Southern Forest Economics Workers

2010 Annual Meeting Agenda

Pinehurst Resort	Pinehurst, North Carolina	March 15-17

Monday, March 15

5:30 PM - 7:00 PM	Early Bird Registration (Front Porch, Carolina Inn)
5:30 PM – 7:00 PM	Social Mixer (West Lawn)

Tuesday, March 16

7:15 – 8:15 AM Registration and Morning Coffee (Conference Center Foyer)

8:15 – 8:30 AM Introduction and SOFEW Update (Olmstead Room)

Dr. Tom Holmes, Southern Research Station, USDA Forest Service – Welcome

Dr. Robert Grala, Mississippi State University – SOFEW Update

Dr. Dave Wear, Southern Research Station, USDA Forest Service - Comments

8:30 – 10:00 AM General Session (Olmstead Room)

Keynote Speaker #1: Dr. Brian Murray, Duke University, *Forest Economics and Climate Policy: If Faustmann Could See us Now*

Keynote Speaker #2: Dr. Robert Abt, North Carolina State University, *The Role of Residuals, Traditional Industry Displacement, and the Current Resource Status in Achieving Bioenergy Goals*

Keynote Speaker #3: Dr. Alan Lucier, National Council for Air and Stream Improvement, Inc., *Influences of Environment and Energy Policies on Timberland Management and Markets for Forest Products*

10:00 – 10:30 AM Coffee Break (Conference Center Foyer)

10:30 – Noon Concurrent Sessions

<u>Session A: Carbon (Ross/ Tufts Room)</u>

Moderator: Evan Mercer

Carbon Markets and Urban Forestry Offsets: Are the Buyers Interested? – N.C. Poudyal, J.P. Siry, and J.M. Bowker

Competitiveness of Carbon Offset Projects on NIPF Lands - E. Mercer, P. Lal and J. Alavalapati

The Potential Role for Public Lands in Greenhouse Gas Mitigation and Climate Policy – D. Cooley

Solving the Ugly and Inconvenient Problem of Carbon Dioxide Emissions – S.J. Chang

Session B: Timber Sector (Olmstead Room)

Moderator: Robert Grala

The Mississippi Timber Economy and the Great Recession – J.E. Henderson

Harvest Probabilities and Inventory Availability – N.P. Singh, R. Abt, F. Cubbage, and J. Coulston

Influence of Transportation Network on Location of Forest Products Manufacturers in Mississippi: Spatial Analysis – T.A. Hagadone and R.K. Grala

Asymmetric Price Transmission in the Woods Products Sector in the Southern United States – X. Liao and C. Sun

12:00 Noon – 1:30 PM Lunch (South Room)

1:30 – 3:00 PM Concurrent Sessions

Session C: Bioenergy I (Ross/ Tufts Room)

Moderator: Neelam Poudyal

Screening and Ranking Announced Wood-Using Bioenergy Projects – B.C. Mendell and A. Hamsley Lang

Going EMO from BCAP – K. Abt, J. Fortney, F. Cubbage, and R. Abt

Bioenergy as a Niche Product to Increase Forest Sector Competitiveness in Atlantic Canada: Opportunities and Challenges – R. Chaini

Outlook for Pulpwood Production in the U.S. South: Drivers, Factors, and Influences – T. Sydor and B. Mendell

Session D: Financial Performance (Olmstead Room)

Moderator: Joseph Chang

An Analysis of the NCREIF Timberland Index – C. Zinkhan, B. Stansell, T. Henderson, S. Radcliffe, J. Wikle

Impacts of U.S. Forest Products Firms' Timberland Divestitures and Conversion into REITS on their Financial Performance: An Event Analysis with OLS and GARCH models – M.M. Rahman, C. Sun and I.A. Munn

Investigating Real Option Values in Timber Production – R. Mei and Michael Clutter

Longleaf Pine Wood and Pine Straw Yields, Cash Flows, and Net Present Value Estimates from Two Old-Field Planted Sites in Georgia – E.D. Dickens, D.J. Moorhead, R. Hicks, and B.C. McElvany

3:00 – 3:30 PM Coffee Break (Conference Center Foyer)

3:30 – 5:00 PM Concurrent Sessions

Session E: Management Regimes (Ross/ Tufts Room)

Moderator: Robert Huggett, Jr.

Impact of Carbon Payments on Management Regimes of Loblolly Pine and Cherrybark Oak Stands in Mississippi – P. Nepal, R.K. Grala, and D.L. Grebner

Willingness to Accept for Selling Ecosystem Services in Texas: Results from a Landowner Survey – Y. Li, H.S. Simpson, C.L. VanderSchaaf, and A.B. Carraway

Costs of Performance Standards for Forestry Reclamation of Surface Mined Lands – J. Sullivan and G. Amacher

The Future of Southern Forests – R.J. Huggett, Jr., D.N. Wear, and R. Li

Session F: Forest Disturbances (Olmstead Room)

Moderator: Jeff Prestemon

A Spatial-Dynamic Value Transfer Model of Residential Forest Losses from the Hemlock Woolly Adelgid – T.P. Holmes, A. Liebhold, K. Kovacs, and B. Von Holle

Outcomes from the Evaluation of the Administration of the North Carolina Southern Pine Beetle Prevention Program – R. Estevez, D. Hazel, R. Bardon, E. Sills, and A. Oltmans

Long-run net benefits of wildfire suppression – J.P. Prestemon

Impact of Socioeconomic Factors on Wildfire Occurrence in Mississippi – R.K. Grala, K. Grala, A. Hussain, and W. Cooke

6:00 – 8:00 PM Social Mixer (Evergreen Music Room, The Holly Inn)

Wednesday, March 17

7:45 – 8:30 AM Morning Coffee (Conference Center Foyer)

8:30 – 10:00 AM Concurrent Sessions

Session G: Bioenergy II (Ross/ Tufts Room)

Moderator: Neelam Poudyal

Bioenergy Suppies from Forestlands – R.H. Beach

Assessing Non-Industrial Private Landowner's Willingness to Harvest Woody Biomass in Support of Biofuel Processing in Mississippi: Preliminary Results – S. Gruchy, D. Grebner, I. Munn, and A. Hussain

Woody Biomass Policies and Location Decisions of the Bioenergy Industry in the Southern United States – Z. Guo and D. Hodges

Session H: Efficiency and Competition (Olmstead Room)

Moderator: James Henderson

International Comparative Efficiency in Wood and Fiber Utilization – J. Buongiorno and H. Kando

An Evaluation of the Global Competitiveness of West Virginia's Forest Products Industry: Preliminary Results – K.G. Arano, J. Wang, and M. Parsons

Business Clustering within the U.S. Forest Sector: Stakeholder Perspective – R.K. Grala, F.X. Aguilar, I.A. Munn, S.M. Bratkovich, and K. Fernholz

Impact of Environmental Labeling and Disclosure of Product Origin on Consumer's Willingness-to-Pay for Wood Products in the U.S. and U.K. – F.X. Aguilar

10:00 – 10:30 AM Coffee Break (Conference Center Foyer)

10:30– Noon Concurrent Sessions

Session I: Hunting and Wildlife Recreation (Ross/ Tufts Room)

Moderator: David Dickens

An Empirical Analysis of Landowners' Attitudes toward Fee-Access Hunting – Y. Deng and I. Munn

Capitalization of Hunting Lease Rates into Forestland Values in Mississippi – R. Smith, I.A. Munn, A. Hussain, W.D. Jones,J. Brashier, and S. Spurlock

Economic Impact of Wildlife-Associated Recreation on the Southeast U.S. Economy – A. Hussain, I.A. Munn, S. Spurlock, and J.E. Henderson

Benefits to Forest Industry from Hunting Club Cooperatives – M.K. Measells, S.C. Grado, and D.A. Miller

Session J: Forest Landowners (Olmstead Room)

Moderator: Ian Munn

Exploring Nonindustrial Private Forest Ownership Objective Categories, Willingness to Harvest Timber, and Interest in Non-Timber Uses – P. Koonnathamdee

Understanding Family Forest Landowner Preferences for Receiving Advice on Managing their Forestland: Using National Woodland Owner Survey Data for the 13 Southern States – B.R. Kaetzel, L.D. Teeter, and B.J. Butler

Forest Landowner Behavior and Dynamics of Ecosystem Services under Policy Uncertainty – J. Henderson

Southern Forest Economics Workers

2010 Annual Meeting

Tuesday, March 16, 2010

10:30 AM – Noon

Session A: Carbon

Manuscript:

Carbon Markets and Urban Forestry Offsets: Are the Buyers Interested?

Neelam C. Poudyal et al.

Carbon Markets and Urban Forestry Offsets: Are the Buyers Interested?

Authors: Neelam C. Poudyal[1], Warnell School of Forestry and Natural Resources, University of Georgia; Jacek P. Siry, Warnell School of Forestry and Natural Resources, University of Georgia; and J. M. Bowker, USDA Forest Service, Southern Research Station

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Carbon Markets and Urban Forestry Offsets: Are the Buyers Interested?

Abstract

This study surveyed the carbon offset buyers to assess the desirability of carbon credits sourced from urban forestry projects. The survey results indicated that the buyers preferred to know the type and location of offset projects. Specifically, potential buyers expressed stronger preferences for credits sourced locally. Carbon credits sourced from urban forestry projects were found to be more desirable than those sourced from other types of projects, such as methane capture or agriculture.

Keywords: Urban Forestry, Carbon Credits, Buyers, Chicago Climate Exchange (CCX)

Introduction

Existing urban forests in the United States indicates an opportunity for marketing carbon credits. Tree coverage accounts for approximately 27% of urban area,, with millions of trees along streets and in parks, riparian buffers, and other public areas (Nowak et al., 2001). In addition, there is a growing interest at local levels to initiate carbon storage projects and offset trading. For example, Poudyal et al. (2009) recently surveyed local governments in the United States and found that many cities have the technical and managerial capability to implement offset projects, while also being genuinely interested in selling carbon stored in urban trees and forests.

However, little is known about the preferences among potential buyers for urban forestry carbon credits. Answering this question based on market data is difficult partly because the credit prices currently traded in the market do not reflect the type and location of the offset project. It is reasonable to expect that offset buyers could place different levels of preference and value for credits sourced from different projects/sources. For example, companies buying urban forestry credits from local government choose to fund the green projects in the city, provide amenity and recreational benefits to city residents and maintain good relationships with local governments. Moreover, buyers might see potential marketing or public relations gains associated with demonstrated green projects in areas of high population density or low income.

To get a better understanding of the desirability of urban forestry carbon credits, survey of current and prospective buyers of carbon credit was conducted. The specific objective was to assess the buyer's general attitudes, preferences toward carbon credit sources. In addition, buyer's willingness to pay a price premium for urban forestry carbon credits was assessed.

Methods

Current and prospective buyers of urban forestry carbon credits, i.e., the current members and associate members of Chicago Climate Exchange (CCX) were surveyed. The survey was implemented following a Modified Tailored Design Method (Dillman, 2000) during the fall of 2009. The survey instrument contained questions about buyer's attitude toward emission control regulations, preference for carbon credits based on the characteristics and location of offset projects, motivations to purchase, and willingness to pay for carbon credits sourced from urban forestry projects.

Results

The effective response rate for the survey was approximately 41%. Respondents were diverse in many aspects. In terms of ownership, roughly 55% were private or for-profit organization, about 25% were NGOs or public organizations, and the remaining 20% were government entities. Regarding workforce size, respondents raged from as low as two to as many as 21,000 employees with the mean size of nearly 10,000. the geographical scope of organizations ranged from the United States as the only marketing or the primary area of business (48%) to worldwide scope (35%). Nearly all respondents (98%) had a rough estimate of their annual GHG emissions with an average emission of 5.26 million metric tons per year. However, roughly 36% of them had no target set for reducing their GHG emissions in the next 5 years. About 10 % had a target of reducing emissions by less than 5%, 23% had a target of reducing 6-10%, 12% had a target of reducing 11-20%, while 9% targeted emission reduction plans at 21- 50%. Only about 7% claimed a target reduction level of 51-100% over the next five years.

Participation in carbon trading ranged from 1-3 years for about 40% of respondents, 3-5 years for 21%, while 29% of the sample had been participating for more than 5 years, with about 7% just beginning trading this year. On average, respondents had bought roughly 33,000 CO_2 equivalent credits in 2008.

In terms of their opinion on costumer relations and attitudes, a majority (73%) of respondents felt that their customers would favor a company that reduces its GHG emissions. Consequently, about two-thirds (67%) of respondents agreed that their company would consider paying a premium to a supplier that reduced GHG emissions of its business activities.

Three quarters of the respondents indicated that they were interested in knowing the location of the offset project from which they bought or would buy credits. Respondents most preferred credits generated from local projects and least preferred those generated from international projects.

Regarding the type of offset projects, a clear majority (72%) expressed interest in knowing the nature of offset projects generating credits. Respondents most preferred credits generated from a permanent switch to renewable energy and least preferred credits from agricultural projects. Credits generated from rural forestry and urban forestry projects ranked second and third behind renewable energy projects. However, the difference in preference between rural and urban forestry credit was statistically insignificant.

When asked about the motivation to purchase urban forestry carbon credits, respondents identified several important attributes associated with urban forestry carbon credits. They clearly indicated that community economic and environmental benefits, public image, and environmental responsibility were more important than factors like proximity and relationship with the local governments. More importantly, 69% of them considered potentially high quality of carbon credits from urban forestry projects as important.

When asked if they were willing to pay more for credits sourced from urban forestry projects, about 55% indicated the affirmative. Comparatively a lower proportion of respondents showed a higher willingness to pay for credits sourced from other projects. For example, 34% were interested in paying more for credits sourced from forestry projects in the rural parts of the United States or credits from projects promoting nature conservation in developing countries, and 48% were willing to pay more for credits from projects aimed at alleviating poverty in developing countries through carbon payments to forest landowners.

Discussion and Conclusion

This study provides an initial perspective from carbon credit buyers on the desirability of urban forest carbon credits. Buyers were very interested in knowing the location and type of projects generating credits, and preferred locally generated credits, as well as renewable energy, urban and rural forestry projects. Also, buyers placed a great deal of value on some of the attributes associated with urban forestry carbon credits, such as community economic and environmental benefits, public image, and quality of credits. This suggests that credits sourced from urban forestry projects would be more competitive and in higher demand were they available in the market. A significant proportion of buyers indicated a positive willingness to pay a price premium for urban forestry credits. Hence, local governments nationwide could benefit from participating in carbon trading and strategically marketing their product's attributes to generate revenue. Findings presented in this study may have important policy implications in carbon offset project management, and urban forestry, particularly in establishing market protocols and trading platforms for carbon credits sourced from urban forestry practices.

References

Dillman, D. A. 2000. *Mail and internet surveys: The tailored design method*. John Wiley and Sons, New York. 480 p.

Nowak, D. J., M. H. Noble, S. M. Sisinni, and J. F. Dwyer. 2001. Assessing the US urban forest resource. *Journal of Forestry* 99 (3): 37042.

Poudyal, N. C., J. P. Siry, and J. M. Bowker. 2009. Factors influencing current interests and motivations of local governments to supply carbon offset credits from urban forestry. In Southern Forest Economics Workers 2009 Annual Meeting Proceedings (Eds. Zinkhan C., and B. Stansell), pp 67-73.

Southern Forest Economics Workers

2010 Annual Meeting

Tuesday, March 16, 2010

10:30 AM – Noon

Session B: Timber

Manuscript:

Asymmetric price transmission in the wood products sector in the Southern United States -

Xianchun Liao and Changyou Sun

Asymmetric price transmission in the wood products sector in the Southern United States

Xianchun Liao[2] and Changyou Sun[3]

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Asymmetric price transmission in the wood products sector in the Southern United States

Abstract

Prices play a key role in the market economy. Asymmetric price transmission (APT) is a price phenomenon that is ignored in the forest sector, particularly in the United States, although it has been the subject of considerable attention in the agricultural sector or other sectors. In this study, the presence of price transmission asymmetry for wood products sector in the Southern United States is investigated. The Error Correction Model (ECM) is used with quarterly prices at two stages from standing timber to delivered timber and to lumber markets and vice-versa from 1977 to 2008. All prices are found to be nonstationary, and there is evidence of Engle-Granger (EG) co-integration for six pairs of price series. The estimated results of the ECM-EG for APT reveal that the asymmetric price transmission exists in the four pairs of price series in the long and short term. Moreover, the existence of positive APT that squeezes the margin more rapidly than it stretches the margin is widely expected in this study. Meanwhile, the negative APT that is not usually observed in the past does exist in this study.

Key Words: wood market, Error Correction Model, asymmetry price transmission

INTRODUCTION

The Southern U.S. states have long been a timber production base, and most of the forestlands (i.e., 70%) in the South is owned by nonindustrial private forest (NIPF) landowners (Smith, et al.). A fundamental question is whether the price transmission in the supply chain from NIPF landowners to loggers and processors is symmetric. Traditionally, economic theory has assumed that prices adjust rapidly to equate demand and supply (Brännlund,1991). Thus, upstream price change (e.g. sawtimber price) symmetrically triggers downstream price change (e.g. lumber price), other things being equal. The latest literature provides evidence of asymmetric price transmission (APT) in the agriculture, gasoline, and financial markets (Meyer and von Cramon-Taubadel, 2004). The presence of APT is also coded in the wood sector in the case of Greece (Koutroumanidis, Zafeiriou and Arabatzis, 2009). Whether asymmetric price transmission exists in the wood products industry in the Southern U.S. is unclear.

In addition, there has been widespread concern about market efficiency and welfare distribution for policy analysis. If the APT occurs in the wood products industry in the Southern U.S., most of previous public programs need to be revisited. For example, the cost-share program that intended to reduce costs in upstream stage might not benefit consumers or users of the lumber market efficiently. Likewise, the monetary policy that kept low interest rate to stimulate the housing market might not benefit logging sector or even landowners because the margin might be squeezed by the manufacturing processors.

Moreover, most previous studies have not examined data stationarity, and the static structural parameter estimation might have the problem of spurious regression if some series of data are not stationary. To overwhelm this problem, an error correction model (ECM) can be employed (Harris and Sollis, 2003). Recently a few studies have examined wood sector (Zhou and Buongiorno, 2005**;** Hänninen, Toppinen and Toivonen, 2007**;** Koutroumanidis, Zafeiriou and Arabatzis, 2009). For example, Koutroumanidis, Zafeiriou and Arabatzis (2009) investigates asymmetry in the price transmission mechanism between the producer and the consumer prices in the sector of forest products in Greece. However, no such work has been performed in the wood products industry in the Southern U.S.

The objective of this study is to investigate the presence of price transmission asymmetry for the wood products sector in the Southern United States. The Error Correction Model (ECM) is used with quarterly prices at two stages from standing timber to delivered timber and to lumber markets from 1977 to 2008. This study will reveal the magnitude and speed of the price transmission in the wood products sector, furthermore, provide an understanding of market information efficiency and welfare distribution between timber suppliers, processors and consumers. This study also will help policy makers in designing appropriate programs in helping landowners, loggers and wood products industry improve their competitiveness in challenging market conditions.

LITERATURE REVIEW

Historically, economic theory states that economic equilibrium is simply a state where economic forces are balanced and a market price is established through competition such that quantity demanded and quantity supplied are equal. Over the past two decades, the literature has developed which presents the evidence of the presence of asymmetric price transmission (APT) in agriculture, gasoline market, and financial market (Meyer and von Cramon-Taubadel, 2004). Early studies seek to explain the price phenomenon by identifying APT and thus the possible policy intervention. Estimation techniques are the strong focus on agricultural markets (Houck, 1977; Ward, 1982; Wolffram, 1971). These can be referred to as the 'pre-cointegration' approaches (Meyer and von Cramon-Taubadel, 2004). It is clear the estimation might have the problem of spurious regression if some series of data are not stationary and cointegrated. The first attempt to employ co-integration techniques in testing for APT is von Cramon-Taubadel and Fahlbusch (1994). Since then, they have been used extensively in the study of APT (von Cramon-Taubadel, 1998; Balke, Brown and Yücel, 1998; Frost and Bowden, 1999).

The relation between stumpage prices and wood product prices has been examined in several studies. Among these early studies, Haynes (1977) analyzes the link between regional stumpage and lumber markets with a theoretically derived demand model. When this model is applied to empirical data, the derived demand function for stumpage is found to be less elastic than the lumber demand function. Regional estimates of this relationship are found to differ widely with the South being more elastic than the West.

