in a corresponding change in total output greater then the initial impact, as the sectors that experience an increase in final demand for their products will increase purchases of inputs from other sectors, hence causing the direct impact to multiply.

Methodology

In undertaking I-O analysis, the estimation of the impact event or shock, as the output from the model is only as realistic as the impact quantity. The impact shock for this study is the total expenditure that households make in the pursuit of their recreation at the CMA. To assess this, a survey on visitors to the CMA was administered that contained detailed expenditure questions to determine total expenditures by OHV riders at the CMA. The estimated day-use number for fiscal year 2006 was provided by the Florida Division of Forestry and used to estimate total number of households visiting the CMA. The total visitor day-use number was divided by parties per household to attain total household day-use numbers, which was used to estimate total trip expenditures (Figure 1). Household day-use was then divided by mean household trips per year to achieve the number of households recreating at the CMA. The estimated household population was used to attain total annual equipment expenditure (Figure 2). Expenditure levels were determined for both resident households, defined as households residing in Florida, and non-residents, defined as households residing outside of Florida. Only non-resident trip expenditures made within Florida were included in the analysis, as expenditure not made in Florida has no impact on Florida's economy. Likewise, non-resident annual equipment expenditures were not used as it was assumed that non-residents would purchase equipment near their state of residence. To increase the accuracy of the impact estimate, a question was included in the survey asking if the CMA was a major factor in their purchase decisions for OHV related purchases. The percentage of ves responses by resident participants was applied to resident expenditure levels to attain a more precise estimate of the unique impact of the CMA to Florida's economy. The total expenditure quantity achieved was then analyzed using a four-sector I-O model, treating households as exogenous and endogenous to determine type I and type II impacts from OHV recreation at the CMA.



Results and Discussion

The population estimate for both residents and non-residents are provided in table 2. Participants in the survey were mainly Floridians, with 96% indicating their primary residence within Florida. This translates into over 21,230 total day-use days for resident households. Total non-resident

household day-use was estimated at over 953 days. To evaluate annual equipment purchases by households, it was necessary to identify the total number of

Table 2: Visitor Population Estimates							
	Total Day Use 2006*	% of Population	Total Household recreation Days	Mean Household Members per Trip	Total Household Rec. Days	Mean Trips per Household	Total Household Rec. at the CMA
Non- resident	71.500	4%	2860	3.00	953.33		
Resident	, 1,000	96%	68640	3.23	21230.23	18.66	1137.6

*2006 CMA total day use estimates were provided by the Florida Division of Forestry

households recreating at the CMA, not just total household day-use, to avoid over estimating equipment expenditures through the double counting of households. A total household population estimate is not given for non-resident households as it is assumed that they make equipment purchases in their state of residence. Tables 3 & 4 provide the mean and total trip expenditure for resident and non-resident households. The adjusted total column for resident household is the level of expenditure by the population that occurs because of the CMA's existence, in this case 86.1% of the total expenditure level. This is the number that represents the percentage of yes responses to the question of whether the CMA was a major factor in participants' purchase decisions. The adjusted total in the non-resident column represents the trip expenditure made within Florida, in this case 90%. Total annual household trip expenditures were estimated at roughly \$5.3 million and \$4.4 million for resident and non-resident households respectively.

experiantales							
Expenditure Category	Mean	Total	Adjusted Total	Expenditure Category	Mean	Total	Adjusted Total
OHV related purchases	\$71	\$1,509,795	\$1,299,933	OHV related purchases	\$260	\$743,600	\$669,240
Purchases related to transportation to the CMA	\$100	\$2,120,945	\$1,826,133	Purchases related to transportation to the CMA	\$450	\$1,287,000	\$1,158,300
Food & beverage purchases	\$63	\$1,347,943	\$1,160,579	Food & beverage purchases	\$467	\$1,334,676	\$1,201,209
Lodging	\$31	\$648,283	\$558,172	Lodging	\$300	\$858,000	\$772,200
Entertainment, gift and souvenir purchases	\$8	\$163,864	\$141,087	Entertainment, gift and souvenir purchases	\$133	\$381,324	\$343,191
Miscellaneous/other purchases	\$18	\$385,908	\$332,267	Miscellaneous/other purchases	\$100	\$286,000	\$257,400
Total	\$291	\$6,176,738	\$5,318,171	Total	\$1,710	\$4,890,600	\$4,401,540

Table 3: Resident household mean	, total,	and a	djusted total	annual trip
expenditures				

Table 4: Non-Resident household mean	, total,	and	adjusted	total
annual trin expenditures				

Table 5 provides the estimated equipment expenditures for resident households. The adjusted column total is treated the same way for annual equipment expenditures as it was for resident household trip expenditure. Resident households spent an estimated \$8.2 million in purchasing OHV related equipments. The sum of resident total trip expenditure, non-resident total trip expenditure, and total resident equipment expenditure is the direct impact of OHV recreation at the CMA. Total expenditure was estimated at \$17,980,303 and, when introduced as a shock to an I-O model, the impact will multiply as sectors are forced to adjust inputs in response to an increase in output demand, generating indirect (type I) and induced impacts (type II).

As stated previously, the total expenditure is also the direct impact and by applying total expenditure as a change in final demand, Y in the equation $X=(I-A)^{-1}*Y$, the associated change in final output can be attained. The accounting table used in this model was the 2003 Florida statewide accounting table (Table 6). The associated output and income multipliers derived from Table 6 are specified in Table 7. Output multipliers indicate the change in output in a sector for an additional dollar of goods demanded from that sector. Income multipliers indicate the change in income for an additional dollar demanded in the associated sector. The manufacturing sector has the greatest

Table 5: Resident household mean, total, and adjusted total annual equipment expenditures

Resident Household Annual Equipment Expenditures	Average	Total	Adjusted Total
Repairs / routine maintenance to OHVs	\$682	\$775,895	\$668,045
OHV equipment modifications and upgrades	\$752	\$855,320	\$736,431
OHV Riding apparel	\$528	\$600,981	\$517,445
Equipment or purchase of rentals related to the transport of OHVs	\$1,007	\$1,145,618	\$986,377
OHV expenditure related to permits, fees, insurance, titling, club membership	\$293	\$333,435	\$287,087
New OHV Purchases	\$4,937	\$5,616,049	\$4,835,418
Miscellaneous/other purchases related to OHV riding	\$235	\$266,887	\$229,789
Total	\$8,434	\$9,594,183	\$8,260,592

multiplier effect within Florida for type I output, type I income, and type II income; 1.4004, 1.6417, and 2.9201 respectively. The utilities and services sector has the greatest multiplier effect for type I output at 3.7006. This is not surprising given that the retail industry is part of the utilities and services sector, and with labor by far the largest input, when households are considered endogenous there is substantial feedback within the model.

Table 6: 2003 Florida Accounting Table (\$ millions)

	S1	S2	S3	S4	HH	Govt	Export	Total	
S1	3005.38	0.6	308.01	3170.03	5373.6	522.79	18975.17	31355.58	
S2	0.97	33.78	235.36	109.06	0.6	2.11	1544.97	1926.85	
S3	707.96	27.41	7132.62	5247.5	3741.96	9953.22	40378.23	67188.9	
S4	5777.04	335.79	12825.37	99158.53	196008.41	99201.01	109492.93	522799.08	
HH	13337.39	1033.29	22993.22	337910.28	0	0	0	375274.18	
Gov	43.59	10.51	25.49	7500	34305	74946.44	89767.29	206598.32	
Import	8483.25	485.47	23668.83	69703.68	135844.61	21972.75	6582	266740.59	
Total	31355.58	1926.85	67188.9	522799.08	375274.18	206598.32	266740.59	1471883.5	

S1 Forest & Agricultural Products

S2 Other natural resource products

S3 Manufacturing

S4 Utilities and services

Table 7: Output and income multipliers by industry sector

	Ou	tput	Income		
Sector	Type I	Type II	Type I	Type II	
Forest & Agricultural Products	1.3982	3.3543	1.5269	2.7159	
Other natural resource products	1.2625	3.3640	1.3012	2.3144	
Manufacturing	1.4004	3.0925	1.6417	2.9201	
Utilities and services	1.2622	3.7006	1.2526	2.2280	

Table 8 gives the breakdown of the impacts derived from this model resulting from expenditure made by visitors to the CMA. The direct impacts of \$17.98 million have an indirect impact of \$4.71 million, equaling a type I output impact of \$22.69 million. The induced impacts were 43.75, resulting in total type II output impacts of 66.44 million.

Table 8: Total Output Impacts (\$ millions)							
Direct	Total						
17.98	4.71	43.75	66.44				

Conclusion

OHV recreation at the CMA has a substantial impact to the Florida economy. There is no doubt that a study encompassing riding throughout the state would reveal considerably more impact in line with other statewide economic impact studies on OHV recreation undertaken in the past and mentioned previously. This form of recreation has the potential to be utilized as a rural development tool, as the participants in this expenditure intensive form of recreation prefer rural areas for riding.

It is important for policy makers to be aware of type I and type II impacts when making policy decisions that will affect the associated activity. OHV recreation participants experienced a reduction in areas where they can legally ride. In Florida it will increasingly be a problem as riding areas in National Forests will further be reduced through the continuation of the Access Designation Process. Any reduction in the population of riders that a lack of riding areas may precipitate will correspond in a decrease in economic activity. The Florida Division of Forestry has committed to providing more state riding areas to supply the demand. By opening more areas the DOF can potentially maintain the economic impacts and, by opening potential areas in rural areas, has the potential of producing riding areas that OHV participants want, while also spurring economic growth in underdeveloped rural regions.

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How Do Timber and Non-timber Products Coexist in Uneven-aged Forests?

An Econometric Approach

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Abstract

This paper investigates the joint production of timber and trees diversity for nonindustrial private forest owners using a micro-econometric household production model. Our economic model is based on the maximization of their utilities depending on the revenues of harvesting and the trees diversity with respect to technological and budget constraints. The global objective of the paper is to explain the links between some harvest strategies of forest owners, the unit prices variability and the observed diversity of trees. More precisely, we analyze (1) their demand of species diversity and their timber supplies, (2) the jointness in timber and non timber products.

We consider the forest owner in a multi-product framework where the different products are related to the species, their diameter and their quality. We use a database of some unevenaged forests in France for which several economic and ecological variables are regularly collected. We estimate a model of simultaneous equations using three-stage least square method by taking into account the problem of endogeneity of the tree diversity.

Our results allow to better understand the effective strategic behavior of the forest owner in uneven-aged forests concerning his production of joint timber and non-timber products.

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Changes in the Distribution and Size of Hardwood Sawmills in

Tennessee, 1989 to 2000

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Abstract

Over the last several decades hardwood lumber production has increased but the number of hardwood sawmills has decreased as mills have become larger. This trend is evident in Tennessee, as mills with production of 5 million board feet or greater accounted for 60 percent of sawmill capacity in 2000 compared to 46 percent in 1989. Prior studies have attributed this trend to smaller mills going out of business or increasing in size, i.e., expanding or exiting the market. However, in Tennessee, more than 40 percent of the mills in operation in 2000 were not in operation in 1989 and three of these new mills had production capacities approaching or exceeding 10 million board feet. Although there was some support for the expand-or-exit concept (many of the mills that remained in operation between 1989 and 2000 increased employment), most of the increase in new mills can be attributed to increased capacity in the plateau and eastern regions of the state. Timber in these regions had historically been less utilized than timber in the central and western portions of the state, allowing for expansion of the sawmilling industry. The plateau and eastern regions also contained relatively high quantities of red oak, a species that was highly utilized by the flooring, cabinet, and furniture industries in the 1990s.

Key Words: Hardwood, lumber, sawmill

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Introduction

Between 1989 and 1999, eastern hardwood lumber production increased by 11 percent (Luppold 2006) while the number of mills decreased (Luppold 1996). A similar pattern of industry concentration for the southern pine industries, as noted by Granskog (1978, 1989), was associated with increased economies of scale resulting from improved production technology. Other studies of the hardwood sawmilling industry have indicated that Granskog's findings may apply to the hardwood industry. Bush et al. (1987) found that larger mills tend to purchase more sophisticated and efficient equipment, which implies some economies of scale in production. Hammett et al. (1992) found that larger mills tend to have dry kilns and thus can sell both green and dried lumber. Hammett also found that larger mills have a larger sales staff and a greater tendency to export lumber, and may have economies of scale in distribution.

Theory infers that as more efficient sawing technology or timber procurement and distribution procedures are developed, existing mills could adopt these changes and become larger or eventually be forced out of the industry because of a comparative cost disadvantage. The expand-or-exit explanation seems especially relevant in the hardwood industry because the lack of information serves as a barrier to entry. The exception is micro-mills producing less than 500 thousand board feet per year (bdf/y). These mills appear and vanish as hardwood lumber prices cycle.

The expand-or-exit theory seems to explain changes in the hardwood sawmilling industry prior to the early 1990s (Luppold 1996). However, a recent examination of the 1989 and 2000 forest industries directories for Tennessee (Tenn. Dep. Conserv. 1991, Tenn. Dep. Agric. 2001) appears to challenge this theory. In this paper we examine changes in the hardwood sawmilling industry in Tennessee and contrast these changes by mill size and region. Regional changes in production are be examined in terms of relative utilization of the hardwood sawtimber inventory.

Changes in the Number of Mills

Table 1 presents hardwood mills existing in Tennessee in 1989, "new" mills in operation in 2000 that were not listed in the 1989 directory, total number of mills in operation in 2000, and the percentage of total mills represented by new mills. Existing mills include operations that have changed ownership or name but retained the address and/or phone number.

Over half of the new mills are micro-mills with 1 to 3 employees. Fifty-three percent of these mills listed band head rigs, which suggests that thin-kerf Woodmizer-type mills are displacing small circle mills. An additional 29 percent of mills built between 1989 and 2000 had 4 to 9 employees. While these firms could be producing large volumes of industrial products, such mills typically produce less than 2 million board feet per year (bdf/y). However, nearly 18 percent of the new mills had 10 or more employees, indicating full-time operations with production exceeding 2 million bdf/y. Three of the new mills are large operations with 50 or more employees.

Employee size class	Existed in 1989 ¹	New by 2000 ²	Total in 2000 ²	New as a percent of total
1 to 3	64	87	151	58
4 to 9	80	47	127	37
10 to 19	44	16	60	27
20 to 49	37	9	46	19
50 to 99	10	3	13	23
100 or >	1	0	1	0

Table 1. Number of mills existing in Tennessee in 1989 that are still operating, number of mills new by 2000, total number of mills in 2000, and new mills as a percent of the total mill operating in 2000, by size class.

¹Developed from Tenn. Dep. Conserv. 1991.

² Developed from Tenn. Dep. Agric. 2001.

Development of Capacity Data

One difficulty in analyzing changes in Tennessee's sawmilling industry is that the 1989 directory (Tenn. Dep. Conserv. 1991) classified mills into 8 capacity groups and 6 employment groups while the 2000 forest directory (Tenn. Dep. Agric. 2001) classified mills only by the 6 employment groups. Although mill size is related to employment, this relationship becomes less distinct in larger mills because of additional value-added enterprises, i.e., kiln drying and sorting. Mills with the same number of employees in 1989 and 2000 were assumed to have not changed in size unless an additional source of capacity data was available. Additional sources of information on mill capacity are the Hardwood Purchasing Handbook (2005), trade articles on specific mills, internet home pages, ads in trade publications, and individuals associated with trade publications. Estimated capacity developed from the 1989 directories and alternative sources were available for all mills with more than 50 employees, for 25 of 48 mills with 20 to 49 employees, and for 17 of 60 mills reporting 10 to 19 employees.

For new mills for which no information was available and existing mills that had changed in employment size classification, we estimated capacity using averages of capacities developed from the 1989 directory and alternative sources. Using this procedure we estimated that the remaining 23 mills with 20 to 49 employees each produced 7.9 million bdf/y, and the remaining 43 mills with 10 to 19 employees produced 3.4 million bdf/y. Mills with unknown capacities and with 3 to 9 employees were estimated to produce 1.2 million bdfy, while mills with 1 to 3 employees were estimated to produce 300 thousand bdf/y.

Changes in Lumber Production

Table 2 presents number of mills, production volume, and proportional production volume by size class in Tennessee for 1989 and $2000.^2$ Mills producing less than 1 million bdf/y decreased as the number of mills that went out of business exceeded the number of new mills. Most mills in this production category are micro-mills with 3 or fewer employees. However, more than 10 percent of the small mills employed 4 to 9 workers and produced 500 thousand to 999 thousand bdf/y.

Year	Less than 1 million	1 to 4.99 million	5 to 9.99 million	Greater than 10 million	Total				
		Number of mills							
1989 ¹	219	161	23	15	418				
2000^{2}	180	159	36	25	400				
		Production v	olume (millio	n bdf)					
1989 ³	70	405	173	225	873				
2000^{4}	62	358	237	368	1025				
Proportional production (percent)									
1989	8.0	46.4	19.8	25.8	100				
2000	6.0	35.4	22.6	35.9	100				
Average mill size (million bdf)									
1989	0.32	2.51	7.52	15.0	2.09				
2000	0.34	2.25	6.58	14.7	2.56				

Table 2. Number of hardwood sawmills in Tennessee and proportion of production by size class in million bdf/y, 1989 and 2000.

¹ Developed Tenn Dep. Conserv. 1991.

² Developed Tenn Dep. Agric. 2001.

³ Developed Tenn Dep. Conserv. 1991, using procedures described in Luppold 1996.

⁴ Developed Tenn Dep. Agric. 2001, using procedures described in text.

In 1989, production in intermediate size sawmills producing between 1 and 4.99 million bdf/y exceeded the combined volume of large mills producing between 5 and 9.99 million bdf/y and very large mills producing a least 10 million bdf/y. Between 1989 and 2000, absolute and relative production by intermediate-sized mills decreased while absolute and relative production in large and very large mills increased. This change was in part the result of new mills, but also was driven by existing mills increasing in size and moving up to the next production class. This resulted in a decrease in the average size of mills in the medium and large classes. Examination of mill data found that 62 of the mills that existed in 1989 increased by one or more employment group while 25 mills reported a decreasing number of employees.

² Volume estimates for 1989 are based on Luppold 1996.

Regional Changes in Estimated Capacity

Although production capacity in Tennessee hardwood sawmills increased by 150 million bdf/y (17.4percent) between 1989 and 2000, the change in production varies considerably by region as defined by the USDA Forest Service's, Forest Inventory and Analysis survey units (Figure 1). Capacity in the west and west-central regions increased modestly between 1989 and 2000 while capacity in the central region actually decreased. This is in stark contrast to the 29 and 84 percent increases in capacity that occurred in the plateau and east regions, respectively. A possible explanation for these changes is resource availability as indicated by the ratio of hardwood sawtimber to mill capacity. Lower ratios indicate higher apparent sawtimber utilization. As seen in Table 3, the higher ratio of inventory to mill capacity, the greater the growth in lumber capacity between 1989 and 2000.



Figure 1. Forest survey units for Tennessee.

The level of utilization is driven in part by species composition and quality, and the markets for specific species and qualities of hardwood lumber. The eastern region historically has contained greater volumes of hardwood and softwood sawtimber than the other regions, but much of this volume is in less desirable species such as chestnut oak and Virginia pine. By contrast, white oak grown in the central region has color and other growth attributes that are desirable. In 1989, high-quality white oak was being demanded by both Japanese and European buyers. This quality-to-market disparity partially explains why the ratio of inventory to capacity was 4.3 times higher in the east than in the central region.

Since 1989, domestic and international demands for higher quality appearance white oak have declined even though demand for barrel staves has increased. By contrast consumption of hardwood lumber in flooring production nearly tripled between 1991 and 2000, with red oak the preferred flooring species (Hardwood Mark. Rep. 2005). More than 35 percent of the select red oak and nearly a quarter of the other red oak sawtimber in Tennessee are in the eastern region (USDA For. Serv. 2006). The plateau region also contains relatively high quantities of red oak species as well as large quantities of hickory (USDA For. Serv. 2006), which was heavily used by the kitchen cabinet industry in the late 1990s (Hardwood Mark. Rep. 2005). The combination

of wood that is desired by the market and relatively low utilization rates apparently is the primary reason why sawmilling capacity increased in the east and plateau regions.

Year	West	West Central	Central	Plateau	East	
		Mill capac	ity (million bdf)		
1989 ¹	185	181	232	185	89	
2000^{2}	205	194	224	238	164	
	Change in mill capacity (percent)					
1989 to 2000	10.8	7.2	-3.4	28.6	84.3	
	Hai	dwood sawtim	ber inventory (million bdf)		
1989 ³	8,334	6,547	7,073	10,150	11,853	
2000^{3}	10,125	8,922	10,376	13,246	17,208	
		Ratio of inv	entory to mill c	apacity		
1989	45	36	30	55	134	
2000	49	46	46	56	105	

Table 3. Sawmill capacity in Tennessee, percent change in mill capacity, hardwood sawtimber inventory, and ratio of production to sawtimber inventory, 1989 and 2000

¹ Developed Tenn Dep.. Conserv. 1991, using procedures described in Luppold 1996.

² Developed Tenn. Dep. Agric. 2001, using procedures described in text.

³ Source: USDA For. Ser. 2006.

Of the three very large mills built in Tennessee since 1989, the largest operating in 2000 was built in the east region (Hard Purchasing Handbook 2005). The second largest new mill was built in the plateau region and is associated with a large pallet operation (TimberLine 2001) and a pulpwood operation (Tenn. Dep. Agric. 2001). The third largest mill was built by a pulp and paper company in the west region (Tenn. Dep. Agric. 2001), apparently to use the better logs that were harvested for pulpwood production. Although initially owned by a paper company, this mill has been sold at least once and currently is controlled by a firm that operates sawmills in several states. The west also was the only region to lose a mill employing 50 or more people.

Conclusion

In this paper we examined changes in the hardwood sawmilling industry in Tennessee and contrasted these changes by mill size and region. Luppold (1996) suggested that change in industry concentration has followed an expand-or-exit pattern with few new mills emerging other than small micro-mills that seem to emerge and vanish with the hardwood lumber cycle. Micromills always have been a fluid part of the industry, but these mills have become relatively less important in overall production. Our analysis did find some support for the expand-or-exit concept as many of the mills that remained in operation between 1989 and 2000 increased employment. However, most of the increase in new mills can be attributed to increased capacity in the plateau and eastern regions of the state. Timber in these regions historically has used less than timber in the central and western portions of the state, allowing for expansion of the sawmilling industry. Also, the plateau and eastern regions contain relatively high quantities of red oak, a species that was highly utilized by the flooring, cabinet, and furniture industries in the 1990s.

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Regional Shifts in Hardwood Lumber Production: 1984 to 2003

William G. Luppold and Matthew S. Bumgardner¹

Abstract

Between 1984 and 1999 production of eastern hardwood lumber increased by nearly 3 billion board feet. Since 1999, the hardwood lumber industry has suffered 4 years of declining production and demand before experiencing a small increase in 2004. However, the production increases and decreases have not been uniform among states and regions. Recognizing regional differences in hardwood lumber production is important because the hardwood industry is a collection of individual mills that with access to different timber species and markets. Furthermore, the demand for and relative price of specific species have changed continually over the last 20 years. Understanding how prices, markets, and timber availability have influenced regional hardwood lumber production over the last two decades may be useful when assessing future timber demand. We examine changes in hardwood lumber production to changes in demand by major end-use markets.

