Southern Forest Economics Workers
2009 Annual Meeting Proceedings

Carolina Inn
Chapel Hill, NC
March 8-10, 2009

Editors:

Chris Zinkhan
Blake Stansell

Southern Forest Economics Workers (SOFEW)
2009 Annual Meeting Agenda

Carolina Inn | Chapel Hill, NC | March 8 – 10, 2009

Sunday, March 8

5:00 PM - 7:00 PM Pre-Registration
6:30 PM - 7:00 PM Welcome Reception

Monday, March 9

7:15 AM - 8:15 AM Registration and Morning Coffee

8:15 AM - 8:30 AM Introduction and SOFEW Update

Chris Zinkhan, The Forestland Group, LLC - Welcome
Changyou Sun, Mississippi State University - SOFEW Update

8:30 AM - 10:00 AM General Session

Keynote Panel I: Alternative Products and Services and Timberland Investments in a Volatile Environment

Moderator: John C. Welker, American Forest Management, Inc.
Panelists:
Victor P. Haley, Sutherland
Tom E. Johnson, Timber Investment Resources, LLC
Kaarsten Turner Dalby, The Forestland Group, LLC

Keynote Panel II: Valuation of Ecological Services and Timberland in a Volatile Environment

Moderator: Richard P. Ludington, The Conservation Fund
Panelists:
Mike Clutter, University of Georgia
Samuel J. Radcliffe, Prentiss and Carlisle Management Company
Jeff Wikle, TerraSource Valuation

10:00 - 10:30 AM Coffee Break

10:30 - 12:00 Noon Concurrent Sessions

<u>Session A: Investments</u>
Moderator: Hunter Jenkins
Global Forest Plantation Investment Returns in 2008 - Frederick Cubbage
Alternative Timberland Investments: What's the Story with Timber REITs? - Brooks Mendell
Determinants of Bare Land and Pre-merchantable Timber Stand Values in South Alabama: A Hedonic Study - Li Meng
Event Analysis of the Impact of Industrial Timberland Sales on Shareholder Values of Major Forest Products Firms - Xing Sun

Session B: Bioenergy I
Moderator: Sayeed Mehmood
Factors Affecting Nonindustrial Private Forest Landowners' Willingness to Supply Woody Biomass for Bioenergy - Omkar Joshi
Determinants of Non-industrial Private Forest Landowners' Willingness to Accept Price Offers for Supplying Biomass – Shivan G.C.
Emerging Biomass Markets and Land Use - Fanfan Weng
Impact of Bioenergy Policies in Florida: A Computable General Equilibrium (CGE) Analysis - Ming-Yuan Huang

12:00 Noon - 1:15 PM Served Lunch

1:15 PM - 3:00 PM Concurrent Sessions

Session A: 2010 RPA Assessment: Forecasting the Forest Sector
Moderator: David N. Wear
The US Forest Assessment System: Modeling and Forecasting the Forest Sector in the United States - David N. Wear
Forecasting Future Southern Forest Conditions in the USFAS - Robert J. Huggett
Timber Supply and Demand Structure in the US Forest Products Module (USFPM) - Peter J. Ince
Bioenergy Demand and Forest Based Biofuels: The Implications of the IPCC Scenarios on the Global Outlook for Wood Products and Forests - Ronald P. Raunikar

Session B: Nonindustrial Private Forest Landowners/Forest Inventory
Moderator: Samuel J. Radcliffe
Use of Focus Groups to Evaluate Nonindustrial Private Forest Owners' Perceptions of Effectiveness and Economic Feasibility of Field Forestry Management Applications - Matthew B. Howle
Modeling NIPF Landowner Behavior: Developing "A Willingness to Sell Timber" in the Future Model - Kevin Hoyt
Impact of Hurricane Katrina on Mississippi Nonindustrial Private Forest Landowners - Robert K. Grala
Forest Inventory and Management – Sun Joseph Chang

Session C: Urban Forestry
Moderator: Thresa Henderson
Impact of Urban Trees and Landscaping on Tourism and Sustainable Development - Bin Zheng
Tree Shade and Residential Electricity Demand during the Peak Summer Month: An Empirical Study - Ram Pandit
Factors Influencing Current Interests and Motivations of Local Governments to Supply Carbon Offset Credits from Urban Forestry - Neelam C. Poudyal

3:00 PM - 3:15 PM Coffee Break

3:15 PM - 5:00 PM Concurrent Sessions

Session A: Bioenergy II
Moderator: Brooks Mendell
Timber Market and Economic Implications of Locating Wood Biomass Facilities - Tim Sydor
Changes in the Fuel Pellet and Briquette Industry in the Lake States Region: 2005 to 2008 - William Luppold
Exploratory Analysis of Willingness to Invest in Renewable and Wood-Based Energies in the U.S. - Francisco X. Aguilar