Zhou and Buongiorno (2005) investigates the prices of products at different stages of manufacturing with quarterly prices of softwood stumpage in the U.S. South and national prices of forest products from 1977 to 2002. All prices are found to be nonstationary, and there is no evidence of co-integration between prices. Vector autoregressive models show that there is a one-to-one permanent positive response of the southern sawtimber stumpage price to a permanent change in the national lumber price. There is also a one-third permanent positive response of the national paper price to a permanent change in the national pulp price. There is no relation between regional pulpwood prices and national pulp or paper prices. When price transmission is significant, the full adjustment takes about two years.

For European markets, Hänninen, Toppinen and Toivonen (2007) analyzes the mechanism by which economic changes in European consumer markets and sawnwood prices pass through to exporters' domestic roundwood prices. Results based on seemingly unrelated regression analysis indicate that price transmission exhibits similarities between old and new EU member countries. Overall development in both sawnwood and sawlog prices displays convergence in the study period and indicates that deepening integration in the European markets is also detectable in the forest sector.

The latest study, Koutroumanidis, Zafeiriou and Arabatzis (2009) examines asymmetry in the price transmission mechanism between the producer and the consumer prices in the sector of forest products in Greece. In particular, the research is focused on the roundwood of long length. The Johansen co-integration and two dynamic models (the Error Correction Model and LSE−Henry general to specific model) are estimated. The existence of a long-run relationship between the producers and the consumers in the Greek round wood market is detected. The consumer price Granger causes the producer price whereas the reverse is not valid, so the existence of asymmetry in the price transmission mechanism within the round wood market is confirmed.

Overall, asymmetry in price transmission has been examined in numerous issues in the agriculture, gasoline market, and financial market (Meyer and von Cramon-Taubadel, 2004). Applications related to the U.S. wood products industry have been limited. In particular, to our best knowledge, no study has been conducted to evaluate APT in the wood products industry in the Southern U.S.

RESEARCH METHODS

Prices drive resource and welfare allocation and price transmission integrates markets vertically (Meyer and von Cramon-Taubadel, 2004). Of special interest are those processes that are referred to as asymmetric price transmission (APT). APT is the pricing phenomenon occurring when downstream prices react in a different manner to upstream price changes, depending on the characteristics of prices or their changes. To better understand where the asymmetric transmission occurs, the vertical market linkages are dissected into two stages: Stage I is from standing timber prices to delivered timber prices and Stage II is from delivered log prices to the lumber market. In this study, the asymmetry of price transmission is examined for the timber and wood products market in the southern United States using an approach: Error Correction Model (ECM).

The ECM approach

The approach takes into consideration the time series properties of data. Applications of the ECM in testing for APT include von Cramon-Taubadel (1998) and Grasso and Manera (2007). The potential for spurious regression in the case of asymmetry tests can be solved by incorporating asymmetric adjustment terms so it provides a more appropriate specification for testing APT. Following the previous studies' framework (Granger and Lee, 1989; von Cramon-Taubadel and Loy, 1999), a dynamic asymmetric model can be presented:

$$\Delta P_{dt} = \beta_0 + \sum_{i=1}^{n_1} \beta_{1i} \Delta P_{dt-i} + \sum_{i=0}^{n_2} \beta_{2i}^{+} \Delta P_{ut-i}^{+} + \sum_{i=0}^{n_3} \beta_{2i}^{-} \Delta P_{ut-i}^{-} + \beta_3^{+} \upsilon_{t-1}^{+} + \beta_3^{-} \upsilon_{t-1}^{-} + \eta_t \quad (1)$$

where n_1 and n_2 represent the length of the lags with regard to rising and falling prices series, respectively, and $\upsilon_t = P_{dt} - \phi_0 - \phi_1 P_{ut}$ (residuals from the co-integration). A formal test of the symmetric hypothesis is:

$$\begin{aligned} H_0 : \sum_{i=0}^{n_2} \beta_{2i}^{+} &= \sum_{i=0}^{n_3} \beta_{2i}^{-} \text{ in the short term} \\ \beta_3^{+} &= \beta_3^{-} \text{ in the long term} \end{aligned} \quad (2)$$

The Wald test is applied to the examination of the equality validity.

Before implementing APT test, the stationarity property of individual series needs to be examined by the Augmented Dickey-Fuller (ADF) test (Enders, 1995, pp.433) because the data used in this study are time-series and may not be stationary. This test aims at testing the null hypothesis that there is a unit root. Following testing procedure (Pfaff, 2008, pp.630), we estimate the ADF equation with the presence of a constant and trend, with an intercept but without trend, and without both constant and trend, respectively. The general equation is expressed as:

$$\Delta P_t = \zeta_1 + \zeta_2 t + \pi P_{t-1} + \sum_{j=1}^{k} \gamma_j \Delta P_{t-j} + u_t \quad (3)$$

where P is any price time series. If the test for $\pi = 0$ is denied, there is no need to proceed further. If the null hypothesis of H_0: $\xi_2 = \pi = 0$ is rejected, then test again using standardized normal. Under the normal circumstance, if the test for $\pi = 0$ is not rejected, the series is unit root, *I(1)*. Otherwise, it is *I(0)*. If the null hypothesis of H_0: $\xi_2 = \pi = 0$ is not significant, reestimate the equation without a time trend. Likewise, if the null hypothesis of H_0: $\xi_1 = \pi = 0$ is rejected, then test again using standardized normal. Under the normal circumstance, if the test for $\pi = 0$ is not rejected, the series is *I(1)*. Otherwise, it is *I(0)*. If the null hypothesis of H_0: $\xi_1 = \pi = 0$ is not significant, reestimate the equation without a drift or constant and a trend, if it is rejected, it is *I(0)*, otherwise, it is *I(1)*. Alternatively, Phillips-Perron (PP) test is applied to confirm ADF test because the advantage of the PP test is that it allows for weak dependence and heterogeneity of the error process (Phillips and Perron, 1988). Another test is Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test that null hypothesis is a stationary process, where it is unit root process in the former tow tests (Kwiatkowski, et al., 1992). One thing should be kept in mind is that the tests are sensitive to number of lags. The optimum number of lags depends on the likelihood test statistic (Sims, 1980). If three tests can make consistent conclusion on each series as *I(1)*, then a co-integration analysis can be conducted.

Before performing APT test, another requirement needs to conduct co-integration analysis because the analysis is a statistical property of data that can describe the long-term co-movement of economic time series. Engel and Granger propose a two-step estimation procedure to do so. The first step of the procedure is to estimate the long-run relationship between price series as the following:

$$P_{dt} = \varphi_1 + \varphi_2 P_{ut} + \upsilon_t \text{ for } t=1,\ldots,T \tag{4}$$

where υ assigns the error term. Traditional ordinary least squares (OLS) is applied to the equation because the cointegrating vector can be estimated super-consistently (Stock, 1987). In the next step, an augmented Dickey-Fuller test is employed to check the residuals to see if the price series of each equation are cointegrated. The residual of the long-run (LR) relationship is expressed as the following:

$$\Delta\upsilon_t = \rho\upsilon_{t-1} + \omega_t \tag{5}$$

where ω is the error term for the residuals. Given the LR relationship, P_d and P_u are cointegrated if $\rho = 0$ is rejected.

Furthermore, APT tests are conducted by a dynamic ECM-EG with splitting price series and error terms into two parts: positive and negative series in equation (1) if they are cointegrated. Otherwise, error term cannot enter into the equation and we turn to a dynamic asymmetric model in equation (6). If all variables at first difference level and error correction terms are stationary, the OLS method is applied to the ECM-EG models. Note that the model selection with lag lengths is determined by Akaike Information Criterion (AIC) because it is referred to a penalized loglikelihood (Crawley, 2007, pp.353), while the significance of all lags is also considered. The Wald test is applied to examine the APT after the estimation of the model in the equations (1). If the null hypothesis $\beta_3^+ = \beta_3^-$ is rejected, then there is an asymmetric price transmission in the long term. If he null hypothesis $\alpha_2^+ = \alpha_2^-$ or $\beta_2^+ = \beta_2^-$ is denied, then there is an asymmetric price transmission in the short term. Otherwise, there is no symmetric price relationship. Lastly, APT can be further classified as either positive or negative, depending on reaction speed and magnitude (Peltzman, 2000). If downstream price reacts more fully or rapidly to an increase in upstream price than to a decrease, the asymmetry is defined as positive, otherwise, negative correspondingly.

DATA SOURCES

A summary of data description and statistics of the selected variables are reported in Table 1. The data are collected in three stages. In the first stage, standing timber prices are collected from Timber-Mart South (www.tmart-south.com) (1977.1q-2008.4q). In terms of area consistency, the three area prices are converted into two before 1992 because the prices for three reporting areas were changed to two (Prestemon and Pye, 2000). Likewise, the mean in each quarter before 1988 are used as quarterly observation because the reporting frequency has changed from monthly to quarterly since 1988 (Prestemon and Pye, 2000). In order to match timber and lumber prices by region, we average standing timber prices for Southern pine sawtimber over four states (AL, LA, MS, and TX) on the Westside and 11 states (AL, AK, FL, GA, LA, MS, NC, SC, TN, TX, VA) in the South, respectively.

Table 1. Definition and Data Summary for the Selected Eight Variables

Variable	*Definition*	*Mean*	*Std. Dev.*	*Min.*	*Max.*
DIW	Lumber dimension of Southern pine 2×4#2 on the Westside in the South	299.5	83.2	177.0	499.0
STW	Lumber stress of Southern pine 2×4#1 on the Westside in the South	332.5	91.0	198.0	535.0
DPW	Average delivered price of Southern pine sawtimber for four western states in the South	291.8	101.7	128.0	485.0
SPW	Average standing price of Southern pine sawtimber for four western states in the South	223.3	83.8	89.0	387.0
BOA	Lumber boards of Southern pine 1×4#3 in the South	235.4	64.1	134.0	408.0
SLE	Lumber selects of Southern pine1×4 in the South	735.6	231.6	342.0	1147.0
ADS	Average delivered price of Southern pine sawtimber for 11 states in the South	273.9	94.2	120.0	439.0
ASS	Average standing price of Southern pine sawtimber for 11 states in the South	201.4	73.1	80.0	274.2

In the second stage, delivered timber prices are also taken from Timber-Mart South. The three area prices are converted in to two for all states and time series are changed from monthly to quarterly like standing timber prices. Correspondingly, delivered timber prices are averaged over four states on the Westside and 11 states in the South, respectively.

In the third stage, the prices of lumber are obtained from the *Forest Product Market Price and Statistics Yearbook* published by Rand Lengths from 1977 to 2008. The prices for lumber dimension of Southern pine 2×4#2 and stress of Southern pine 2×4#1 are used as lumber price series for the Westside in the South. Similarly, the prices for lumber boards of

Southern pine 1×4#3 and selects of Southern pine1×4are employed as lumber price series for the Southern U.S. The mid month observations in each quarter are employed as quarterly data to achieve time consistency because the reporting frequency is on monthly basis. All data are quarterly time series for the period from January 1977 to December 2008 (128 observations). In this study, the price time series are nominal and do not need to be deflated with Producer Price Index because further analysis takes price logarithm form for all variables (Kinnucan and Forker, 1987).

EMPIRICAL RESULTS

The results of the ADF, PP, and KPSS tests are reported in Table 2. It should be noted that all variables are in logarithm form and defined as in Table 1. In addition, all statistics are no longer standard Student t distributed and critical values are larger than the normal (Dickey and Fuller, 1981). Augmented Dickey-Fuller (ADF) test for the null hypothesis that has a unit root against a stationary is used and the 5% and 10% critical values without a constant and trend are -1.95 and -1.62. The ADF test shows that all variables are not significant for the presence of trend and constant. Further estimation without trend and constant at level reveals that all variables are unit root because the null hypothesis cannot be rejected. In contrast, estimation without trend and constant at first difference implies that all variables are not unit root. Lag lengths are determined by Akaike Information Criterion.

Table 2. Results of the Unit Root Tests

Series	ADF test		PP test		KPSS test		Results with lags[a]
	Level	First diff.	Level	First diff.	Level	First diff.	
	(no constant & trend)		(with constant & trend)		(with constant)		
DIW	-0.17	-7.00**	-2.90	-11.11**	2.60**	0.10	*I(1)*,2
STW	-0.06	-6.91**	-2.41	-9.96**	2.70**	0.11	*I(1)*,2
DPW	1.32	-5.84**	-1.97	-8.84**	3.79**	0.19	*I(1)*,2
SPW	0.70	-6.87**	-2.00	-9.34**	3.36**	0.19	*I(1)*,2

BOA	-0.41	-4.84**	-3.11	-7.53**	3.32**	0.06	*I(1)*,3
SLE	0.18	-3.91**	-2.07	-6.04**	3.81**	0.26	*I(1)*,2
ADS	1.17	-4.98**	-2.00	-8.55**	3.99**	0.23	*I(1)*,3
ASS	0.92	-6.14**	-1.97	-8.66**	3.66**	0.24	*I(1)*,2

[a] *I(1)* indicates that a variable is nonstationary and integrated of order one.

[b] ** and * denote rejection of the null hypothesis at the 5% and 10% significant levels, respectively.

Similarly, Phillips-Perron (PP) test for the null hypothesis that has a unit root against a stationary is employed and the 5% and 10% critical values incorporating a constant and a linear trend are -3.46 and -3.15. The PP test reveals that all variables are unit root at level including constant and trend, but not integrated of order one at first difference. Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test for the null hypothesis that is stationary is applied and the 5% and 10% critical values including a constant are 0.46 and 0.35. The KPSS test shows opposite results because its null hypothesis is different from the former two tests. The test also suggests that all variables are unit root without trend. Overall, the three tests make a consistent conclusion that all variables are nonstationary and integrated of order one. Thus, Engel-Granger co-integration analysis can be conducted in this study.

The results of Engel-Granger two-step procedure are presented in Table 3. The OLS estimation for long-run relationship reveals that all variables are significant at 5% level or better.

Table 3. ***.*** *Engle-Granger: Co-integration Tests*

Pair of price series	Long run coefficient (t-statistic)	Statistic of ρ for EG co-integration test[a]
DIW-DPW	0.61**(16.17)	-3.74*
STW-DPW	0.62**(17.35)	-3.92**
DPW-SPW	0.90**(57.78)	-2.22

DPW-DIW	1.10**(16.17)	-3.08
DPW-STW	1.14**(17.35)	-3.33
SPW-DPW	1.07**(57.78)	-2.43
BOA-ADS	0.68**(23.29)	-5.73**
SLE-ADS	0.87**(42.78)	-5.29**
ADS-ASS	0.93**(67.36)	-2.91
ADS-BOA	1.20**(23.29)	-5.15**
ADS-SLE	1.07**(42.78)	-4.99**
ASS-ADS	1.05**(67.36)	-3.12

** and * denote rejection of the null hypothesis at the 5% and 10% significant levels, respectively.

The further co-integration analysis indicates that six pairs of price series are cointegrated because the null hypothesis $\rho = 0$ is rejected at 10% significant level or better, while other six pairs are not cointegrated. The six pairs of prices that are cointegrated include two dual relationships between lumber boards of Southern pine 1×4#3 in the South (BOA) and average delivered price of Southern pine sawtimber for 11 states in the South (ADS), and lumber selects of Southern pine1×4 in the South (SLE) and ADS. There are also two one-way relationships from average delivered price of Southern pine sawtimber for four western states in the South (DPW) to lumber dimension of Southern pine 2×4#2 on the Westside in the South (DIW) and from DPW to lumber stress of Southern pine 2×4#1 on the Westside in the South (STW). Note that the critical values are larger than those in the ADF test, given -3.83 and -3.51 for 5% and 10% significant levels (Engle and Yoo, 1987). The six pairs that are cointegrated can be accepted for further ECM-EG analysis. In contrast, the other six pairs of price series that are not cointegrated can be used to conduct vector autoregressive (VAR) analysis at first difference level and produce consistent estimation based on equation (1) because they all are *I(1)*.

The estimated results of the ECM-EG for APT are reported in Tables 4. Again, the model selection with lag lengths is determined by Akaike Information Criterion (AIC).

Table 4. ECM-EG Tests for the Relationships from Upstream to Downstream Price Series

Series	DPW→DIW	DPW→STW	ADS→BOA	ADS→SLE
	Coeff.(*t*-stat.)	Coeff.(*t*-stat.)	Coeff.(*t*-stat.)	Coeff.(*t*-stat.)
ΔP_{dt-1}^{+}	-0.46**(-3.27)	-0.25*(-1.64)	0.07(0.52)	0.34**(2.69)
ΔP_{dt-1}^{-}	-0.25(-1.45)	0.23(1.36)	0.66**(4.26)	0.33**(2.16)
ΔP_{dt-2}^{+}	-	-	-0.25*(-1.91)	-
ΔP_{dt-2}^{-}	-	-	-0.45**(-2.71)	-
ΔP_{ut}^{+}	1.16**(3.76)	0.87**(3.13)	0.25(1.28)	0.13(0.98)
ΔP_{ut}^{-}	0.68**(1.99)	0.46(1.50)	0.92**(3.33)	0.35*(1.92)
ΔP_{ut-1}^{+}	-0.55*(-1.78)	-0.42(-1.54)	-0.08(-0.42)	0.35**(2.84)
ΔP_{ut-1}^{-}	-0.18(-0.51)	-0.12(-0.39)	-0.08(-0.24)	0.01(0.05)
ΔP_{ut-2}^{+}	-	-	0.01(0.05)	-
ΔP_{ut-2}^{-}	-	-	0.57**(2.04)	-
$\Delta \upsilon_{t-1}^{+}$	-0.17(-1.48)	-0.13(-1.16)	-0.20**(-2.53)	-0.23**(-2.55)
$\Delta \upsilon_{t-1}^{-}$	-0.22*(-1.94)	-0.21**(-2.09)	-0.09(-0.90)	-0.13(-1.56)
Wald test short-run	11.0**(ΔP_{dt-1})	3.5(ΔP_{dt-1})	1.2(ΔP_{dt-1})	15.9**(ΔP_{dt-1})
	27.6**(ΔP_{ut})	18.1**(ΔP_{ut})	23.9**(ΔP_{ut})	7.1**(ΔP_{ut})
	4.4(ΔP_{ut-1})	3.3(ΔP_{ut-1})	18.5**(ΔP_{ut-1})	9.3**(ΔP_{ut-1})
Wald tests for long-run	8.3**($\Delta \upsilon_{t-1}$)	7.7**($\Delta \upsilon_{t-1}$)	10.2**($\Delta \upsilon_{t-1}$)	16.2**($\Delta \upsilon_{t-1}$)
APT in LR	Negative	Negative	Positive	Positive

** and * denote rejection of the null hypothesis at the 5% and 10% significant levels, respectively.

The analysis reveals that the error-correction terms for four pairs of price series are negative and significant at the 5% level or better. This further confirms the finding of the long term relationship by the short-term model. The negative coefficients of the error-correction terms guarantee that the long term equilibrium can be achieved. The absolute value of the error-correction terms implies the adjust speed to the long-term equilibrium. The results show that the adjustment for all equations is slow. In this study, the critical values of Wald-test for asymmetry at the 5% and 10% significant levels are 5.99 and 4.61, respectively. The Wald tests indicate that the asymmetric price transmission applies to the four pairs of price series (DPW→DIW, DPW→STW, ADS→BOA, and ADS→SLE) in the long term and the short term. According to the speed and magnitude of the long run adjustment, the results imply that the positive APT exists in two pairs of price series (ADS→BOA and ADS→SLE), while the other two pairs of price series (DPW→DIW and DPW→STW) have the negative APT phenomenon in the long term. In the short term, there is no consistent conclusion on the classification of APT.

DISCUSSION AND CONCLUSION

In this study, the existence of asymmetry in the price transmission in the timber and lumber markets in the Southern United States is examined by time series method vertically. The data feature is examined by the ADF, PP, and KPSS tests because it will produce spurious regression with traditional method if price time series occur nonstationary. In addition, EG co-integration analysis is conducted to see if they can achieve long term economic equilibrium. The further APT analysis with ECM is used to examine the existence of asymmetry in the price transmission in the short and long term. The advantage of the method is that it picks up the dynamic characteristics of time series of data.

The results of the ADF, PP, and KPSS tests reveal that all variables are nonstationary and integrated of order one. This is in line with the literature (Zhou and Buongiorno, 2005). Thus, traditional way that deals with the nonstationary data using variables at level will produce spurious estimation. On the other hand, an unrestricted VAR system in first difference form cannot be used either if all variables are nonstationary and cointegrated, because the estimates obtained by the standard VAR model cannot be consistently specified (Engel and Granger, 1987).