Key Words: Hardwood, production, demand

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Introduction

Between 1984 and 1999 production of eastern hardwood lumber increased by nearly 3 billion board feet (bbf) (Figure 1). More amazingly, hardwood lumber production in the 1990s was 10 percent higher than the previous peak period of 1904 to 1913. Since 1999, the hardwood lumber industry has suffered 4 years of declining production and demand before experiencing a small increase in 2004. However, the production increases and decreases have not been uniform among states and regions.

Figure 1.-- Eastern hardwood lumber production 1982 to 2004 (developed using procedures described in Luppold and Dempsey 1989, 1994).



Recognizing regional differences in hardwood lumber production is important because the hardwood industry is a collection of individual mills with access to different timber species and markets. Furthermore, the demand for and relative price of specific species have changed continually during the last 20 years. Understanding how prices, markets, and timber availability have influenced regional hardwood lumber production over the past two decades may be useful when assessing future timber consumption in these regions. However, it is difficult to define hardwood regions because data on lumber production are developed on a state basis. Also, the hardwood resource and markets can vary within a state and have changed over time. In this paper we examine change in lumber production in the northern, west central, central Appalachian, and southern hardwood regions (Figure 2) that have been delineated based on forest composition. Figure 2-- The northern, west central, central Appalachian, and southern hardwood regions.



Regional Differences in the Timber Resource

The states in the northern region contain significant quantities of softwood timber, but hardwood species account for more than two-thirds of the regional sawtimber inventory (Table 1). Hard maple, soft maple, and select red oak (primarily northern red oak) are the most plentiful hardwood species within this region. Cooler temperatures and slower rates of growth contribute to a relatively small average diameter of timber in this region though slow growth rates also result in lumber with a high ring count, smooth texture, and other appearance attributes that have commanded higher prices. The northern region accounts for about 29 percent of eastern hardwood sawtimber inventory.

While sawtimber inventories have increased in all regions, the northern and west central regions have experienced greater increases than the central Appalachian and southern regions. However, it should be noted that there are inconsistencies in sawtimber volume data. For example, estimated hardwood sawtimber inventory in Missouri has increased nearly 220 percent since 1977, but nearly half of this increase apparently is the result of redefining cull trees as sawtimber (Luppold and McWilliams 2000). Timber inventories for Mississippi and Florida have not been completed since 1994 and 1995, respectively, while sawtimber inventories in most eastern states have been estimated since 2001.

Characteristic	Northern	West Central	Central Appalachian	Southern
Democrat hondress of 1	(()	01.1	77 5	
	00.8	91.1	//.3	40.0
Average diameter (inches)	16.5	18.1	18.4	18.8
Total volume 2005 (billion bf)	314.6	226.4	253.0	290.0
Total volume 1977 (billion bf) 2	149.0	94.8	149.3	170.2
Change in volume (percent)	110.8	138.5	69.5	66.5
Composition of hardwood inventory (percent) ¹				
Select white oak	5.4	17.7	11.3	9.5
Other white oak	2.1	8.3	7.8	7.6
Select red oak	13.0	7.0	8.0	5.7
Other red oak	4.7	16.0	10.5	26.8
Hard maple	14.8	3.5	3.2	0.2
Soft maple	17.0	4.2	7.4	2.9
Yellow-poplar	2.2	11.0	22.2	7.3
Sweet/black gum	0.3	2.8	6.8	21.8

Table 1. -- Regional characteristics of sawtimber inventories, 2005

¹ USDA For. Serv. 2006.

^{2} Powell et al. 1994.

The composition of forests in the west central region is overwhelmingly hardwood; true white oak and black oak are predominant. Many states in the central region also contain hard and soft maple. The average diameter of the sawtimber in this region is larger than that in the northern region. However, the ring count, texture, and color of the lumber produced in this region varies among and within individual states. The west central region accounts for 21 percent of the eastern hardwood sawtimber inventory.

Yellow-poplar, red oak, and white oak are the most abundant species in the central Appalachian region, which also contains smaller quantities of hard and soft maple. The average diameter of timber in this region is relatively high due to the presence of yellow-poplar and numerous oak species that regenerated before 1950. This region accounts for 23 percent of eastern sawtimber volume.

The southern region contains nearly equal amounts of hardwood and softwood sawtimber, including relatively large quantities of mixed red oak species and mixed gum species. Two species groups, other red oaks and sweet/blackgum, account for nearly half of the entire hardwood inventory. Warmer temperatures in this region allow timber to grow faster, as reflected in the relatively high average diameter. However, faster growth causes lower ring counts and grainy textures. The southern region accounts for more than 27 percent of the eastern hardwood sawtimber inventory.

Changes in Hardwood Consumption

There are two general markets for hardwood lumber: appearance and industrial. Lumber used in appearance applications such as furniture, millwork, cabinets, and flooring have a higher value than lumber used for industrial applications. Most exports of hardwood lumber are mid to high value material for appearance applications. Hardwood lumber used in industrial products such as pallet and crossties are primarily derived form the center portion of saw logs or lower quality timber.

Between 1982 and 1991, about 50 percent of hardwood lumber was used for appearance applications (Table 2). Since this period, the hardwood flooring industry has grown, resulting in the increased use of lower grade oak lumber for this application. Concurrently, increased recycling of pallets and pallet material has caused relative demand for industrial lumber to decline to 40 percent. However, lumber use in appearance applications has changed considerably.

Industry	1982 ¹	1987 ²	1991 ³	1999 ⁴	20034	
, and a second sec						
	million board feet					
Furniture	2,178	2,547	2,198	2,600	1,600	
Millwork	604	912	789	1,300	1,300	
Cabinets	562	1,085	955	1,200	1,400	
Flooring	265	476	526	1,400	1,500	
Exports	325	688	850	1,200	1,200	
Pallets	2,900	4,513	4,704	4,500	4,000	
Railroad ties	819	781	600	700	800	
Total	7,653	11,002	10,622	12,900	11,800	
			percent			
Furniture	28.5	23.2	20.7	20.2	13.6	
Millwork	7.9	8.3	7.4	10.1	11.0	
Cabinets	7.3	9.9	9.0	9.3	11.9	
Flooring	3.5	4.3	5.0	10.9	12.7	
Exports	4.2	6.3	8.0	9.3	10.2	
Pallets	37.9	41.0	44.3	34.9	33.9	
Railroad ties	10.7	7.1	5.6	5.4	6.8	

Table 2. -- Actual and relative hardwood lumber consumption by major industry groups 1982, 1987, 1991, 1999, and 2003 in millions of board feet volume (MMBF) and relative change (percent)

¹ Luppold 1993, with 70, 20, and 10 percent of dimension assigned to furniture, cabinets and millwork, respectively.

² Luppold 1993, with 55, 30, and 15 percent of dimension assigned to furniture, cabinets and millwork, respectively.

³ Luppold 1993, with 55, 30, and 15 percent of dimension assigned to furniture, cabinets and millwork, respectively.

⁴ Hardwood Mar. Rep. 2005.

In the mid-1980s, the use of hardwood lumber for furniture manufacturing exceeded the combined uses for lumber in all other appearance applications plus exports. Between 1982 and 1999 lumber use for furniture production cycled between 2.2 and 2.6 bbf per year. During this period lumber use for all other appearance applications increased primarily due to the desire for hardwood material for housing fixtures (cabinets, millwork, and flooring). Since 1999 lumber use by the furniture industry has declined as imports from China have decimated domestic manufacturing in this industry. Still, demand for all other appearance application has remained steady or has increased.

Shifts in Regional Lumber Production

Because of the cyclical nature of hardwood lumber production, it is important to examine changes in production between portions of this cycle. Table 3 shows regional changes in lumber production between three peak production periods: 1984, 1990, and 1999, and between the most recent major peak (1999) and low point (2003). Between 1984 and 1990, production of eastern hardwood lumber increased by 1.8 bbf but nearly 50 percent of this increase occurred in the west central region (Table 3, Figure 3). The driving factor behind this increase was demand for red oak by domestic furniture, cabinet, and millwork manufacturers and increased international and domestic demand for white oak. Mills in this region could increase production as a result of increasing sawtimber inventories.

	1984 - 1990		1990 - 1999		1999 - 2003	
	Volume	Relative Change	Volume F	Relative Change	Volume	Relative Change
Region	(MMbf)	(percent)	(MMbf)	(percent)	(MMbf)	(percent)
Northern	536	21.3	432	14.1	-605	-17.3
W Central	882	39.9	301	9.7	-408	-12.0
Central Appalachian	369	15.2	381	13.6	-439	-13.8
Southern	2	0.0	18	0.1	-339	-13.2
Total	1,789	18.5	1,132	9.9	-1,791	-14.2

Table 3. -- Regional changes in hardwood lumber production for 1984-1990, 1990-1999, and 1999-2003, in millions of board feet volume (MMBF) and relative change (percent) (developed using procedures described in Luppold and Dempsey 1989, 1994).

Lumber production increased in the northern region, but more than two-thirds of this increase occurred in Pennsylvania. This increase was facilitated by the 150-percent increase in sawtimber volume in this state since 1977 (USDA For. Serv. 2006, Powell et al. 1994). Lumber production also increased in the central Appalachian region with the largest increases in North Carolina and Ohio. The driving factor behind these increases was demand for red oak and white oak in domestic and international markets. During this period, the central Appalachian region and Pennsylvania had considerable quantities.

Figure 3 – Hardwood lumber production in the northern, west central, central Appalachian, and southern regions, 1984 to 2004 (developed using procedures described in Luppold and Dempsey 1989, 1994).



of larger diameter red oak with the ring count and other physical characteristics desired by the market. Since 1977, relative oak sawtimber inventory in Pennsylvania has declined from 48 to 33 percent and maple volume has increased (USDA For. Serv.2006, 1982).

While lumber production in other regions was expanding in the late 1980s, southern lumber production was stagnating. In the 1950s and 1960s much of the red oak lumber produced in this region was used for flooring and cross ties. During this period, flooring production remained at relatively low levels and there were relatively few new domestic or international markets for southern oak and gum species.

Between 1990 and 1999, production of eastern hardwood lumber rose by more than 1.1 bbf. Demand for red oak by furniture, cabinet, and millwork producers remained stable, while exports of white oak to Europe and Japan declined. By contrast, demand for maple by domestic and international users increased during this period and flooring producers emerged as a major consumer of lower and mid grade red and white oak. The strong demand for red oak and maple caused lumber production to increase in all regions; the increase was greatest in the maple-rich northern region.

Between 1999 and 2003, production of eastern hardwood lumber declined by nearly 1.8 bbf. One-third of this decline was in the northern region. This was unexpected given the high price of maple during this period. However, maple is only one component of the northern forest, and while maple production increased, production of red oak and other species has decreased since 2003. Also, during the last 20 years, timber costs have been higher in the northern region than in the other regions primarily because lumber from slower grown timber has been preferred by cabinets, millwork, and furniture consumers.

Lumber production in the west central and central Appalachian regions decreased as domestic demand for furniture and pallet lumber decreased, though demand for flooring lumber increased slightly. The continual demand for red oak by the flooring market cushioned the
decline in lumber production in the southern region, but the reduced demand for frame stock and other products used by domestic consumers also resulted in reduced southern production.

Conclusion

This brief analysis demonstrates that regional shifts in hardwood lumber production result from an interaction of the composition and attributes of the sawtimber inventory and from changing demands. Many of the changes in demand over the past 20 years would have been difficult to project and predicting future changes in demand will continue to be problematic. However, several known aspects about the hardwood resource and market can provide insight on how production may change in the future. Sawtimber supply and quality seems the best predictor of long-term regional production trends. Species diversity also seems a good indicator of regional production as style trends can affect regions with a small number of species that cycle in and out of popularity. Therefore, states with higher quality timber and a broad composition of species may experience more consistent production.

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Consumer Choices of Outdoor Garden Wooden Decking

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Abstract

Consumer choices of outdoor garden wooden decking depend on personal preferences but also on the usage context, the information provided and price. Using the hedonic sensory analysis approach, the present study deals with the issue of A) how preferences are modified by information about the wooden decking samples, their price, origin and treatment and B) how preferences, of different types of wooden decking are contingent on usage context. The results imply that the usage context and knowledge/information about the wood product all have influence on preference.

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Comparison of Private Forestry in Florida and New Brunswick:

Implications for Canada-US Softwood Lumber Dispute

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Abstract

Growing concerns for the protection of public forests have been prompting the expansion of private forests in the United States and Canada. Both countries have been implementing a host of regulatory and incentive policies to ensure sustainable forest management. These policies will not only address negative and positive externalities associated with timber and non-timber products production, but will also influence the profitability of forestry and, thus, the timber supply. A comparative advantage in the form of regulatory or incentive policies for private forestry would add fuel to the on-going Canada-US softwood lumber trade dispute. In the study reported here, we conducted a systematic comparative analysis of institutions and policies influencing private forestry in the US and Canada using case studies from Florida and New Brunswick, in both of which private forestry is significant. Our study concluded that though the regions share a similar burden of regulation, the marketing services and cost-share programs in New Brunswick are more extensive than those offered in Florida. The qualitative results of our analysis help reduce the potential for the extension of the current trade dispute to the private sector.

Key Words: Analysis, institutions, policy, United States, trade

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Introduction

The past two decades of softwood lumber trade between the United States (U.S.) and Canada have hosted the longest and largest trade dispute in the countries' histories (Cashore, 1997). The dispute, which is predominantly localized to the trade of timber harvested on public lands, was catalyzed by Canada's increased share of the U.S. market due to a reduction in the supply of timber from U.S. public forests (Cashore, 1997). Some scholars claim that this reduction was caused, in part, by increased environmental regulations in U.S. forestry (Cashore, 1997). Legislation can similarly lead to a reduction in timber harvests on non-industrial private forests (NIPF), which are increasingly important suppliers for global timber markets as harvesting on public lands dwindles (Ellefson & Cheng, 1997; Rosen & Kaiser, 2003). This trend has been widely documented; in 1996, NIPF owners accounted for 59% of timber harvests in the U.S. while harvests in national forests constituted just 5%, a full 8% less than their share just 10 years earlier (Rosen & Kaiser, 2003). The supply of timber form Sindustry land declined by 6% (Rosen & Kaiser, 2003). The supply of timber from NIPFs in recent years has become crucial (Haines, 2005).

In the context of the U.S. and Canada's longstanding softwood lumber dispute, the growing dependence on the products of NIPFs, and the evidence of the potentially significant effects of regulation on wood supply, a comparative study of the policies affecting private forestry in the two countries is valuable. This paper presents a case study that outlines and compares the organizations, programs, and policies that affect private forestry in Florida and New Brunswick, where private forestry is significant. The study's primary purpose is to reduce the potential for the current trade dispute expanding to the rapidly growing private sector by providing an improved understanding of the programs and policies in place in both regions. However, it is critical to recognize that there is remarkable variation between states and regions when it comes to regulatory programs for forestry (Ellefson & Cheng, 1997). Thus, one must use discretion when extrapolating the findings of this study to more extensive contexts.

Section 1 focuses on the structure of the forestry communities in both regions. Section 2 details the support provided to NIPF owners by governmental and nongovernmental organizations, Section 3 describes incentive and assistance programs (including specific tax provisions for NIPFs), and Section 4 discusses regulatory policies. These four dimensions represent the significant sources of external influence on the productivity of private forestry; together they provide an excellent base for a holistic comparative analysis.

1. NIPF Demographics and Physical Resources

To demonstrate the utility of a case study of Florida and New Brunswick, some background information on the demographics and physical resources of the regions is in order. The most significant information is perhaps the following: while the proportion of NIPF ownership to total timber land in Florida is the lowest of any southern state (as of 1995), the percentage of NIPF ownership in New Brunswick (30%) is comparatively high (private ownership for Canada as a whole is only 6%) (Brown, 1999; CFS, 2005). This case study is thus not representative of private forestry, in general, in the two countries – today. However, the forecasted growth of private forestry promises to create an environment in which private forestry is comparably pervasive in the states and provinces of the U.S. and Canada. Thus, in anticipation, this study compares a state and province in which the

percentage of NIPF ownership to total timberland is similar and in which the acreage of commercially productive forestland is nearly identical. Some statistics on the characteristics of forestry in the two countries are provided in Table 1 and Figure 1.

	Florida	New Brunswick
Forest cover	16.2 mi. ac (47% of land base)	15.4 mi. ac (85% of land base)
Commercially	14.74 mi. ac	14.6 mi ac
productive forestland		
Share of NIPF	53%	30%
ownership	(8.59 mi. ac)	(4.62 mi. ac.)
Forest employment	132,000	18,000
Softwood share	50%	68%
Avg. annual softwood	199 mi. ft ³	74.2 mi. ft^3
harvest from NIPFs		
Avg. NIPF land size	69% own < 9 ac	100 ac

Table 1Statistics relating to forestry in Florida and New Brunswick.

Value of NIPF timberUS\$382.4 million (2003) Can103 mi (2001)^1$ Note. From Carter and Jokela, 2002; NBFPA, 2005; INFOR, 2005.



Figure 1. Forest ownership by sector, represented as a percentage of the total forestland in New Brunswick and Florida.

Note. From Carter and Jokela, 2002; Hodges, Mulkey, Alavalapati, Carter & Kiker, 2005; NBFPA, 2005; INFOR, 2005.

Although Florida's total land mass is double the size of New Brunswick's, the regions contain a nearly equal number of acres of commercially productive forest land; Florida has 14.7 million acres and New Brunswick has 14.6 million acres. However, because of their difference in total landmass, only 42.3% of Florida's land is productive forestland compared to 80% of New Brunswick's. An obvious conclusion is that the economy of New Brunswick

¹ At the time of this writing, September 2005, 1.00 U.S. dollar= 1.13 Canadian dollars, at an exchange rate of 1.1785 (Bank of Canada 2005).

is vastly more dependent on forestry than is Florida's, where the tourism industry claims to hold the largest stake (Hodges, Mulkey, Alavalapati, Carter & Kiker, 2005). For example, in New Brunswick, fourteen communities are entirely dependent on the forest industry for economic survival and approximately 40 others rely greatly on forest-related business; NIPF lands provide 25% of the province's wood requirements (INFOR, 2005). Although New Brunswick's economy is more closely linked to the forestry industry, it is important to note that a larger percentage of Florida's forests are privately owned; NIPF owners in Florida own 8.59 million acres of forests, while NIPF owners in New Brunswick own 4.5 million acres.

2. Organizational Support

The forestry communities of Florida and New Brunswick are equipped with an organizational infrastructure of governmental and non-governmental institutions. The creation of policy is an essential first step; the job of ensuring the landowner's awareness of its existence and understanding of its complexities is equally crucial. We assume that the efficiency and effectiveness with which organizations carry out this task correlates directly with the level of participation in offered programs and compliance with regulations. However, the nature of the two communities' organizations differs greatly; these differences may lead to potentially significant impacts on the institutional capacity to transfer services and information to NIPFs and, subsequently, on the productivity and profitability of the forestry communities. Thus, it is important to this study to examine the organizations and their subsequent roles in the operations of NIPFs. Table 2 delineates the most pervasive institutions in Florida and New Brunswick and briefly defines their roles in providing services to NIPFs in terms of education, practical management, and marketing assistance.

Table 2	
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New Brunswick	Primary Role in Non-Industrial Private Forests			
Organizations				
	·Federal organization.			
	·Focuses on broad issues of national and international concern and provides			
Canadian Forest Service	little direct guidance to NIPF owners.			
(CFS)	•As early as 1981, the CFS recognized the lack of attention given to private			
	woodlots and proposed a more proactive role for the organization in			
	enhancing the private woodlots' contribution (Reed, 1981).			
	·Provincial organization.			
Department of Environment	·Responsible for wetland legislation.			
And Local Government	·Source for applications for Watercourse Alteration Permits.			
·Authority for enforcing compliance with permit stipulations.				
·Seven non-profit, non-governmental organizations				
Forest Products Marketing	·Seek to guarantee that woodlot owners of varying sizes secure a fair share			
Boards	in available markets by negotiating prices, contracts and market access for			
	NIPF owners (INFOR, 2005).			
	·Umbrella organization of the marketing boards.			
New Brunswick Federation Represents the concerns of woodlot owners to government and fac				
Of Woodlot Owners	communication between seven marketing boards (INFOR, 2005)			
	Private organization- receives funding, in part, from the provincial			
INFOR	government			

Summary of the most influential institutions and the services they provide to NIPF owners in Florida and New Brunswick.

	Dravidas information consulting and technical services to NIDE owners		
	Provides information, consulting and technical services to type to owners.		
	·Publishes Best Management Practices Manual		
Florida Organizations			
	·Federal organization.		
	·Main function is forestry research.		
U.S. Forest Service	·The Forest Service's State and Private Forestry Organization is the self		
	proclaimed "federal leader" in providing technical and financial assistance		
	to landowners (U.S. Forest Service, 2005).		
	·State organization.		
	·Administers federal cost-share and grant programs, technical services, and		
	landowner training and educational events.		
	·FDOF's County Foresters provide assistance to owners of 10 or more acres		
Florida Division of Forestry	of forested land; this includes a forest management plan, information on the		
(FDOF)	timber market, a timber buyer list, a master logger list, a forest consultant		
	list, a prescribed fire management plan.		
	•Monitors compliance of Florida's Best Management Practices; since 1981,		
	the division has conducted biennial Compliance Surveys (Florida Division		
	of Forestry [FDOF], 2005).		
	·Five state organizations		
Water Management	·Serve as the primary regulatory agencies for forestry in Florida.		
Districts (WMD)	·Authority for all water-related regulations within their district's		
	jurisdiction.		
	· Non-governmental organization		
	· Provides educational programs for paid members		
Florida Forestry Association	· Authors the "Environmental Law Manual"- a comprehensive catalogue of		
	the legislation regulating forestry activities		
	· Lobbies for the interests of NIPF owners		
	·Outreach arm of the University of Florida		
University of Florida	•An extension agent is assigned to each county who conducts educational		
Cooperative Extension	programs, answers landowners' questions and distributes forestry		
Service	publications.		
	·Provides timber pricing report. Timber Mart South.		

Analysis

The NIPFs of both Florida and New Brunswick possess a comprehensive body of public and private institutions. Forestry activities in both regions are supervised by a federal Forest Service with broad national goals, a state or provincial body with a largely administrative role, and numerous local institutions equipped with valuable resources for education and assistance. Though the regions' chief differences in terms of organizational structure are evidenced in their non-governmental organizations, it is important to note that the levels of involvement of public agencies in the activities of NIPFs vary significantly. While the USDA Forest Service has formed a State and Private forestry organization, the Canadian Forest Service has no equivalent. This trend is similarly apparent in the state and provincial agencies; the Florida Division of Forestry's mission statement directly instructs the agency to "encourage the active management of Florida's private non-industrial forest lands" while the New Brunswick Department of Natural Resources' (NBDNR) role in private forestry is relatively limited (FDOF, 2004). In terms of forestry, this provincial body's primary duty is to regulate the management of New Brunswick's Crown (public) forests (NBDNR 2005). The duties of the FDOF, however, are comparable to those of the

marketing boards and the New Brunswick Federation of Woodlot owners, which have no Floridian equivalent.