The results of Engel-Granger two-step procedure indicate that four pairs of price series are cointegrated. The results are not consistent in the literature (Zhou and Buongiorno, 2005). The possible explanation is that this study breaks market linkages down into two stages, while the previous studies just have one stage. In addition, the previous study uses national lumber price index as a downstream price that does not match stand timber price well regionally. The presence of the co-integration for the four pairs of price series allows the construction of ECM-EG model. The estimated results of the ECM-EG for APT reveal that the asymmetric price transmission exists in the four pairs of price series in the long term and short term. After a careful examination, we find the positive APT for two pairs of price series in the long term. The existence of positive APT is widely found in the literature. This finding indicates that any price movement that squeezes the margin is transmitted more rapidly and /or completely than the movement that stretches the margin (Meyer and Cramon-Taubadel, 2004). Meanwhile, the negative APT for the other two pairs of price series is found in the long term. The negative APT is not usually observed in the past but does exist in the forest sector in the case of Greece (Koutroumanidis, Zafeiriou and Arabatzis, 2009), agricultural sector or other sectors (Peltzman, 2000; Meyer and Cramon-Taubadel, 2004). This finding implies that a shock that may lead to an increase in the cost of lumber production causes an increase in the lumber price but not in a symmetric way. The proposed explanation for the presence of vertical APT in the forest sector in the Southern United States is due to non-competitive markets and adjustment costs. Political intervention, asymmetric information, and inventory adjustment can also be candidates for the explanation for the presence of vertical APT.

Therefore, it should be kept in mind that the results from this study need to be interpreted with caution. The findings are based on relatively less types of timber markets. In addition, the findings are constrained by the empirical analysis technology. Nevertheless, this study is helpful to understand not only the gaps in economic theory but also the existence of market failure, and thus possible welfare distortion. The results should be interesting to those who are interested in market analysis and policy assessment. Further research is needed to examine if there exists APT in paper markets and spatial APT considering the large variations in the U.S. Moreover, the causes of APT should be investigated and more complicated methods such as threshold co-integration analysis should be applied.

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Southern Forest Economics Workers

2010 Annual Meeting

Tuesday, March 16, 2010

1:30 PM – 3:00 PM

Session D: Financial Performance

Manuscripts:

Financial performance of U.S. forest products firms on the event of their timberland divestiture and REIT-conversion - Mohammad Mahfuzur Rahman et al.

Longleaf Pine Growth and Economics on Old-field Planted Sites in Georgia – Results through Age 21-years - E. David Dickens et al.

Financial performance of U.S. forest products firms on the event of their timberland divestiture and REIT-conversion

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Financial performance of U.S. forest products firms on the event of their timberland divestiture and REIT-conversion

Abstract

In the last two decades, most big firms in the U.S. forest products industry have either divested their timberlands or changed their corporate structures from C-corporations into real estate investment trusts (REITs). Whether or not this large scale change in timberland ownership has altered the financial performance of these firms has not been fully assessed. This study evaluates the impacts of these firms' timberland ownership change on their financial performance using event analysis. The findings of this study reveal that the capital market responded to divestiture events with the improvement of buying firms' market value significantly. In 3-day, 19-day, 25-day, 31-day event windows, the average cumulative abnormal returns for buying firms were 1.52%, 5.31%, 7.56% and 7.61% respectively. The announcement of REIT-conversion did not significantly impact the performance of the timber REITs as a group. The study suggests that timberland divestiture could be preferable to changing corporate structures to REITs.

Keywords: Abnormal Return; C-corporation; Equity Market; Event Analysis; Risk;

1. Introduction

The forest industry of the United States owns about 71 million acres of timberland representing 10% of U.S. timberland [1]. In 2007, wood product manufacturing (North American Industrial Classification System, NAICS 321), paper manufacturing (NAICS 322) and furniture manufacturing (NAICS 337) sectors of the United States produced shipments that valued close to $101.88 billion, $175.81 billion and $84.97 billion respectively [2] totaling $362.66 billion. About 1.45 million employees were rendering their service in this industry with the annual payroll of about $55.9 billion [2]. But in 2002, the total shipment value of the industry was $319 billion and the number of employees was 1.63 million [3]. It suggests, from 2002 to 2007, the size of shipment of the industry increased by $43.66 billion while the number of employees declined by 0.18 million. Due to restructuring activities through mergers and acquisitions and sale of timberlands and conversion into REITs, the extent of the industry had greatly reduced with a cut of this 0.18 million jobs in just five years.

Best and Wayburn [4] reported that an estimated 28% of timberland changed hands in the 1990s with much of it going entirely out of ownership by vertically integrated forest products companies. An increasingly important role is being played by real estate investment trusts (REITs). According to Mendell et al. [5], four publicly traded timber REITs namely Plum Creek Timber Company (PCL), Rayonier International (RYN), Longview Fiber (LFB) and Potlatch Corporation (PCH) converted over 12 million acres of timberland into REITs between 1999 and 2006. The driving factors behind the sale-off and REIT-conversion were consolidation within the industry, strategic restructuring to focus on production manufacturing due to higher tax burden, and shifting of capital towards foreign timberland purchases. Beginning in the 1990s, this ownership structure enjoyed much lower tax rates than the traditional forest products firms [6,7]. Thus, REIT-conversion became a favorite option for forest product firms like traditional paper companies that are classified as C-corporations [8]. Investments in real estate provided investors with income and appreciation. The Tax Reform Act of 1986 allowed REITs to manage their properties directly, and in 1993 REIT investment barriers to pension funds were eliminated. This trend of reforms continued to increase the interest in and value of REIT investment. Today, there are more than 193 publicly traded REITs operating in the United States; their assets total over $500 billion [9].

Li and Zhang [10] examined the acreages of industrial timberlands owned by major public forest products firms from 1988 and 2003 and concluded that timberland holdings have been positively related to the financial performance of these firms. Greene [11] and Rinehart [12] investigated that, a double tax burden had compelled big forest product firms to divest their timberlands. Yin [13] and Diamond [14] gave a comprehensive compilation of timberland divestiture events. Very recently, Mei and Sun [15] conducted a traditional event study on the financial performance of U.S. forest product industry due to mergers and acquisitions. Choi and Russell [16] reported that, in mergers and acquisitions, target firms' financial performance was improved. On the contrary, Pesendorfer [17] reported that the financial efficiency of most acquiring firms improved after an acquisition. Mendell et al. [5] compared the financial data of the publicly traded Timber REITs and C-corporations. Mendell et al. [18] further conducted an event study and discussed the investors' responses to the timberlands structure as REITs. NAREIT [9] maintains a comprehensive directory that contains ample information about REITs. Udpa [19] broadly explained why and how firms switched from C-corporations to REITs. Deweese [20] reported the emerging history of Timber REITs, problems of paper manufacturers and their fighting to boost up their share price in the equity markets.

There is a great dearth of investigations that have rigorously addressed the after-effects of industrial timberland sale-off sand REIT conversions on the specific firms in U.S. forest product industry. No specific investigation had been made on whether sale-off or REIT-conversion of timberlands could be a better option for forest products firms to boost up their financial performance in the capital market. Thus a research need related to the prediction of the impact of industrial timberland sale-off and forest product firms' conversion from C-corporations into REITs on their financial performance was obvious. The objective of this study was to evaluate the impact of U.S. forest products firms' timberland divestitures from 1986 to 2007 and some forest products firms' conversion into REITs on their financial performance. The reason behind choosing this period is that, most timberland divestiture events took place in this period

2. Empirical methods

2.1. Event and event window

An event study includes several generic stages; defining an event of interest and identifying the period over which the impact of the event is examined constitute the first stage. The events of interest in this study were the major divestitures of the industrial timberlands of the U.S. forest product industries over a period from 1986 to 2007. There are debates in the thoughts to the length of event window. A number of studies [15,21-27] debated on how broad an event window could be to explain the impact of an event. However, the length of the event window should be long enough to capture the significance of the event, but short enough to exclude the confounding effects. In this study, seven different event windows were selected to investigate the extent and persistence of abnormal return over different windows.

$(t_1, t_2) = (-1, +1), (-3, +3), (-6+6), (-9, +9), (-12, +12), (-15, +15)$. The length of the event window was defined as $T = t_2 - t_1 + 1$ and thus the lengths of the event windows were 3, 7, 13, 19, 25 and 31 days respectively. Time before the event windows is termed as estimation window while the days after the window constitute the post event window. For each event, the estimation window covered 250 trading days before the event window. Following MacKinlay (1997) and Mei and Sun (2008), four lengths were employed for post event risk analysis: 50, 100, 150 and 200 days.

2.2. Abnormal return for individual firm

Abnormal return on the security of a firm is the difference between its actual return and predicted return of the firm over an event window. In this study, market model is used to obtain the predicted return.

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

Where, $t \in [1, T]$ and T is the length of the event window; R_{it} is the return of firm i on day t; R_{mt} is the return of a market portfolio of day t; α_i and β_i are the parameters to be estimated; ε_{it} is the error term assumed $i.i.d \sim N(0, \sigma^2)$. In this study, S&P 500 index was chosen as the proxy of the market portfolio.

After estimating α_i and β_i through ordinary least square, the abnormal return, A_{it} of firm i on day t over an event window can be calculated using equation (2).

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

Under the null hypothesis that the event has no impact on the returns of the security of the firm, A_{it} does possess a normal distribution (MacKinlay, 1997). In actual estimation, A_{it} is just the predicted residual of the market model on an out-of-sample basis (Mei and Sun, 2008).

Average cumulative abnormal return, C_{iT} for firm i can be obtained by aggregating the abnormal return, A_{it} over T day event window using equation (3).

$$C_{iT} = \sum_{t=1}^{T} A_{it} \tag{3}$$

According to Medeiros and Matsumoto [28], when the estimation window is sufficiently large, the variance of C_{iT} can be asymptotically measured using equation (4), given the central limit theorem.

$$Var(C_{iT}) = T\sigma_{\varepsilon_{it}}^2 \tag{4}$$

Where, T is the length of the event window and $\sigma_{\varepsilon_{it}}^2$ is the variance of the disturbance term in the market model. C_{iT} has a normal distribution and the null hypothesis of C_{iT} being zero can be examined following MacKinlay (1997).

2.3. Abnormal return across all firms

Following Mei and Sun [15], the average cumulative abnormal returns across the firms can be measured using equation (5).

$$C_{NT} = \frac{1}{N}\sum_{i=1}^{N} C_{iT} \tag{5}$$

Here, C_{NT} is the average cumulative abnormal return for N firms as a group over T -day event window. Substituting equation (3) into (5) yields,

$$C_{NT} = \frac{1}{N}\sum_{i=1}^{N}\left(\sum_{t=1}^{T} A_{it}\right) \tag{6}$$

Equation (6) can be splitted as follows:

$$C_{NT} = H_{N\delta} + \sum_{t=\delta+1}^{T}\left(\frac{1}{N}\sum_{i=1}^{N} A_{it}\right) \tag{7}$$

Where, $H_{N\delta}$ is the average cumulative abnormal return for N firms up to δ day over the event window and $\delta \in [1,T]$. $H_{N\delta}$ has an estimate for each specific day in the event window and $H_{N\delta}$ equals C_{NT} when δ approaches T.

With the assumption of asymptotically normal distribution, the variance of the average cumulative abnormal return for the sample firm can be calculated and its statistical significance can be examined by z-statistic.

$$Var(C_{NT}) = \frac{1}{N^2}\sum_{i=1}^{N} Var(C_{iT}) \quad (8)$$

$$z = \frac{C_{NT}}{\sqrt{Var(C_{NT})}} \sim N(0,1) \quad (9)$$

2.4. Cross sectional regression

When comparing a firm's financial ratios to industry ratios, it may not be suitable using the average industry value when there is wide non-symmetric dispersion of individual firm ratios within the industry. In this situation, a cross sectional analysis may be appropriate, where an individual firm can be compared to a subset of firms within the industry that are comparable in size and characteristics [29].

In this study, cumulative abnormal returns were explained by different criteria of the firms involved in the events of interest.

$$C_{iT} = \beta_0 + \beta_1(ALL_i) + \beta_2(TIME_i) + \beta_3(ROA_i) + \beta_4(SIZE_i) + \beta_5(PARTY_i) + \beta_6(TRAN_i) + \mu_i \quad (10)$$

Where, C_{iT} is the average cumulative abnormal return for firm i over T day event window; βs are the regression coefficients. In this study, we have defined six variables that explain the response variable, average cumulative abnormal return. Three dummy variables were defined to differentiate the events under investigation- ALL, $PARTY$ and $TRAN$. The variable ALL equaled one when the forest product firm sold all its timberlands and zero otherwise. $PARTY$ equaled one for a buying firm and zero for a selling firm. One was assigned to $TRAN$ when the transaction money was one billion or above and zero otherwise. The time trend variable $TIME$ was weighted as the integer value of the difference between the year 2006 and the year of divestiture announcement in the Wall Street Journal or in the New York Times. ROA was the return on asset of firm i, $SIZE$ was defined as the ration of the transaction size of the event in million U.S. dollars to the total asset of firm in million dollars and μ_i is the mean zero error term with constant variance.

2.5. Risk analysis

The security of any firm is a risky asset and thus risk assessment is an integral part of any event study. A comparison of the statistical estimates of systematic risk before and after the divestiture event of interest can be supplementary to the analysis of abnormal return. Jensen [30] employed the capital asset pricing model (CAPM) to measure the systematic risk associated with the events with the following statistical specification.

$$R_{it} - R_{ft} = \alpha_i + \beta_i \left(R_{mt} - R_{ft} \right) + \psi_i \tag{11}$$

Where, R_{it} is the realized return at time t on asset i, R_{mt} is the realized return at time t of the market portfolio m and R_{ft} is the return on the three-month T-bills (a risk free asset) at time t. The parameter β_i is termed as asset i's beta and can be viewed as a standardized measure of systematic risk [31]. ψ_i is the error term having a normal distribution with mean zero, constant variance and serial independence.

Following Mei and Sun [15], we have incorporated a dummy variable, D_i to determine the difference in beta values for an individual firm before and after the divestiture events. D_i equaled one on and after the day of announcement of the event and zero for the days before. γ_i was the coefficient of the interaction term and captured the state of change in the firm i's systematic risk after the event had taken place.

$$R_{it} - R_{ft} = \alpha_i + \beta_i \left(R_{mt} - R_{ft} \right) + \gamma_i D_i (R_{mt} - R_{ft}) + \psi_i \tag{12}$$

3. Data sources

Three online databases namely LexisNexis Academic, Newspaper Source and Academic Search Premier were searched to collect the timberland divestiture data. All issues of the Wall Street Journal and the New York Times from 1986 to 2007 were rigorously searched for any announcement of timberland divestiture in them. Some transaction records were also collected from Yin et al.[13] and Diamond et al. [14]. In this study, a total of 33 timberland sales were recorded from 1986 to 2007. In every sale, the money transacted was not less than $50 million.

Daily security returns of the firms were collected directly from the database of Center for Research in Security Prices (CRSP). As the proxy of the market portfolio, we used the value-weighted S&P 500 Composite Index. The daily returns of this Index from 01 January 1985 to 31 December 2008 were also collected from CRSP database. For cross sectional analysis, we collected information regarding a firm's return on assets, total assets and net income. These were collected from the COMPUSTAT database. These were the fiscal year end data preceding the announcement of the divestiture event. For a risk assessment of the firms involved in the timberland divestitures, we used the rate of risk free returns as the market rate of the 3 month U.S. T-bills [32]. Data related to REITs were collected from National Association of Real Estate Investment Trust [9] and the annual reports of the companies on the form 10-K of the Securities and Exchange Commission (SEC) for the years 2006 and 2008.

4. Empirical results

4.1. Abnormal returns

The average cumulative abnormal returns, H_δ on specific days in a 31-day event window for all the 33 firms involved in timberland transactions are presented in Figure 1. H_δ Values were calculated for 15 days prior to and after the sale-off announcement was made and on the last day of the event window H_δ approached C_{NT}. Figure 1 depicts how buying and selling firms behaved immediately after the event took place. Average cumulative abnormal return sharply rose for the buying firm and less sharply fell for the selling firms. The combined H_δ line ran in between the selling and buying lines.

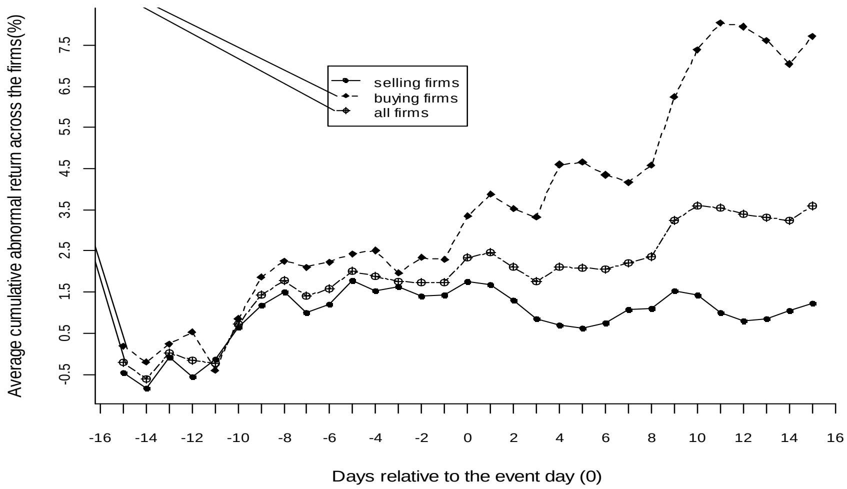

Figure 1. Average cumulative abnormal returns up to a specific day over the 31-day event window obtained in OLS model for 33 forest products firms involved in timberland divestitures from 1986 to 2007

Table 1 represents the average cumulative abnormal returns (C_{NT}) for different event windows. The impact of the timberland divestiture on the return of the security of the firm was immediate. The 3-day event window was selected just to examine what happened the previous and the next day of the event. The C_{NT} values for selling firms did not change significantly in any of the event windows and thus the null hypothesis that C_{NT} was zero could not be rejected at 5% level for those firms. On the other hand, the buying firms continuously kept on accumulating positive abnormal returns. In 3-day, 19-day, 25-day, 31-day event windows, the C_{NT} values for buying firms were 1.52%, 5.31%, 7.56% and 7.61% respectively all of which were significant. It suggests that the performance of the selling firms was relatively poor and the buying firms' market value was significantly improved. When all firms were considered as a group, the C_{NT} values were significant only in 25-day (3.32%) and 31-day (3.64%) event windows.

Table 1. Average cumulative abnormal return (C_{NT}) by different event windows

Event Windows	Selling firms		Buying firms		All firms		REITs	
	C_{NT} (%)	*z*-stat	C_{NT} (%)	*z*-stat	C_{NT} (%)	*z*-stat	C_{NT} (%)	*z*-stat
3 days	0.27	0.32	1.52	1.67[c]	0.72	1.14	1.88	1.39
7 days	-0.67	-0.52	0.74	0.54	-0.16	-0.16	1.03	0.50
13 days	-0.35	-0.20	2.18	1.15	0.57	0.43	2.36	0.84
19 days	0.79	0.37	5.31	2.33[b]	2.43	1.54	0.21	0.06
25 days	0.90	0.37	7.56	2.92[a]	3.32	1.83[c]	0.15	0.04
31 days	1.38	0.51	7.61	2.67[a]	3.64	1.81[c]	-0.36	-0.08

[a] Significant at 1% level [b] Significant at 5% level [c] Significant at 10% level

Figure 2 represents the varying reaction of the equity market to the announcement of REIT-conversion of four publicly owned timber REITs (PCL, RYN, LFB and PCH) from C-corporations. The most dramatic change was showed by RYN. Just on the next day of the announcement, it earned an abnormal return of 12.3% and retained the trend till the last day of the 31-day event window when the average cumulative abnormal return reached 11.2%. On the other hand, PCL's performance in the equity market was exactly the opposite. On the next day of the event announcement, it earned a -3.6% average cumulative abnormal return. It showed the lowest average cumulative abnormal return of -16.6% on the 11th day after announcement and on the closing day of the window, the rate was -13.1%. The reaction of equity market to PCH's and LFB's REIT-conversion announcement was mild. When all these REITs were considered together as a group, the C_{NT} values were not significant in any of the event windows (Table 1). That is, the reaction of the equity market to the REIT-conversion was not drastic as a whole.

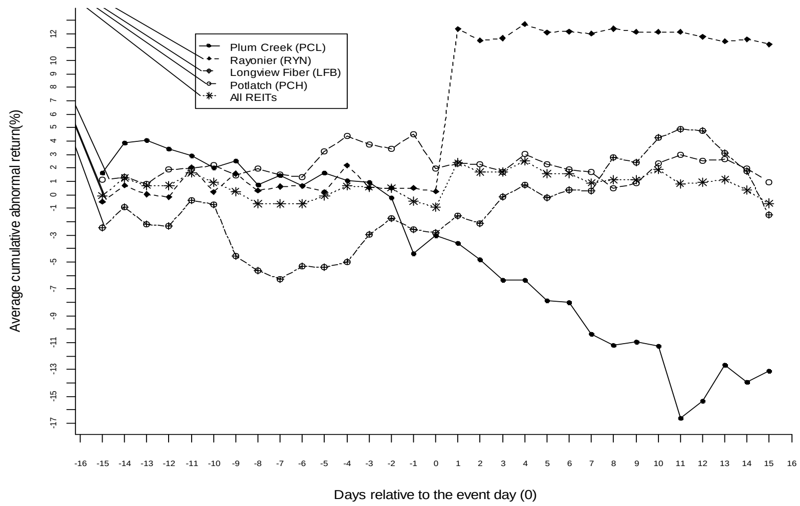

Figure 2. Cumulative abnormal returns up to a specific day over the 31-day event window obtained in OLS model for four timber REITs.

In timberland divestiture events, the buying firms' financial performance in the capital market was significantly improved. When all firms, involved in divestitures, were considered as a single group, they performed well only when longer event windows (25 days and 31 days) were chosen. In contrast, the REIT-group's financial performance was not significantly altered due to the declaration of change in their corporate structure. Thus, it turns out, as far as financial performance is concerned, timberland transaction is a better option compared to changing corporate structure to REIT.

4.2. Cross-sectional analysis

Out of the 33 firms involved in timberland divestitures, six were dropped of the study as these firms did not have firm level financial data available in COMPUSTAT database. As a result, cross sectional study analyzed the financial information for the remaining 27 firms. The mean of the variable ALL was 0.4231 meaning 42.31% of the firms sold all their timberland. Similarly, the variables $PARTY$, $TRAN$, $SIZE$, $TIME$ and ROA had the means 0.308, 0.8077, 1.01, 12.42 (years) and 11.96 respectively.

Table 2 represents the results of cross sectional study. Compared to other variables, ROA and $TRAN$ were found to contribute significantly in the variation of average cumulative abnormal return in a 3-day event window only. This suggests that, these two variables might not contribute in accumulating cumulative abnormal return to the firms when the event windows were larger than 3 days.

Table 2. Cross sectional regression of average cumulative abnormal return (C_{NT}) on different financial characteristics of all the firms by different event window

Variables	3-day C_{NT}		7-day C_{NT}		13-day C_{NT}		19-day C_{NT}		25-day C_{NT}		31-day C_{NT}	
	β_i	t-stat	β_i	t-stat	β_i	t-stat	β_i	t-stat	β_i	t-stat	β_i	t-stat
Intercept	-16.34	-2.09[c]	-15.98	-0.87	-15.86	-0.89	-21.53	-0.65	-7.05	-0.17	-16.19	-0.36
ALL	-0.76	-0.62	-1.05	-0.37	-0.90	-0.32	-0.90	-0.17	2.52	0.38	2.18	0.30
TIME	0.05	0.25	0.19	0.42	-0.19	-0.44	-0.19	-0.24	-1.39	-1.34	-1.26	-1.12
ROA	0.19	2.64[b]	0.16	0.95	0.25	1.56	0.42	1.41	0.38	1.00	0.45	1.09
SIZE	0.07	0.34	-0.11	-0.22	-0.05	-0.11	-0.03	-0.03	-0.11	-0.10	-0.15	-0.12
PARTY	1.88	1.33	0.88	0.27	0.69	0.22	0.82	0.14	1.95	0.26	2.76	0.33
TRAN	15.91	2.48[b]	13.49	0.90	18.32	1.26	23.48	0.87	23.09	0.67	31.57	0.84

[b] Significance at 5% level   [c] Significance at 10% level

4.3. Risk analysis

For risk analysis, we selected 25 firms. The screening process was based on the availability of daily stock return. Some of the firms were merged with other firms and they are no longer listed in the stock market. Therefore, the daily data of their stock return were not available. The results of risk analysis and their statistical significance are reported in Table 3. The standardized measure of systematic risk (β_i) were all significant except for Kimberly-Clark Corporation (1999-06-10) and U.S. Timberlands Company (1999-06-09). As a market portfolio contains all the risky assets, all the unique or unsystematic risks attributable to individual assets in the portfolio are diversified away. But systematic risks remain in the portfolio and change over time with the variation of macroeconomic variables that affect individual firms and industries. So the changes in the systematic risks in the forest product firms due to their timberland divestiture are quite reasonable.

Table 3. Comparison of risks of the firms before and after the divestiture events

Date	Firms	β_i				γ_i			
		50 days	100 days	150 days	200 days	50 days	100 days	150 days	200 days
1995-09-26	Fiber board Corporation	0.82[a]	0.75[a]	0.70[a]	0.78[a]	0.05	0.01	-0.02	-0.02
1995-11-28	Weyerhaeuser Company	0.73[a]	0.69[a]	0.85[a]	0.79[a]	-0.05	-0.05	-0.04	-0.03
1996-02-28	Hanson PLC	1.05[a]	1.09[a]	1.13[a]	1.21[a]	0.15	0.08	0.01	0.00

1996-03-06	IP Timberlands Ltd	0.73[a]	0.92[a]	0.90[a]	0.86[a]	-0.06	-0.03	-0.03	-0.03
1996-03-12	Hanson PLC	1.00[a]	1.13[a]	1.15[a]	1.21[a]	0.11	0.02	-0.02	-0.01
1996-07-23	Weyerhaeuser Company	0.86[a]	0.97[a]	0.74[a]	0.79[a]	0.00	0.02	-0.01	-0.01
1996-08-07	River wood International Corporation	1.06[a]	1.07[a]	1.15[a]	1.13[a]	0.01	-0.04	0.02	-0.01
1996-12-17	Kimberly-Clark Corporation	0.58[b]	0.73[a]	0.79[a]	0.82[a]	-0.01	0.00	-0.01	-0.01
1996-12-26	Georgia-Pacific Corporation	1.31[a]	1.09[a]	1.02[a]	1.02[a]	0.09	0.04	0.02	0.01
1997-02-18	James River Corporation	0.58[ba]	0.71[a]	0.72[a]	0.72[a]	0.07	0.04	0.01	0.00
1997-08-04	International Paper Company	0.85[a]	0.70[a]	0.74[a]	0.72[a]	-0.06	0.00	0.00	0.01
1997-09-15	Trillium Corporation	1.10[a]	1.12[a]	1.09[a]	1.18[a]	-0.04	-0.03	-0.01	0.00
1998-03-10	IP Timberlands Ltd	0.90[a]	0.77[a]	0.80[a]	0.72[a]	0.03	0.00	0.00	0.02
1999-01-06	Kimberly-Clark Corporation	0.67[a]	0.61[a]	0.64[a]	0.61[a]	-0.02	-0.05	-0.07	-0.07
1999-06-10	Kimberly-Clark Corporation	0.18	0.28[c]	0.43[a]	0.50[a]	0.10	0.08	0.07	0.09
1999-07-30	Smurfit-Stone Container Corporation	0.51[a]	0.28[c]	0.45[a]	0.38[a]	0.04	0.16[b]	0.11[c]	0.08
1999-10-13	Alliance *Forest* Products International	0.57[b]	0.49[a]	0.43[a]	0.47[a]	-0.01	0.08	0.18[a]	0.10
1999-11-01	Timber Company, Georgia-Pacific	0.56[b]	0.77[a]	0.93[a]	1.05[a]	-0.14	-0.05	-0.02	-0.04
2001-10-23	Bowater International	2.27[a]	2.11[a]	2.29[a]	2.06[a]	1.04[b]	0.92[a]	1.05[a]	0.96[a]
2003-12-15	Weyerhaeuser Company	0.70[a]	0.63[a]	0.66[a]	0.50[a]	0.13	0.28[c]	0.20[c]	0.23[b]
2006-04-04	International Paper Company	1.60[a]	1.34[a]	1.50[a]	1.37[a]	-0.03	-0.05	-0.08	-0.06
1986-09-04	Louisiana-Pacific Corporation	0.71[b]	0.59[a]	0.68[a]	0.71[a]	-0.12	-0.07	-0.11[b]	-0.13[a]
1995-11-28	Roseburg Forest Products Company	0.73[a]	0.69[a]	0.85[a]	0.79[a]	-0.05	-0.05	-0.04	-0.03
1996-02-28	Weyerhaeuser Company	0.83[a]	0.93[a]	0.87[a]	0.91[a]	-0.10	-0.05	-0.04	-0.04
1996-03-12	Willamette Industries	0.73[a]	0.86[a]	0.90[a]	0.83[a]	-0.08	-0.03	-0.04	-0.04
1996-07-23	U.S. *Timberlands*	0.86[a]	0.97[a]	0.74[a]	0.79[a]	0.00	0.02	-0.01	-0.01
1997-02-18	Hancock Timber Resource Group	0.58[a]	0.71[a]	0.72[a]	0.72[a]	0.07	0.04	0.01	0.00
1998-03-10	IP *Forest* Resources Company	0.90[a]	0.77[a]	0.80[a]	0.72[a]	0.03	0.00	0.00	0.02
1998-10-06	Plum Creek Timber Company LP	0.76[a]	0.77[a]	0.70[a]	0.73[a]	-0.23[c]	-0.22[a]	-0.23[a]	-0.17[a]
1998-11-02	McDonald Investment Company	0.73[a]	0.78[a]	0.73[a]	0.74[a]	0.03	-0.09	-0.14[a]	-0.11[b]
1998-11-16	Campbell Group International	0.50[a]	0.68[a]	0.64[a]	0.63[a]	0.24[c]	0.02	-0.06	-0.05
1999-06-09	U.S. Timberlands Company	0.23	0.29[c]	0.43[a]	0.51[a]	0.08	0.07	0.06	0.08
1999-06-10	Joshua Management LLC	1.42[a]	1.37[a]	1.35[a]	1.29[a]	-0.05	-0.04	-0.04	-0.05

[a] Significant at 1% level [b] Significant at 5% level [c] Significant at 10% level

For 50 days before and after the announcement of divestiture event, the standardized measure of systematic risk increased significantly for two firms and decreased for one firm. For 100 days before and after the risk increased significantly for three firms and declined for one firm. For 150 days before and after the divestiture announcement was made, systematic risk increased for three firms and decreased also for three firms. And finally, for 200 days before and after the risk increased for two firms and decreased for three firms. For all the windows, the systematic risk increased significantly for Bowater International (2001-10-23) and decreased for Plum Creek Timber Company LP (1998-10-16).

5. Conclusion

This study suggests that the capital market responded to timberland divestiture events with the improvement of buying firms' market value. The nature and extents of average cumulative abnormal return conform with Pesendorfer [17]; but contrast with Choi [16] and Mei and Sun [15]. The declaration of changing the corporate structure of forest products firms from C-corporations to REITs did not change the firms' financial performance in the equity market. Hence timberland divestiture might be a better financial decision than changing corporate structure into REITs. However, in the present study only four timber REITs were taken into consideration. So small a sample might not reflect the true financial conditions of the REITs. This may be further investigated when more timber REITs will enter in the market.

There might be more contributing reasons behind these abnormal gain or loss of the firms other than the divestiture and REIT-conversion announcements. Again, as the timberland had been sold, the control of uninterrupted supply of raw materials for the forest product firms shifted from their hand to the buyers. Thus the sellers were subject to face more risky situations while the buyer gained better ability to control input-output markets. Furthermore, the buying firms might have some better financial or managerial strategies that helped perform better. However, these questions were not addressed in this study. In cross-sectional analysis, only two variables namely ROA and $TRAN$ were found significantly affecting the cumulative abnormal returns of the firms in a 3-day event window. The risk analysis did not show a well defined trend as to how the systematic risk changed over time. Systematic risk constantly increased for only one firm and decrease also for only one firm over time in all post event windows.

There are so many factors that are believed to have leverage on equity market. Many of those factors were beyond the specification of this study. Thus a more detailed study could be suggested to investigate the cross-sectional factors that can influence equity returns. In this study, value added S&P 500 index was used as the proxy of the market portfolio which contains only the U.S. securities and bonds. This study could be carried out more correctly using Morgan Stanley World Equity Index or Brinson Partners Global Security Market Index that contain U.S. and international stocks & bonds. Overall, this study improves our understanding on how and to what extent the forest product firms' equity return could be affected due to announcements of industrial timberland divestitures or the conversation of forest products firms' structure from traditional C-corporations into REITs.

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Longleaf Pine Growth and Economics on Old-field Planted Sites in Georgia – Results through Age 21-years

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Longleaf Pine Growth and Economics on Old-field Planted Sites in Georgia – Results through Age 21-years

Abstract

Little is known or published concerning longleaf pine's growth rate, wood and pine straw yields, and profitability on old-field sites. The University of Georgia installed two study areas in December 1986 in old-field planted, unthinned longleaf stands in Screven and Tift County Georgia in 2003 to address the old-field longleaf pine growth and economics. Soil series were delineated and replicated plots with a control (no fertilizer) and two levels of fertilization were imposed at each site. This paper will focus on longleaf pine wood and pine straw yields, cash flows, and net present value (NPV) calculated at four, six, and eight percent discount rates from the unfertilized plots through age 21-years. Mean annual increment total wood yields were 221 and 203 ft^3/acre/year at the Screven and Tift County sites, respectively. Pine straw yields averaged 4236 and 3912 pounds/acre/year at the Screven and Tift County sites, respectively. Longleaf pine chip-n-saw and pulpwood and pine straw gross revenues were \$2432 and \$2283/acre for the Screven and Tift County sites, respectively. Longleaf pine chip-n-saw and pulpwood and pine straw NPVs were \$909 and \$847/acre at four percent, \$521 and \$571/acre at six percent and \$333 and \$276/acre at eight percent discount rate for the Screven and Tift County sites, respectively.

Keywords: longleaf pine, old-field, growth and yield, mean annual increment, pine straw, NPV

Introduction and Objectives

Over 200,000 acres of old-field sites in Georgia have been planted to longleaf pine since 1999. Little is known of the upper end of longleaf pine growth rate, wood and pine straw yields, and profitability on old-field sites. Most old-field sites have a large fertility reserve, essentially no competing hardwoods and good surface soil tilth. Accelerated growth rates for loblolly and slash pine have been noted in Georgia during first 10 to 20-years on these old-field sites. The main objectives of this study on old-field sites were to: (1) determine the growth rate on longleaf pine, (2) estimate pine straw yields, (3) discern the economics (gross revenues and NPVs), and (4) quantify the value of additional fertilization with a single or split application of nitrogen, phosphorus and potassium. The focus of this paper is to discuss old-field longleaf pine growth, wood and pine straw yields, and economics from the unfertilized plots. Fertilization (one-half + one-half dose or a single dose compared to no fertilization) benefits will be discussed in other papers.

Methods

We installed two study areas in December 1986 planted old-field longleaf stands located in Screven and Tift County, Georgia. The soil series were delineated by a Natural Resource Conservation Service soil mapper as Blanton (well drained, fine sand Grossarenic Paleudult) and Bonneau (well drained, loamy sand Arenic Paleudult) at the Screven County site and Albany (somewhat poorly drained, sandy Aquic Arenic Paleudult) and Leefield (somewhat poorly drained, loamy sand Arenic Plinthaquic Paleudult) at the Tift County site. A randomized complete block experimental design was used at both locations. There were 3 (Tift county) or 4 (Screven County site) replications of each treatment per study area. Gross treated (1/4 acre) plots were installed with a 1/10th acre internal permanent measurement plots (IPMP). There are 40 feet of untreated buffer between each plot. Treatments included: (a) control (no fertilization), (b) a full dose of NPK (DAP+urea+muriate of potash; 150 N, 50 elemental-P and 50 elemental-K lbs/ac), and (c) a split (half + half) dose of NPK (DAP+urea+muriate of potash) with the first application applied in mid-February 2004 (both full and half dose treatments). The second half dose of the split dose treatment was applied in February 2007 to the split dose plots. Each living tree in the IPMP was aluminum tree tagged, numbered, and measured for dbh, total height, height to base of live crown, and fork or broken top, and tree form, and defects noted in December 2003 for the Screven County site and February 2004 for the Tift County site). A single glyphosate herbicide with a surfactant, was used one-time in mid-summer 2004 on all study area plots to keep the stand clean for straw production. Baseline soil (0-6") and foliage samples were collected in December 2003 at the Screven county site and in February 2004 at the Tift county site. Planted longleaf volume equations from Baldwin and Saucier (1983); log total tree wood+bark volume = -2.552214 + 0.99928 log dbh^2 * total height where dbh is in inches, height in feet, and volume in cubic feet were used to estimate volume/acre and product class distribution on these old-field stands. Pine straw yields were estimated in each plot annually from four 4x4 feet angle iron grids. Litter layers from each grid were collected, bagged, field weighed, oven dried for 48 hrs at 60^o C, dry weighed and converted to dry weight per acre.

Results

In unfertilized plots through age 21-years, mean trees per acre were 303 at both the Screven and Tift County sites, approximately one-half of the original planting stocking level. Diameters (dbh) were 9.2 inches at the Screven County site and 8.8 inches at the Tift County site. Basal areas were 135 ft^2/ac and 126 ft^2/ac at the Screven and Tift County sites, respectively (Table 1). Wood (stemwood+bark) yields were 4644 ft^3/ac and 4261 ft^3/ac (146 and 134 tons per acre) at the Screven and Tift County sites, respectively. Mean annual increments through 21-years were 221 and 203 cubic feet per acre per year (6.6 and 6.1 tons per acre per year) at the Screven and Tift County sites, respectively (Table 2).

Pine straw yields (litter layer on a dry weight basis) were first estimated in 2004 at age 17-years and were 2960 lb/ac at the Screven County site and 3500 lb/ac at the Tift County site. Pine straw yields peaked in the 18th growing season at both sites yielding 5660 lb/ac at the Screven County site and 5220 lbs/ac at the Tift County site. Pine straw yield estimates from 2004 through 2008 averaged 4236 lb/ac/yr at the Screven County site and 3912 lb/ac/yr at the Tift County site (Table 3). Longleaf pine straw bale prices ranged from $0.60 to $1.00 per bale so we used an average price of $0.80 per bale (assuming one bale = 20 lbs dry weight) or $0.04 per pound for the study period. Pine straw income estimates from 2004 through 2008 were $847/ac at the Screven County site and $782/ac at the Tift County site.

Longleaf pine wood yields were broken into two product classes; pulpwood (PW; trees with a d.b.h of 4.6 through 8.5 inches plus 50 percent of the chip-n-saw volume due to tree defects) and chip-n-saw (CNS; 50 percent of the trees' volume where d.b.h. > 8.5 inches). Prices per ton used were $9.15 for PW and $15.50 CNS from Timber-Mart South (2009) for Georgia. Stumpage values at the Screven County site were $781 PW and $803 CNS per acre ($1584 per acre total). Tift County longleaf stumpage values were $777 in PW and $724 per acre in CNS ($1501 per acre total). Gross revenues of wood+straw were $2432/ac at the Screven County site and $2240/ac at the Tift County site (Table 4). Gross cash flows (wood+straw) through 21-

years were $116 per acre per year from the Screven County site and $109 per acre pear year from the Tift County site. Net present values (NPV's) were calculated using $135 per acre site preparation and planting costs as well as a $25 per acre herbicide cost incurred in 2004 prior to pine straw raking for both sites. NPV values per acre at the Screven County site were $909 @ four percent, $571 @ six percent, and $333 @ eight percent. Tift County NPV values per acre were $847 @ four percent, $521 @ six percent, and $306 @ eight percent (Table 4). These two longleaf old-field studies indicate that through 21-years attractive financial cash flows and NPV values can be achieved. We intend to follow these two study areas over the next six to ten years as a thinning is planned for 2010.