Marketing Services

Sanctioned by a regulation under the Natural Products Act, New Brunswick's seven forest product marketing boards are involved most directly and intensively in private forestry operations there. The Act (1999) orders "[...] that a board be established for the purpose of the promotion, control and regulation [. .] of the marketing of the farm product," which includes a "product of the forest." The central goal of the marketing boards is to guarantee that woodlot owners of varying sizes secure a fair share in the available markets by negotiating prices, contracts, and market access for NIPF owners who market primary forest products (INFOR, 2004). By setting standards and providing funding, the federal and provincial governments give agency to the marketing boards to enforce environmental laws and regulate the production of forest products; the boards present significant interventions to the activities of NIPF owners (MacNaughton, 1996). The secretary manager of the New Brunswick Federation of Woodlot Owners estimated that "70% of people who market wood in New Brunswick utilize the services of marketing boards" (K. Hardie, personal communication, 2005). Since the boards are non-profit, non-governmental organizations, they cover administration costs by collecting a percentage of levies from the sale of primary forest products (INFOR, 2005). For example, the Southern New Brunswick Forest Products Marketing Board (SNB) charges NIPF owners a check-off fee of \$.50/cord for softwood/hardwood pulp and studs (SNB, 2005). Additionally, marketing boards administer the Provincial Silviculture Program and finance several other programs, as discussed later, which are designed to encourage better management of woodlots.

The marketing services represent the most significant source of disparity between the institutional services available to NIPF owners in Florida and New Brunswick. Although the county foresters from the FDOF, upon request, will provide NIPF owners with information regarding the current timber market, a timber buyer list, and sample contracts, contact between professionals and NIPF owners in the U.S. is extremely limited (Rosen & Kaiser, 2003). Studies have consistently shown that most NIPF owners do not solicit professional forestry help when marketing their timber, but instead allow loggers to conduct the entire sale without requiring any competitive bidding (Rosen & Kaiser, 2003). Dave Conser, Alachua County forester, estimates that 30% of Florida's NIPF owners hire consulting foresters to market their timber, 30% look to the Division of Forestry for assistance and the remaining 40% "stumble through the process without any guidance whatsoever" (personal communication, January 25, 2006). Again, in New Brunswick, an estimated 70% of NIPF owners allow marketing boards to market their timber. Most notably, Rosen and Kaiser (2003) conclude that the key reason most NIPF owners in the U.S. do not participate in timber markets is their "lack of knowledge about how timber markets work." They suggest that there is a vital need in the current market reporting system to transfer information from forestry professionals to the millions of forest landowners (Rosen & Kaiser, 2003). Marketing boards fill this void in New Brunswick.

While it is apparent that marketing boards are a source of "valuable services," it is important to consider the "frustrating constraints" they may provide for NIPF owners and wood producers (MacNaughton, 1996). MacNaughton (1996) contends that the boards' system of issuing delivery tickets to individuals who desire to sell their wood to a wood processor allows them to determine how much wood will be harvested from the NIPFs in their region. For example, if a woodlot owner is unable to sell his/her wood without a sales contract negotiated by a marketing board (this is usually the case despite the prescribed "voluntary" nature of marketing boards), then the individual is forced to agree to a marketing board's conditions (relating to the volume and species of timber to be sold) in order receive a delivery ticket (MacNaughton, 1996).

Despite the potentially significant influence that marketing boards exercise over private woodlots through their role of controlling market access, the benefits of their services significantly outweigh the costs of their absence in Florida. Conser stressed that the NIPF owners who market their timber without assistance suffer "huge economic losses" as they "rarely get the full value for their timber" (personal communication January 25, 2006). Thus, it is reasonable to conclude that New Brunswick's forest product marketing boards, which negotiate prices, contracts, and market access for their constituents for a relatively small price, place New Brunswick's NIPF owners at a comparative economic advantage to Florida's NIPF owners.

Education

The educational services available to NIPF owners in both regions are appreciable, though it appears that Florida leads in this area. Florida cooperative extension (FCE)—a "partnership" between the University of Florida's Institute of Food and Agricultural Sciences, the U.S. Department of Agriculture and Florida's county governments—is a significant source of "scientific knowledge and expertise" for Florida's NIPF owners (IFAS, 2006). The FCE administers an online library of publications centering on technical matters of forest management, sustainable agriculture, competitiveness in world markets, and natural resource conservation (IFAS, 2006). The FCE has created a website for each county in Florida that directs landowners to education materials and programs.

Tom Beckely, professor at the University of New Brunswick explains that "until the late 1990s, when a conservative government eliminated it as a cost-cutting measure, New Brunswick had an extension branch as part of its Department of Natural Resources and Energy (DNRE)" (personal communication, January 20, 2006). As opposed to the U.S., this was a solely government endeavor with minimal ties to the University (T. Beckely, personal communication, January 20, 2006). INFOR, a "quasi-private, quasi-public extension service run on a thin budget, mostly on a fee-for-service basis," now manages the significant extension library previously amassed by the DNRE's extension service (T. Beckley, personal communication, January 20, 2006). The organization strives to provide NIPF owners with the information they need, "but is limited in it's ability to have a 'field presence'" (T. Beckley, personal communication, January 20, 2006).

3. Assistance Programs and Tax incentives

In order to overcome two main barriers for optimal investments in NIPFs, lack of upfront capital and low expected rates of return, the governments of the U.S. and Canada have instituted cost-share assistance programs to help stimulate NIPF investment by reducing landowners' initial costs for reforestation and improving rates of return (Haines, 1995). Several studies have concluded that cost-share assistance programs have proven to be effective mechanisms for increasing the productivity of NIPFs (Haines, 1995; Kilgore & Blinn, 2002). In fact, "technical assistance, educational, and cost-share programs account for 88% of all state and provincial programs directed at encouraging forest landowners to use the practices suggested in their guidebooks" (Kilgore & Blinn, 2002). Preferential tax treatment of NIPFs is also an important tool for influencing management decisions (Hibbard, Kilgore, & Ellefson, 2003). It is critical for this study to examine the extent of each country's efforts to ease the economic burdens of timber production.

This section focuses on cost-share programs and specific taxation provisions that are directed at enhancing the productivity, and subsequent profitability of private forestry operations.² Considering the voluntary nature of the assistance programs, it is important to note that economic rationality often accompanies mimetic effects, peer pressures, and sense-making in the decision of landowners to adopt regulatory incentives (Heeks & Duncombe, 2003). In other words, though cost-share programs may be a practical business decision for many NIPF owners, the economic viability of a program does not ensure a high participation rate.

Florida: Forest Land Enhancement Program

The Forest Land Enhancement Program (FLEP), implemented by the Florida Division of Forestry, is the only cost-share assistance program directed at increasing the productivity of NIPFs in Florida. The goal of FLEP is to "enhance the health and productivity of the non-industrial private forest lands in the United States for timber, habitat for flora and fauna, soil, water, and air quality, wetlands, and riparian buffers." (FDOF, 2005). These multiple objectives are evidenced by the types of activities funded by the program, which are listed in Table 3. The federally funded FLEP allocates money to the states, which are given the authority to tailor the program to address the state's specific needs. In Florida, private landowners with possession of 10 to 10,000 acres of forested land and a forest management plan are eligible to apply for the program, which covers either 50% or 75% of the cost of specified activities (FDOF, 2005). NIPF owners must agree to partake of these activities for 10 years, may treat up to 1,000 acres of their forestland per year, and may receive no more than \$100,000 of the program's total \$100 million in funds for the life of the Farm Bill (USDAFS, 2005; FDOF, 2005).

Table 3

² This section does not address the host of programs which primarily seek to promote wildlife, land, and water conservation. A survey of programs with this goal reveals that they are more prevalent in Florida. The state-sponsored Landowners Incentives Program, and the 2002 Farm Bill conservation programs such as the Wildlife Habitat Incentive Program, the Environmental Quality Incentives Program, and the Conservation Security Program are just a few of the voluntary programs that are designed to improve wildlife conservation and environmental quality in Florida by providing economic incentives and compensation for conservation practices on NIPFs. Also, the loss of forest land in the non-industrial private sector of Florida has been offset by public land purchases by conservation programs (Hodges, Mulkey, Alavalapati, Carter, & Kiker, 2005).

PWSAP Cost- Share	New Brunswick	Florida FLEP	FLEP Cost-
Rate	PWSAP Practice	Practice Title	Share Rate
	Title		
80%	Pre-commercial	Reforestation/Afforestation	75%
	thinning		
80%	Mechanical plantation	Forest stand improvement	75%
	cleaning		
80%	Fill planting	Water quality	75%
		improvement	
80%	Full planting	Fish and wildlife habitat	75%
80%	Site Preparation	Forest health and	50%
		protection	
	Plantation and/or	Fires and catastrophic risk	
80%	natural stand	reduction	75%
	chemical release		
80%	Woodlot management	Fires and catastrophic	75%
	recommendations	event rehabilitation	

FLEP and PWSAP cost share rates for corresponding management practices.

Note: From FDOF, 2005 and NBDNR, 2005

New Brunswick: Private Woodlot Silviculture Assistance Program (PWSAP)

Canada's counterpart to America's FLEP is the Private Woodlot Silviculture Assistance Program, which is administered by Natural Resources Canada and delivered to landowners through the seven forest products marketing boards. Funding for the program, which comes from both the provincial and federal governments, has grown dramatically; in 1993, \$3 million was spent on the treatment of 5,248 hectares — in 2004, \$7.2 million was spent on the treatment of 11,902 hectares of NIPF (NBDNR, 2005). For 2005, the program covered 80% of the estimated total cost of approved activities, which are listed in Table 3; the additional 20% was paid either by the marketing boards through a check-off fee system, or by the landowners directly (NBDNR, 2005). In fact, most boards provide additional funding to complement the government program to further reduce the landowner's out-of-pocket cost (SNB, 2005).

With funding from industry and check-off fees from commercially sold timber, six of the seven marketing boards also administer a unique set of programs and incentives for the woodlot owners within their jurisdiction. Figure 2 illustrates the opportunities offered to landowners by one marketing board, the Carelton-Victoria Forest Products Marketing Board.

•<u>Member statistics</u>: Every year, the Carleton-Victoria marketing board markets wood or carries out forest management activities for over 500 private woodlot owners. Administration costs are covered by a 1.7% levy that is deducted from all sales of primary forest products from within the CVMB regulated area.

•<u>Harvest bonus</u>: St. Anne-Nackawic Pulp Company Ltd. provides funding each year to the Carleton-Victoria Forest Management Fund. Part of this fund is used to pay a bonus of \$3.50 per ton to wood producers who use a selection harvest to treat tolerant hardwood stands. This program intends to ensure that quality in these types of stands is improved and that good quality hardwood stands are treated in a sustainable fashion.

•<u>Management plan</u>: The Forest Management Fund covers 88% of the cost of having a management plan written. The cost to the woodlot owner is only \$1 per acre of land that is or is planned to be put into forest production (ie. reforestation of fields).

•<u>Managed woodlot bonus</u>: Woodlot owners are paid \$10 per acre on up to 20% of the woodlot area per year for following the recommendations and timing that is prescribed in their management plans.

Figure 2. Programs offered to NIPF owners by the Carelton-Victoria Forest Products Marketing Board in New Brunswick.

Note: From Carleton-Victoria Marketing Board [CVMB], 2005

Analysis

The impetus for the creation of the PWSAP explains the narrow focus of its approved activities compared with those of the FLEP, which includes provisions for improving the environmental quality of NIPFs (habitat for flora and fauna, soil, water, air quality, etc.). In New Brunswick, past harvesting practices, spruce budworm-related mortality, and industrial expansion led to an unbalanced age-class distribution (particularly for softwood species) that placed the long-term supply of wood for industry in jeopardy (Macfarlane & Zundel, 1995). At the time of their research, MacFarlane and Zundel (1995) reported that wood supply forecasts predicted a shortfall of sawlog quality softwood timber suitable for harvest within 15 to 20 years. The PWSAP was implemented with the primary goal of increasing the rate of growth of the softwood forest through silviculture activities in order to ensure the sustainability of the forest sector (Macfarlane & Zundel, 1995). Thus, all of the activities approved under the PWSAP are directed toward this goal.

The central question remains: which program has the larger impact on the productivity of NIPFs? The answer is overwhelmingly New Brunswick's PWSAP. The variant goals of the programs are only part of the answer; an examination of the programs' funding provides the substantial evidence. Of the total \$100 million that the U.S. federal government originally allocated to fund FLEP, \$20 million was disbursed to state agencies in 2003, \$40 million was transferred to wild land fire suppression in 2004 and was not repaid, and \$20 million was cancelled in 2005 (USDAFS, 2005). Only \$5 million was released into the field in 2004 and \$10 million in 2005; \$5 million is available for the program in 2006 (USDAFS, 2005). Unlike New Brunswick's PWSAP, which in 2005 alone, distributed \$7.2 million in cost-share assistance exclusively to NIPF owners in the province, FLEP is a nationwide program, so these funds are divided between all of the states which request them. In 2003, Florida spent only \$573,678 of FLEP funds: 15% on technical assistance, 5% on education, 70% on financial assistance, and 10% on administration costs (Committee on Agriculture, 2004). In 2004, Florida had no funding for FLEP and \$498,000 was spent in

2005 (K. Boutwell, FLEP Coordinator for FDOF, personal communication, January 30, 2006).

FLEP's funding problems were vocalized in the FLEP hearing before the Committee on Agriculture in the House of Representatives in July 2004; Charles W. Stenholm, a representative from Texas lamented that "states are facing requests for assistance that far exceeded the funding that was available." This concern is consistent with evidence from Florida: in 2003, 150 of 206 applications for FLEP funding were denied; in 2004 (a small amount of money was left over from 2003), 231 of 347 applications were denied; and in 2005, 187 of 429 applications were denied (K. Boutwell, FLEP Coordinator for FDOF, personal communication, January 30, 2006). Of the FLEP, Alachua county forester Dave Conser said:

"The federal government took back FLEP's funding and we don't know that there will be any more. The lack of funding for cost-share assistance is really hurting Florida's NIPF owners. The amount of peninsular lands planted correlates directly with the cost-share monies available; with assistance, a lot more people would be doing a lot more planting of pine trees. I used to plant between 1,500 and 2,500 acres each year; now I am down to between 300 and 500 acres per year." (personal communication, January 25, 2006).

Confirming this same correlation in New Brunswick, MacFarlane and Zundel's (1995) economic analysis of the impacts of the program concluded that almost two thirds of the owners surveyed said they would not have conducted silviculture activities without the program's funds. Thus, the impact of PWSAP is appreciable.

It is also important to mention that the harvest, reforestation, and managed woodlot bonuses offered by some of New Brunswick's marketing boards provide a boost to the profitability of *sustainable* forest management in the region. There are no equivalent incentives in Florida.

Florida: Tax provisions

In 2000, each state in the U.S. administered 66 programs which prescribed preferential tax treatment of forestland (Hibbard, Kilgore, & Ellefson, 2003.) For less productive sites, especially, forest management practices quickly become economically unviable if the tax rate is increased (Greene, Straka, & Dee, 2003). In the U.S., the federal income tax has a particularly profound influence on the profitability of timber management (Greene, Straka, & Dee, 2003). Seven provisions of the federal income tax provide incentives for NIPF owners to follow sound management and reforestation practices: 1) treatment of qualifying income as a long-term capital gain, which is taxed at lower rates than ordinary income. 2) annual deduction of management expenses, 3) depreciation and the Section 179 deduction, which is a large, one-time deduction for part or all of the cost of qualified depreciable property, 4) deductions for casualty losses or other involuntary conversions, 5) reforestation tax credit, a 10% investment tax credit on up to \$10,000 of a landowner's investment in planting trees, 6) amortization of reforestation expenses, and 7) the ability to exclude qualifying reforestation cost-share payments from gross income (FLEP does not qualify) (Greene, Straka, & Dee, 2003).

In addition to the federal income tax provisions, property taxation is a particularly visible and important tool for affecting the management of NIPFs (Hibbard, Kilgore, & Ellefson, 2003). Sanctioned by a Florida statute, Florida's Greenbelt Law established

agriculture (the Greenbelt Law's definition of agriculture includes forestry) as a separate class of property to be taxed on the agricultural value of the land rather than its value for development (Broward County Property Appraiser [BCPA], 2005). For example, in 2006 in Alachua County, the assessed value (value of land for tax purposes) of planted pine forests is \$90 to \$340 an acre, depending on the land's soil classification (land with poor quality soil is taxed the least), even if the land's market value is \$30,000 an acre (J. Sweirs, Alachua County Property Appraiser, personal communication, January 19, 2006). The property appraiser essentially "devalues" the forested land for taxation purposes, as the tax rate remains the same. The exact taxation amount is determined by the property appraiser in each county, but "varies little from county to county" (J. Sweirs, Alachua County Property Appraiser, personal communication, January 19, 2006). Forested land must meet three requirements before it may be considered for the significantly lower property tax rate: agricultural use must be the primary activity on the land, the agricultural use must be commercial, and it must be bona fide (BCPA, 2005). Securing the agricultural classification makes commercial forestry an attractive option for landowners, as "natural" forestland is taxed at the slightly higher rate of \$110 to \$360 an acre.

New Brunswick: Tax provisions

Comparable literature on the federal and provincial taxation of private woodlots in New Brunswick is unavailable.³

4. Regulatory Policies

Growing public concern over the integrity of forest and related ecosystem values has been manifested in the U.S. and Canada in a host of regulatory policies designed to mitigate the negative externalities associated with timber production (Ellefson & Cheng, 1997). However, the regulation of management practices undeniably generates significant burdens for private forestland owners (Ellefson & Cheng, 1997). Ensuring compliance robs landowners of time, energy, and money which they must invest in understanding the laws, implementing potentially unfamiliar and costly practices, and rounding up required permits.

As the market share of publicly harvested timber shrinks, with NIPFs increasingly taking up the slack, the potential for NIPF owners in the United States and Canada to compete in a shared market grows greater. Comparative advantage enjoyed by the NIPF owners who must submit to the least stringent regulations – or even an impression of inequity – could become a potential source of trade conflict. This section examines the regulations in the most significant areas of concern for forest management: wetlands/watercourse protection, endangered species protection, prescribed burning, and pesticide use. Because timber harvesting practices that affect water quality are the most common component of state and provincial regulations, we discuss these in the most detail (Kilgore & Blinn, 2002). Legislation relating to endangered species protection, prescribed burning, and pesticide use is delineated in Table 4.

³ Additional work on this issue is critical to improve the quality of comparative analysis as taxation provisions are extremely influential in Florida.

Water Regulations: Florida

"Of all federal and state regulations, water laws are Floridian foresters' number one concern." (P. Gornicki, Florida Forestry Association, personal communication, 2005). The regulations governing the harvesting of timber near a watercourse or wetland in Florida are numerous, complex, and are enforced by both the federal and state government. While Florida does not have a goal of no net loss of wetland or water surface *acreage*, the state does have the goal of sustaining no net loss in wetland or other surface water *functions*; importantly, this goal excludes losses resulting from exempted and permitted forestry silviculture activities (Florida Department of Environmental Protection [FDEP], 2005).

At the federal level, Section 404 of the Clean Water Act regulates the discharge of dredged or fill material in the waters of the United States — a form of nonpoint source pollution often produced by forestry operations (FFA, 2004). Section 404 (F) is of particular importance to forestry because it exempts most forestry operations from obtaining a permit from the Army Corps of Engineers. It is "extremely rare" for a legitimate forestry operation to have to obtain a permit from the federal government (P. Gornicki, personal communication, 2005).

The regulation of water-related activities is largely the responsibility of state governmental agencies in Florida. Forestry activities which impede, impound, or divert the flow of water in wetlands or any other surface waters (i.e. fill road construction, stream crossings, ditches etc) are regulated by the Environmental Resource Permitting Program (ERP), which is administered jointly by the Department of Environmental Protection and the state's five Water Management Districts (WMD). According to the director of responsible forestry at the FFA, "99% of what we do in forestry comes under the WMD permitting system" (P. Gornicki, personal communication, 2005). To obtain a permit to conduct an activity which alters the flow of water, the WMD requires that specific performance criteria be met, forestry BMPs be applied, and a notice of intent be provided by the landowner to the appropriate district. Applicants must provide reasonable assurance that their activities will not adversely affect the wetland or water system before they are issued a permit (Suwannee River WMD, 2005).

Before progressing to New Brunswick's water-related regulations, Florida's Best Management Practices warrant some additional consideration, as they are the primary mechanism used to achieve the minimum standards for preserving water quality in Florida.⁴ In 2004, the FDOF established a new voluntary rule, Rule 5I-6, to provide an additional incentive for landowners to follow forestry BMPs (FDOF 2005.) The incentive is a "presumption of compliance" with state water quality standards; this means that if an NIPF owner follows BMPs during forestry operations, he or she would not be held responsible for a water quality standard violation, should one occur (FDOF 2005). To comply with this rule, the landowner must submit a "notice of intent" to the FDOF, which is simply a commitment to follow BMPs during all forestry operations; they must also keep records necessary to verify BMP compliance (FDOF 2005). Though most counties in Florida deem silviculture BMPs "voluntary," (they are regulatory in some counties, such as Alachua County) a multitude of legislation-based incentives effectively motivate most NIPF owners to administer them. Anyone who wishes to conduct silviculture operations that are not in

⁴ BMPs also define appropriate management practices for forest roads, stream crossings, timber harvesting, site preparation and planting, firelines, pesticide and fertilizer applications, waste disposal, and wet weather operations (FDOF, 2004).

compliance with the BMP manual must seek and obtain a permit from the appropriate governmental agency. The ensuing combination of bureaucratic red tape and expenses (potentially exceeding the cost of implementing BMPs) makes the permitting process a poor choice of action for landowners, and as Phil Gornicki states, "almost everyone opts to fit the exemption criteria" (which means adhering to BMPs) (Personal communication, 2005). The Florida DOF has monitored BMP implementation by conducting a biennial Compliance Survey since 1981; through 2001, the long-term average for BMP compliance in Florida is 93% (FDOF, 2004).

Water Regulations: New Brunswick

Water-related policies are similarly the forefront of concern for NIPF owners in New Brunswick. The provincial and federal policies are designed to ensure no loss of Provincially Significant Wetland Habitat and all other wetlands larger than 1 hectare. There are two specific regulatory mechanisms for managing activities in or near wetlands and all other water bodies: the Environmental Impact Assessment Regulation (EIAR) under the Clean Environment Act and the Watercourse and Wetland Alteration Regulation (WWAR) under the Clean Water Act.

• any changes made to existing structures in the watercourse or wetland, whether the water flow in the watercourse or wetland is altered or not

 \cdot operation of machinery on the bed of a watercourse other than at a recognized fording place

• operation of machinery in or on a wetland

- \cdot deposit or removal of sand, gravel, rock, topsoil or other material into or from a watercourse
- or wetland or within thirty meters of a wetland or the bank of a watercourse
- \cdot disturbance of the ground within thirty meters of the bank of a watercourse
- \cdot removal of vegetation from the bed or bank of a watercourse, from a wetland, or from

Figure 3. Wetland and watercourse alterations requiring Watercourse Alteration Permits under Canada's Clean Water Act.

Note. From New Brunswick Department of Environment and Local Government [DELG], 2003

The EIRA requires that an environmental impact assessment be conducted for any activity (including forestry silviculture activities) that affects a wetland greater than 2 hectares (5 acres) (INFOR, 2005). The WWAR provides more explicit terms of operation for

activities near water bodies and makes it illegal to make or perform any watercourse or wetland alteration (*alteration* is formally defined as "a temporary or permanent change made at, near, or to a watercourse or wetland, or to water flow in a watercourse or wetland") unless authorized to do so by a permit issued by the Minister of the Environment and Local Government (DELG, 2003). The activities that require a permit are delineated in Figure 2. It was estimated that permits are awarded to 95% of people who request them (DELG, personal communication, 2005).