Table 1. Trees per acre, dbh, basal area and total height for December 1986 unthinned, old-field planted longleaf pine plots without fertilization in Screven and Tift Counties, Georgia through age 21-years and four year increment (age 17- through age 21-yrs) in parenthesis

Site – County	Trees per acre	Dbh (in)	Basal area (ft^2/ac)	Total height (ft)
Screven	303 (-7%)	9.2 (+0.9)	135 (+14)	60.1 (+10)
Tift	303 (-5%)	8.8 (+0.8)	126 (+12)	60.8 (+9)

Table 2. Total volume per acre (stemwood+bark), mean annual increment (MAI), pulpwood (PW; dbh <8.6") and chip-n-saw sized (CNS; dbh ≥ 8.6") tree volumes for December 1986 unthinned, old-field planted longleaf pine plots without fertilization in Screven and Tift Counties, Georgia through age 21-years

Site – County	Total volume (ft^3/ac)	MAI (ft^3/ac/yr)	PW (ft^3/ac)	CNS (ft^3/ac)
Screven	4643	221	1070	3485
Tift	4261	203	1216	2974

Table 3. Pine straw yields for December 1986 unthinned, old-field planted longleaf pine plots without fertilization in Screven and Tift Counties, Georgia from age 17- through age 21-years

Site-county	---------------------- age in years (lbs/ac) -------------------------------					Mean/yr
	17	18	19	20	21	
Screven	2960	5660	5000	3880	3760	4236
Tift	3500	5240	5220	3440	2160	3912

Table 4. Estimated costs, gross revenues, and net present values (NPVs) for December 1986 unthinned, old-field planted longleaf pine plots without fertilization in Screven and Tift Counties, Georgia through age 21-years

Site	$ cost/acre[a]	Gross revenue[b] (wood+ straw) $/acre	NPV @ 4% $/acre	NPV @ 6% $/acre	NPV @ 8% $/acre
Screven	-147.34 @ 4%	2432	909	571	333
Tift	-143.76 @ 6%	2283	847	521	276
	-141.26 @ 8%				

[a]Cost per acre = 1986 planting cost (Dubois et al. 2003) of $0.054/seedling @ 605 trees/acre = $31.70, seedling cost @ $40/M and 30% over-run for culls x .605 = $40.90, site prep = $20 chisel plow, 1st and 2nd year Oust spraying = $42.40 = $135 + discounted herbicide treatment in 2004 @ $25 = $12.34 @ 4%, $8.76 @ 6% and $6.26 @ 8%

[b]Gross revenues @ $9.15/ton PW, $15.50/ton CNS, and $0.04/lb for pine straw (litter layer)

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Southern Forest Economics Workers

2010 Annual Meeting

Wednesday, March 17, 2010

8:30 PM – 10:00 PM

Session G: Bioenergy II

Manuscripts:

Woody biomass policies and location decisions of the bioenergy industry in the southern United States - Z. Guo and D. Hodges

Woody Biomass Policies and Location Decisions of the Bioenergy Industry

in the Southern United States

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Abstract

Woody biomass for bioenergy production has been included in a few renewable energy policies since the 1970s. Recently, several states have implemented a variety of new woody biomass policies to spur the establishment of new bioenergy industry. The strength of policy incentives or the competitiveness for new projects differs among the states. This study employs a conditional logit model (CLM) to explore the effects of woody biomass policies on the siting decisions of new bioenergy projects. In addition, significant state attributes influencing the births of new bioenergy firms such as resource availability and business tax climate are identified. The results may have substantial implications regarding woody biomass policies and the creation of a new bioenergy industry.

Keywords: CLM, policy incentives, resource availability, state attributes

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Woody Biomass Policies and Location Decisions of the Bioenergy Industry in the Southern United States

Introduction

Woody biomass for bioenergy production has been included in a few renewable energy policies since the 1970s. Recently, several states have implemented a variety of new woody biomass policies to spur the establishment of new bioenergy industry. Woody biomass policies can be categorized as tax incentives, subsidies and grants, financing and contracting, regulations, and education and consultation supports (Becker and Lee 2008). These statutes cover many aspects of project planning such as market demand, capital appropriation, and legal environment. All these factors are important for business investment.

The number and category of regulations and programs vary by state. This distinction suggests that the strength of policy incentives or the competitiveness for new projects differs by state, based on the assumption that a positive relationship exists between the strength of policy incentives and the number of new plants established. Yet, the significance of the state woody biomass policies in new bioenergy plant location decisions remains unstudied.

In the past 20 years, several researchers have investigated how governmental policies influence firm location behaviors, especially the impacts of environmental regulations on siting decisions (Jaffe et al. 1995; Levinson 1996; List and Co 2000). The results of the studies, however, were inconsistent. Some reveal no effects or a negative influence; others a positive relationship (Jeppesen and Folmer 2001). The explanations for these results also varied. More importantly, very few location studies investigated the forest products industry.

A few studies explored the siting decision of wood products industry and the paper and allied products industry (Duffy 1994; Levinson 1996; Sun and Zhang 2001). Significant state factors identified included market conditions, unionization, resource endowment, and tax system. The time-series cross-section model results of Sun and Zhang (2001) indicated that environmental stringency may have a negative impact on new plant locations in the long-run, while other studies revealed no effects on the location choice of forest product firms. Nonetheless, none of these papers included the new bioenergy industry using woody biomass.

This study attempted to examine the impacts of governmental policies including woody biomass incentives as well as environmental regulations on the siting decision of bioenergy plants. Other state attributes influencing the location of new bioenergy firms were also identified. Since the southern states hold one-third of forest inventory and nearly one-half of the timber removals in the United States, forest biomass utilization for bioenergy will be more feasible and imperative in the South. So this study investigated the effects in the 13 southern states[9], but the results may be meaningful for the whole nation.

Method and Data

The conditional logit model (CLM) was used in this study to investigate the location choices of the new bioenergy industry using woody biomass in the southern United States. The establishment data, the number of new plants built after the implementation of woody biomass policies, were employed as the measure of investment activities for the CLM.

CLM for the number of new plants

Developed by McFadden (1974), the CLM is one of the major frameworks widely used for plant location decision analysis (Carlton 1983; List and Co 2000; Sun and Zhang 2001). Following previous work (Bartik 1988; Levison 1996; Sun and Zhang 2001), this study assumed that each firm screens locations based on a latent profit function that is dependent on a variety of state attributes where it plans to locate. Firms will select a state if its expected profits exceed those of all other states. The profit function can be written as:

$$\pi_{ij} = \beta' X_j + \mu_{ij} \qquad (1)$$

where π_{ij} is the expected profits of firm i if locating the new plant in state j, X_j is a vector of observable characteristics of state j, β is a vector of estimated coefficients, and μ_{ij} are the random disturbance term. Assuming that the disturbance terms are independently and identically distributed (iid) and following a Weibull distribution, the probability of a new bioenergy plant i locating in state j will be:

$$P_{ij} = \frac{e^{\beta' x_{ij}}}{\sum_{k=1}^{K} e^{\beta' x_{ik}}} \qquad (2)$$

where k indexes the state, K is the total number of southern states, and the parameter β is estimated using the maximum likelihood method with the log-likelihood function given by:

$$L(\beta) = \prod_{j=1}^{K} p_{ij} \ . \qquad (3)$$

The assumption that the disturbance terms μ_{ij} in equation (1) are iid is quite strong. This assumption imposes the so-called “Independence of Irrelevant Alternatives” (IIA) restriction on the predicted probabilities (Greene 1993). This may be problematic since it is probable that a firm’s location decision in a state is affected by the attributes of neighboring states. Rather than

[9] Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

using regional dummy variables to correct this problem, which is more appropriate for the analysis of whole nations (Levinson 1996; List and Co 2000), this study applies the IIA test proposed by Hausman and Mcfadden (1984). In case of failure of this assumption, a sequential logit model can be employed.

Variables and Data

The dependent variable was the number of new biorefinery facilities and electricity generating plants using woody biomass that had been established in the southern states since 1970. The biorefinery project data were mainly obtained from the BioSAT website (http://www.biosat.net/). It summarizes the information of all the biorefinary plants using biomass in the United States and some other countries. The electricity plant data were obtained from the Energy Information Administration website. For each observation, one was assigned to the chosen state and zero to all other 12 states.

The independent variables were generally split into two components: policy attributes and other observable state characteristics. The policy attributes considered in this study include governmental incentives (*POLI*) through various woody biomass policies and the stringency of environmental regulations (*ENVI*). Since the federal policies and programs are generally considered as providing the same incentives across the southern states, they will not affect the location decision of new firms and, therefore, are excluded from this analysis. To quantify the strength of state government supports, a state woody biomass policy index (Table 1) was created by scoring each statute and weighting different categories of incentives based on their importance to new plant investors.

Table 1: Woody biomass policy scores and ranking of the southern states

State	Score	Ranking
Alabama	7.8	7
Arkansas	4.0	11
Florida	23.2	2
Georgia	13.6	6
Kentucky	16.0	4
Louisiana	4.0	11
Mississippi	5.8	9
North Carolina	33.7	1

Oklahoma	6.2	8
South Carolina	15.2	5
Tennessee	5.6	10
Texas	20.2	3
Virginia	4.0	11

Studies have suggested that bioenergy production may cause water evaporation loss or consume a large amount of water, as well as result in a potentially large pollution load on aquatic systems (Frings et al. 1992; Giampietro et al. 1997; Berndes 2002). Water and waste pollution originating from some bioenergy plants have also been reported. Therefore, it is possible that environmental regulations will influence the establishment of a new bioenergy facility. So this study also included the environmental stringency as an explanatory variable. The industry-adjusted index of state environmental compliance costs created by Levinson (2001) was used as an indicator of environmental regulatory stringency. It controlled for states' industrial compositions at the level of two-digit SIC codes, eliminating the bias that high compliance costs are associated with the number of polluting industries rather than a state's regulations.

Other state attributes that may affect new plants' location decisions are those typically used in previous work such as resource endowment, market size and accessibility, and business taxes (Table 2). With regard to market size and accessibility, the median family income (*M_INC*), was included as a proxy to reflect state market conditions. Resources mainly involve biomass availability and price. Biomass resources are especially important for new bioenergy plants. Facilities are generally located close to resources to minimize transportation costs. Therefore, forest inventory and analysis data were used to represent the abundance of woody biomass resources (*INVEN*) in each state. In addition, the delivered price of pine or hardwood pulpwood (*PULP*) was used to indicate competition from the existing timber industry and the woody biomass costs. The choice of delivered prices depends on the majority of species in an individual state. For example, hardwood is the dominant forest type in Tennessee. It will also be more likely used for bioenergy production. Therefore, hardwood rather than pine pulpwood price will be more closely represent timber market conditions.

Table 2. Independent variable definition and data sources

Variable	Definition	Source
POLI	Woody biomass policy index	Created based on Becker and Lee (2008)
ENVI	Index of state environmental compliance costs	Levinson (2001)
TAX_CL	Business tax climate index	Tax Foundation
INVEN	Forest inventory (thousand green tons)	U.S. Forest Service
PULP	Pulpwood delivered price ($/ton)	Timber-Mart South, KY Division of Forestry
M_INC	Median family income ($)	U.S. Census Bureau

Evidence from previous research suggests that business taxes are significant state characteristics that affect investment activities (Sun and Zhang 2001; Guimaraes et al 2004). To account for the effects of business taxes, the state business tax climate index (SBTCI) was used as an explanatory variable for the analysis. It consists of five components: the corporate tax index, property tax index, sales tax index, unemployment tax index and individual income tax index. The SBTCI fully represents the competitiveness of each state's tax system. Higher scores mean more favorable tax systems for new business and therefore this variable is expected to have a positive sign for the coefficient.

Empirical Results

Based on the chi-square test of the log-likelihood ratio, the regression was significant at the 5% level. This indicated that the model fits the data well. The results of the CLM were presented in Table 3. Five of the six independent variables in the model had the expected sign. One coefficient was significant at the 5% level and one at the 1% level. Both the forest inventory and state business tax climate index had significant positive effects on bioenergy plants' location choices. The coefficients of environmental regulation stringency and wage rate had negative signs but were not statistically significant. The woody biomass policy index had an insignificant positive effect on new plant locations. The coefficient of pulpwood price had a positive sign, which contradicts *a priori* expectations. However, this variable showed no significant effects on siting decisions of new bioenergy plants.

Table 3. Empirical results of the conditional logit model.

Variable	Coefficient	t-ratio
POLI	0.0371391	1.28
ENVI	-1.027391	-1.14
INVT	0.0011500**	2.27
PULP	0.0361319	0.41
M_INC	-0.0000404	-1.22
TAX_CL	0.9650795***	3.00
Log likelihood	–123.37838	
Chi-squared	14.87	
No. of observations	663	

NOTE: *** = Significant at 1% level, ** = Significant at 5% level.

Discussion

This study attempted to assess the effects of state attributes, especially the state woody biomass policy incentives, on the siting decisions of new bioenergy plants. According to previous research, the establishment-level data rather than the aggregate data (e.g. net investment or employment growth in bioenergy industry) were more appropriate in investigating the location choices of new plants (Levinson 1996). Therefore, the number of new bioenergy plants was employed as the measure of investment activities for the CLM. The parameter *POLI* had a positive sign as expected. However, no evidence from the CLM supported the assumption that the policy index significantly impacted the location choices of new bioenergy plants using woody biomass. Nonetheless, this cannot be simply interpreted as state governmental policies being ineffective on forest biomass plants. The possible reasons for this result may lie with the small number of observations in the model.

The number of new plants built after the enactment of state governmental regulations and programs was critical for this analysis. However, most woody biomass policies were implemented after 2000. Though a few state policies were implemented as early as the 1970s, they were not specific to woody biomass utilization. Only a small number of bioenergy plants using woody biomass were established in recent years. The plants analyzed in this study included the biorefinery facilities built in recent years and the electricity generating plants initially built after 1970, including power plants operated by the wood processing industry. Still, the number of observations in the model is not sufficiently large. Also, the location choices of power plants whose primary purpose was wood product or others instead of electricity generation would not be greatly influenced by woody biomass policies. Hence, the impacts of governmental incentives and supports on plant location choices were difficult to observe.

Levinson's (2001) industry-adjusted index of state environmental compliance costs was employed to represent the environmental regulatory stringency of each state. The results suggested that it had insignificant negative impacts on the siting decisions of new bioenergy plants, which was consistent with previous research (Levinson 1996; Sun and Zhang 2001).

Tax was identified as a significant attribute influencing plants' location choices. Instead of using per capita property tax as proxy for the effects of business taxes, the state business tax climate index (SBTCI) was employed for the analysis. It consists of five components and fully represents the competitiveness of each state's tax system. This state attribute had highly significant positive effects on the siting decision of new bioenergy plants.

Results indicated that forest inventory had significant positive impacts on the location choices of new bioenergy plants. It was consistent with the finding of Sun and Zhang (2001) who suggested that forest inventory positively affects location decisions. Duffy (1994) had a contrary result that commercial forest holdings had no effect on the growth of the lumber and paper industry. However, forest inventory rather than commercial forest holdings is a more appropriate measure of resource availability for this study, because the forest biomass used by bioenergy plants is mostly small diameter wood or solid wood waste and not large commercial timber. The total forest inventory reflects the general availability of woody biomass resource such as logging residues and wood wastes. The other explanation for the contradictory results could be the difference in transportation costs of large and small wood materials. Due to the bulky nature and high moisture content of small diameter wood, the procurement costs are substantially higher than that for traditional forest products (Sun and Zhang 2001; Guo et al 2007). Therefore, bioenergy industry should be located even closer to forests than other wood product industries to minimize raw material costs. Thus, the location of new bioenergy plants should be more resource-oriented than other wood industries, and it is reasonable that forest inventory impacts siting decisions significantly.

The other attribute indicating state resource endowment, the delivered price of pulpwood, exhibited no effect on the location choices of bioenergy plants. This was consistent with the results of the CLM by Sun and Zhang (2001). One possible explanation could be that the effect was captured by forest inventory and woody biomass policy incentives. Data suggest that the delivered price of pulpwood was negatively correlated with forest inventory and governmental incentives. Since the multicollinearity problem is not severe with this variable, it was kept in the model.

Conclusion

This study explores the effects of state attributes on siting decisions of bioenergy plants in the southern US. Results indicate that resource endowment and tax system are significant state characteristics influencing location choices of the bioenergy industry. This industry may be more resource–oriented than other forest product industries due to the nature of the small diameter wood used. This has important implications for state woody biomass policy. Currently some regulations and programs have addressed the procurement costs of forest biomass. Though the CLM results suggested that state government incentives did not have significant effects on the state screening of new plants, conclusions cannot be simply drawn that policy incentives do not effectively spur woody biomass utilization. It may be a matter of time for business investors to respond to state government supports.

The significance of the tax system on location choice also proves this point. A better business tax climate attracts more bioenergy plants. States such as North Carolina, Kentucky, Georgia, Florida, and Texas provide strong tax incentives on woody biomass utilization. These polices will be favorable for investments in new bioenergy plants. Therefore, in spite of the insignificant coefficient of policy incentives, this study provides essential implications regarding woody biomass policies.

This study first used the CLM to explore the effects of woody biomass policies and other state attributes on the location decisions of bioenergy plants. The limitations of this analysis are mainly within the data. Future studies with a larger number of bioenergy facilities as explained variable will give more meaningful results. Also, appropriate proxies for market condition and labor force are still needed to capture their effects on the siting decisions of new bioenergy industry.

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Southern Forest Economics Workers

2010 Annual Meeting

Wednesday, March 17, 2010

8:30 PM – 10:00 PM

Session H: Efficiency and Competition

Manuscripts:

International comparative efficiency in wood and fiber utilization
- J. Buogiorno and H. Kando

International efficiency in wood and fiber utilization

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International efficiency in wood and fiber utilization

Abstract

The efficiency of industrial roundwood utilization increased in most OECD countries from 1961 to 2005. There was also a strong decrease in the amount of wood pulp used for a given level of paper and paperboard production. The main determinant of the differences in efficiency of wood utilization between countries was the forest area per capita. The wood pulp price and population density were the main variables explaining the differences in wood pulp utilization.

Keywords: Forest industries, efficiency, technical change, international.

Introduction

The objective of this study was to define a measure of utilization efficiency, and to use it to compare the efficiency of the transformation of industrial roundwood and wood pulp into products between countries and over time. Then, we investigated some of the determinants of utilization efficiency.

Measures of Efficiency

The efficiency of industrial roundwood utilization, E_{it}^{R}, in a particular country, *i*, and year, *t*, relative to a reference region and period was defined as:

$$E_{it}^{R} = \frac{IRC_{it}}{\hat{IRC}_{it}} \qquad (1)$$

where IRC_{it} was the industrial roundwood consumed in country *i* and a year *t*, and $\hat{IRC}_{it}$ was the industrial roundwood that would have been consumed in the same country and year to produce the same amount of sawnwood, panels, and wood pulp with a reference technology. The reference technology was that of the average OECD country from 1961 to 2005, described below.

The efficiency ratio (1) allowed efficiency comparisons between years in a country, between countries in a particular year, and between different countries and years. An analog index measured the efficiency of wood pulp utilization.

Reference technologies

The reference technologies were based on data from OECD countries from 1961 to 2005. The data from different years and countries were pooled in a single "panel data" set.

The following regression equations represented the relationship between output and input:

$$IRC_{it} = \alpha SWP_{it} + \beta PULP_{it} + u_{it} \qquad i=1,\ldots,N;\ t=1,\ldots,T \qquad (2)$$

$$PULC_{it} = \gamma N_{it} + \delta W_{it} + \mu O_{it} + u_{it} \qquad (3)$$

where in equation (2) *IRC* (m^3y^{-1}) is industrial roundwood consumption, *SWP* (m^3y^{-1}) is solid wood production, including sawnwood and wood-based panels (veneer and plywood, particleboard, and fiberboard). *PULP* (ty^{-1}) is wood pulp production (mechanical, chemical, and semi-chemical). *N* is the number of countries, and *T* is the number of years in the sample. α and β are parameters, and *u* is an error term.

In equation (3) *PULC* is wood pulp consumption, and *N*, *W*, and *O* are the production of newsprint, printing and writing paper, and other paper and paperboard, all measured in metric ton per year. γ, δ, and μ are parameters.

The input-output (I-O) coefficients of OECD countries from 1961 to 2005 obtained from the regression models (2) and (3) are in Table 1. On average, the production of 1 m^3 of sawnwood and panels required about 1.65 m^3 of industrial roundwood, and the production of 1t of wood pulp required 2.67 m^3 of industrial roundwood. An average of 1.06 t of wood pulp was used per ton of newsprint, and 1.03 t of wood pulp per ton of printing and writing paper. Less than 0.4 t of wood pulp was consumed on average to produce 1t of other paper and paperboard. Thus, compared to newsprint and printing and writing paper, other paper and paperboard production used more non-wood fibers or recycled paper.

Table 1 Input-output coefficients estimated from panel data from OECD countries from 1961 to 2005.

Input	Output	Coefficient	Units
Industrial roundwood	Sawnwood & panels	α = 1.65(0.06)[1]	m^3m^{-3}
	Pulp	β = 2.67(0.17)	m^3t^{-1}
Wood Pulp	Newsprint	γ = 1.06(0.09)	tt^{-1}
	Printing & writing paper	δ = 1.03(0.06)	tt^{-1}
	Other paper and paperboard	μ = 0.31(0.03)	tt^{-1}

[1]Standard error in parentheses

Efficiency levels, and trends

To compare the efficiency level in different OECD countries we computed the average efficiency within each country from 1961 to 2005, $\overline{E}_i$, and ranked the countries accordingly. $\overline{E}_i$ higher than 1 meant that a country had been less efficient than the average OECD country from 1961 to 2005. The trend in efficiency within each country was estimated with a linear regression of E_{it} over time.

Table 2 shows the time-average efficiency of industrial roundwood utilization, $\overline{E}_i$, and the average annual change in efficiency, b_i in Equation (4), for selected countries, from 1961 to 2005. Japan and Switzerland had been the most efficient users of industrial roundwood (Table 2).

For their level of output they both used 25 percent less industrial roundwood than the average OECD country would have used during that period. But, while the efficiency in Japan had not changed significantly from 1961 to 2005, it had improved at 0.7 percent per year in Switzerland.

Australia and Canada had been the least efficient. From 1961 to 2005 Australia used 32 percent more industrial roundwood than the average OECD country, for the same level of output. Canada used 25 percent more (Table 2). Canada's efficiency had improved at 1 percent per year over the period, while Australia's had not changed significantly. For the OECD as a whole, the efficiency of industrial roundwood utilization had improved at about 0.4 percent per year. Although it was statistically highly significant this seems to be a small improvement in practice.

Figure 1 shows specific country data in more detail with the three-year moving average of the efficiency ratio from 1961 to 2005. Sweden's index indicated similar efficiency as in the United States, with little change throughout the period, while the efficiency of Switzerland and the United Kingdom improved substantially (Figure 1).

For wood pulp, the utilization efficiency from 1961 to 2005 was highest in the Netherlands, followed by Denmark (Table 3). The Netherlands used 36 percent less wood pulp, and Denmark used 30 percent less than the average OECD country through the same period to produce the same amount of paper and paperboard.

Table 2 Average level and annual change in industrial roundwood utilization efficiency in selected countries from 1961 to 2005.

Country, i	Average, $\bar{E}_i$	Annual change, b_i
Australia	1.32(0.04)**	-0.01(0.01)
Canada	1.25(0.02)**	-0.010(0.001)**
Sweden	1.16(0.02)**	0.001(0.002)
Mexico	1.15(0.02)**	-0.006(0.001)**
Finland	1.14(0.01)**	-0.002(0.001)**
Portugal	1.13(0.02)**	-0.007(0.004)
United States	1.11(0.01)**	-0.003(0.002)
…	…	…
Austria	0.82(0.01)**	-0.005(0.001)**

Germany	0.78(0.03)**	-0.010(0.002)**
Greece	0.78(0.03)**	-0.009(0.003)**
Turkey	0.77(0.03)**	-0.01(0.01)
Switzerland	0.75(0.02)**	-0.007(0.002)**
Japan	0.75(0.01)**	0.003(0.002)

Numbers in parentheses are standard errors. *,** indicate an average significantly different from 1, or an annual change significantly different from 0 at the 0.05 or 0.01 significance level, respectively.

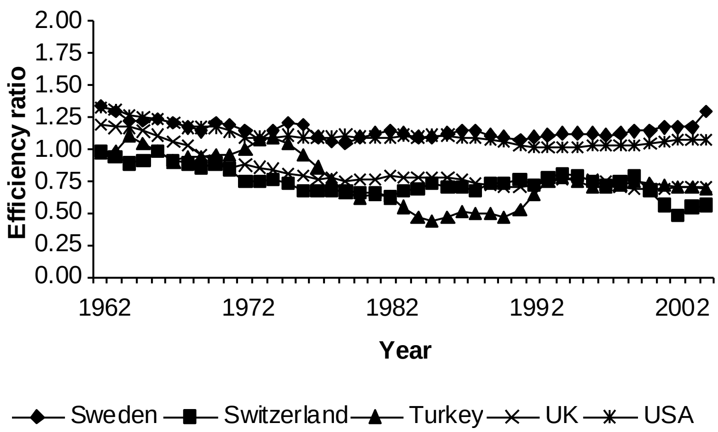

Figure 1. Trends in industrial rounwood utilization efficiency in selected countries.

At the other extreme Sweden and New Zealand both used 49 percent more wood pulp than the average OECD country to produce a given amount of output. The systematically negative annual change (Table 3) shows that wood pulp utilization efficiency had improved in all the countries from 1961 to 2005. And in most countries (the exceptions were New Zealand and Portugal), the improvement was statistically significant.

Table 3 Average level and annual change in wood pulp utilization efficiency in selected countries from 1961 to 2005.

Country, *i*	Average, $\bar{E}_i$	Annual change, b_i
Sweden	1.49(0.03)**	-0.016(0.002)**

New Zealand	1.49(0.02)**	-0.005(0.003)
United States	1.44(0.02)**	-0.011(0.001)**
Poland	1.38(0.03)**	-0.02(0.01)**
Portugal	1.24(0.05)**	-0.006(0.004)
Australia	1.23(0.05)**	-0.021(0.002)**
…	…	…
Germany	0.84(0.04)**	-0.018(0.002)**
Mexico	0.77(0.04)**	-0.015(0.003)**
Switzerland	0.77(0.03)**	-0.013(0.001)**
Denmark	0.70(0.04)**	-0.02(0.01)**
Netherlands	0.64(0.02)**	-0.012(0.002)**

Figure 2 shows the efficiency indices in selected countries as three year moving averages from 1961 to 2005 The efficiencies of the United States and Switzerland had changed almost in parallel from 1961 to 2005 (Figure 1e), wood pulp utilization being much higher in the United States. By the end of this period, the United Kingdom's efficiency had almost converged with that of Switzerland.

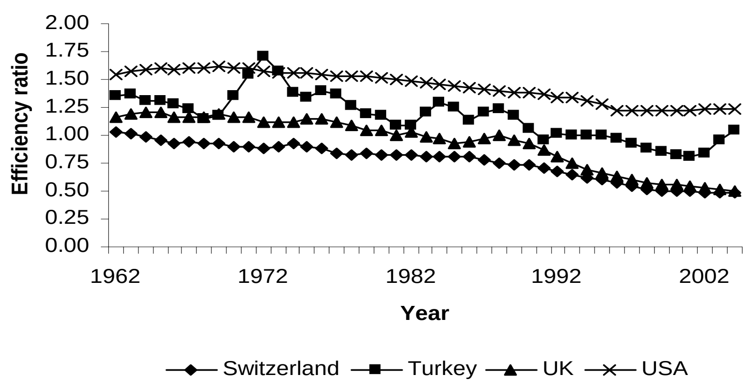

Figure 2. Trends in wood pulp utilization efficiency in selected countries.

Determinants of efficiency

Table 4 shows the results of hypotheses tests concerning the causes of technical efficiency. For industrial roundwood the average efficiency in each country from 1961 to 2005 was regressed on forest area per capita, GDP per capita, industrial roundwood price, and industrial roundwood production per capita during the same period. The four explanatory variables accounted for 55 percent of the variation in utilization efficiency between countries. Wood utilization efficiency was lower in countries that had more forest area per capita and higher production of industrial roundwood per capita. It was higher in countries with high GDP per capita and higher industrial roundwood price. However, only the forest area per capita had a statistically significant effect.

For wood pulp, the average efficiency from 1961 to 2005 was regressed on forest area per capita, GDP per capita, wood pulp price, population density, and urbanization. The five explanatory variables accounted for 48 percent of the variation in utilization efficiency. Four of the five variables had coefficients of the expected sign. The exception was the positive coefficient of GDP per capita, but it was not significantly different from zero. Utilization efficiency was significantly higher in countries of high wood pulp price and high population density.

Table 4 Effect of selected variables on the utilization efficiency of industrial roundwood and wood pulp in OECD countries.

Input	Explanatory variables	Coefficients
Industrial roundwood	Forest area per capita	0.04(0.01)**
	GDP per capita	-0.006(0.003)
	Industrial roundwood price	-0.10(0.61)
	Industrial roundwood production per capita	0.01(0.01)
	R^2	0.55
Wood pulp	Forest area per capita	0.003(0.016)
	GDP per capita	0.003(0.006)
	Wood pulp price	-1.77(0.64)*
	Population density	-0.0009(0.0003)**
	Urbanization	-0.005(0.004)
	R^2	0.48

Numbers in parentheses are heteroskedastic-robust standard errors.

*,**: coefficients significantly different from zero at 0.05 and 0.01 significance level.

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2010 Annual Meeting

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Session I: Hunting and Wildlife Recreation

Manuscripts:

Benefits to forest industry from hunting club cooperatives
- M. Measells et al.

Benefits to Forest Industry from Hunting Club Cooperatives

by

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Benefits to Forest Industry from Hunting Club Cooperatives

Abstract:

Forest industry, including Real Estate Investment Trusts (REITs) and Timber Investment Management Organizations (TIMOs), typically lease hunting access on sizable portions of their landholdings to various groups (e.g., hunting clubs). Studies have shown both market and non-market values and benefits associated with these leases but there are also negative issues such as inter-club disputes or incompatible hunting practices among club members. However, for companies involved in this activity, monetary incentives and stewardship gained from leases usually outweigh these negatives. In some cases, hunting club cooperatives (HCC) have been employed to ease facilitation of hunting lease programs, wildlife management, and habitat management. These cooperatives can improve management for white-tailed deer, the most often pursued game animal in North America, via quality deer management (QDM) principles. HCCs are relatively new, especially in the southern United States, and appear to provide additional benefits to both the forest industry landowners and hunting clubs. With more hunters and hunting clubs wanting to implement QDM, HCCs, with state agency tie-ins, have the potential to assist in reaching the program's goals. A recent survey of Mississippi hunting clubs leasing Weyerhaeuser Company land indicated that willingness-to-pay increased when a cooperative implementing QDM practices was established. Hunters currently enrolled in a cooperative indicated they would pay $1.42 more per acre while those not enrolled in a cooperative were willing to pay $1.13 more per acre over their current lease price if they were enrolled in such a cooperative. Such HCCs have the potential to improve lease prices, provide greater deer management opportunities, and increase customer satisfaction.

Key words: benefits, cooperatives, forest industry, hunting clubs, hunting leases, willingness-to-pay

Background:

Numerous studies have examined hunting leases on nonindustrial private forest (NIPF) lands (e.g., Benson 2001, Hussain et al. 2004, Mozumder et al. 2007) but fewer have focused directly on forest industry leases (Marsinko et al. 1999, Morrison et al. 2001, Guynn and Marsinko 2003, Cook 2007) while even fewer have discussed hunting cooperatives (Guynn et al. 1983, Messmer et al. 1998, Yarrow et al. 1989, Enck et al 2003). While the cooperative framework has been around many years, it has not been widely used, and therefore, not widely studied. This paper will describe previous studies and also detail a case study of a current hunting club cooperative (HCC) in Mississippi.

A number of studies show the increasing amount of industrial lands being leased for hunting. Forest industry, including Real Estate Investment Trusts (REITs) and Timber Investment Management Organizations (TIMOs), typically lease hunting privileges on sizable portions of their forest landholdings to hunting clubs (Capozzi and Dawson 2001, Morrison et al. 2001), which occupy approximately 40 million acres in the southern U.S. (Wear and Greis 2002). A 1999 study by Capozzi and Dawson (2001) reported that forest industry companies in New York had 75% of their lands in recreational leases. Morrison et al. (2001) reported the amount of industry land leased to hunting clubs and individuals was 76.6% compared to 64.5% in 1994 while during this time period there was a 42% increase in lease values per hectare, from $6.82 to $9.69.

Many benefits were observed by landowners, including forest industry, when leasing land for hunting privileges. Such investments in hunting leases provided for consistent supplemental annual revenues to landowners, improved access control, land protection and in-kind labor assistance, increased property values, an increased feeling of stewardship, while also creating public relations opportunities with sportspersons (Marsinko et al. 1999, Yarrow 1999, Morrison et al. 2001). Yarrow (1999) additionally stated that hunters benefit with increased quality and availability of hunting opportunities and an increased standard of hunter behavior (i.e., less trespassing and land abuse problems). Along with these benefits, negative issues also arise. Yarrow (1999) stated that disadvantages of leases included liability issues, resentment by local hunters (especially if the leases go to non-residents), cost of habitat and administrative management, lack of financial incentives, and lack of technical and educational support to facilitate leasing. Problems reported by Morrison et al. (2001) included road damage, trash dumping, illegal hunting, and legal over-harvest of game animals but these issues had the potential to be resolved by implementing a leasing program. Cordell et al. (1999) forecasted that game quality, scenery, improved facilities, control of human impacts, habitat improvements, and other related services would be more heavily demanded in the future. Mozumder et al. (2007) indicated that amount of private lands available for recreational leasing may continue to decline into the future. This indicates that forest industry may play a larger role in filling the lease market niche.

One way to improve white-tailed deer (*Odocoileus virginianus*) herds and buck quality is use of Quality Deer Management (QDM) principles which involve habitat, hunter, and herd management (including protection of younger bucks and adequate doe harvest) and monitoring (Collier and Krementz 2006, Edwards and Miller 2008, Miller 2010, Quality Deer Management Association 2010). Bull and Peyton (2001) found that 55% of Michigan survey respondents supported management techniques that produced an older age structure among bucks and 59% of those who supported antler restrictions were interested in seeing and/or harvesting bucks with larger antlers. In Mississippi and South Carolina (Woods et al. 1996) and New York (Enck et al. 2003), hunter satisfaction increased on areas managed using QDM principles. Although QDM may increase hunter satisfaction and provide economic incentives to landowners to implement such a program, QDM is more effectively applied on a land base larger than a typical lease holding (Miller 2010). Also, because most leaseholders operate independently, there is limited ability to effectively manage deer herds within a given area. In Mississippi, the typical lease size is smaller than 1,000 acres (Table 1). Therefore, formation of HCCs, where adjoining hunting clubs collectively manage the deer herd thus increasing effective area of management, may also increase QDM program success and increase stakeholder interaction. Hunting quality (a current focus of hunters and many state wildlife agencies) and revenue from hunting may be enhanced through HCCs and adherence to QDM principles.

Because hunters have clearly shown a willingness to pay higher lease rates to maintain access to quality hunting land (Fried et al. 1995, Green et al. 2004, Hussain et al. 2004), there may be opportunities for landowners to charge higher lease prices by providing higher quality hunting experiences. For example, Huggins et al. (2005) found hunters in Oklahoma bid higher on lands where they had previous hunting experience and knew the quality of bucks. Hussain et al. (2004) determined that Alabama hunters were willing to pay $1.29/acre/hunter, an increase of $0.77/acre/hunter over what respondents currently paid for their leases. Huggins et al. (2005) determined there was no economic loss for implementing moderate buck harvest limits on leases in Oklahoma. By decreasing the buck harvest limit from 12 to 3, the mean bid was only 15% lower for the 3 buck harvest area compared to the 12 buck harvest area (Huggins et al. 2005). Huggins et al. (2005) also noted that the highest bids were received from groups with prior experience on the property noting they had observed deer patterns and buck quality. Willingness-to-pay for the New York hunting club respondents increased by more than 70% for those with incomes in excess of $50,000 and those more avid hunters (measured by annual expenditures and days afield at camp) also increased willingness-to-pay (Green et al. 2004). Income and avidity were positively correlated to a respondent's willingness-to-pay (Fried et al. 1995, Green et al. 2004). Cook (2007) found that quality deer availability had no influence on observed lease prices, but also stated that data used for his analysis may be the limiting factor causing that outcome. Mozumder et al. (2007) stated that hunters were willing to pay higher lease prices for access to private lands due to the hunting quality found on public lands.

Table 1: Example hunting lease acreages and prices from various forest industries in Mississippi during the 2009-2010 hunting season.

Acreage	Lease Price ($)	Price/Acre ($)
52.90	489.33	9.25
180.24	1,892.52	10.50
308.46	3,692.33	11.97
619.37	7,432.36	12.00
678.55	7,124.78	10.50

Proper education and management advice from state wildlife agencies could also be key in HCC and QDM implementation. Benson (2001) found that 96% of wildlife agencies believed hunting access to private lands was vital to their organization's objectives. Benson (2001) also recognized that more cooperation, landowner empowerment, technical support, educational assistance, and funding were goals that landowners and state wildlife agencies must achieve to impact proper wildlife and habitat management and recreationists behavior on private lands. Yarrow (1999) also concluded that state wildlife agencies must develop stronger programs working with landowners leasing lands to protect and enhance wildlife habitat and develop assistance programs supporting landowners leasing lands. This indicated that greater cooperation between wildlife agencies and landowners was needed. Supporting this assessment, Collier and Krementz (2006) indicated that only 19% of Arkansas hunting camps have worked with Arkansas Game and Fish Commission (AGFC) biologists and this was more prevalent on camps leasing lands from forest industry. Most respondents (56%) suggested that direct contact and/or recommendations from AGFC biologists would be most beneficial for their camp followed by management assistance programs (49%), population estimation (47%), and habitat development programs (43%) (Collier and Krementz 2006).

Studies regarding lease cooperatives were few with most not addressing industrial landholdings. However, cooperatives allow for landowners, hunters, and wildlife management agencies to reap many benefits while negating many disadvantages associated with hunting leases. Messmer et al. (1998) studied participants in Utah's Cooperative Wildlife Management Units (CWMUs) which provided public access to private lands that had previously been closed to the public. Hunters enjoyed the CWMUs because there were fewer hunters, chances of harvesting animals increased, and a better quality hunt was available to them (Messmer et al. 1998). Many landowners participated in the CWMUs to help control trespassing, property damage, and vandalism. Messmer et al. (1998) concluded that cooperative programs could help balance landowner concerns, hunter interest in wildlife, and the biological needs of wildlife. Guynn et al. (1983) indicated that management of deer harvests in Mississippi must occur across private lands due to the nature of this State's landownership. Guynn et al. (1983) discussed the Mississippi Cooperative Deer Management Program (MCDMP) which was initiated in 1977 by the Mississippi Department of Wildlife Conservation (now Mississippi Department of Wildlife, Fisheries, and Parks). Program goals included actively involving the sportsmen in the management process, reduce deer densities, and increase quality of deer harvested (Guynn et al. 1983). With increased education, hunter attitudes towards harvesting antlerless deer changed and led to a cooperative management agreement among numerous clubs in the area (Guynn et al.

1983). Yarrow et al. (1989) described three landowner demonstration cooperatives in northeast Mississippi consisting of 62 landowners. Landowners were informed how to organize cooperatives, provided management recommendations, and provided technical management and marketing assistance to use the existing natural resources in increase their profits. Yarrow et al. (1989) also listed several advantages of forming cooperatives including a larger land base for management, increased recreational opportunities for sportspersons, increased awareness of wildlife values on NIPF lands, and increased investments in wildlife and forest management activities. Disadvantages included difficulty among groups to agree on management objectives and efforts required to coordinate the cooperative activities. These programs demonstrated the effectiveness for managing deer on private lands and have led to improved deer herds.

Case Study:

In an effort to verify willingness-to-pay and improved public relations garnered from hunting club leases implementing QDM techniques, Weyerhaeuser Company (hereafter, Company) established an HCC program during the fall of 2004. It consisted of six hunting clubs covering 11,500 contiguous acres, imbedded within 60,000 acres of Company lands, in Kemper County, Mississippi with the purpose of implementing QDM on a large landscape. This was a collaborative endeavor between the six hunting clubs, the Company, and Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP). Weyerhaeuser Company and MDWFP were interested in continuing this effort, potentially expanding it to other Company lands, and perhaps to other landowner groups and/or hunting clubs. To understand marketability of this concept, the Company cooperated with MDWFP and researchers from Mississippi State University to develop survey instruments for both HCC and non-HCC club members. Prior to survey implementation, we pilot-tested both surveys with three hunters to ensure the instruments would deliver the desired information and results. Our formal survey process (Dillman 2000) consisted of mailing the survey in June 2009, one week later sending a thank you/reminder postcard, and four weeks after mailing the initial survey, mailing a second survey. The survey was mailed to all members (n = 132) of the six HCC hunting clubs. Additionally, we randomly selected 750 hunters from a database of all hunters leasing Company lands in Mississippi. We also offered an incentive (randomly drawn participant from each survey group received a gift card of nominal value) to increase response rates.