When applying for the permits, landowners may be required to provide engineering scale drawings, dimensioned sketches of the proposed alteration, and a map of the area of the proposed activity (DELG, 2005). The WWRA allows the minister of the environment and local government to impose any terms and agreements he/she deems appropriate unto any activity that has the potential to alter a watercourse or fish habitat (DELG, 2005). These "conditions of approval" appear as riders on the watercourse alteration permits. If convicted of an offence under the Wetland Alteration Regulation, an individual may be fined up to \$50,000 (DELG, 2005).

Table 4

Legislation in Florida and New Brunswick relating to endangered species protection, prescribed burning and pesticide use.

	Florida	New Brunswick
	·Federal: Endangered	·Federal: Species at Risk Act
	Species Act (ESA)	(SARA)
Endangered Species	·State: Florida Endangered	·Provincial: Endangered Species
Protection	and Threatened Species	Act
	Act and Threatened	
	Species Protection Act	
Prescribed Burning	·State: Prescribed Burning	·Federal: Forest Fires Act
_	Act	
	· Federal: Fungicide and	·Federal: Pest Control Act (PCA)
Pesticide Use	Rodenticide Act & Food	·Provincial: New Brunswick
	Drug and Cosmetic Act	Regulation under the PCA
	·State: Florida Pesticide Law	

Analysis

The regulations in the aforementioned areas each occupy a space on a "continuum of intensity" based on the extent to which they restrict the activities of NIPF owners. This study found that in the four areas—wetlands/watercourse protection, endangered species, prescribed burning, and pesticide use—landowners in Florida and New Brunswick must submit to a comparably intensive set of regulations. There are, as will be discussed, perceivable differences in the requirements of the legislation pertaining to watercourse protection, prescribed burning, and pesticide use. However, a qualitative analysis permits us to conclude that they are probably not significant enough, economically, to warrant serious attention. When considering the extent of regulatory regimes, it is important to bear in mind that regulatory frameworks are employed by only 39% of the states and provinces to implement sustainable timber harvesting practices (Kilgore & Blinn, 2002).

As previously mentioned, water quality regulations are the most common and intensive of all regulations for NIPFs in Florida and New Brunswick. Florida's detailed BMPs and Environmental Resource Permitting Program appear to be more restrictive and costly than New Brunswick's rather broad permitting system, which awards permits to 95% of people who request them. However, it was found that in the southeastern United States, the most productive timber stands are in plain areas where BMP costs are lowest, meaning that BMP implementation has the potential to reduce timber harvest volumes only slightly (Lickwar, Hickman, & Cubbage, 1992). It is also important to consider that New Brunswick's wetland and watercourse alteration permits are loaded with riders which tailor specific requirements for the permitted activity. There is no way to circumvent the permitting system in New Brunswick, as following BMPs in Florida allows. In the context of water-related regulations, a qualitative comparison is somewhat inconclusive—an economic analysis of the costs incurred while ensuring compliance with these laws would allow us to discuss this with a higher degree of certainty.

Endangered species legislation in both regions is nearly identical in content, intent, and scope of impact. Both Florida's Endangered Species Act (ESA) and New Brunswick's Species at Risk Act (SARA) were created to control the rate of human-caused extinctions of flora and fauna. The ESA prohibits private landowners from "taking" an endangered species, making it illegal to "harass, harm, pursue, hunt, shoot, kill, trap, capture, or collect" a listed species; harm is defined broadly to include significant habitat modification (FFA 2004). Likewise, the provincial Endangered Species Act protects the 16 listed species, their residences, and their critical habitat by making it illegal to "disturb, harass, or harm" a listed species (NBDNR, 2005). The secretary manager of the New Brunswick Federation of Woodlot Owners admits that "there isn't any listed species of flora or fauna that significantly affects private forestry activities in New Brunswick" (K. Hardie, personal communication, 2005). Though the 100 threatened and endangered species listed under the ESA likely occupy Florida's NIPFs "to a great extent," the ESA similarly affects the management of NIPFs in Florida "very little, because good forest management does not harm or threaten endangered species or their habitat" (FFA, 2004; D. Conser, personal communication, January 27, 2006).⁵ Of all the listed species, the Red-Cockaded Woodpecker and the Bald Eagle have the largest impact on forest management in Florida (S. Talley, personal communication. January 30, 2006).

In order to conduct a prescribed fire, landowners in both Florida and New Brunswick are required to obtain appropriate permits. Florida Statute 590.125 requires all prescribed fires to be authorized or permitted by the FDOF (Long, 1999). The FDOF authorizes an average of 113,000 permits per year to burn approximately 2 millions acres of land in Florida (FDOF, 2005). To conduct a prescribed fire in New Brunswick, a pre-inspection must be conducted and a burn plan and permit must be submitted to the New Brunswick Department of Natural Resources (NBDNR, 2005). In Florida, NIPFs owners who are not "certified burners" do not have to provide a burn plan to the country Division of Forestry office to

⁵ A similar discussion with Scotland Talley, a wildlife biologist working for the Fish and Wildlife Conservation Commission, regarding the impact of Endangered Species legislation on the management of Florida's NIPFs revealed that "there is so little information and so few surveys" documenting the presence of endangered species on private lands (S. Talley, personal communication, January 30, 2006). Scotland Talley charges that the Endangered Species legislation motivates landowners "to manage their forests so as to avoid creating habitat for endangered species" (personal communication, January 30, 2006). Additional research in this area is highly warranted.

obtain a permit "nor do they really have to have one if they are not a certified burner" (A. Long, personal communication, 2005). However, the issuance of a permit in New Brunswick is contingent upon the written burn plan that landowners are required to submit to the NBDNR. The requirements of the Forest Fires Act reveal that that burn plans are detailed, time consuming, and often require technical assistance.

The application of insecticides, herbicides, and fungicides (collectively referred to as *pesticides*) to reduce the mortality of desired trees, improve overall production, and favor a particular tree species in commercial forestry operations has been documented to increase yields of forest products (FFA, 2004). The majority of the pesticide regulations in the two regions are identical; all pesticides must be registered at the federal level, and they must be used in a manner consistent with its label, which, for example, may indicate maximum rates of applications. However, there is one major difference. Though some pesticides in Florida require the applicator to be certified by the Florida Department of Agriculture and Consumer Services, the New Brunswick Regulation (1996) under the federal Pest Control Act states that "no person shall sell or supply a non-domestic pesticide to a person who is not the holder of a permit authorizing the person to apply that pesticide, a vendor's license, a pesticide operator's license or a pesticide applicator's certificate."

5. Conclusion

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In the context of timber harvested on public lands, "U.S. lumber companies look north with envy at what they perceive to be less regulated Canadian competitors" (Cashore, 1997). It appears that this perception is not yet pervasive in the private sector; based on the findings of this research, it would be largely unjustified. We contend, with others, that New Brunswick's NIPF owners encounter government legislation "in an almost infinite number of ways throughout their daily lives" and that this legislation affects decisions relating to "almost every aspect and component of their woodlots" (MacNaughton, 1996). This paper illustrates that the same can be said for landowners in Florida.

Though the regions share a similar burden of regulation, it is apparent that the marketing services and cost-share assistance programs are profoundly more extensive in New Brunswick than in Florida. We speculate that the extent to which these enhance the profitability and ease of production in New Brunswick is substantial and thus warrant additional consideration in future research to ensure continued amicable trade of timber from privately held lands in the U.S. and Canada.

These conclusions meet the rather broad goal of this research: to examine the policies affecting private forestry in Florida and New Brunswick and draw comparisons on the extent of its influence on NIPF operations. However, an obvious quantitative question lingers: how much or little do organizational set-up, incentive programs, and regulations inhibit or enhance the profitability of private forestry in these regions? Such an economical analysis lies beyond the scope of this research; however, it is recommended for future study.

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Two Eras of Globalization and Hardwood Sawtimber Demand

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Abstract

In the early 1970s, the adoption of floating exchange rates resulted in more fluid transfers between international currencies and spurred increased international demand for hardwood lumber produced in the United States. Initially, Germany was the most important European customer for U.S. products while Japan was the most important Asian customer. The consumer cultures in both countries were quality oriented, requiring high-grade hardwood lumber and veneer. However, the major consumer of hardwood lumber remained the domestic furniture industry which required long and wide midgrade boards. This combination of quality-oriented international markets and a large board-oriented domestic market resulted in new technology that obtained maximum value yield from high-quality logs. As a result, the demand for and subsequent value of high-grade hardwood sawtimber surged while prices of mid and lower grade sawtimber stagnated. Since the late 1990s, China and India have become major players in the global economy while the influence of European and Japanese markets has diminished. Furniture production in the United States has decreased as a result of Chinese imports but hardwood demand by the domestic flooring and cabinet industries has increased. In this second global era, factors such as price and service have replaced quality and board size as market drivers. Emphasis on cost has caused individual mills to reexamine production and marketing processes and to reevaluate the use of low- and mid-value sawtimber. These changes have major implications for the future value and management of hardwood timber.

Key Words: Hardwoods, international, lumber

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Introduction

Hardwood lumber producers face a competitive market, cyclical prices, and occasional structural changes in lumber demand that ultimately influence the valuation of hardwood sawtimber. Such a structural change occurred in the early 1970s with the adoption of floating exchange rates for international currencies for developed western (non-Communist) economies. Floating exchange rates allowed the value of currencies to be determined by market forces rather than by intergovernmental negotiations. These changes initially caused the dollar to be devalued against European and Japanese currencies thus lowering the prices and increasing exports of hardwood lumber produced in the United States. Floating exchange rates also facilitated easier transfer of currencies, between trading partners, resulting in an overall increase in international trade between the developed economies.

This increase in European and Japanese export demand caused the price of higher grades of lumber, logs, and stumpage to increase (Luppold 1996; Luppold and Baumgras 1995). This new demand encouraged mills to add dry kilns to serve a new customer base that wanted kiln-dried lumber. Still, the largest market for grade lumber continued to be the domestic furniture industry which preferred green lumber of sufficient length to conform to furniture production technologies developed decades earlier.

Another more recent structural change was the rapid decline in lumber demand by the domestic furniture industry and increased furniture imports, primarily from China (Schuler and Buehlmann 2003). From 1999 to 2004, lumber demand by the U.S. furniture industry decreased by 50 percent or 1.3 billion board feet (Hardwood. Mark. Rep. 2006). China also became the largest offshore market for exported lumber accounting for one-third of exports to countries other than Canada (USDA For. Ag. Serv. 2006). However, unlike the high-quality, high-value exports to Europe and Japan, exports to mainland China consisted primarily of lower value lumber (USDA For. Ag. Serv. 2006).

We call the major structural changes since the early 1970s the eras of globalization because global economic forces caused these changes. The first era of globalization was associated with the adoption of floating exchange rates between developed western economies. The second was associated with the emergence of mainland China as a major player in the overall market for hardwood product manufacturing. It is difficult to know precisely when these eras began and ended because there were periods of transition and adjustment between them. In both eras, the transition period was marked by several years of declining hardwood lumber production (Figure 1). For this paper we assume that the first era spanned 1975 to 1999 and then transitioned to the second era and continues today. In the remainder of this paper we examine the first era of globalization and the transition to the second era of globalization, discuss probable trends in domestic and international demand for hardwood lumber in this new era, and explain how domestic lumber production and sawtimber prices might be influenced by these trends. Figure 1 – Eastern hardwood lumber production, 1965 to 2004 (developed using procedures described in Luppold and Dempsey 1989, 1994).



The First Era of Globalization: 1975 to 1999

The first apparent change in the hardwood market that resulted from the implementation of floating exchange rates began in 1975 as exports to Europe increased (Luppold and Araman 1988) and price premiums for shipments of First and Seconds red and white oak lumber were implemented (Hardwood Mark. Rep. 1975). Between 1975 and 1979, lumber exports to Europe increased by 600 percent while overall exports increased by 70 percent. This change in export demand provided the sawmilling industry with a profitable market for high-quality lumber. However, as indicated in Table 1, the furniture industry consumed nearly 12 times more lumber than was exported in 1977 and 65 percent more lumber than all other appearance uses (exports, millwork, cabinets, and flooring) combined. Unlike the export market, domestic furniture manufacturers primarily purchased green or airdried lumber and refused to purchase short boards.

High interest rates and stagnant economic growth caused lumber demand and production to decline in 1981; however, exports of hardwood lumber continued to increase as Japan and Taiwan began to import U.S. lumber. Concurrent with increased international demand were increasing demand by the cabinet, millwork, and flooring industries that raised total demand for hardwood lumber to 11 billion board feet in 1987. The hardwood lumber industry was able to supply increased volumes of oak because sawtimber supplies were increasing as trees that regenerated prior to 1930 matured. However, lumber demand by the furniture industry decreased between 1977 and 1987 (Table 1) even though the value of shipments were similar (Figure 2) due to the increased use of particleboard and importation of furniture parts.

Industry	1977 ¹	1987 ²	1991 ²	1999 ³	2004^{3}
	million board feet				
Furniture	2,753	2,547	2,198	2,600	1,300
Millwork	620	912	789	1,300	1,200
Cabinets	489	1,085	955	1,200	1,500
Flooring	304	476	526	1,400	1,600
Exports	240	688	850	1,200	1,300
Pallets	2,313	4,513	4,704	4,500	4,000
Railroad ties	735	781	600	700	900
Total	7,454	11,002	10,622	12,900	11,800
			percent		
Furniture	36.9	23.2	20.7	20.2	11.0
Millwork	8.4	8.3	7.4	10.1	10.2
Cabinets	6.6	9.9	9.0	9.3	12.7
Flooring	4.1	4.3	5.0	10.9	13.6
Exports	3.2	6.3	8.0	9.3	11.0
Pallets	31.0	41.0	44.3	34.9	33.9
Railroad ties	9.8	7.1	5.6	5.4	7.6

Table 1.-- Actual and proportional hardwood lumber consumption by major industry groups 1982, 1987, 1991, 1999, and 2004

¹ Source: Luppold 1993, with 75, 20, and 5 percent of dimension assigned to furniture, cabinets and millwork, respectively.

² Source: Luppold 1993, with 55, 30, and 15 percent of dimension assigned to furniture, cabinets and millwork, respectively.

³ Hardwood Market Report. 2006.

The 1990s began with a large decline in production (Figure 1) as an economic recession caused furniture production to decline (Figure 2). As the decade progressed, lumber demand by the furniture industry rebounded to 1987 levels but proportional demand remained at around 20 percent (Table 1). The decline in lumber demand in the 1990s was greatest in the pallet industry due to increased recycling and increased price for lower grade oak lumber resulting from increased demand for flooring. However, the most notable change in the 1990s was the continued growth in exports and increased lumber consumption for flooring, kitchen cabinets, and millwork. By 1999, non furniture appearance uses of hardwood lumber were nearly twice that for lumber used by the furniture industry even though furniture shipments were at an all time high.

Figure 2.--Value of domestic wood household furniture shipments and imports in constant 1982 dollars, 1975-2004 (source 1975 to 1988:–Nolley 1994, 1989 to 1998: Emanuel and Rhodes 2002, 1999 to 2002: Akers 2006, 2003 to 2004 Akers 2006 updated).



While supplies of higher grade sawtimber increased between 1975 and 1999, the price of higher grade logs and stumpage also increased because demand for this material exceeded supplies. This increase in demand resulted from a combination of increased international demand for higher quality logs, lumber, and veneer; increased domestic millwork demand for high-grade lumber; and continued demand for long, wide boards by the domestic furniture industry. Higher prices of quality stumpage and logs caused lumber producers to invest in expensive sawing equipment which allowed greater recovery of high-grade lumber from high-grade logs to serve high-value offshore customers and the needs of the domestic furniture industry. However, the competitive nature of the hardwood market caused short-term profits obtained from purchase of this equipment to eventually accrue to the resource, resulting in even higher priced timber.

A Period of Transition: 1999 to 2004

Between 1999 and 2004, consumption of lumber by the furniture industry declined by 50 percent as imports from China and other countries displaced domestic furniture production (Figure 2). Pallet producers also reduced lumber consumption because of the continual recycling of pallets and pallet parts. Use of hardwood lumber by the millwork industry also declined slightly. Exports increased slightly but exports to China increased by 150 percent (Table 2). Italy and Spain became the most important markets while exports to Germany and Japan declined. While the average value per thousand board feet of exported lumber increased for Europe and Japan, the unit value of exports to China decreased by 8 percent (Table 2).

Country	1	999	2005		
2	Volume (MMbf)	Price (\$/Mbf)	Volume (MMbf)	Price (\$/Mbf)	
China	40	1,005	102	923	
Germany	27	1,690	17	1,753	
Italy	42	1,261	39	1,394	
Japan	34	1,261	20	1,531	
Spain	38	1,315	43	1,491	

Table 2.--Volume and imputed price of lumber exported to China, Germany, Italy, Japan, and Spain 1999 and 2005

Source: USDA Foreign Agricultural Service 2006

The decrease in hardwood lumber demand by the furniture industry since 1999 was considerably larger than the value of shipment (Figure 2) because of the importation of furniture parts. The two types of furniture that have been least affected by Chinese imports, high-end 18th century reproductions and low-cost, ready-to-assemble furniture constructed primarily of particleboard, have a fairly low ratio of lumber use per unit dollar of sales. Perhaps a better indicator of the plight of the domestic furniture industry is the nearly 40-percent decline in wood household furniture employment between 1999 and the end of 2004 (Figure 3). By contrast, employment in the kitchen cabinet industry increased by 17 percent over the same period.

Figure 3.--Employment in wood household furniture industry, December 1990 to December 2005 (source: USDL Bureau of Labor Statistics 2006).



decline of the furniture industry and the growth in hardwood flooring and kitchen cabinet production demonstrate the increased importance of home construction and remodeling on hardwood lumber demand. Thus, economic indicators such as housing starts and interest rates will become increasingly important to the hardwood industry. This is in sharp contrast to the late 1970s when furniture consumed 65 percent more lumber than all other appearance-based lumber uses combined. In addition, the offshore export market has shifted from being influenced by users of high-priced lumber, e.g. Germany and Japan, to users of lower priced lumber, primarily China (Table 2). This is likely to result in increased global competition in export markets.

The

The Second Era of Globalization: 2005 and Beyond

Since the emergence of the Chinese furniture industry, there has been increased emphasis on pricing and costing of U.S. hardwood products at every market level. Chinese plants have been built to produce high volumes of furniture at a low cost. This price leadership business model extends to reducing the cost of raw material, which ultimately has caused China to seek out the lowest cost material. This has led to the development of new supplies of hardwood lumber and logs from central Asia and Eastern Europe.

In the future it will be crucial to identify the extent of alternative timber sources available to Asian manufacturers and to monitor their sustainability to access the potential impact of alternative lumber species. It also will be necessary to understand the level of acceptance by U.S. consumers of products made from this timber. For example, rubberwood increased from 1 percent of the bedroom and dining room showings at the High Point, NC Furniture Market in 2000 to 6 percent of the showings in 2005 (Appalachian Hardwood Manuf. 2002, 2005). This suggests that lower priced imported species can be introduced successfully to the U.S. market. Promotion of U.S. species will continue to be important

both in pushing the advantages of domestic species to offshore manufacturers and developing pull demand from U.S. consumers.

The high cost of timber and timber processing in the United States makes it difficult for domestic hardwood sawmills to compete in this new global era. Providing additional customer services could increase profitability for both hardwood lumber producers and customers. At the producer levels value will be inherently linked to the separation of lumber in a manner that will reduce the cost of production and/or increase the profit margin of wood purchasers. This may include better color sorts that allow secondary processors to use less costly finishing systems to length and width separations that result in a higher yield of lumber into dimension. However, the probability that markets will continue to evolve means that hardwood lumber producers must be sufficiently flexible to react to continual change with a continual emphasis on reducing cost.

Conclusion

The structural changes that have occurred in the domestic hardwood lumber market since 1999 have caused demand to decline and the hardwood lumber industry to contract, resulting in a more competitive environment for surviving producers of hardwood lumber. Although the efforts of China to seek out new supplies of hardwood timber may have a dampening effect on demand and price of U.S. timber in the next decade, the decentralized nature of the hardwood lumber industry allows for independent ideas to evolve and solutions to develop. Implementation of these solutions will temporarily increase the profitability of sawmills. However, the competitive nature of the hardwood market also ensures that shortterm increases in sawmill profitability will eventually transfer to stumpage price.

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Property Taxes: Do They Affect Forestry and Agricultural Land Uses?

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Abstract

This study uses nested logit model to analyze changes between agricultural, forestry, and developed land uses in Louisiana during 1982-1997 using NRI point data. The model utilizes modern land use theory based on the land rent theory. In addition to the returns, we incorporated into the model property tax paid per acre of land for each of the three studied land uses. We found that property tax is significantly influencing probabilities of land use change in Louisiana.

Key words: land use change, property tax, discrete choice, nested logit, Louisiana.

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Introduction

Land use changes, while driven by maximization of economic benefits to the land owner, often produce negative externalities such as air and water pollution, biodiversity loss, wildlife habitat fragmentation, and increased flooding. In the conditions when majority of land base is privately owned, like in the US South, it is important to understand how economic, social, environmental factors, as well as intended or unintended consequences of public policies, affect private landowners' decisions concerning land use change.

Most of existing studies of land use in the US are based on the classic land use theory developed by David Ricardo and Johann von Thünen in the nineteenth century. This theory explains land use patterns in terms of relative rent to alternative land uses, which depends on land quality and location. Due to the data limitations, majority of econometric land use studies utilize aggregated data describing areas or proportions of certain land use categories within well defined geographic area such as a county or other region as a function of socioeconomic variables and land characteristics aggregated at the level of geographic unit of observation (Alig and Healy, 1987; Plantinga et al., 1990; Stavins and Jaffe, 1990). Some of the studies, employing aggregated data, model shares of exhaustive set of land use within specified land base using binomial or multinomial logit model of shares, which allows restricting shares to unity (Parks and Murray, 1994; Hardie and Parks, 1997; Ahn et al., 2000). A few most recent studies use parcel-based observation of land characteristics and land use transitions. Depending on the number of land use categories considered (choices) they use binominal probit (Kline et al., 2001), or nested logit (Lubowski et al, 2003) models.

There were two major applications of empirical studies of land use and land use change in the US. First, the estimates of econometric models were used to predict forest area trends and timber supply (Alig and Wear, 1992; Ahn et al., 2000) as well as potential of carbon sequestration through forest area expansion (Stavins, 1999). Second, studies had examined the effects and effectiveness of government programs such as Conservation Reserve Program (Schatzki, 2003), flood control projects (Stavins and Jaffe, 1990), programs for wetlands conservation (Parks and Kramer, 1995), zoning and urban control policies (Carrion-Flores and Irwin, 2004). However, there have been a very little research about the effect of property taxes, and in particular, preferential valuation, on the land use changes. In this paper, we analyze the effect of property taxes on the land use change on the Louisiana private lands using USDA Natural Resource Inventory sample plots.

The Theoretical Model

Consider a risk-neutral landowner choosing to allocate a non-divisible parcel of land of uniform quality to one of several possible alternative uses. We assume that a landowner's decision is based on the maximization of net present value of future returns generated by the land. The owner's expectations concerning future returns generated by different land uses are drawn from the characteristics of the parcel and historical returns. The net present value of parcel *n* in use *i* is $\frac{R_{ni}}{r}$, where R_{ni} is the annual net returns from land uses *i* and *r* is the discount rate. Converting a parcel from use *i* to alternative use *j* also involves one time conversion cost C_{nij} . We assume that landowner's utility of new land use *j* conditional on

current land use *i* could be expressed as $U_{nj|i} = \frac{R_{nj}}{r} - C_{nij}$. Neither return for each of the land

uses, nor conversion costs are directly observable for individual parcels, however, there are other observable attributes of the land uses $\mathbf{x}_{nj} \forall j$, and observable attributes of plots \mathbf{s}_n , that are related to either returns or conversion costs, so that $U_{nj|i} = V_{nj|i} + \varepsilon_{nj}$, where $V_{nj|i} = V(\mathbf{x}_{nj}, \mathbf{s}_n)$ is the representative utility and ε_{nj} captures the factors that are affecting utility, but not included into representative utility, and assumed to be random. The probability of converting parcel *n* to land use *j* is $P_{nj} = Prob(U_{nj} > U_{nj} \forall k \neq j)$

$$P_{nj|i} = \operatorname{Prob}(U_{nj|i} > U_{nk|i} \forall k \neq j)$$

=
$$\operatorname{Prob}(V_{nj|i} + \varepsilon_{nj} > V_{nk|i} + \varepsilon_{nk} \forall k \neq j)$$

=
$$\operatorname{Prob}(\varepsilon_{nj} - \varepsilon_{nk} > V_{nk|i} - V_{nj|i} \forall k \neq j)$$

=
$$\int I(\varepsilon_{nj} - \varepsilon_{nk} > V_{nk|i} - V_{nj|i} \forall k \neq j) f(\varepsilon_{n}) d\varepsilon_{nk}$$

where $I(\cdot)$ is the indicator function, equaling 1 when the term in parenthesis is true and 0 otherwise, and $f(\varepsilon_n)$ is the joint density of the vector of probabilities ε_{nj} . Depending on assumptions about the density distribution of random components of utility, several different discrete choice models could be derived from this specification (Train, 2003). Assuming random components are independent and identically distributed (iid) with a type I extreme value distribution, conditional logit model (McFadden 1974) is derived:

$$\operatorname{Prob}(Y_n = j) = P_j = \frac{\exp(\boldsymbol{\beta}' \mathbf{x}_{nj})}{\sum_{j=1}^{J} \exp(\boldsymbol{\beta}' \mathbf{x}_{nj})}$$

Conditional logit model is easy to estimate and interpret. However, the independence of irrelevant alternatives (IIA) property of the conditional logit model is unlikely to represent actual structure of choices in many real situations. Grouping alternatives into several a priory identified more homogenous nests allows partial relaxation of the requirements of identical distribution and independence among random components of alternatives. This model is referred to as nested logit model and allows for correlation of unobserved portions of utilities within a nest as well as for the different variances for the groups of alternatives among nests. In a two-level nested logit model, we divide a set of *J* alternatives into *L* nests. The vector of observed attributes is viewed as partitioned into subset determining choice of nest \mathbf{z}_{nl} and subset determining choice of alternative within nest \mathbf{x}_{njl} . The probability of individual *n*

choosing alternative *j* is a product of probability of choosing nest *l* and probability of choosing alternative *j* within nest *l*:

$$P_{njl} = P_{nj|l} \times P_{nl} = \frac{\exp(\boldsymbol{\beta}' \mathbf{x}_{nj|l})}{\sum_{j=1}^{Jl} \exp(\boldsymbol{\beta}' \mathbf{x}_{nj|l})} \times \frac{\exp(\boldsymbol{\gamma}' \mathbf{z}_{nl} + \tau_l I_l)}{\sum_{l=1}^{L} \exp(\boldsymbol{\gamma}' \mathbf{z}_{nl} + \tau_l I_l)}$$

Where I_l is an inclusive value for nest *l* defined as

$$I_l = \ln\left(\sum_{j=1}^{J_l} \exp(\boldsymbol{\beta}' \mathbf{x}_{nj|l})\right),$$

and τ_l is an inclusive value parameter. Inclusive value parameter τ_l is a measure of independence among choices in the nest *l* and the statistics $1 - \tau_l$ is a measure of correlation

(Train 2003). When $\tau_l = 1$, the choices within nest *l* are independent, so when $\tau_l = 1 \forall l$ model becomes conditional logit, which can be tested by imposing appropriate restrictions.

Data

Land use data for Louisiana are derived from the National Resources Inventory (NRI) obtained from USDA National Resources Conservation Service (NRCS 2000). The NRI is a longitudinal panel survey of the Nation's soil, water, and related resources designed to assess conditions and trends every five years. The details of NRI sampling design, data collection, and estimation procedures are discussed by Nusser and Goebel (1997). The 1997 NRI dataset provides results that are nationally consistent for all nonfederal lands for four points in time: 1982, 1987, 1992, and 1997. The NRI dataset for Louisiana contains 23679 points representing 31.4 million acres. In this study we used data for NRI plots in Louisiana which can be classified as nonfederal lands in either agricultural, forest, or developed uses at the beginning and at the end of each of the three five-year periods. This constitutes 13414 points representing 22.6 million acres (see Table 1). Other land uses, which include rangelands, other rural lands, rural transportation, small and large water bodies, federal lands, and CRP land were not included in the analysis because of small share (e.g., rangelands) or because changes in these land uses are not driven by market forces (e.g., federal lands). Land quality is an important characteristic determining potential return from agricultural and forestry uses. There are two variables in NRI database, which characterize land quality of each sample plot (except federal lands, developed lands and waters). One variable is land capability class, which is a categorical variable taking values I to VIII and indicating existence and severity of limitations that reduce the choice of plants or require moderate conservation practices, or preclude cultivation and limit the use of plot mainly to pasture, range, forestland, or wildlife food and cover. Studies that model land use at county level utilized aggregated NRI land quality characteristics as proportion of certain land capability class (Hardie and Parks, 1997; Miller and Plantinga, 1999) or as average land capability class (Ahn et al., 2002). Lubowski et al. (2003) model land use change at the parcel level and use land capability class as a set of dummies. Another variable characterizing land quality in NRI database is a binary variable that indicates whether plot is classified a prime farmland that is a land on which crops can be produced for the least cost and with the least damage to the resource base. For this study we selected "Prime farmland" variable to represent land quality of a sample plot.

In order to quantify effect or population and proximity to populated places, we use population interaction index (PII), which is similar to a gravity index. PII is derived from Census tract population data of 1980, 1990, and 2000 and linked to the NRI plots. We used linear interpolation to obtain PII for 1982, 1987, and 1992, which are starting years of three five-year transition periods.

Initial	Period	Final land use				
land use		Agriculture	Forestry	Developed	Other	Total
Agriculture	1982-87	8356.4	170.9	81.5	97.9	8706.7
	1987-92	8210.5	136.5	47.9	187.2	8582.1
	1992-97	7969.6	167.1	61.6	75.3	8273.6
Forestry	1982-87	202	13043.7	64.4	110.9	13421
	1987-92	48.3	13015.4	53.9	116.1	13233.7
	1992-97	29.8	13034.9	57.6	50.4	13172.7
Developed	1982-87	0.2		930.5		930.7
	1987-92		0.1	1080.5		1080.6
	1992-97			1183.4		1183.4
Other	1982-87	23.5	19.1	4.2	8271.6	8318.4
	1987-92	14.8	20.7	1.1	8443.8	8480.4
	1992-97	45.1	24.4	3.2	8674.4	8747.1
Total	1982-87	8582.1	13233.7	1080.6	8480.4	31376.8
	1987-92	8273.6	13172.7	1183.4	8747.1	31376.8
	1992-97	8044.5	13226.4	1305.8	8800.1	31376.8

Table 1. Transitions between major land use categories in Louisiana (thousand acres)

We used parish level return and property tax data. Property tax per acre of agricultural, forest, and developed land for 1981, 1987, and 1992 were calculated using the data available from Biennial Reports of Louisiana Tax Commission (State of Louisiana, 1982; Louisiana Tax Commission, 1988, 1994). These reports contain data on assessed values and acreages of land and improvements for various land use categories, as well as the millage rates for various local taxes for each parish. Total amount of property tax was obtained by applying millage rates to assessed values of land in each of the land uses. Acreages of land in forest and agricultural land uses for calculation of property tax per acre were taken from the Louisiana Tax Commission Reports. Because of these reports contain number of lots rather than acreage for developed lands (country and city lots), we used acreage of urban and builtup land from NRI data to obtain per acre property tax for this land use category. As a proxy for per acre agricultural returns we used market value of agricultural crops divided by acreage of croplands from the Census of Agriculture data available at http://agcensus.mannlib.cornell.edu/. Forestry returns were calculated as the value of stumpage sold in a parish averaged over 5 year period and divided by acreage of timberlands in a parish. The values of stumpage by parish and by year for Louisiana were derived from the severance tax data by Louisiana Forestry Commission and are available from the annual Louisiana timber and pulpwood production reports at

http://www.ldaf.state.la.us/divisions/forestry/reports/timberpulpwood/. Returns of developed land were calculated from the assessed values of developed land, which are defined as 10% of fair market value, and assuming 10% capitalization rate. Table 2 presents descriptive statistics of explanatory variables.

Variables	Ň	Minimum	Maximum	Mean	Std dev
Parish level					
Return from agricultural lands, \$/ac	155	4.19	356.36	95.96	77.55
Return from forestry lands, \$/ac	155	0.00	63.87	16.24	12.13
Return from developed lands, \$/ac	155	39.30	1811.55	607.87	395.04
Property tax for agricultural land, \$/ac	155	0.43	6.39	1.81	0.89
Property tax for forestry land, \$/ac	155	0.13	2.52	0.86	0.43
Property tax for developed land, \$/ac	155	3.90	229.67	52.20	45.59
Plot level					
Population interaction index	35790	10.58	1468.78	117.77	125.13
Prime farmland	35790	0.00	1.00	0.49	0.50

Table 2. Descriptive statistics of explanatory variables.

Estimation Results

We model transition between three broad land uses (agriculture, forestry, and developed) over tree five-year intervals. Because transition to developed land use is practically irreversible, we consider two initial land uses (i) and three final land uses or alternatives (j). We combine parish (p) specific attributes of alternatives with attributes of plots (n) to obtain the following utility function for each alternative:

 $U_{nj|i} = \beta_{ij}^0 + \beta^1 R_{pj} + \beta^2 T_{pj} + \beta^3 P I I_n^D + \beta^4 P R I M E_n^A + \varepsilon_{nj},$

where β_{ij}^0 is set of transition specific intercepts $(i \neq j)$ indicating conversion costs, $\beta^1 \dots \beta^4$ are parameters, R_{pj} is return for land use j in parish p, T_{pj} is property tax for land use j in parish p, PII_n^D is plot specific population influence index for developed land use alternative, and $PRIME_n^A$ is plot specific dummy "prime farmland" for agricultural land use alternative. It is assumed that population influence index affect the utility of the choice of developed land and "prime farmland" affects the choice between agricultural and forestry land uses being irrelevant for the choice of developed land. In order to take care of possible differences in variances and correlation between outcomes, we formulate nested logit model by grouping alternatives into two nests: (i) "rural", consisting of agricultural and forestry land uses, and (ii) "urban", consisting of developed land use. We assumed that there is a significant similarity between agricultural and forestry land uses (with possible correlation between variances of their utility functions), while choice of developed land use differs from two the choice of two former alternatives. Because of "urban" nest consist of one alternative, this model is partially degenerate, and therefore overparameterized with respect to inclusive value parameters (Hunt, 2000). Recall, that inclusive value parameter is a measure of independence between choices within nest. For identification purpose, we restrict inclusive value parameter of the "urban" nest to unity.

We estimated conditional logit and two-level nested logit models using NLOGIT 3.0 (Greene, 2002). Nested logit model was estimated using Full Information Maximum Likelihood (FIML) method. All observations were weighted using NRI expansion factors scaled so that they sum to the number of observations. The estimation results of conditional logit and nested logit models are presented in Table 3. McFadden's pseudo- R^2 indicates good fit of both models. The likelihood ratio test was carried for nested logit specification against the null hypothesis of conditional logit specification. The value of likelihood ratio
statistic is 11.802 with 99% critical value of $\chi_1^2 = 6.63$, which rejects null hypothesis. The inclusive value parameter for "rural" nest is different from unity at 1% level of significance, supporting nested logit versus conditional logit once again.

	Coefficient Estimates						
	Conditional	Logit	Nested Logit				
Conversion agriculture to forestry	-3.0524***	(0.0914)	-2.9775***	(0.0923)			
Conversion forestry to agriculture	-5.4795***	(0.1018)	-5.5581***	(0.1062)			
Conversion agriculture to developed	-5.3709***	(0.1871)	-6.1801***	(0.3523)			
Conversion forestry to developed	-6.5210***	(0.1727)	-6.5348***	(0.1766)			
Property tax	-0.0082***	(0.0031)	-0.0081***	(0.0031)			
Return	0.0013***	(0.0004)	0.0013***	(0.0004)			
PII for developed	0.0058***	(0.0004)	0.0056***	(0.0004)			
Prime farmland for agriculture	1.0381***	(0.0960)	1.1572***	(0.1033)			
Inclusive value for rural			0.1223 ^{†††}	(0.2654)			
Inclusive value for urban			1.0000	Fixed			
McFadden R ²	0.9350		0.9351				
Log Likelihood	-3104.4		-3098.5				

Table 3. Conditional logit and nested logit estimates of land use change in Louisiana

Notes: *** significantly differ from 0 at 1%; ^{†††} significantly differ from 1 at 1%.

Analyzing regression coefficients presented in table 3, we see that for both conditional logit and nested logit models the transition specific intercepts indicating conversion costs are significantly different from zero and negative, as expected. The highest are costs of transition from forestry to developed use, while the lowest are costs of transition from agriculture to forestry. Population size and proximity reflected by population influence index is a factor significantly influencing probability of conversion to developed land use, while quality of land is an important determinant of land being converted to or retained in agricultural land use. Returns to alternative land uses are significant and have positive sign. This confirms the basic assumptions of Ricardian land rent theory. Finally, the amount of property tax levied from land in particular use inversely impacts probability of conversion to this land use. While being significant and consistent with underlying theory, the coefficients of conditional and nested logit models presented in Table 3 are difficult to interpret. One of the reasons is that the same vector of coefficients is used in all utility functions, thus in our model one coefficient determines nine elasticities. Table 4 presents matrices of partial elasticities and crosselasticities of the probabilities of land use change with respect to returns and property taxes for both conditional and nested logit models.

Transition	Prime	Prob.		Elasticities of transition probabilities with respect to						
				Return to			Property tax on			PII for
			Agr	For	Dev		Agr	For	Dev	Dev
Agr→Agr	0	0.950	0.004	-0.001	-0.007		-0.001	0.000	0.004	-0.007
Agr→Agr	1	0.980	0.002	0.000	-0.009		0.000	0.000	0.005	-0.015
Agr→For	0	0.045	-0.088	0.021	-0.007		0.013	-0.006	0.004	-0.007
Agr→For	1	0.014	-0.140	0.016	-0.009		0.014	-0.006	0.005	-0.015
Agr→Dev	0	0.005	-0.011	0.000	0.810		0.002	0.000	-0.436	0.537
Agr→Dev	1	0.006	-0.017	0.000	0.912		0.002	0.000	-0.481	0.623
For→Agr	0	0.004	0.082	-0.027	-0.004		-0.014	0.008	0.003	-0.005
For→Agr	1	0.013	0.082	-0.027	-0.005		-0.015	0.008	0.003	-0.005
For→For	0	0.992	0.000	0.000	-0.004		0.000	0.000	0.003	-0.005
For→For	1	0.983	-0.001	0.000	-0.005		0.000	0.000	0.003	-0.005
For→Dev	0	0.004	0.000	-0.003	0.768		0.000	0.001	-0.449	0.510
For→Dev	1	0.004	0.000	-0.003	0.818		0.000	0.001	-0.508	0.513

Table 4. Land use transition probabilities and elasticities (averaged over observations) by land quality (nested logit model)

Conclusion

This paper analyses determinants of land use changes in Louisiana during the period 1982-1997. Land quality is an important factor determining allocation of land to agricultural land use while urbanization (proximity and concentration of population) plays an important role in conversion to developed land use. Higher return to a particular land use increases the probability of conversion to this land use and decreases the probability of converting to other land uses. This finding corresponds with results of most of the studies of land use change (e.g, Lubovski, 2003). Higher property tax to a particular land use decreases the probability of conversion to this land use and increases the probability of converting to other land uses. This result supports underlying theory, however as to our knowledge, it was not reported in empirical studies of land use. This result has an importing policy implication by allowing evaluating effect and effectiveness of particular property tax policies on land use change. The shortcomings of this study are that it does not take into account possible spatial correlation and possible temporal autocorrelation in pooled cross sectional data

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Effect of Urbanization on the Forest Land Use Change in Alabama: A Discrete Choice Appproach

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Abstract

The study focuses on exploring the impacts of urbanization on changes in forest land use/land cover in Alabama for the period between 1972 and 2000. Nested logit analysis of the discrete land use choices made by the private landowners show that initial forest type and population gravity index significantly explain the variation in forest type transition. Anthropogenic factors influence the decision in favor of forest land conversion to non-forest use. Softwood stands were more preferred for harvests relative to hardwood while hardwood was the more preferred choice for maintaining land in forest cover near the population centers relative to softwood.

Key Words: nested logit, urbanization, land use, population gravity.

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Introduction

Land use change and respective change of land cover attributed to human activities on land is a common phenomenon associated with population growth, market development, technical and institutional innovation and policy action.

Vitousek (1994) identified land cover changes by humans as the primary effect of humans on natural systems. Few forested areas on our planet have not been influenced by human actions, yet the effects of long-term human influences on land use/land cover changes from forestry are not well documented. Various models differing in temporal and spatial scales and quantitative techniques have been applied by researchers/scientists to uncover the determinants of land use change. A close look at past land use studies reveals that biophysical factors such as land quality and topography; economic factors such as population, market conditions, proximity to population centers and income; and institutional factors such as government policy are the major determinants of land use change. The objective of this paper is to explore the effect of increasing population pressures on choices made by the private forest landowners of Alabama. Alabama ranks second in the nation in acres of forestland (excluding Alaska), ((NRI, 1997)

<u>http://www.al.nrcs.usda.gov/technical/nri/97highlights.html</u>) and the forests of the state account for 13% of the total timber removals in the South (Smith et al 2002). The impacts on forestry land use including changes to non-forest uses viz. agriculture and urban/developed land or changes in forest types (land cover changes) will have significant effects on the ability of Alabama's forests to provide both timber and non-timber amenities in the future.

Literature Review

Empirical land use change models have been constructed using primarily two approaches. The first is the aggregated approach that models areas or proportions of land in different use categories such as forestry, agriculture and urban (Alig 1986, Hardie and Parks 1997) or different forest types such as softwood, mixed hardwood, hardwood, agriculture and urban land (Zhang et al 2005) within a well defined geographic region such as a county as a function of socioeconomic variables and land characteristics aggregated at the level of the geographic unit of observation. The second is the spatially explicit approach that explicitly models land use change on the basis of pixels, parcels, or sample points (Bockstael 1996, Chomitz and Gray 1996, Munn and Evans 1998, Wear and Bolstad 1998, Kline et al., 2001, Lubowski, 2002). While the aggregated approach has the disadvantage of averaging the physical land characteristics for the unit of study, the spatially explicit approach has often found it difficult to obtain spatial socio-demographic data at scales finer than the census tract level which are virtually nonexistent. Also in the former approach, the coefficients of the model capture simultaneously both the spatial and temporal effects and has done a poor job in projecting land use shares through time (Ahn et al., 2000). In contrast, the spatially explicit approach models the change directly by taking into account the dynamic nature of the land use change decision.

Empirical Land Use Model

Researchers have extensively used multinomial logit models (Chomitz and Gray 1996; Turner et al. 1996; Hardie and Parks 1997) for explaining landowners' choice of land use without taking into consideration the possibility of correlation between alternative choices. A feature of our study is the use of the less restrictive nested logit econometric

framework which relaxes the assumption of Independent and Irrelevant Alternatives (IIA) [⁵] to account for the possible substitution patterns amongst alternative choices.

We employ a discrete choice approach to model the land use decision making behavior of private forest landowners. It is assumed that a landowner starting with an initial forest type chooses between the five possible discrete alternatives the one that maximizes his utility. The alternative choice set includes either converting forest into non-forest use, regenerating into one of the three forest types (hardwood, softwood or mixed) following harvest and a no harvest [⁶] decision to maintain the initial forest type. A landowners' utility gained from choosing a particular alternative depends on the attributes associated with each forest plot. For models of land use change, the vector of plot characteristics, **x**, typically consists of data on land quality, socio-demographic, socio-economic and rent (return) to alternative land use choices. In this discrete choice framework, a risk neutral landowner is assumed to choose for parcel *i* an alternative *k* from a set of *J* alternatives that maximizes his utility at time *t*.[⁷] Assume that the landowner's utility function for choice *j* is given by:

$$V(\mathbf{\beta}_{i}, \mathbf{x}) = v(\mathbf{\beta}_{i}, \mathbf{x}) + \varepsilon_{i}$$

where **x** is the vector of attributes of plot characteristics and $\boldsymbol{\beta}_j$ is a vector of preference parameters on the observable portion of the landowner's utility function for the alternative *j*, $v(\boldsymbol{\beta}_j, \mathbf{x})$. Finally, ε_j is the unobservable portion of the landowner's utility function and is assumed to be a function of certain forest plot characteristics and the characteristics of the decision maker. The landowner then compares all potential choices in his choice set '*J*' and chooses the best land use alternative '*j*' such that:

$$V(\boldsymbol{\beta}_{j}, \mathbf{x}) > V(\boldsymbol{\beta}_{k}, \mathbf{x}) \quad \forall \quad j \in J, \quad k \in J, \quad k \neq j$$
(2)

The challenge is to take the model given by (1) and (2) and develop a statistical model that will enable the recovery of the parameters β . The structure of the model will depend heavily on the assumptions about the form of the distribution of error terms. Assuming error terms ε_j are independent and identically distributed (i.i.d.) with a Type I Generalized Extreme

Value distribution (GEV) [⁸], (1) and (2) are expressed as a multinomial logit model:

$$\operatorname{Prob}(k) = \frac{\exp(\boldsymbol{\beta}_{k} \cdot \mathbf{x})}{\sum_{j \in J} \exp(\boldsymbol{\beta}_{j} \cdot \mathbf{x})}$$
(3)

This denotes that the ratio of probabilities of choices k and j would remain unchanged with a change in the parameters of choices other than k and j (IIA). In reality, that might not be the case. For example, a change in the stumpage price of hardwood might influence the ratio of probabilities of transition to pine plantation vs. probability of transition to agricultural land. A study by Lubowski (2002) on the economic and policy determinants of land use change

^{[&}lt;sup>5</sup>] McFadden (1973) suggested that IIA implies that conditional and multinomial logit models should only be used in cases where the outcome categories can plausibly be assumed to be distinct and weighed independently in the eyes of each decision maker.

^[6] This study does not assume type transition if there is no harvest and considers the forest type as fixed until harvest occurs.

^[7] For notational simplicity the subscripts *i* and *t* will be dropped from the equations.

^[8] Type I GEV also known as Gumbel distribution is based on simplifying assumptions such as independent and identical distribution (iid) of random components and the absence of heteroscedasticity and autocorrelation in the model (see Mcfadden (1974) for details).

using a nested logit model supports the need for exploring alternative nesting structures in land use studies. We use a three level nested logit model, which assumes that decisions are made at three hierarchical levels (Figure 1).