The HCC group had a response rate of 56.6% (n=64) while the non-HCC group response rate was 34.2% (n=206). Overall, HCC respondents were more positive towards the Company in general (63.5%) than before starting the HCC program (52.4%). As for the cooperation and guidance given to the clubs, HCC respondents ranked the Company more positively (69.8%) than the general respondents (48.5%). Most (78.7%) HCC responders indicated they were satisfied with their current situation and 69.8% felt they were achieving an acceptable return for their club investment into the cooperative. Willingness-to-pay was also greater for the HCC group compared to the general respondents with the HCC respondents willing to pay $1.42 compared to $1.13 more per acre, respectively, over their current lease rates for the hunting club cooperatives. A summary of these results were also presented to hunters in the HCC in Scooba, Mississippi and they were, in general, favorably received by those in attendance.

Conclusions:

Previous research and the Weyerhaeuser Company case study have demonstrated that hunting leases have many benefits not only for the landowner but also for hunters, hunting clubs, and wildlife agencies involved. Forming a HCC could potentially lead to higher annual revenues being produced from lease fees charged to hunting clubs. Perceptions towards forest industry and the wildlife agencies could be enhanced by forming the cooperative and having more interactions with hunting clubs. Also, by having multiple clubs covering larger acreages in agreement with management programs, improvements to the quality of the deer herd is more feasible, resulting in a true win-win situation for all involved.

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Session J: Forest Landowners

Manuscripts:

Exploring nonindustrial private forest ownership objective categories, willingness to harvest timber, and interest in non-timber uses – P. Koonnathamdee

Understanding family forest landowner preferences for receiving advice on managing their forestland: Using national woodland owner survey data for the 13 southern states – B.R. Kaetzel et al.

Exploring NIPF Ownership Objective Categories, Willingness to Harvest Timber, and Interest in Non-Timber Uses

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Exploring NIPF Ownership Objective Categories, Willingness to Harvest Timber, and Interest in Non-Timber Uses

Abstract:

Fragmentation and parcelization of forestland represent two of the more significant issues for Sustainable Forest Management (SFM) in the United States. Resolving the problems resulting from these issues requires information about forest owners. This study illustrates a simultaneous-equation model to estimate interactions among ownership objective categories and planned behavior. This study categorized multiple ownership objectives including dimensions of non-timber benefits, monetary, farm or home site values, and bequest. Factors influencing those categories then were estimated and discussed. The study also estimates factors influencing willingness to harvest in the future and interest in managing for non-timber uses. The empirical results reveal that forest landowners are not homogenous and possess multiple ownership objectives. The interaction among ownership objective categories and planned behavior reveal that implementing incentives and revising U.S. forest policy with SFM objectives should be considered in order to remedy the current forest problems.

Keyword: Nonindustrial private forest owner, Sustainable Forest Management, Objective Categories, Willingness to Harvest, Non-Timber Uses

Introduction

Fragmentation and parcelization of forestland represent two the more significant issues for Sustainable Forest Management (SFM) in the United States. According to DeCoster (2000), "about 3 million acres are being split into pieces smaller than 100 acres every two years… around 2.4 million acres of forestland are also being converted to developed land every two years." While fragmentation results from both natural disturbances and human activity (DeCoster, 2000), parcelization is due primarily to forest landowner decisions (McEvoy, 2004). In addition, recreation use, residential development, and other objectives have become increasingly important to nonindustrial private forest (NIPF) owners. Because the external environment for forestry and forest landowners' behavior are continuously changing, existing forest policies must be adjusted constantly. SFM policies that balance the economic, social, and environmental dimensions of management can be one solution to address these problems. In order to implement the appropriate policies and to effectively deliver essential information regarding forest management to NIPF owners, we must better understand their reasons for owning forests, attitudes, and behavior.

Few studies had been focused on landowner attitudes, beliefs, and motivations prior to 1990 (Bliss and Martin, 1989). Conversely, NIPF landowner behavior has been studied extensively since 1990, particularly with regard to how they make decisions (Newman, 2002; Amacher et al., 2003; Conway et al., 2003). Without incorporating existing knowledge of landowner behavior and objectives, harvesting and reforestation policies are incomplete, because landowners might be interested in factors such as recreation and bequests (Conway et al., 2003). In addition, "behavior is driven by a much richer set of values and preferences" (Becker, 1993); self-interest or material gain may not be the only objective. In fact, landowners do not possess a single objective. Therefore, understanding landowner objectives and behavior requires a multiple objective framework. However, much of the existing NIPF literature either assumes that all landowners behave similarly, uses a representative agent model[12], or does not differentiate decisions by ownership types. Kuuluvainen et al. (1996), Kurttila et al. (2001), Janota and Broussard (2008) and Majumdar et al. (2008) are some of the exceptions.

The objectives of this paper are to explore NIPF landowner reasons for owning forests and to test for the existence of differing NIPF ownership categories. The study estimated models that address all of the important, and related, NIPF landowner objectives and future decisions. In other words, the study provides information on heterogeneous forest landowner objective categories and the link between each ownership type and behavior. The second objective is to estimate how forest owner objectives influence actual behavior. This objective provides some insight into the current problems of fragmentation and parcelization, which are projected to reduce future timber supplies. Specifically, examining the effects of different categories of

[12] A representative agent model is employed generally in economics assuming all agents' preference and behavior are similar.

ownership objectives on making decision may offer opportunities to mitigate the extent of fragmentation and parcelization.

Empirical Model

This analysis follows conventional economic assumptions including the assumptions of Becker (1993) that individuals (NIPF owners) maximize welfare as they envision it. Their behavior is forward-looking that is grounded in the past, and assumed to be consistent over time. In addition, forest owners try to anticipate the uncertain consequences of their actions. With these assumptions, ownership objective categories, which may be seen as beliefs, values, or preferences, not only directly affect decisions, but also affect other attitudes. Decisions and attitudes also influence forest owner objectives as feedback or rational expectation. We also apply Ajzen (1991), the theory of planned behavior, to our analysis. Because the willingness to harvest timber in the future and interest in managing for non- timber uses in fact are intention, they affect actual behavior directly. Based on these assumptions, we hypothesize interaction among ownership objective categories, intention, and behavior.

Ownership objective categories as used in this study were derived from 16 reasons for owning forests stated in question 6 of the questionnaire. Each objective category was based on the forest owner utility maximization, including benefits from tangible and intangible values[13]. Each category contained different weights of 16 ownership reasons therefore it follows the multiple objectives scheme. This concept differs from those in previous studies that assumed only one objective for holding a forest, mostly timber production.

Based on the discussed assumptions, our empirical model was comprised of three related models. First, a multinomial logit or polytomous logistic regression model was used to estimate the probability of differences in forest ownership categories or types. Second, a probit model was utilized to estimate the probability of landowners planning future timber harvests. Finally, a linear regression model estimated by ordinary least squares (OLS) is employed to estimate landowner interest in managing for non-timber objectives. The models are discussed below.

NIPF ownership objective categories

Previous studies of NIPF owner ownership objectives suggest that landowners should not be treated as one homogenous group (Kurttila et al., 2001; Majumdar et al., 2008; Kaetzel, 2008). Landowners may differ with regard to ownership motivations, views on stewardship, and forest management behavior. These differences can be logically related to various landowner groups. Majumdar et al. (2008) characterized NIPF owners in Alabama, Georgia, and South Carolina. Based on multivariate cluster analysis, forest owners are described as belonging to one

[13] Considering each reason for owning forests as goods and services from the forest, the owner receives many dimensions of benefits and utility from it. Although each NIPF owner has several bundles containing goods and services from his forest, with theory of consumer behavior he can compare and pick the best bundle with highest utility. Therefore, a forest owner can compare and rank all possible reasons for holding a forest.

of three groups; those with timber, non-timber, or multiple objectives. Using the concept of strategic management, Kurttila et al. (2001) categorized NIPF owners' forestry business units into four business groups: Stars, Cash Cows, Wildcats, and Dogs[14]. The authors estimated these strategic choices using multinomial logit model with forest owner and forest holding characteristics as explanatory variables. Kaetzel (2008) employed principal component analysis to group NIPF owners of the Tennessee Northern Cumberland Plateau. The author categorized forest owners into four groups, heritage, privacy, utility, and undecided. Based on these results, the multinomial logit model was employed to estimate the probability of the type of motivation for owning woodland, using selected independent variables of owners' information, attitudes, and behavior.

The model was based on the principle that a rational forest owner makes decisions to hold forest to maximize the utility gained from that choice. The forest landowner type equation was specified as a predicted probability:

$$\Pr(y_i = m | x_i) = \frac{\exp(\mathbf{x}_i \boldsymbol{\beta}_m)}{1 + \sum_{j=2}^{J} \exp(\mathbf{x}_i \boldsymbol{\beta}_j)}. \quad (1)$$

$\Pr(y_i = m | x_i)$ represents the probability of observing outcome m given $\mathbf{x}$, where y is the dependent variable with J nominal outcomes, $\mathbf{x}$ represents a vector of independent variables influencing landowner objective categories, and $\boldsymbol{\beta}$ is a vector of parameters. The maximum likelihood method was used to estimate the model requiring asymptotic properties in order to produce efficient estimators (Long, 1997). The probability of landowner objective types can be derived as a function of land characteristics, and landowner information including demographic characteristics, perception, and behavior.

Willingness to harvest timber in the future

The willingness to harvest model was developed to estimate the importance of the objective types to expected behavior. The major research question for this model, then, is how ownership objective categories affect the willingness to harvest timber in the future.

Several relevant studies have been conducted on harvesting decisions and behavior, which are reviewed by Beach et al. (2005) and Cubbage et al. (2003). Many of the estimated models are discrete choice models of previous harvesting decisions or harvested acreage models with linear regression. The willingness to harvest timber in the future is another NIPF owner decision now requiring increased attention due to increasing forest fragmentation and parcelization. Hoyt (2008) estimated a future harvest model using logistic regression and

[14] These groups are related to forest strategies matrix; strengths, weaknesses, opportunities, and threats. Based on strengths, Stars are the forest businesses containing opportunities while Cash cows are the businesses containing threats. Based on weaknesses, Wildcats are the businesses with opportunities while Dogs are the businesses with threats.

concluded that NIPF owners are more likely to harvest timber if they (1) had harvested timber in the past, (2) had timber production as primary ownership objective, (3) had received forest management advice, (4) and were interested in improving forest health.

This study utilized a probit model of future harvest planning using maximum likelihood method. The estimated model results in the probability of willingness to harvest timber in the future and factors influencing it. The dependent variable was the respondents reported intention to harvest or not harvest timber in the future, while the independent variables were forest ownership categories; land characteristics; demographic characteristics; and owner's perception, attitudes, and previous harvesting[15].

Level of landowner's interest in managing for non-timber uses

This model was constructed with the hypothesis that ownership objective categories affect landowner interest in managing for non-timber uses. Previous studies of landowner management interest in non-timber activities include Conway et al. (2003), Arbuckle et al. (2009) and Poudyal and Hodges (2009). These studies employed linear regression using OLS to observe factors influencing landowner interest in non-timber activities such wildlife management (Poudyal and Hodges, 2009), recreation, and agroforestry (Arbuckle et al., 2009). Conway et al. (2003) reported that size of tract and absenteeism are very important predictors of non-timber activities, while Arbuckle et al. (2009) found that environmental or recreational motivations for land ownership and contacts with natural resource professionals are positively associated with interest in agroforestry. Poudyal and Hodges (2009) substantiated the latter work. They found that receiving professional forest management advice increases the chance of forest landowners considering wildlife and avian habitat in their management decisions.

This study employed OLS, the most frequently used regression method, to assess the importance of the factors influencing landowner interest in non-timber uses. This model differs from the landowner objectives with non-timber benefits in the first model because this model examined forest owner behavior, rather than simply objectives. The dependent variable was the expressed level of landowner interest in various forms of non-timber management. The independent variables examined were forest ownership categories; land characteristics; demographic characteristics; use of government incentives; and owner's perception and attitudes.

Data collection and survey

Data were obtained using a 2007 mail survey of approximately 2,000 NIPF landowners. The survey covered the 16-county Cumberland Plateau region of Tennessee[16]. This region, a

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[15] Hoyt (2008) found that "NIPF landowners who actually have sold timber in the past were 2.7 times more likely to harvest timber in the future."

[16] The study area can be separated into the North Plateau containing, Campbell, Cumberland, Fentress, Morgan Overton, Pickett, Putnam, and Scott Counties and the South Plateau containing Bledsoe, Franklin, Grundy, Marion, Sequatchie, Van Buren, Warren and White Counties.

part of the world's longest hardwood forested plateau, has been pressured by the increased demand for recreational use and residential development. Landowner names were randomly selected from county property tax records. A pretest was conducted on a random sample of Cumberland Plateau NIPF landowners prior to finalizing the questionnaire. The revised survey included two follow-up contacts with non-respondents, following Dillman (2000) Tailored Design Method. Approximately 250 names were eliminated from the sample population because the individual no longer owned forestland in the region, had died, or the tax records contained an incorrect address. The total number of respondents to the survey was 689, with a final response rate of 39%. The survey process and its detail is discussed in Hoyt (2008).

Variables used in this study were comprised of choice, binary, and continuous variables. The descriptive statistics are presented in Table 1.

Table 1. Descriptive statistics

Name	Mean	Standard deviation	Min	Max	Description
Dependent variable					
pref	2.502	1.145	1	4	Preference: 1 = non-timber benefits; 2 = monetary values; 3 = farm and home site values; 4 = bequest benefits
harp	0.463	0.499	0	1	Past timber harvesting: 1 = harvest; 0 = no harvest
harf	0.375	0.484	0	1	Planning to harvest in the future: 1 = plan to harvest; 0 = plan to no harvest
int_ntu	0	1	-2.612	1.135	Level of landowner interest for managing non-timber uses (obtained by regression factor scores)
Independent variable					
small	0.526	0.500	0	1	Small ownership: 1 = landowner has 50 acres or less; 0 = otherwise
medium	0.231	0.422	0	1	Medium ownership: 1= landowner has 51-100 acres; 0 = otherwise
large	0.243	0.429	0	1	Large ownership: 1 = landowner has more than 100 acres; 0 = otherwise
pur	0.714	0.452	0	1	Acquisition of the majority of forest land: 1 = purchased it; 0 = otherwise
inh	0.211	0.408	0	1	Acquisition of the majority of forest land: 1 = inherited it; 0 = otherwise

tenure	40.484	38.532	1	215	Number of years the landowner's family owned the land
tenures	3121.464	6023.779	1	46225	Square of tenure
multiple	0.256	0.437	0	1	Multiple tracts: 1 = if landowner owns more than one tract in the area; 0 = otherwise
f1	0	1	-3.031	2.038	Forest owner preference toward non-timber benefits (obtained by regression factor score)
f2	0	1	-2.836	3.013	Forest owner preference toward monetary values (obtained by regression factor score)
f3	0	1	-2.309	2.957	Forest owner preference toward farm and home site values (obtained by regression factor score)
f4	0	1	-2.325	2.770	Forest owner preference toward bequest benefits (obtained by regression factor score)
inhf	0.761	0.427	0	1	Plan to do with forestland: 1 = inheritance for heirs; 0 = otherwise
devf	0.063	0.243	0	1	Plan to do with forestland: 1 = develop it; 0 = otherwise
sellf	0.193	0.395	0	1	Plan to do with forestland: 1 = sell it for profit; 0 = otherwise
res	0.523	0.500	0	1	Residency: 1 = primary residence on forestland; 0 = absentee
conv	0.101	0.302	0	1	Forestland conversion: 1 = converted forestland; 0 = no conversion
perc	0	1	-2.304	1.344	Perception of the current level of land clearing and timber harvesting on the Plateau (obtained by regression factor score)
advice	0.233	0.423	0	1	Forest management advice: 1 = yes 0 = no
parti	0.075	0.263	0	1	Participation in government cost-share assistance programs: 1 = yes; 0 = no
loss	0.477	0.500	0	1	Pine tree loss during Southern Pine Beetle epidemic: 1 = yes; 0 = no
enh	0	1	-2.850	2.165	Forest enhancement attitude for selling timber (obtained by regression factor score)
mny	0	1	-2.925	3.556	Monetary attitude for selling timber (obtained by regression factor score)

nti	0.214	0.410	0	1	Derivation non-timber income: 1 = derived non-timber income; 0 = no non-timber income from the forestland
finnt	0	1	-1.679	1.457	Financial incentives in managing for non-timber uses (obtained by regression factor score)
retired	0.327	0.469	0	1	Working status: 1 = retired; 0 = otherwise
age	61.910	12.335	24	96	Age of landowner
ages	3984.734	1530.248	576	9216	Square of age
male	0.751	0.433	0	1	Gender: 1 = male; 0 = female
married	0.770	0.421	0	1	Marital status: 1 = married; 0 = otherwise
college	0.435	0.496	0	1	Education: 1 = college graduate or some college or Vo-tech training; 0 = otherwise
highed	0.211	0.408	0	1	Education: 1 = some graduate school and graduate degree; 0 = otherwise
lowinc	0.163	0.369	0	1	Level of income: 1 = landowner gross annual income less than 25 K; 0 = otherwise
highinc	0.299	0.458	0	1	Level of income: 1 = landowner gross annual income greater than 75 K; 0 = otherwise

Note: Number of observations = 683

Estimation Method

This study required a set of reduced form equations or the simultaneous equation model:

$$pref = f\begin{pmatrix} small, medium, pur, inh, tenure, tenures, \\ perc, male, married, highed, highinc, \\ harf, int\_ntu \end{pmatrix} \quad (2)$$

$$harf = f\begin{pmatrix} harp, f1, f2, f3, f4, small, medium, tenure, sellf, \\ res, conv, perc, advise, parti, loss, enh, mny, age, \\ married, college, highed, lowinc, highinc \end{pmatrix} \quad (3)$$

$$int\_ntu = f\begin{pmatrix} finnt, nti, small, medium, pur, inh, tenure, tenures, \\ res, perc, advise, enh, mny, age, college, highed, \\ lowinc, highinc, f1, f2, f3, f4 \end{pmatrix} \quad (4)$$

Equation (2) included two endogenous variables, *harf*, and *int_ntu*, that can be explained by other sets of independent variables. Unlike the single equation model, in the simultaneous equation models we could not estimate the parameters of Equation (2) without taking into account information provided by other equations[17] (Cameron and Trivedi, 2005; Maddala, 1983). Maddala (1983) suggests a technique for estimating a simultaneous equation system with discrete dependent variables, while Cameron and Trivedi (2005) offer a technique for estimating a simultaneous equation system with an endogeniety problem with a system containing a continuous dependent variable.

The estimation procedure in this study entailed first, estimating Equation (2) using the multinomial logit model. The estimated results were the base case. We next estimated Equation (3) via the probit model and obtain predicted probability, *h1*. Third, we estimated Equation (4) using OLS. We then calculated the residual from the estimated Equation (4). Finally, we re-estimated Equation (2) by using the multinomial logit model, replacing predicted probability from Equation (3) *h1* to *harf* variables, and adding a variable called *eint*, representing the residual of estimating Equation (4) as an endogeniety correction variable. Therefore, Equation (5) is the efficient equation without endogenous regressor problem. Based on the correction method stated in Maddala (1983) and Cameron and Trivedi (2005), the estimates from this equation were consistent. The specification of the new equation was,

$$pref \quad = f\begin{pmatrix} small, medium, pur, inh, tenure, tenures, \\ perc, male, married, highed, highinc, \\ h1, int\_ntu, eint \end{pmatrix}. \tag{5}$$

The study estimated Equations (3)-(5) separately by the methods described.

Empirical results and Discussion

Factors affecting NIPF ownership objective categories

Based on the category of non-timber benefits, most independent variables (i.e., landowner characteristics, decision to harvest in the future, and forest owner interest factors) were related to NIPF ownership objective categories except for *inh* and *highinc*. This confirms our hypothesis regarding the interaction among ownership objective categories, intention, and behavior that was not discussed in previous studies. This implies that forest landowners have different objective categories. The predicted probabilities for forest landowner type groupings were 0.142 for non-timber benefits, 0.255 for monetary, 0.327 for farm or home site, and 0.276 for bequest. The partial change or marginal effect of the multinomial logit models are presented in Table 2. For example, if a forest landowner owns less than 50 acres, the probability of

[17] An endogenous regressor is usually correlated with the error term of the equation in which it appears as an explanatory variable resulting in inconsistent estimators. This problem, which is also called endogeniety, violates the law of large numbers and the estimated parameters do not converge to their true population values.

favoring non-timber benefits is 0.127 lower than a landowner with more than 50 acres. This is consistent with Conway et al. (2003) that “landowners with larger tracts engage in more non-market activities, perhaps because there are greater resource activities.” In contrast, if an individual owns less than 50 acres, the probability of favoring bequest is 0.125 greater than those owning more than 50 acres. Each additional 10 years of holding the land in the family increased the probability of being a bequest category landowner by 0.004, while it decreased the probability of being a non-timber benefits category landowner by 0.004.