The decision at each of these three levels is modeled as an outcome of separate utility maximizing decisions. The decision to harvest or not to harvest at the uppermost level of the nested tree can be modeled as a binary logit model. Assuming the landowner makes the decision to harvest, he has to make another decision at the medium level of the nested model, which is whether to keep the land in forest or convert it to non-forest use. This can also be modeled as a binary logit model. Finally, assuming the landowner decides to keep the land in forest use, he decides whether to regenerate it to a softwood, mixed or hardwood type of forest. Each of these decisions is taken with a view of maximizing utility. The three level nested model decomposes the choice probability into three components, the marginal probability of choosing a particular subgroup (nest) s at the uppermost level, S=1,2 for harvest or no harvest, the marginal probability of choosing a particular sub-nest l within the nest s, where L=1,2 for non-forest or forest, and the conditional probability of choosing a particular alternative j at the lowest level within the alternative set $J=1...J_{l,s}$ in the sub-nest l and nest s conditional on the choice of that sub-nest and nest. Given this, the probability that a landowner *i* is observed choosing alternative *j* at time *t* in the nested logit formulation requires the decomposition of the choice probability in (3) into three components: the marginal probability P_{is} of choosing a particular nest s (s=1,2) and conditional probabilities $P_{il|s}$ and $P_{ij|l,s}$ of choosing a particular sub-nest l (l=1,2) conditional on the choice of that nest s and choosing a particular alternative j from within the alternatives (j=1,2,3,4,5) conditional on the choice of that nest and sub-nest. The probability defined in (3) thus becomes:

$$P_{islj} = P_{is} \times P_{il|s} \times P_{ij|l,s} = \frac{\exp(\boldsymbol{\delta}_{s} \mathbf{y}_{i} + \tau_{s}I_{is})}{\sum_{k \in S} \exp(\boldsymbol{\delta}_{k} \mathbf{y}_{i} + \tau_{k}I_{ik})} \times \frac{\exp(\boldsymbol{\gamma}_{l} \mathbf{z}_{i} + \sigma_{l|s}I_{il})}{\sum_{m \in L} \exp(\boldsymbol{\gamma}_{m} \mathbf{z}_{i} + \sigma_{m|s}I_{im})} \times \frac{\exp(\boldsymbol{\beta}_{j} \mathbf{x}_{i})}{\sum_{n \in J} \exp(\boldsymbol{\beta}_{n} \mathbf{x}_{i})}$$
(5)

where τ_s and $\sigma_{l|s}$ are the parameters associated with the Inclusive Value (IV) for nest *s* and sub-nest *l* defined as

$$I_{is} = \ln \sum_{m \in L} \exp(\gamma_m \, \mathbf{z}_i + \sigma_{m|s} I_{im}) \tag{6}$$

and

$$I_{il} = \ln \sum_{n \in J} \exp(\boldsymbol{\beta}_n \, \mathbf{x}_i) \tag{7}$$

where, \mathbf{y}_i are the observed plot attributes influencing the choice of the nest, \mathbf{z}_i are the observed plot attributes influencing the choice of the sub-nest and \mathbf{x}_i being the observed plot attributes influencing the decision to keep land in an alternative forest type conditional on the choice of the nest and sub-nest. The inclusive value for nest *s* and sub-nest *l* defined in (6) and (7) is the log of the denominator of the conditional probabilities in (5) and measures the average utilities of the alternatives within that subset of alternatives for the choice of a particular nest *s* and sub-nest *l*. If the parameters δ_k and γ_m are zero and the inclusive value parameters τ_k , $\sigma_{m|s}$ are jointly equal to one then the model will collapse into a multinomial logit model shown in (3).

Data and Variables

The data for this study comes from the Forest Inventory and Analysis (FIA) [⁹] program of the U. S. Department of Agriculture (USDA) Forest Service, USDA Economic Research Service (ERS), Bureau of Census and the Regional Economic Information System (REIS) of the Bureau of Economic Analysis (BEA). We used Alabama FIA data for the census years 1972, 1982, 1990 and 2000 and the Census Bureau data on population demographics for the same periods [¹⁰]. REIS provided us with the per capita personal income by county for the corresponding years. All the plots considered for the study were restricted to be in forest use at the beginning of the period and privately owned. The total number of observations for the period (1972-2000) of the study that consisted of three transition periods was 10383.

All the explanatory variables in the model, associated with the FIA plots were lagged values based on the previous period '*t-1*' to incorporate the general trends in the variable's effect on the landowners' discrete choice as observed at the current period *t*. For example a FIA plot observed in a particular land use for the FIA survey year 1982 had all the corresponding explanatory variables from the FIA survey 1972 and the population census for the year 1970 and so on. From among the array of variables used in this study the key variable that represents the influence of humans on forest land use change is the Population Gravity Index (PGI). The PGI was constructed by utilizing information on the location of the FIA plots in relation to the location of Census populated places within 100km. The geographic location of census places [¹¹] was taken from ESRI Data and Maps, 2005

(<u>http://www.esri.com/data/about/data_maps_media.html</u>). Other variables in the model include the initial forest type dummy for the three classes of forest type denoted by the variable names SW (softwood), MX (mixed) and HW (hardwood) for each FIA plot. Volume in cubic feet of all the trees within a FIA plot divided by the plot acres is denoted by VOL and was included as a potential measure of the propensity to harvest for the plot. We also included the growing stock removals in cubic feet (from FIA county data) per unit of county

^[9] Historically FIA provides detailed data on forest inventory for all the states on approximately 10-year periodic cycle with each plot roughly representing a 3×3 mile grid pattern

^{[&}lt;sup>10</sup>] Census collects decennial data and so for the FIA counterpart of 1972 and 1982 we used its closest census counterpart which was 1970 and 1980.

^{[&}lt;sup>11</sup>] Bureau of Census definition for a place is "concentration of population either legally bounded as an incorporated place, or identified as a Census Designated Place (CDP) including comunidades and zonas urbanas in Puerto Rico. Incorporated places have legal descriptions of borough (except in Alaska and New York), city, town (except in New England, New York, and Wisconsin), or village".

land area in acres (from ERS) as a proxy for forest land use return (RET) hypothesized as one of the chief economic drivers of land use change in almost all of the previous land use models. SLOPE in percent for the FIA plots was included to examine the potential influence of topography on landowner choice. Finally, to explore the full potential of the urbanization pressures acting on forest land use change, county level estimates of per capita personal income (INC) from REIS of the BEA deflated by the Consumer Price Index (Urban South, 1982=100), and county level estimates of population density (PD) were also included in the model. A list of the variables used in the analysis with their sources and standard statistical summary is given in Table 1.

Variable	Definition	Source	Mean	Std.dev.
PGI	Number of persons/Km ² around each FIA plot within 100 Km radius of each FIA plot	FIA plot and Census Bureau	136.03	99.60
VOL	Average volume in cubic feet per acre for the FIA plots	FIA plot data	1027.19	965.92
SW	Initial forest type dummy for Softwood forest	FIA plot data	0.35	0.47
MX	Initial forest type dummy for Mixed forest	FIA plot data	0.44	0.50
HW	Initial forest type dummy for Hardwood forest	FIA plot data	0.20	0.40
INC	Real (1982=100) per capita personal income by county in \$	BEA	111.95	23.48
RET	Growing stock removals in cubic feet per acre of county land area	FIA county data and ERS	37.53	18.40
SLOPE	Slope in percent for FIA plot	FIA plot data	9.93	10.75
PD	Number of persons per unit of land area by county	Census Bureau	73.28	97.75

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Population Gravity Index

A 100km [¹²] buffer around Alabama incorporating the influence of census places from the four contiguous states of Georgia (GA), Tennessee (TN), Mississippi (MS) and

^{[&}lt;sup>12</sup>] 100 km within an average 60-minute commute time from FIA plots was assumed as the threshold distance and varying this distance did not substantially affect the sign and magnitude of the estimated coefficients of the gravity index and other variables.

Florida (FL) in addition to all the designated census places within the state of Alabama was created. Population Gravity index (PGI) $[^{13}]$ for a plot *k* was specified as

$$PGI_{k} = \sum_{p} \frac{P_{pt}}{D_{kp}^{2}} \quad \forall \ p : D_{kp} \le 100 \ km$$

$$\tag{8}$$

where P_{pt} is the population of populated place p at time t, and D_{kp} is the distance between FIA plot k and populated place p.

PGI was previously found to be positively correlated with conversion to non-forest use from forest use (Majumdar et al. 2005).

Results

The three utility functions representing the variables likely to influence landowners' decisions at the three decision nodes of the nested tree and the attribute vectors in \mathbf{y}_i , \mathbf{z}_i and

 \mathbf{x}_i are:

Pr(no harvest relative to harvest) = f(VOL, SLOPE, SW)(9)

 $Pr(Non-forest relative to Forest) \equiv f(PGI, INC, RET, PD)$ (10)

 $Pr(Softwood \text{ or Mixed or Hardwood}) \equiv f(SW, MX, HW, PGI)$ (11)

We estimated a three level nested logit model in which the landowner decides to either harvest or not to harvest at the top level, then makes the decision to convert the harvested plots into non-forest use or keep them in forest use at the next level, and finally decides on whether the forested plot will be of softwood, mixed hardwood, or hardwood forest type at the lowest level (see Figure 1 for the nested tree depiction).

The reference category [¹⁴] in (9) was harvest and in (10) forest. In (11) the reference category was hardwood (for PGI) and no change in forest type for the variable initial forest types (SW, HW or MX) respectively. The results are summarized in Table 2.

Variable	Coefficient	Standard Error	Odds Ratio	t-statistic
No Harvest Vs. Harvest				
$SW \times C_{NH}$	-0.5714	0.059*	0.56	-9.61
$SLOPE \times C_{NH}$	0.0217	0.002*	1.02	10.12
$VOL \times C_{NH}$	0.0009	0.00003*	1.00	32.31
Non-Forest Vs. Forest				
$PGI \times C_{NF}$	0.0011	0.0005**	1.00	2.16
$\operatorname{RET} imes \operatorname{C}_{\operatorname{NF}}$	-0.0172	0.004*	0.98	-4.40
$PD imes C_{NF}$	0.0019	0.0005*	1.00	3.99
$INC \times C_{NF}$	-0.4266	0.0397*	0.65	-10.75
Forest Type				
$MX \times C_{SW}$	-1.9815	0.1225*	0.14	-16.17

 Table 2 Nested Logit Parameter estimates for the three-level nested model

^[13] Kline et al (2001) used a similar formulation of gravity index but with different exponents on the population and distance components of the index and they used three cities with population greater than 5000 and greatest urban influence based on their gravity index on each FIA plot.

^{[&}lt;sup>14</sup>] With all the explanatory variables being characteristics of the FIA plot and not the alternative land use choices we used interactions of each variable with the dummy of choice alternatives and hence had to remove a particular choice and make it as a reference base for model identification.

$MX \times C_{HW}$	-2.3806	0.1032*	0.09	-23.06
$\mathrm{HW} imes \mathrm{C}_{\mathrm{SW}}$	-0.2388	0.1184**	0.79	-2.02
$HW \times C_{MX}$	0.4010	0.0909*	1.49	4.41
$SW \times C_{MX}$	-0.9931	0.0857*	0.37	-11.59
$\mathrm{SW} imes \mathrm{C}_{\mathrm{HW}}$	-1.2661	0.0874*	0.28	-14.48
$PGI \times C_{SW}$	-0.0045	0.0005*	0.99	-8.72
$PGI \times C_{MX}$	-0.002	0.0003*	0.99	-6.88
IV ^e (Forest)	0.87	0.1360*		6.42
IV ^e (Harvest)	0.85	0.1311*		6.48
Log likelihood	10096			
McFadden's LRI	0.39			
Observations	10383			
3				

 $^{a}C_{SW}$, C_{MX} , C_{HW} , C_{NF} , C_{NH} represent the dummies for the choice alternatives softwood, mixed, hardwood, non-forest and no harvest respectively

^e IV were constrained to be the same at each nest level for model identification, moreover for degenerate branches the such as Non-forest and No harvest IVs cannot be identified (for detail see Hunt 2000), * p < 0.10, ** p < 0.05

The nesting structure in figure 1, together with equations (5)-(7) and (9)-(11) can be used to formulate appropriate log likelihood function to estimate the parameters of the model. The nested logit model was estimated using full information maximum likelihood estimation in SAS 9.1. Maddala (1983, page 73) states that if the IV parameters lie outside the range of zero to one then this should be considered as evidence for a specification error and warrants re-examination of the model. Further McFadden (1981) states that if the dissimilarity coefficients (IV coefficients) are larger than 0 and not statistically larger than 1, it can be concluded that the nested model is consistent with stochastic utility maximization. The results support the choice of a nested logit model, over a more restrictive multinomial logit model that does not allow for correlation within nests.

The estimated maximum likelihood nested logit model had a reasonable fit with McFadden likelihood ratio index statistic (pseudo- R^2) being 0.39.

No Harvest Vs Harvest

SW, representing the initial forest type as pine, had the expected negative sign and indicates less likelihood of no harvest of a pine plot. In other words there is a greater likelihood that pine plot will be harvested relative to hardwood or mixed plot. SLOPE had the expected positive sign with the statistically significant parameter estimate which indicates that with an increase in slope there is a greater likelihood of no harvest due to a possible hindrance to accessibility of logging equipment and associated increase in harvesting cost. Moreover steep slope also constrains excessive harvests to prevent erosion. The result is consistent with previous studies (Wear and Flamm 1993).

VOL, denoting the average volume per acre in cubic feet for the FIA plot had a positive sign. This implies that higher the volume the less likely it will be harvested. This is contrary to our expectation that greater average volume would lead to a greater probability of harvest. A close examination [¹⁵] reveals that most of the harvests took place in the softwood plantation type, which typically has lower average volume in comparison to the hardwood plots.

Non-forest Vs Forest

The population gravity index (PGI), representing the developmental pressure on forestland, had a statistically significant positive coefficient indicating that with a increase in PGI there is a greater likelihood of forestland conversion to non-forest use. This is an expected result since in general demand for developed land near the population centers with higher PGI is high in comparison to the demand for forests. Researchers have found other measures of urbanization like increase in population density (Nagubadi and Zhang 2005) and decrease in distance from the center of the county to the nearest city (Ahn et al 2002) to favor an increasing non-forest share of land.

INC had a statistically significant negative coefficient suggesting that counties with higher real per capita income are more likely to maintain their forests, with less inclination for conversion to non-forest use, *ceteris paribus*. This is contrary to the expectation of a casual observer and inferences drawn from previous research (Zhang and Nagubadi 2005). The intuitive explanation could be that with an increase in income the landowner may perceive the returns from the consumptive use (aesthetics, amenities) of his forestland as higher in comparison to the return that can be gained with conversion to a developed use (intuitively somewhat like an environmental Kuznets curve).

RET, denoting the total amount of removals of growing stock from all the FIA plots within a county adjusted for the difference in county land area in cubic feet per acre has a negative coefficient and is statistically different from 0 at the1% level of significance. This result is consistent with our expectation, since counties with higher timber removals represent the timber basket of the state and have less likelihood of forestland conversion to other uses. This result is consistent with the Ricardo-Thünnen land rent theory of land use change that proposes that land is put to the land use alternative that provides the highest land rent. Positive forest use returns (denoted by higher RET) are expected to decrease the likelihood of forest conversion to non-forest use.

PD had a statistically significant positive coefficient reflecting the increased likelihood that a plot will be converted to non-forest use when there is an increase in demand for land for residential purposes, a result consistent with past studies on land use change (Wear et. al 1998, Nagubadi and Zhang 2005).

Forest Types

The negative parameter estimate for five out of the six (except HW × C_{MX}) [¹⁶] initial forest type variables indicates less likelihood of a forest type transition from one type to another relative to its likelihood of remaining as the same type reflects the costs of conversion constraints (Alig and Butler 2004). However the positive estimate for hardwood plots to be regenerated into a mixed type (HW × C_{MX}) following harvest indicates a contrary

^[15] Separate models had to be estimated which could include interaction terms of VOL and the initial forest type keeping the VOL main effect for each forest type due to collinearity problem and results showed the coefficient of the interaction term of pine with the average volume as negative while that of the hardwood and mixed as positive

^{[&}lt;sup>16</sup>] C_{SW}, C_{MX}, C_{HW}, C_{NF}, C_{NH} refer to the choice alternatives: softwood, mixed, hardwood, non-forest and no harvest respectively.

result. Zhou et al. (2003) found a significant percentage of FIA plots in the South (upland hardwood), which were not harvested, transitioned to a mixed type in the subsequent survey and considering that there were a large percentage of plots (53.2 %) in our study that were not harvested, this result seems reasonable. Also depending on the FIA classification [¹⁷] of a forest type, it is possible that a stand classified as hardwood could be retyped as a mixed type in the subsequent census.

The negative significant parameter estimate for $PGI \times C_{SW}$ and $PGI \times C_{MX}$ reveals landowners' (who are closer to population centers) preferences for regeneration of hardwoods.

Discussion

The nested logit model seems to be an appropriate choice for studying the discrete choice behavior of the private forest landowner. It is superior to multinomial logit, an econometric technique widely used to model land use, and allows for correlation of the error terms within a nest of similar choices. To our knowledge application of the nested logit technique to analyze the forest harvesting decision by the landowner has not been considered previously. Our results show that the initial forest type and population gravity index are significant variables in explaining the variation in type transition. Consistent with previous research findings population gravity index, a proxy for the anthropogenic influence, favored forest land conversion to non-forest use.

The probability that a forest plot will be converted to non-forest at the mean of all the explanatory variables in the model is 0.02. In the softwood, mixed and hardwood forest types those probabilities increased to 0.05, 0.17 and 0.06 following harvest. The probability of no harvest at the mean of the variables was 0.7. In summary, given the 21.7 million acres of private timberland (Hartsell and Brown 2000) our model projects 434,000 acres to be converted from forest to non-forest use over a period of the next 10 years. For the same period the acreage of non-harvested forest plots is projected to be 15.19 million acres with 1,085,000 acres, 3,689,000 acres and 1,302,000 acres of harvested timberland projected to be regenerated as softwood, mixed and hardwood forest types respectively. These results are consistent and can be used for short-term predictions.

^{[&}lt;sup>17</sup>] A classification of forest land is commonly based upon, and named for, the tree species that forms the plurality of live-tree stocking.

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An Analysis of Forest Land Conversion Using Satellite Imagery and US Census Data

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Economic growth during recent decades has accelerated the urbanization around many metropolitan areas in the Southeast of the US. The growing competition among the major land use practices in the region indicates significant amount of forest land has been consumed for urban expansion in recent decades (Reynolds, 2001; Alig et al. 2003). By the mid of this century, estimated increase in population, income and other factors in the sough has been expected to decrease forest area by 6 % of total forest in 1997 (Alig et al. 2003). The conversion of forest land has economic and ecological impacts. The ecological impacts include effects on the conservation of local endangered species. As the forest land in the Southeast serves as a major supply source of timber and outdoor recreation in the nation, understanding the process of forest conversion is important for resource management of the region as well as the nation.

Land use models have been applied to both broad units and fine units, based on the spatial scale of land use. Models of broad units examine patterns of land use from a macro viewpoint. These models generally use counties or county groupings as units to highlight how socioeconomic factors and physical landscape features influence land use allocations (Alig 1986; Hardie and Parks 1997; Miller and Plantinga 1999; Plantinga 1996; and Hardie, et al. 2000). Models of fine units, on the other hand, provide analyses of spatially explicit land use decisions. These models estimate the direct influence of site-specific factors measured at a fine resolution. For example, the road construction and access influences on land development (e.g., Chomitz and Gray 1996; Nelson and Hellerstein 1997; Dale, et al.1993) and the influences of location, topography, and ownership (Turner, et al. 1996; Spies, et al. 1994) are analyzed in this framework. While each type of model independently serves a valuable function, both have limitations as well. Macro-scale analyses do not capture information in a spatially explicit framework, while micro-scale analyses may miss out on broader physical and social phenomena.

This paper attempts to bridge the broad and fine scales of analysis by examining socioeconomic information at the census-block group level (broad units) in conjunction with site-specific satellite imagery data at the pixel level (fine-scale units). This study focuses on

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findings of the determinants of forest land conversion to other two major non-forest use types of urban and agriculture in Cumberland and Morgan Counties, Tennessee.

The Cumberland and Morgan Counties are chosen for this study because of the remarkable demographic change in the counties during the 1990s due to population growth of 28% and increase in retiree rates of 50% (Strickland, 2003). As many of the previous land use researches have found the significant relationship between land use and demographic change, the two counties provide a dramatic laboratory for such a study.

Following Miller and Platinga (1999), Hardie and Parks (1997), and Chomitz and Gray (1996), a multinomial logistic regression was used to observe the forest land conversion to urban and agriculture uses in response to changes of explanatory variables within a given period of time. The discrete choices of retention and conversions of forest land to urban and agriculture uses were treated as a dependent variable in the model. The variables in the right hand side of the model included demographic, economic and spatial factors. The model was estimated using the data reflecting changes in the land use and socioeconomic factors between 1992 and 2000. The probability of forest conversion to urban and agriculture uses were estimated.

Moreover, marginal effects and elasticity were calculated to make the findings more intuitive. Our result found the variables that have significant effects on the conversion of forest land to both urban and agriculture land, only to urban land, and only to agriculture land. Not surprisingly, the spatial influence of urbanization (measured in terms of gravity index) was found to promote forest conversion in favor of urban use rather than agriculture use. The increase in population density and residents' education level, and steeper surface terrain were found to have significant effects on both types of conversion. While the proximity to nearest road was found to be a significant factor in the conversion to agriculture use, the distance to nearest water body, i.e., lake or stream, significantly affected both kinds of conversion. Although proximities to bigger cities were found to be significant factor in both types of conversion, the proximities to smaller cities were found to affect the conversion to agriculture use only.

This study provides a methodological framework to land use research that links the broad and fine-scale observation units. The findings from this study can be useful for local policy makers to design proper land use management options. It also provides a meaningful implication of extending existing land use models with spatial attributes. The prediction of future forest conversion for urban and farming expansion based on estimates from the model might be of interest in real state planning, farmland conservation, and integrated regional development.

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Long-Term Management Impacts and Costs of Forest Certification in North Carolina: The Experience of the Southern Center for Sustainable Forests Partners

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Abstract

The three participating organizations in the Southern Center for Sustainable Forests–North Carolina State University, Duke University, and the North Carolina DENR Division of Forest Resources–received both Forest Stewardship Council (FSC) and Sustainable Forestry Initiative (SFI) certification for their forests in 2001. The total costs of maintaining certification for SFI ranged from \$0.39 per acre per year (NC DFR) to \$3.87 per acre per year (Duke). For FSC, the costs ranged from \$0.42 (DFR) to \$2.92 (NCSU) per acre per year. These annual costs had small impacts on long-terms discounted cash flow returns as measured by the IRR or LEV. The IRR changes were 0.06 to 0.43 percentage points less, and the LEVs were \$10 per acre to \$47 per acre less depending on ownership and species group, at a 6% discount rate. For typical hardwood stands, IRRs decreased by 0.06 percentage points for DFR lands, and 0.42 percentage points for NCSU lands. Certification benefits included better documentation, communication, research, and teaching, but better prices have not been received yet.