Table 1. Marginal effects of the multinomial logit model

Variable	Non-timber benefits		Monetary		Farm or home site		Bequest	
	dy/dx	S. E.	dy/dx	S. E.	dy/dx	S. E.	dy/dx	S. E.
small^{D}	-0.127***	0.048	-0.087	0.056	0.088	0.065	0.125*	0.064
med.^{D}	-0.072*	0.037	-0.172***	0.046	-0.020	0.075	0.265***	0.082
pur^{D}	0.143***	0.049	0.139*	0.082	0.176**	0.070	-0.458***	0.085
inh^{D}	0.098	0.111	-0.098	0.096	-0.147*	0.088	0.147	0.093
tenure	-0.004***	0.001	-0.004**	0.002	0.004**	0.002	0.004***	0.002
tenures	0.000***	0.000	0.000	0.000	0.000*	0.000	0.000*	0.000
perc	-0.008	0.020	0.053**	0.025	0.055**	0.026	-0.100***	0.025
male^{D}	-0.060	0.038	-0.011	0.051	0.095*	0.055	-0.024	0.057
married^{D}	0.070**	0.030	0.108**	0.043	-0.013	0.059	-0.165***	0.059
highed^{D}	0.119*	0.059	-0.024	0.060	-0.198***	0.060	0.102	0.071
highinc^{D}	0.041	0.035	-0.058	0.053	-0.067	0.056	0.084	0.059
int_ntu	0.279***	0.035	-0.055	0.037	-0.208***	0.038	-0.016	0.039
h1	-0.839***	0.103	1.057***	0.098	0.067	0.118	-0.285**	0.111
eint	-0.279***	0.044	0.068	0.052	0.231***	0.056	-0.020	0.059
Predicted Probability		0.142		0.255		0.327		0.276

(^{D}) dy/dx is for discrete change of dummy variable from 0 to 1. Note: ***Significant at 1%, **5%, and **10% level of significance.

The results illustrate that small and medium tract sizes increased the probability of being forest landowners with bequest objectives, for example, while they decreased the probability for the non-timber benefits and monetary returns objectives. If forest landowners purchased the land, they were more likely to possess all objective categories, but not bequest. Landowners with a history of holding forestland in the family were less likely to favor non-timber benefits, but more likely to inherit. Landowner perception of the current level of land clearing and timber harvesting decreased the probability of favoring bequest values. Married forest landowners were more likely to favor non-timber benefits and monetary objectives. Forest landowners with high education were more likely to favor non-timber benefits and bequest. Interest in managing for non-timber uses naturally is highly correlated with the non-timber benefits objective, and less likely to favor farm or home site values. Forest landowners who had expressed a willingness to harvest in the future were more likely to favor monetary objectives, but less likely to favor non-timber benefits.

Willingness to harvest timber in the future

The estimated results reveal that objective categories, particularly non-timber benefits and monetary returns, were significant factors related to future timber harvest plans. If the owner has non-timber objectives, they were less likely to harvest timber, and the opposite was true for monetary returns. A standard deviation change in non-timber benefits category centered around the mean decreased the probability of willingness to harvest timber in the future by 0.123, while a standard deviation change in monetary returns increased the probability by 0.166, holding all other variables constant. Prior timber harvesting decisions were positively related to the willingness to harvest timber in the future. Therefore, if a forest owner had previous harvesting experience, his/her willingness to harvest timber in the future was 0.168 greater than a forest owner who had no experience, ceteris paribus.

The significant factors with increasing probability of willingness to harvest timber in the future were forest owners who had received professional forest management advice (0.155), wanted to sell timber with forest enhancement motivation (0.106), and were highly educated (0.139). Significant factors with decreasing probability of willingness to harvest timber in the future were forest owners who planned to sell their forest in the future (0.110), lost pine trees in the recent Southern Pine Beetle epidemic in Tennessee (0.123), and were elderly (0.004).

Ownership objective categories for holding forest were related to the willingness for future harvests in different ways, especially for landowners who favor non-timber benefits. Forest landowners with non-timber benefits were less likely to harvest timber in the future, while forest landowners with forest enhancement motivation were more likely to harvest. Forest owners will not harvest timber in the future because they obtain non-timber benefits with the forested land, however they will sell timber with forest enhancement motivation, but not for monetary motivation[18].

[18] This point is totally different in the developing countries where forests belong to the public entities. In addition, non-government organizations and governmental bodies are more likely to define forests as the collection of trees. Logging banned is an example of forest protection however this is a failure policy in many countries due to increasing illegal logging and lack of enforcement.

Level of landowner interest for managing non-timber uses

The final landowner decision evaluated was the level of interest in managing for non-timber uses. We hypothesized that ownership objective categories for owning forest are related to landowner interest. The results confirm this hypothesis. Ten variables were statistically significant either at the 0.01, 0.05, or 0.1 levels of significance. The financial incentive factor and non-timber objective were the most two important factors for landowner interest in managing non-timber uses with coefficients of 0.392 and 0.357. Education variables, *college* and *highed*, were significantly and positively related to landowner interest (0.120 and 0.185 respectively). Perception of the current level of land clearing and timber harvesting, forest enhancement motivation for selling timber, and age of landowner variables were positively related to landowner interest (0.1, 0.157, and 0.006 respectively). Only two statistically significant variables were negatively related to landowner interest: landowners who had received forest management advice and landowner who derived non-timber income.

Discussion

Based on the results of the ownership objective category model, larger tract sizes were more likely to increase the probability of favoring non-timber benefits and monetary returns. Therefore, if the trend of fragmentation and parcelization of the forests does not diminish, ownership objective categories are likely to shift to more farm or home sites and bequest values types. Decreasing the number of forest owners interested in monetary returns could reduce future timber supply, while decreasing the number forest owners with non-timber benefits would pose a significant barrier to attempts to focus more efforts on sustainable forest management.

The results could be a starting point for rethinking U.S. forest policy as it relates to fragmentation and parcelization and to promoting SFM. Because of the divergence of objectives for holding forests, policy makers face a wide range of alternative policies to affect all types of NIPF owners. Clearly, developing policies specific to the range of objectives is unwarranted as well as infeasible, but the information can provide insights into how government incentives can affect some ownership objective types. If the objectives of the new policy are to resolve fragmentation and parcelization and support SFM policy, a mix of financial incentives, education, and regulations may be needed. Regardless of the appropriate balance of incentives and restrictions, the results provide some evidence of how different landowner types may respond.

Our results reveal that receiving forest management advice (*advice*) was not only related to an increased willingness to harvest timber in the future, but also to a decreased landowner interest in managing for non-timber uses. This suggests that existing advice and information has been heavily focused on timber production. Therefore, more emphasis is needed on non-timber assistance if the changing landowner population, as well as the general public, is to be served.

Government supported education programs could be a good non-regulatory instrument for these revised objectives. Due to the positive relationship of education parameter(s) in the willingness to future harvest model and interest in managing for non-timber uses model, increasing education programs for forest enhancement, wildlife management,, and recreation could increase timber supply and non-timber uses. Financial incentives such as property tax incentives and government payments, can increase the level of interest in managing for non-timber uses, and indirectly increase probability of being non-timber benefits type.

Concluding remarks

The growing pressures of forest fragmentation and parcelization have increased the rate of forestland conversion to other uses, including residential development. Although sustainable forest management is a challenging solution that balances all demands, appropriate policies are needed to guarantee and enforce the results. We explored NIPF ownership objective categories, intention, and behavior that will influence the success of SFM. In addition, the study observed interactions among ownership objective categories and intentions, and the factors influencing them. This study differs from previous work by explicitly linking ownership objective categories and planned behavior.

We substantiated that forest landowners are not homogeneous and our hypothesis of the interaction among ownership objectives and intention, or planned behavior, was not rejected. In addition, SFM requires combining social, economics, and environmental dimensions. Employing independent decisions (e.g. the harvesting decision model without incorporating other dimensions) will not reflect full picture of SFM, where heterogeneous forest landowners and interdependent decision and practices are required (Kant, 2003; Wang 2004). In our case, we categorized forest landowners into four groups including two major groupings for non-timber and monetary returns, without discarding the other groups. In addition, forest owner behavior is included in the estimating system in order to serve as SFM estimating model.

Because forestland contains factors of market failures, implementing incentives and policies would provide better solutions than a laissez-faire approach. We suggest that government supported education programs be provided to NIPF owners, with a focus on SFM and non-timber products. Because the current direction of SFM in the U.S. emphasizes the emerging market for non-timber products and activities, this dimension still requires much knowledge and information. Therefore, agencies can disseminate forest management information, expand programs and their rate of participation, promote compatible land use practices, and offer new, more directed policies.

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What extension methods do Southeastern United States family forest landowners prefer?

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What extension methods do Southeastern United States family forest landowners prefer?

Abstract

Family forest landowners are an ever changing category of non-industrial private forest landowners. This group collectively owns and manages the majority of the Southeastern United States' forestland. This research in brief summarizes this category of landowners' use of information sources in the past five years, as well as their perceptions of useful information in the future. Data were collected by the United States Department of Agriculture, Forest Service via the National Woodland Owner Survey. Summary results show that traditional methods including publications, newsletters, and contact with a forester are still perceived as useful by family landowners. Results should be useful in landowner outreach.

Keywords: information preferences, NWOS

Introduction

There are approximately 215 million acres of forestland in the Southeastern United States (Wear and Greis 2002). This forestland is among some of the most productive land in the United States and is expected to become increasingly important to ensuring a sustainable timber supply for the nation (Wear and Greis 2002; Zhang and Nagubadi 2005). This forestland is comprised of a diverse ownership ranging from public to private industrial and private family forestland. Family forestland, is defined by Butler and Leatherberry (2004) as

> *…at least 1 ac[re] in size, 10 [percent] stocked, and owned by individuals, married couples, family estates and trusts, or other groups of individuals who are not incorporated or otherwise associated as a legal entity. (p.4)*

Family forest landowners are increasingly controlling more private forestland (Butler and Leatherberry 2004). This rise of family forest landowners raises serious concerns and many opportunities for researchers and communities. With an increase in family forestland owners there is a decrease of large acreage tracts as parcelization of forested land occurs (Wear and Greis 2002). This leads to many different motivations and objectives for forest ownership and management. Also, a landowner’s options for certain uses of their land diminish with parcelization due to tract size and adjacent tract sizes (Wear and Greis 2002). Reaching out to forest landowners with assistance in achieving their objectives is becoming increasingly difficult with these changes in landowner and land dynamics.

This research in brief examines family forest landowners in the 13 southern states and tries to assess what information sources they have used and would find useful in the future. The data were obtained from the National Woodland Owner Survey (NWOS) conducted by the United States Department of Agriculture, Forest Service (USDA FS). Results should be beneficial in assisting information outlets determine what are the most cost-effective ways of disseminating information based upon what services landowners have used and would find useful in the future.

Data and Methods

As mentioned in the introduction, this paper utilizes results of the NWOS conducted by the USDA FS, Forest Inventory Analysis (FIA) unit. The purpose of the NWOS is to determine, "…who are the forest-land owners; why are forest lands owned; how are forest lands used; and what are the owners' plans for their forest lands" (Butler, Leatherberry and Williams 2005, p.1). This survey was administered as a mail out survey to private landowners with follow up telephone interviews to non-respondents from the mailed survey. The mailed survey consisted of 30 questions covering forest land and landowner characteristics, forest use and management, and concerns and issues of landowners. The response rate of the initial mailed survey was 51.3 percent of the original 17,363 surveyed (Butler et al. 2005). NWOS is administered annually with states being surveyed between every 5 to 10 years, Alaska and Hawaii not included (Butler and Leatherberry (2004). Butler and Leatherberry assert that the NWOS is the social complement of the FIA. NWOS observations, i.e. forest landowners, are the representatives of FIA plots since the same sampling frame is utilized. For the FIA survey, 6,000 acre non-overlapping plots are delineated and remote sensing is utilized to establish forested sample points. The probability of a landowner being included in the sample was higher as their acreage approached and/or exceeded 6,000 acres. For all forested plots, landowner records were obtained to include them in the survey (Butler et al. 2005).

The sample was reduced to just family forestland owners that had at least 25 acres of forestland in 13 southern states (n=1241). Results were analyzed to determine which information sources owners had used in the past five years. Next, average scores were calculated from Likert scale responses (1=Very Useful, 4=Neutral, and 7=Not Useful) concerning what family forest owners perceived to be useful information sources based upon motivation-for-ownership clusters (Majumdar, Teeter and Butler 2008). Three clusters were assigned using K-means cluster analysis (timber, multiple-use, and non-timber). These three clusters are defined by the following ownership attitudes (Majumdar et al. 2008):

1) timber – landowners interested in timber, legacy, and investment,

2) multiple-use – landowners interested in biodiversity, aesthetics, timber, investment, hunting, privacy, and legacy, and

3) non-timber – landowners interested in biodiversity, home, aesthetics, and privacy.

Results

State agency foresters (57.60 percent) and private consultants (57.76 percent) were the two most used sources of information in the past five years for family forestland owners (Table 1). The least used sources of information were employees of non-profits (1.38 percent) and other state employees (4.92 percent). Extension foresters were used by approximately 19.66 percent of landowners.

Table 1. Landowner use of information sources in the past 5 years.

Information source	% Landowners
State agency forester	57.60
Extension forester	19.66
Other State Employee	04.92
Natural Resource Conservation Service, Soil and Water Conservation District, Farm Service	27.19
Private Consultant	57.76
Industrial forester	22.58
Logging Contractor	26.57
Employee of a non-profit	01.38
Other landowner, neighbor, friend	23.66

For the clusters assigned by Majumdar et al. (2008) the largest cluster was the multiple-use cluster containing approximately 37.55 percent of landowners (Table 2). The timber cluster was the second largest (approximately 37.07 percent of landowners) followed by the non-timber cluster (approximately 25.38 percent of landowners). If categorized by forestland size, however, the timber cluster is the largest cluster with approximately 55.72 percent of family forest acres followed by multiple-use (approximately 30.48 percent of family forest acres) and non-timber (approximately 13.80 percent for family forest acres).

Table 2. Cluster statistics for 13 southern states.

Motivation Cluster	Landowner %	Forestland %
Non-timber	25.38	13.80
Multiple-use	37.55	30.48
Timber	37.07	55.72

For all three clusters, talking with a forester or other natural resource professional was perceived to be highly useful by family forest owners (Figures 1, 2 & 3). Also, for all three clusters, publications and newsletters were viewed as highly useful. For the multiple-use and non-timber clusters talking with other woodland landowners was viewed as a highly useful source of information (Figures 2 & 3). On the average, almost all other information sources were viewed as useful to neutral except loggers, which were viewed as not useful by the non-timber cluster (Figure 3).

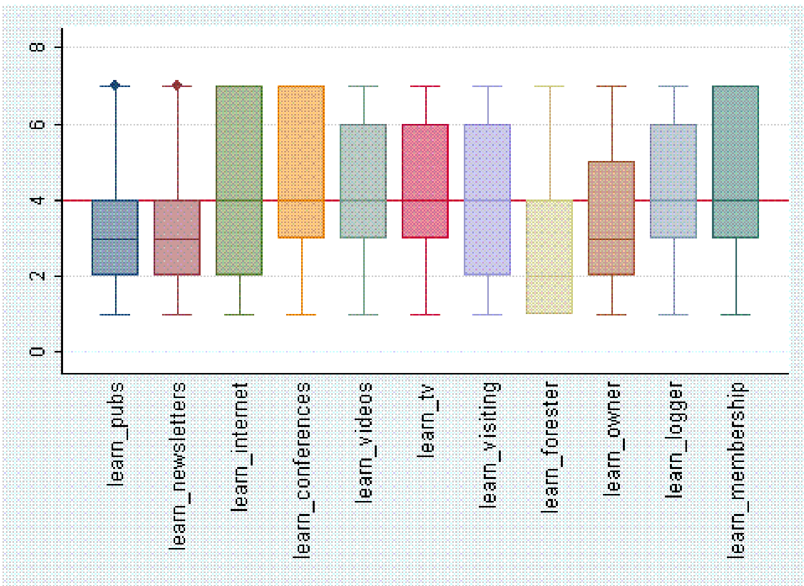

Figure 1. Future information usefulness for the timber cluster

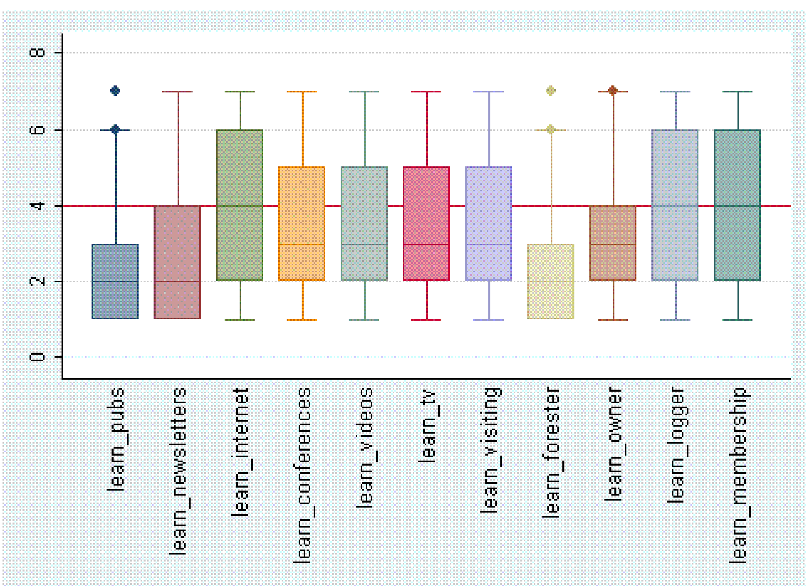

Figure 2. Future information usefulness for the multiple-use cluster

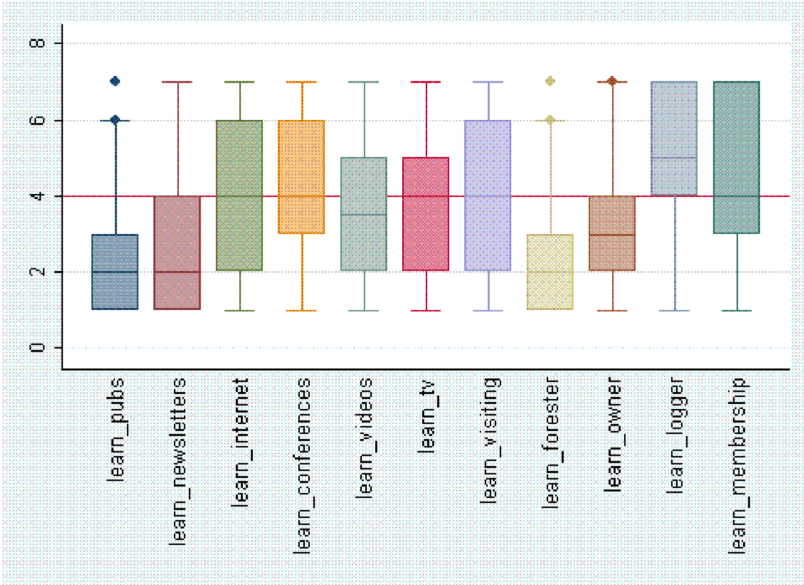

Figure 3. Future information usefulness for the non-timber cluster

Conclusion

Results indicate that for the 13 southern states most landowners are still primarily using traditional sources of information such as contact with a forester or consultant. The important question, however, is what do these landowners perceive to be useful? Perceived usefulness of information sources does vary with ownership motivations. For all three ownership clusters, contact with a forester is still viewed as being very useful by family forest landowners. For the multiple-use and non-timber clusters publications and newsletters are also viewed as useful. This echoes results from Salmon, Brunson and Kuhns (2006) where multiple-use and amenity-focused landowner preferred indirect contact such as brochures. It is important to use extension mediums that are effective and perceived as useful by our audience. However, as pointed out by Rodenwald (2001) we must continue to diversify our extension materials to reach everyone. For now though, we should find some comfort in the fact that the traditional methods of extension and outreach are viewed as useful by family forest landowners.

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