Introduction

Forest certification has been in effect for more than a decade to date, providing more opportunity to examine its costs and impacts. We have cooperated since 2001 in achieving and maintaining forest certification among the three partners of the Southern Center of Sustainable Forests—The North Carolina Division of Forest Resources, Duke University, and NC State University. This article summarizes our assessment of the costs of certification during that time and the long-term impacts on forest management investment returns.

As of 2006, there were about 280 million ha of certified forests in the world, with the large umbrella system of the Programme of Endorsement for Certification Systems (PEFC) having 187 million ha. This system endorses certification systems promulgated by individual

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countries, including the Sustainable Forestry Initiative (SFI) in the U.S. and Canada, which certified 55 million ha as of 2006. The Forest Stewardship Council (FSC) is considered the greenest of the forest certification system because of its development and promotion by environmental non-government organizations. FSC had 73 million ha certified in the world in 2006. FSC has issued about 100 certificates on 5.8 million ha in U.S., and SFI has 132 company participants 52 licensees, with 18 million ha in U.S., and the balance in Canada.

The three partners of the Southern Center for Sustainable Forests (SCSF) certified much, but not all of their forests as part of this cooperative research and outreach project. There were three forests certified: (1) The NC Division Forest Resources—27,000 ac; (2) North Carolina State University—with 3 state and 2 forestry foundation properties—4,500 ac; and (3) Duke University private lands—7,000 ac.

Our forests have diverse tracts and objectives. The state Division of Forest Resources has production; amenity/biodiversity, and demonstration objectives. NC State University has multiple objectives for its forests, including education, forestry camp, income for merit undergraduate and graduate scholarships, outreach, and recreation. Duke manages forests for education, research, and recreation purposes. All of our forests must be self-supporting, and in fact usually must generate cash flows to fund all of the multiple forest objectives, as well as provide some modest returns back to the parent organization.

Southern Center Certification Process and Results

Each organization prepared for certification of our forests in 2000; each had separate forest certification inspections for SFI and FSC in sequence in 2001. The initial certification audits were paid for by a grant from the Pinchot Institute, and we have assumed these costs since. We have had annual re-audits for FSC each year. The annual FSC audits examine progress on the certification implementation and progress on meeting the usually many conditions and continuing action resolutions required by FSC. A major SFI re-audit was due in the third year after certification, although this was delayed until the fourth year due to the timing of the receipt of the actual certification certificate, and problems in issuing the (state) contracts with NC State University and the DENR DFR. SFI will now require annual surveillance audits each year as well. The SFI audits check on ongoing practices, check on correcting minor non-conformances, and our required participation in the State Implementation Committee.

Non-Conformances, Conditions, and Management Responses

We all had a significant challenge in meeting the certification standards for the first time, since we started from no specific preparation to being certified within about one year. For the first certification, the NC Division of Forest Resources had 6 major non-conformances (of 10 objectives) and 5 minor non-conformances. They made written reply on how they would remedy these shortcomings, and were then certified after a review of that report. The DFR was certified by FSC after meeting two pre-conditions. They then had 32 conditions and many recommendations.

In 2001, NC State University had 9 major non-conformances and 6 minor non-conformances under SFI. They made a written reply and plan changes to verify fixes, followed by a December 2001 remedy audit. They then met the standards and became certified in 2002 with 3 minor non-conformances. For FSC, NC State passed the audit with 1 pre-condition (clearcuts must be less than 40 ac), 23 conditions, and 12 recommendations.

Duke had 1 major nonconformance, and 2 minor non-conformances under SFI, and made a written reply to verify that they had corrected the shortcomings. For FSC, they passed the audit with no pre-conditions, and had 14 conditions and 14 recommendations.

Paraphrased examples of the management changes required to meet the SFI standard, or conditions that followed certification for FSC, are shown below.

Table 1. Selected Required SFI Management Changes - NCSU, 2001

- □ Management plans required for each forest
- □ Site specific plans for each timber sale
- Better worker training and safety records
- □ Better roads to meet BMP standards
- Train or use road contractors trained in proper BMP installation
- Quarterly BMP monitoring and inspection
- □ Maintaining all SMZs at 50 feet, not just meeting state Forest Practice Guidelines
- □ Water bars on steep slopes
- □ Water bars/dips on horse path breakdowns
- Clarify visual amenity and clearcut guides

Table 2. Selected Required FSC Management Changes - NCSU, 2001

Pre-condition

□ 40 ac clearcut unless justified

Conditions- change w/in one year (23)

- □ Process to work better w/stakeholders
- Employ post harvest inspection checklist
- □ Plan to include landscape considerations
- Write ecological and silvicultural rationale for stand prescriptions
- Create a chain-of-custody process
- □ Incorporate neo-tropical bird/snag monitoring efforts in management plan
- □ Clarify "Special Use" areas with 20% or more in natural or semi-natural state

Table 3. Selected examples of Required SFI Management Changes - DFR, 2001

- □ Use SMZs by all streams and ditches
- No ditch outlets directly into streams
- Use utilization standards in all timber sale contracts
- Demonstrate current water quality and wildlife research activities
- □ Provide adequate training in wildlife and biodiversity
- □ Incorporate continuous improvement into annual personnel evaluation process

Table 4. Selected examples of Required FSC Management Changes – DFR, 2001

Pre-Conditions:

- Complete management plan
- □ 40 ac plantation clearcut max, unless have green tree retention for vertical structure

Conditions within 1 year

- Demonstrate support of FSC principles
- Develop stakeholder input process
- Provide guidance to field staff on minimum impacts to be assessed in the field before taking actions
- Modify rate prescriptions for chemicals

Conditions within 2 years

- □ Identify alternatives for use of chemicals
- Monitor environmental effects of timber harvesting, site prep, and chemical application
- **D** Publish annual summary of al monitoring on state forest
- □ Identify and delineate high conservation value attributes
- Restore permanent fire lines to their approximate original grade and increase potential for native groundcover

Subsequent efforts required to maintain forest certification for Duke and Division of Forest Resources are paraphrased in the tables below.

Table 5. Selected Duke Internal Efforts, SFI and FSC, 2002-2005

SFI

- **D** Revise wildlife management plan, recalculate Shannon-Weaver Diversity Index
 - o 200 hrs, training
 - o 20 hrs/yr (variable, 8-32 hrs/yr)
- Support of State Implementation Committee 9 hrs
- Senior management review of SFI conformance -2 hrs
- □ Long term sustainable yield calculations 700 hrs

SFI & FSC

- Identification and maintenance of High Conservation Value Forests planning, 12 hrs
- □ Natural Heritage proposal 20 hrs, implementation and maintenance/year

FSC

- Economic analysis of forest practices, 10 hrs
- Disseminate safety guidelines, informational signs
 - o \$700+56 hrs, policies, web site 5 hrs
 - o Plus annual documentation 24 hrs/yr
- □ Written prescriptions w/ecological & silvicultural rationale
 - o 16 hrs plus 20 hrs/year
 - 2 hrs/management prescription
- □ Protocols specifying stand level considerations
 - o 12 hrs plus 20 hrs/yr
 - o 2 hrs/management prescription
- □ Assessment of fertility and compaction 12 hrs
- □ Plans/policies to achieve strategic goals
- □ Annual report and plan 40 hrs/yr
- □ Process for making mgmt plan available
- □ Website 1 hr
- □ Chain of Custody Procedure 16 hrs (implementation)
- Gather stakeholder attitudes/opinions
 - Stakeholder lists, biennial meeting 6 hrs plus 12 hrs/year
- **u** Review of timing of inventory and incorporation into management plan

FSC

- □ Annual audits, 2002-2005
- □ Note contract problems, with FSC and SFI
 - Sole source providers
 - State procurement challenges
- □ Preparation
- Old: Notebooks
- New: CD with hyperlinks to standards
- □ Audit process: day 1: office, paperwork; day 2: field trips
- □ Impression: well organized, friendly

SFI

- □ Needed to become a licensee of SFI
- □ Used same process as FSC with CD, hyperlinks to standards
- \Box Not re-certified 2 major non-conformances
 - Inability to perfect allowable cut
 - o Inadequate continuous improvement element in job descriptions
- □ Impression: well organized, tense, intimidating and unfriendly
- DFR issues: lack of exact plantation area prevents exact allowable cut
- □ In theory, a new audit (not re-inspection), so need not show improvement yet

Certification Preparation and Audit Time and Costs

The time and costs for obtaining and maintaining certification for each system have been monitored by each of our organizations. The initial direct costs for obtaining certification were reported in Cubbage et al. (2003), and are updated below in Table 7. The subsequent annual time and costs of maintaining certification are summarized in the several tables below. Table 8 summarizes the time and costs for NC State with detailed breakdowns by type of activity as an example; Tables 9 and 10 summarize these data for all organizations. Table 10 includes the cost of preparing and paying for the audits, which were similar for all organizations, regardless of size. Payments included an average of \$3,500 per year for the SFI audits, and \$5,200 per year for the FSC audits for each organization. The SFI audit was a one-time cost after three years. This cost will increase in the future now that SFI has changed to require surveillance audits each year, and will be close to FSC annual costs.

Practice / System	NCSU	Duke	DFR	All
Acres	4500	8 000	27 000	39 500
	cc	ost in doll	ars per acr	e
Inspections				
FSC (\$70K)	-	-	-	1.77
SFI (\$37K)	3.77	1.10	0.36	0.94
Preparation				
FSC (\$15K)	1.87	0.60	0.06	0.38
SFI (\$33K)	3.95	1.54	0.14	0.84
Total Direct				
FSC (\$85K)	-	-	-	2.15
SFI (\$70K)	7.72	2.64	0.50	1.77

Table 7. Direct initial costs of obtaining forest certification, 2001 (\$)

Notes: FSC costs were received as one price for all organizations, so are not separable. NCSU cost includes payment for a second remedy audit.

Table 8.	North Carolina State	University D	irect Preparat	ion Hours and	Costs, 2002-
2005					

	Direct Prepara	ation Hours	Direct Preparation Costs (\$)		
	<u>SFI</u>	<u>FSC</u>	<u>SFI</u>	FSC	
Project Component					
Preliminary meetings	32	24	1600	1200	
Pre-audit meetings and	160	240	8000	12000	
preparation					
Documentation preparation	160	240	8000	12000	
and collection of evidence					
Office visits by auditors	36	32	1800	1600	
Field visits by auditors	36	32	1800	1600	
Post audit work	4	8	200	400	
Report analysis and response	4	40	200	2000	
Total – four years	408	632	20400	31600	
Average per year	102	158	5100	7900	

Note: Costs assume labor and overhead at \$50 per hour

-	Direct Prepar	ation Hours	Direct Preparation Costs (\$)		
	<u>SFI</u>	<u>FSC</u>	<u>SFI</u>	<u>FSC</u>	
Project Component					
NC State University					
4 year total	408	632	20400	31600	
Avg/yr	102	158	5100	7900	
Duke University					
4 year total	829	240	41450	12000	
Non-conformance response	1059	755	52950	37750	
Total	1888	995	94400	49750	
Avg/yr	472	249	23600	12450	
NC DFR					
4 year total	550	500	27500	25000	
Avg / year	138	125	6900	6250	
All Ownerships					
4 year total	2846	2127	142300	106350	
Avg / yr	711	532	35550	26600	

Table 9. Certification Preparation Hours and Costs, 2002-2005

Note: Costs assume labor and overhead at \$50 per hour; Duke reported separate costs to correct minor non-conformances.

Practice	Prepa	ration		Audits		Total
System	SFI	FSC	SFI	FSC	SFI	FSC
NCSU	1.13	1.76	0.78	1.16	1.91	2.92
Duke	3.37	1.78	0.50	0.74	3.87	2.52
NC DFR	0.26	0.23	0.13	0.19	0.39	0.42
Average Per Year for All	0.92	0.69	0.27	0.41	1.19	1.10

 Table 10. Direct initial costs of maintaining forest certification per acre per year, 2002-2005

 (\$)

We also estimated the impact of the preceding costs on discounted cash flow returns. For representative planted pine and natural hardwood stands, we estimated the base cash flows and capital budgeting returns with and without forest certification costs. Essentially, these costs are just an added negative cash flow in each year that they occur. We used the case of NC State and DFR in these analyses, which bracket the range for all three institutions. The effects of the returns on Duke would be fairly similar to those of NCSU.

These results of the discounted cash flow analyses are summarized in Table 11. Depending on the ownership size, certification costs reduced the Internal Rates of Return (IRRs) for typical pine management by .04 percentage points (DFR) to 0.31 percentage points (NCSU), and Land Expectations Values (LEVs) by only \$10 per acre for DFR lands to \$47 per acre for NCSU lands, at a 6% discount rate. For typical hardwood stands, IRRs decreased by 0.08 percentage points for DFR lands, and 0.43 percentage points for NCSU lands. Hardwood LEVs decreased \$10 per acre for DFR lands and \$54 per acre for NCSU lands.

Species	Without Certification		With Certification				
			SFI				
	IRR (%)	LEV (\$/ac)	IRR (%)	LEV (\$/ac)	IRR (%)	LEV (\$/ac)	
Planted Pine							
NC DFR	9.46	604	9.40	596	9.39	595	
NCSU	9.46	604	9.11	557	9.03	543	
Natural							
Hardwoods							
NC DFR	3.63	-153	3.55	-163	3.54	-164	
NCSU	3.63	-153	3.20	-207	3.20	-225	

Table 11. Analyses of Timber Investment Returns With and Without Forest Certification Costs: Internal Rate of Return and Land Expectation Value (6% discount rate)

Discussion

This ongoing demonstration, research, and education project of the Southern Center for Sustainable Forests has provided considerable information about the practice and costs of forest certification for a range of ownership types and sizes. This summary provides one of the most detailed data sets on forest certification practices required, times involved, and costs that is publicly available. It provides a range of data based on the different size ownerships, which are still larger than almost all non-industrial private forest owners in the South.

The costs we computed and impacts are representative of larger owners, and include both paying for the audit costs and imputed costs of time spent on maintaining certification. We used \$50 per hour for our "labor" costs of foresters, or essentially \$100,000 per year. This is more than our foresters make, but would be a proxy for all the overhead costs including vehicles, fringe benefits, offices, equipment, etc. This should also provide a "high" estimate of costs and their impacts; it may be cheaper in some cases. Note also that it was the preparation costs that were most expensive in our certification. If less time could be spent, such as for large forest ownerships, or in group certification, or as in the Tree Farm System, the costs of forest certification would be very small and financial impacts minor.

Time and Costs

The time it took each organization to prepare for our first audits and receive certification varied considerably, from 67 hours to 117 hours per system for the NC DFR, and from 336 to 863 per system for NCSU (Cubbage et al. 2002). This time included document preparation, the field visits, and post audit required to satisfy any non-conformances or pre-conditions. To maintain certification, we needed to spend between 100 to 650 hours per year as well, including pre-audit meetings and preparation, document preparation, and field visits with auditors.

The time required to maintain certification led to moderate expenses for the foresters involved. This included the direct costs of paying for the audits each year, which averaged about \$3,200 for SFI and \$5,200 for FSC, which will both be more similar in the future with annual surveillance audits for both systems. The indirect costs of preparing for the audits and maintaining certification as an environmental management system were more significant. FSC average costs ranged from \$6,250 (DFR) to \$12,450 (NCSU) per year for each organization, and SFI costs ranged from \$5,100 (NCSU) to \$26,000 (Duke) per year.

The total costs of maintaining certification for SFI ranged from \$0.39 per acre per year (NC DFR) to \$3.87 per acre per year (Duke). For FSC, the costs ranged from \$0.42 (DFR) to \$2.92 (NCSU) per acre per year. These annual costs had small impacts on long-term discounted cash flow returns as measured by the IRR or LEV. The IRR changes were 0.06 to 0.43 percentage points less, and the LEVs were \$10 per acre to \$47 per acre less depending on ownership and species group. Forest certification costs had minimal impacts on the already low hardwood timber investment returns, and small impacts on pine plantation returns. Combined impacts of maintaining both SFI and FSC certification were greater, but still modest. For pine plantations, the worst case would be NCSU. For them, the IRR dropped from 9.46% to 8.71%, and LEV at 6% decreased from \$604 to \$495 per acre. For hardwoods, the comparable changes were an IRR decrease from 3.63% to 2.69% for NCSU and LEV decreases from -\$153 to -\$280 per acre. While significant, these costs are less than other costs (or benefits) that forest landowners may incur, such as sudden substantial property tax rises, changes in regulations, or government subsidy payments for forestry activities. Intensive management, better marketing, or timber stumpage price fluctuations and effective sales may have much greater impacts on timber investment returns than these forest certification costs.

Benefits

We also can identify benefits that we received from certification. None of these are better prices, unfortunately, but they are significant. First, we all surely have better environmental management systems (EMSs) since we adopted forest certification. We have better planning and discussion about our forest management, more thought about our principles and practices, more dialogue within our forest management and laborer groups, more continuous improvement of our practices, and much more documentation and records. We provide more

explicit training for workers, and pay more attention to guidelines for pesticides and best management practices.

We communicate more among our Southern Center partners, among the faculty and forest managers, and with external stakeholders. Certification has helped us learn and teach more about the principles, and probably increased morale among the foresters, even if it is for the common problems that achieving forest certification has caused. These indirect benefits also may help us maintain our reputation as leaders in forestry, and help forestry enhance its professional image.

Conclusions

Our experience found that maintaining forest certification has moderate direct costs to pay for audits and indirect costs of maintaining a forest certification EMS. NC State University had less costs for SFI than FSC; FSC was cheaper at the Division of Forest Resources and Duke. The total costs to prepare and maintain forest certification were fairly similar regardless of forest size. Thus the large DFR holding was consistently cheaper per acre than the smaller NCSU forests. Our conversations with industrial forest owners suggest that our cost range is typical of their expenses, with the large DFR ownership being more similar to the case of large ownerships.

FSC direct costs were more expensive because it required annual audits, but SFI has adopted that requirement as well now. FSC seemed to require less preparation time to maintain certification once it was received. This is somewhat surprising, since all our organizations had many FSC conditions and only a few SFI minor non-conformances. However, a minor SFI nonconformance—such as an excellent forest inventory or harvest scheduling approach—may sometimes require an effort that only large landowners are apt to be able to achieve well. FSC does take into account the scale of the owner in its audits, per explicit wording in its standards. However, comparative program costs surely depend on forests, staff, and certifier; there are no universal rules

We might consider these certification costs in terms of their opportunity costs, as economists suggest. At NC State, the audit expenses of about \$5,000 are equal to one or two undergraduate scholarships per year. These funds also may infer foregone opportunities for other forest management. On the other hand, the costs are only a fraction of the much larger Department and College research support and expenditures, which exceed \$1 to \$2 million per year.

Our efforts in obtaining and maintaining forest certification provide a practical example of its benefits and costs for fairly small scale owners. We all have one or more professional foresters on staff, but run fairly low-budget operations that must make a profit for our parent institutions. Certification has helped us learn more about EMS approaches and helped us teach more about the systems based on actual experience. We have walked the walk as well as talked.

Based on these efforts and our experience, we will take different paths for the future. We all think that it is too costly to maintain both forest certification systems indefinitely. Duke has chosen to only maintain FSC certification, at least partially due to the high time and cost requirements needed to meet the inventory and harvest scheduling requirements under SFI. The NC DFR has basically decided the same, for similar reasons and an adverse audit in 2006, and the excessive time requirements that would be required to correct the non-conformances. NC State has still maintained both systems, but is considering dropping FSC at least, and perhaps both systems, in favor of the American Tree Farm System. At a minimum, we concur that maintaining dual certification, particularly with the lack of any price benefits, is too expensive and time consuming. We will continue using some certification system in the future after consultation among our managers and internal stakeholders. The benefits we have received have been substantial, so we hope that we can continue to learn more and teach more about these systems based on our practical experience.

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Modeling Consumer Willingness to Pay Premiums for Environmentally Certified Wood Products in the U.S. Market

Francisco X. Aguilar¹ and Richard P. Vlosky²

Abstract

Environmental certification has become an important issue in the wood products industry since its inception nearly 15 years ago. A research question that has been examined is the potential of price premiums for certified products or raw materials to offset certification costs. This study examines willingness to pay for four wood products from the perspective of U.S. consumers. Information was collected for 1995 and 2005 to detect changes in attitudes, perceptions and willingness to pay for certified wood products over a 10-year period. Results of an ordered probit model suggest that higher probabilities of paying a premium are associated to consumers who seek out other environmentally certified products and who believe certification can lessen environmental impacts such as tropical deforestation. There is also a strong relationship between respondent income and willingness-to-pay. Despite the current industry structure in the U.S. that has adopted a mass-certification strategy that does not charge consumers price premiums for certified products, results suggest that such premiums may exist for imported certified tropical wood products. We foresee that niche markets can potentially be exploited in the U.S. and price premiums captured by wood products manufacturers in tropical regions and/or American importers.

Keywords: Environmentally certified wood products; WTP; price premiums; U.S.

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Finding the Balance between Wildfire Hazard Mitigation and Biomass Utilization: A Review of Incentive Programs

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Abstract

Currently in the United States, there is a great deal of variations among individual state's policies and programs in place to assist private landowners with fuel reduction and wildfire hazard mitigation. There is an even greater disparity among the states when considering the degree to which they promote usage of forest biomass. Moreover, these programs have been developed often without joint consideration or proper coordination of wildfire mitigation and biomass utilization. Such a policy disconnection may have hindered their adoption and reduced their effectiveness. This study is intended to conduct a review of existing federal and state incentive or assistance programs related to wildfire hazard mitigation. Our emphasis is to identify incentive or assistance programs that have been met with success and make recommendations for improving existing programs to enhance wildfire mitigation, biomass utilization, and income generation. In addition to elevating the policy effectiveness, complementarities among these programs will enable forest landowners to better capitalize on existing programs and implement sound forest management practices.

Preliminary Results of a Biorefinery Project in the Arkansas Delta

Matthew H. Pelkki, Sayeed R. Mehmood

Abstract

Potlatch Corporation is investigating the feasibility of creating a biorefinery at its Cypress Bend Paper Mill in Arkansas City Arkansas. The feasibility study will investigate the supply and costs of in-forest residues, mill residues, agricultural residues, municipal solid waste, and dedicated energy crops. Processing and conversion technologies, equipment requirements, and markets for various bio-energy production mixes (liquid fuels, electricity, thermal energy, and solid fuels), and non-energy chemical products are identified and analyzed. A regional economic impact analysis will be presented with potential energy and economic impacts for Arkansas with extensions to the southeast United States.

Existing and Potential Incentives for Practicing Sustainable Forestry on Non-industrial Private Forest Lands

John L. Greene,³ Michael A. Kilgore,⁴ Michael G. Jacobson,⁵ Steven E. Daniels,⁶ and Thomas J. Straka⁷ Abstract

This study examined the compatibility between sustainable forestry practices and the framework of public and private financial incentive programs directed toward nonindustrial private forest (NIPF) owners. The incentives include tax, cost-share, and other types of programs. The study consisted of four components: a literature review, a mail survey of selected management assistance foresters in all 50 states, focus groups of NIPF owners in each national region, and a comparative analysis of findings from the first three components. The literature review identified three approaches that consistently lead NIPF owners to apply sustainable forest management practices on their land: technical assistance, cost-shares, and programs that put owners in direct contact with a forester or other natural resource professional. The management assistance foresters regarded the Forest Land Enhancement Program as the workhorse federal financial incentive program, with the Forest Stewardship, Forest Legacy and Conservation Reserve Programs also receiving high ratings. The forest owner focus groups expressly held several concepts in common, including a commitment to long-term stewardship and a preference for technical assistance over other types of incentives. The study findings yielded three main conclusions and nine recommendations to better adapt financial incentive programs to widely-held NIPF owner goals and objectives.

Key Words: Cost-share, tax incentives, technical assistance, focus groups.

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Introduction

We are reporting, in broad terms, on a study that examined the compatibility between sustainable forestry practices and the framework of public and private financial incentive programs directed toward nonindustrial private forest owners. The core hypothesis was that there may be a structural disconnect between the kinds of practices these programs encourage and practices associated with sustainable forestry.

The structure of financial incentive programs for forest owners dates to the 1940s and 50s, and was generally motivated by concern over timber scarcity and recognition that bettermanaged private forests could provide a larger share of the nation's timber supply. Thus, the programs were designed to help forest owners become more active timber managers. It would not be surprising if the incentive programs either ignored sustainable forestry practices or were in conflict with them; certainly the fact that sustainable forest management arose a full half-century after the prototype financial incentive programs makes it unrealistic to expect the incentive programs to have anticipated the concept of sustainability. Perhaps more important, however, is the potential philosophical difference behind the two institutions – are financial incentive programs focusing on timber production and revenues while sustainable forestry includes other objectives as well? And if there is a disconnect between financial incentive programs and sustainable forestry, where does this leave forest owners?

The research design and results attempt to get at these questions by triangulating different kinds of data. First, our goal is to tell a national story, but to understand regional variations as well. That argues for a replicated regional research approach that can be aggregated into a national picture. We want to understand how the people who deliver these programs feel about their effectiveness, but also to contrast that with the views of the nonindustrial private forest owners the programs are intended to reach. Furthermore, we want to be able to blend the kinds of rigorous quantitative results that emerge from survey data with the nuanced understanding that emerges from qualitative research.

Study Objectives and Approach

The purpose of this study was to identify existing and potential incentives for practicing sustainable forestry on nonindustrial private forest lands in the United States. This overall purpose was broken into four distinct objectives:

- To identify tax, cost-share, and other types of financial incentive programs with the potential to enhance the practice of sustainable forestry on nonindustrial private lands;
- To evaluate the relative effectiveness of different types of programs and of different methods of administering similar programs;
- o To provide insight into whether and how the programs interact; and
- o To disseminate the study findings to forestry practitioners and policy-makers.

The scope of the study was all financial incentive programs offered by federal and state agencies, private entities, and nongovernmental organizations. It included program ideas that have only been proposed or implemented on a limited scale as well as established programs.
The definition of sustainable forestry used for the study coincides with that given in the *National Report on Sustainable Forests* -2003 (USDA Forest Service 2004), which specifically includes the concept of biodiversity.

In order to address the first three study objectives, the study was conducted in four parts

- <u>A thorough review of over six decades of literature on the tax, cost-share, and other</u> <u>financial incentives currently available to nonindustrial private forest owners</u>. Priority was given to recent research, but foundational studies also were identified and summarized. Studies included in the review were analyzed for their conclusions regarding the effectiveness of the various types of incentive programs and their apparent impact on forest owner motivations and practices.
- <u>A survey of selected management assistance foresters in state forestry organizations</u> <u>nationwide</u>. The identified foresters were asked to name and describe the public and private forest incentive programs available in their state, plus any private programs in neighboring states they were aware of. They also were asked to assess forest owners' awareness of each program, its overall appeal among the owners aware of it, its effectiveness in encouraging sustainable forestry and in enabling owners to meet their objectives of forest ownership, and to suggest ways that owner participation and administrative efficiency might be improved.
- Focus groups of nonindustrial private forest owners in each national region. The owners were asked to discuss the types of incentive programs they prefer, what forest ownership objectives the programs help them to meet, what use of the programs enables them to accomplish, what additional program approaches would appeal to other ownership objectives they have for their holdings, and what sustainable forestry means to them.
- <u>A comparative analysis</u>. The findings from the first three phases of the study were compiled and summarized, and conclusions and recommendations developed.

The study fourth objective is being addressed through a project website, and through presentations and publications directed to nonindustrial private forest owners, public and private foresters, forest researchers, nongovernmental organizations, and policymakers.

Findings from the Review of Literature

From the time forest owners in the United States were first becoming interested in long-term management, researchers have been suggesting ways to improve the management and sustainability of nonindustrial private forest holdings: technical assistance, perhaps leveraged through coordinated management of forest ownerships (Stoddard 1942, Cloud 1966); financial incentives to owners who demonstrate an interest in managing their forest (Folweiler and Vaux 1944); reduced property, estate and inheritance taxes, more favorable tax credits and deductions, more favorable capital gains treatment of timber income, and more cost-sharing of forest management expenses (Fecso et al. 1982); incentive programs for non-market forest products, such as wildlife and recreation (Greene and Blatner 1986); assistance to manage forests to maintain and improve standing timber values (Blatner and Greene 1989); incentives linked to specific stewardship practices (Greene 1998); and

extension of tax incentives for the production of marketable forest products to environmental goods and services (Koontz and Hoover 2001).

Subsequent research has shown that nonindustrial private forest owners favor some incentive approaches over others: Only a small percentage of owners would consent to coordinated management of their land (Klosowski et al. 2001). Large fractions of owners are unaware that financial and tax incentive programs exist or don't know what the programs can do for them (Yoho and James 1958, Sutherland and Tubbs 1959, Perry and Guttenberg 1959, Anderson 1960, Hutchison and McCauley 1961, McClay 1961, Quinney 1962, Schallau 1962, 1964, Farrell 1964, Christensen and Grafton 1966, Stoltenberg and Gottsacker 1967, Koss and Scott 1978, Greene et al. 2004). Many owners who participate in an incentive would have done the supported practice anyway (James et al. 1951, Brockett and Gerhard 1999, Baughman 2002), although the incentive enables the owners to treat additional acres (Royer 1987, Bliss and Martin 1990). Favorable property tax and capital gains provisions have little effect on forest owner behavior (Stoddard 1961, Ellefson et al. 1995, Brockett and Gerhard 1999); and forest property tax programs are only modestly successful in accomplishing their objectives (Hibbard et al. 2003).

Three approaches, however, have consistently been found to lead nonindustrial private forest owners to apply sustainable forest management practices on their land: technical assistance, cost-shares, and programs – such as the Forest Stewardship Program – that put owners in direct contact with a forester or other natural resource professional. In a foundational study of forest owners in Mississippi, James et al. (1951) found that owners prefer technical assistance over financial or tax incentives. In their recent study of policy tools to encourage application of sustainable timber harvesting practices in the United States and Canada, Kilgore and Blinn (2004) also found technical assistance is the most effective way to encourage owners to apply sustainable practices, followed by cost-share programs.

In their study of the Forest Stewardship Program (FSP) Esseks and Moulton (2000) found that getting the required forest management plan provides two-thirds of participating forest owners their first contact with a professional forester. A like fraction begin managing their land for multiple purposes and using practices that are new to them. Their participation in FSP prompted the owners to spend an average of \$2,767 of their own funds for forest management activities, something nearly two-thirds said they would not have done if they had not received the cost-share (Esseks and Moulton 2000). Both Greene and Blatner (1986) and Baughman (2002) found that direct contact with a forester or other natural resource professional is associated with owners being forest managers. And Egan et al. (2001) cited the aspects of FSP that involve contact with a professional – getting a management plan and technical assistance –as the main things owners like about the program.

Among the key findings from the literature review process are that most financial incentive program approaches have little effect on forest owner behavior. However, three approaches – technical assistance, cost-shares, and programs that put owners in direct contact with a forester or other natural resource professional – consistently lead nonindustrial private forest owners to apply sustainable forest management practices on their lands. Forest owner acceptance of innovations in tax and other financial incentives has been shown to follow traditional diffusion channels, beginning with local leaders (Doolittle and Straka 1987). Finally, from a policy standpoint, linkages are crucial. Incentives will be most effective in

changing forest owner behavior if they are specifically linked to stewardship practices rather than being available regardless of management behavior.

Findings from the Management Forester Survey

Federal Financial Incentive Programs

The survey of state management assistance foresters was conducted using the Dillman (1999) Tailored Design Method. The selected forester in each state was asked to describe and rate nine federal financial incentive programs: the Forest Stewardship Program (FSP), Conservation Reserve Program (CRP), Environmental Quality Incentives Program (EQIP), Forest Land Enhancement Program (FLEP), Forest Legacy Program (FLP), Landowner Incentive Program (LIP), Southern Pine Beetle Prevention and Restoration (SPBPR), Wetlands Reserve Program (WRP), and Wildlife Habitat Incentives Program (WHIP).

Only FSP and FLEP were available in all 50 states. EQIP was available in 47 states; FLP in 45 states; WRP and WHIP in 40 states; CRP in 39 states; LIP in 31 states; and SPBPR in 9 southern states (see Table 1).

The characteristics the foresters rated include forest owner awareness of each incentive program, its overall appeal among owners aware of it, its success in encouraging sustainable forest management and enabling owners to meet their objectives of forest ownership, and percentage of program practices remaining in place and enrolled acres remaining in forest over time. The next several paragraphs highlight results of the ratings, on a program-by-program basis.

FSP was among the highest-rated programs overall regarding forest owner awareness, appeal among owners aware of it, encouraging sustainable forest management, enabling owners to meet their objectives of forest ownership, and percentage of enrolled acres remaining in forest over time. Comparing results across the four regions, foresters in the Midwest indicated that a lower percentage of program practices remained in place over time than those in the other regions.

CRP rated third overall in terms of owner awareness. On a regional basis, forester perceptions of the program's appeal among owners aware of it and its success in encouraging sustainable forest management were highest in the South and lowest in the West.

Among the four regions, foresters in the East rated EQIP lowest in terms of appeal among owners aware of the program, encouraging sustainable forest management, and enabling owners to meet their objectives of ownership. Foresters in the Midwest rated the program lowest with respect to program practices remaining in place and enrolled acres remaining in forest over time.

FLEP seemed to be regarded as the "workhorse" of federal incentive programs, and rated perhaps highest overall of the nine programs. The foresters placed it among the top-rated programs for owner awareness, appeal among owners aware of it, encouraging sustainable forest management, enabling owners to meet their objectives of ownership, and enrolled acres remaining in forest over time. There was little regional variation in the scores assigned to FLEP, except that foresters in the East rated it somewhat lower than those in other regions for helping owners meet their objectives.

FLP was among the programs rated highest overall for encouraging sustainable forest management and enabling owners to meet their objectives of ownership. Management assistance foresters in all four regions gave FLP high marks for program practices remaining in place and enrolled acres remaining in forest over time.

LIP and WRP ranked lowest of the nine programs for owner awareness, although the ratings assigned to them still were good overall. Comparing the results across regions, foresters in the Midwest considered LIP ineffective in nearly all measures surveyed, while foresters in the East considered the program quite effective. Ratings for WRP also were mixed. Foresters in all regions except the South gave the program low ratings for encouraging sustainable forest management, while foresters in all regions except the Midwest rated the program high for enrolled acres remaining in forest over time.

SPBPRP was among the top-rated programs for enabling owners to meet their objectives of ownership. WHIP was among the lowest-ranked programs in terms of owner awareness and appeal to owners aware of it.

Most of the foresters' suggestions for improving owner participation in the programs centered on increased funding and staffing levels, single-agency delivery, and making program rules more consistent over time. Most of their suggestions for improving administrative efficiency centered on improving program application and delivery processes, and simplifying paperwork and reporting requirements.

State and Other Financial Incentive Programs

The management assistance foresters also were asked to name, describe, and rate financial incentive programs offered to nonindustrial private forest owners by their state and by private entities, such as forest industry firms, forest owner associations, or nongovernmental organizations. All 50 states have some type of preferential property tax to protect forest land from being fragmented or converted to other uses. Each state takes its own unique approach, but the foresters rated the programs above average, overall, for forest owner awareness of them and their appeal among owners aware of them. They rated the programs only somewhat successful, however, in encouraging sustainable forest management and enabling owners to meet their objectives of ownership. Few of the foresters suggested improvements to their state property tax. Improvements that were suggested centered on program administration and objectives, guidelines, eligibility requirements, and valuation methods.

Several states have their own forest cost-share programs, many of which are funded by forest tax revenues. Some of the programs help fund timber management, while others focus on wildlife, riparian areas, or conservation easements; one is a state-level forest stewardship program. The foresters rated these programs above average overall for encouraging sustainable forest management and enabling owners to meet their objectives of forest ownership. The most frequently mentioned suggestions for improving the programs include increased funding, and simplified eligibility requirements, administrative procedures and contracts.

Forest industry programs account for the majority of financial incentives offered by private entities, although programs by land trusts or conservation organizations also are common. The management assistance foresters rated these programs somewhat lower than federal or

state incentive programs in terms of forest owner awareness of them and their appeal among owners aware of them. This may be because of the targeted nature of the programs, which are not of interest to many forest owners. The foresters gave privately-sponsored programs high ratings, however, for program practices remaining in place and enrolled acres remaining in forest over time.

Findings from the Forest Owner Focus Groups

Focus groups of nonindustrial private forest owners were conducted in the East, Midwest, South, and West regions following protocols described in *Working Through Environmental Conflict: The Collaborative Learning Approach* (Daniels and Walker 2001). In each region separate focus groups were held for members and non-members of forest owner organizations, resulting in a total of eight groups. Through open-ended questions and verbal prompts, the owners were asked to discuss their experience with financial incentive programs, what forest ownership objectives the programs help them to meet, and what additional program approaches would appeal to other objectives they hold for their land.

Even within focus groups the participants varied widely in terms of size of their forest holding, how long they or their family had held the land, what use they made of the land, and their knowledge and use of past and current incentive programs. A substantial majority of non-forest owner organization members, and in some regions as many as half of members, did not have a written forest management plan.

Despite the differences, all eight groups expressly held several concepts in common. These included a high degree of attachment to their land; a commitment to long-term stewardship and appropriate management; a desire to "do right" by their land; a clear preference for technical assistance – having an extension or service forester "walk the land" with them and explain their options – over cost-share or tax incentives; a commitment to practicing sustainable forestry, although they tended to describe the concept more in terms of sustained yield; and except in the South, a sense that forest ownership is more closely tied to self-identity and lifestyle than to financial return.

The most widely used financial incentive programs were preferential property tax assessment and capital gains treatment of harvest returns. Knowledge of other incentive programs was substantially lower. Virtually every program had been used by someone, but few had been used by many.

The owners leveled a number of criticisms at existing financial incentive programs: that they are inconsistently administered and implemented (both between programs and over time), too slow and bureaucratic, and inadequately funded; that it takes too long for a service forester to visit; and that some owners receive cost-shares despite not fully completing the required activities. These sentiments were shared across the regions, and seemed in some cases to be linked to a broad anti-government sentiment.

Sustainable forestry resonates with owners at a conceptual level, but the specific tactics being used to promote sustainability do not have much traction. In particular, certification has not made significant inroads among owners. Except for those who have been certified through their participation in the Tree Farm program, virtually no owners had pursued certification or expressed much knowledge about or interest in it. In every region there were statements that

certification is an attempt by others (environmentalists were cited in the South and timber companies in the West) to control the management of private forest land.

If sustainable forestry is to make inroads among nonindustrial private forest owners, it will be necessary to frame the concept in terms of the values that motivate their land ownership. Owners are not swayed by arguments that "certified timber gets an *x*-percent market premium" because rate of return is not a primary focus of their ownership. Rather it will be necessary to explain to them – through foresters or other natural resource professionals – how to pursue it on the ground, through forest management practices.

Conclusions and Recommendations

The review of literature, survey of state management assistance foresters, and focus groups of nonindustrial private forest owners yielded three main conclusions:

- Federal and state financial incentive programs currently play a limited role in promoting sustainable forestry practices on the nation's nonindustrial private forests. There is no structural disconnect between the incentive programs and the practice of sustainable forestry; forest owners sincerely desire to practice sustainable forestry and the incentive programs promote application of sustainable forestry practices. The programs, however, play only a minor role in the owners' decisions regarding management and use of their forest land.
- <u>There were considerable differences between the regions with respect to some study</u> <u>findings</u>. Findings that differed from region to region include forest owner objectives and interests, consistency between the owner objectives and the available financial incentive programs, how the programs are administered, and how owners perceive the programs' effectiveness and appeal.
- With respect to other findings, however, there was a consistent message across all four national regions. Three findings were key. First, the highest program priority among forest owners is one-on-one access to a forester or other natural resource professional to walk their land with them and discuss their management alternatives. Second, there is a need for some flexibility in financial incentive programs to address regional differences in forest characteristics and owner objectives. And third, the most effective way to increase the impact of financial incentives would be to ensure adequate funding and stable program requirements over time.

While the study did not find any structural disconnect between existing financial incentive programs and the practice of sustainable forestry, opportunities exist to adapt the programs so they address more fully goals and objectives that are widely held among nonindustrial private forest owners across the nation. The study findings and conclusions generated nine such recommendations:

- Increase funding and availability of one-on-one technical assistance from both extension foresters and state service foresters.
- Use technical assistance rather than certification to convey sustainability ideas; approach sustainability through owners' long-term stewardship and family legacy objectives.

- Make a written forest management plan a requirement for all incentive programs.
- Design incentive programs to put forest owners in direct contact with a forester or other natural resource professional.
- Design some incentive programs to address regional differences in forest characteristics and forest owner objectives.
- Link incentives directly to stewardship practices instead of general forest management practices.
- Fund cost-share applications according to their expected environmental benefit instead of first-come-first-served.
- Make the requirements for owners to participate in incentive programs more uniform and deliver the programs from a single source in each state.
- Maintain adequate funding and stable program requirements for financial incentives over the long term.

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	Environmental Forest Conservation Quality Forest Land Forest					Southern Landowner Pine Beetle Wetlands			Wildlife Habitat
	Stewardship	Reserve	Incentives	Enhacement	Legacy	Incentives	Prevention &	Reserve	Incentives
	Program	Program	Program	Program	Program	Program	Restoration	Program	Program
	FSP	CRP	EQIP	FLEP	FLP	LIP	SPBPR	WRP	WHIP
a. East									
Connecticut	Х		Х	Х	Х	Х		Х	Х
Delaware	Х	Х	Х	Х	Х	Х		Х	
Maine	Х	Х	Х	Х	Х	Х		Х	Х
Maryland	Х	Х	Х	Х	Х	Х		Х	
Massachusetts	Х		Х	Х	Х	Х		Х	Х
N. Hampshire	Х		Х	Х	Х	Х		Х	Х
New Jersey	Х	Х	Х	Х	Х	Х		Х	Х
New York	Х	Х	Х	Х	Х			Х	Х
Pennsylvania	Х	Х	Х	Х	Х	Х		Х	Х
Rhode Island	Х		Х	Х	Х			Х	Х
Vermont	Х	Х	Х	Х	Х			Х	Х
b. Midwest									
Illinois	Х	Х	Х	Х	Х	Х		Х	Х
Indiana	Х	Х	Х	Х	Х			Х	Х
Iowa	Х	Х	Х	Х	Х	Х		Х	Х
Kansas	Х	Х	Х	Х		Х		Х	Х
Michigan	Х	Х	Х	Х	Х	Х		Х	Х
Minnesota	Х	Х	Х	Х	Х	Х		Х	Х
Missouri	Х	Х	Х	Х	Х	Х		Х	Х
Nebraska	Х	Х	Х	Х	Х	Х		Х	Х
N. Dakota	Х	Х	Х	Х		Х		Х	Х
Ohio	Х	Х	Х	Х	Х	Х		Х	Х
S. Dakota	Х	Х	Х	Х				Х	Х
West Virginia	Х	Х		Х	Х	Х		Х	Х
Wisconsin	Х	Х	Х	Х	Х	Х		Х	Х

Table 1. Availablity of federal financial incentive programs in the United States, by region and state.

(Continued, next page)

	Environmental						Wildlife		
	Forest Stewardship Program FSP	Conservation Reserve Program CRP	Quality Incentives Program EQIP	Forest Land Enhacement Program FLEP	Forest Legacy Program FLP	Landowner Incentives Program LIP	Pine Beetle Prevention & Restoration SPBPR	Wetlands Reserve Program WRP	Habitat Incentives Program WHIP
c South	V	V	V	V	V			V	V
Alabama	X	X	X	X	X	37	37	X	X
Arkansas	X	X	X	X	X	X	X	Х	X
Florida	Х	X	X	X	X	X	Х		X
Georgia	Х	Х	Х	Х	Х	Х	Х	Х	Х
Kentucky	Х	Х	Х	Х	Х			Х	Х
Louisiana	Х	Х	Х	Х	Х	Х	Х	Х	Х
Mississippi	Х	Х	Х	Х	Х	Х	Х	Х	Х
N. Carolina	Х	Х	Х	Х	Х	Х	Х	Х	Х
Oklahoma	Х	Х	Х	Х			Х	Х	Х
S. Carolina	Х	Х	Х	Х	Х			Х	Х
Tennessee	Х	Х	Х	Х	Х		Х	Х	Х
Texas	Х	Х	Х	Х	Х	Х	Х	Х	Х
Virginia	Х	Х	Х	Х	Х	Х		Х	Х
d. West									
Alaska	Х		Х	Х	Х				
Arizona	Х			Х	Х				
California	Х		Х	Х	Х				
Colorado	Х	Х	Х	Х	Х			Х	
Hawaii	Х			Х	Х	Х			
Idaho	Х	Х	Х	Х	Х				
Montana	Х	Х	Х	Х	Х				
Nevada	Х		Х	Х	Х	Х			Х
New Mexico	Х		Х	Х	Х				Х
Oregon	Х	Х	Х	Х	Х	Х		Х	Х
Utah	Х		Х	Х	Х				
Washington	Х	Х	Х	Х	Х	Х		Х	Х
Wyoming	Х	Х	Х	Х				Х	Х
Total	50	39	47	50	45	31	9	40	40

Table 1. Availablity of federal financial incentive programs in the United States, by region and state (continued).

Spatial Autocorrelation in Country-Level Models of Species Imperilment

Ram Pandit and David N. Laband¹

Abstract

Modeling the determinants of species' ecological fragility using country-specific data may be complicated by the fact that factors that influence species imperilment may extend or operate beyond arbitrary political boundaries. Following McPherson and Nieswiadomy (2005), we confirm the advisability of controlling for spatial autocorrelation in models focusing on imperilment of birds, mammals, reptiles, amphibians, and vascular plants. We also compare the performance of different definitions of the spatial dependency. Although our *a priori* expectation was that measures that more accurately reflect the degree of spatial interaction between countries, such as the percentage of shared border, would be superior to a measure of simple adjacency, in fact we find that the simple adjacency measure outperforms the other measures in most cases.

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Spatial Attributes Influencing Landowner Participation in Habitat Conservation: An Empirical Model

Jagannadha Matta and Janaki Alavalapati¹

Abstract

Private land participation has been recognized as an important element of strategies to promote habitat conservation in the United States. Yet, spatial models explaining transfers of lands from other uses to conservation are limited. In this study, we develop a spatial econometric model by combining data from a survey of landowners in Florida with the spatial attributes of their lands to estimate the probabilities of a particular land enrolling in a conservation program. The model is further tested with the actual enrolment data on conservation easements in Florida. The results in terms of potential areas enrolled for habitat conservation and their importance in terms of meeting conservation priorities are presented and discussed. Findings of this study not help better identification of private lands for conservation but also effective targeting of areas according to conservation priorities.

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