Session B: Fire
Moderator: Jeffrey P. Prestemon
Accounting for Returning Wildfire Hazard following Fuel Treatments in National Policy Design - Jeffrey P. Prestemon
Measuring Efficiency of Fighting Large Wildfires - Thomas P. Holmes
Identifying at-Risk Communities of Arson Fire - Douglas Thomas
Prescribed Burning in the Southern United States: A Review of Administrative Law - Branden Tolver

Session C: Trade
Moderator: Mike Clutter
Exports and Growth of Forest Industries - Sijia Zhang
Competition of Imported Wooden Bedroom Furniture in the United States - Yang Wan
Impact and Long-Run Multipliers of U.S. – Canada Forest Products Trade: Implications for Sustainable Forest Management - Pracha Koonnathamdee

5:30 PM - 6:30 PM Sponsors' Reception and Graduate Student Poster Competition

Tuesday, March 10

8:00 AM - 8:30 AM Morning Coffee

Steering Committee Breakfast

8:30 AM - 10:00 AM Concurrent Sessions

Session A: Forest Products Industry/Wood Supply
Moderator: Blake Stansell
Business Clustering in Mississippi's Forest Products Industry: Preliminary Results - Todd A. Hagadone
The Wood Household Furniture and Kitchen Cabinet Industries: A Contrast in Fortune - William G. Luppold
The Impacts of Hurricane Katrina on South Mississippi's Wood Supply System - Clayton B. Altizer
The Dynamics of Change in the Mississippi Wood Supply System: 1699 – 1930 - Lance D. Stewart
Forest Biomass Supply for Bioenergy Production in Tennessee - Zhimei Guo

Session B: Agroforestry
Moderator: Thresa Henderson
Economic Value of Riparian Buffers in the Chesapeake Bay Watershed - James F. Casey
Prospects for Alternative Production Forestry and Agroforestry Systems in the Lower Mississippi Alluvial Valley - Gregory E. Frey
Non-Timber Forest Resources: Providing Products Whose Value and Volumes Are Neither Fully Valued nor Managed for - James L. Chamberlain

10:00 AM - 10:30 AM Coffee Break

10:30 AM - 12:00 Noon Concurrent Sessions

Session A: Bioenergy III
Moderator: Richard Phillips
A Real-Time, Web-Based Optimal Biomass Site Assessment Tool (BioSAT) - Andy Hartsell
U.S. Forest Biomass Supply and its Prospective Role in Producing Biofuels - Ken Skog

North Carolina's Renewable Portfolio Standard and its Potential Impact on the Forest Industry and Resources – Jesse Henderson
Role of Bioenergy Plantations in Creating a Transportation Biofuel Industry – Ronalds W. Gonzalez

Session B: Policy
Moderator: Frederick Cubbage
Impacts of Priority Forestry Programs on Regional Timber Supply in China - Can Liu
Bird Community and Timber Responses to Mid-Rotation Management in Conservation Reserve Program Pine Plantations - Lindsey C. Singleton
When More Isn't Always Better: Job Creation through Government Spending - Karen Lee Abt
An Evaluation of Forest Landowners' Participation in West Virginia's Managed Timberland Forest Tax Incentive Program - Jennifer Fortney

12:00 Noon - 1:00 PM   Lunch on Your Own

1:00 PM - 2:30 PM   Concurrent Sessions

Session A: Ecosystem Services
Moderator: Kaarsten Turner Dalby
Payments for Ecosystem Services to US Forest Landowners - Evan Mercer
Increasing Return from Timber Production by Incorporating Carbon Credit Payments - Prakash Nepal
Impacts of FSC and PEFC Forest Certification in North and South America - Frederick Cubbage
Layered Southern Pine Plantation Model - Mike Clutter
Ecosystem Services:
  Satisfying the Legal Requirements for Successful Offset Forest Projects - Monique Lussier
  Opportunities - Kaarsten Turner Dalby

Session B: Recreation
Moderator: Blake Stansell
Wilderness Recreation Demand: A Comparison of Travel Cost and On-Site Cost Models - J.M. Bowker
Is Demand for Outdoor Activities Declining? Evidence from Recreational Hunting in the Southeast - Suman Majumdar
Landowner Willingness to Accept Fee-Based Recreation and the Influence of Institutional Change in the Louisiana Delta - James E. Henderson
Attribute-Based Analysis of Mississippi Hunters' Preferences - Anwar Hussain

Southern Forest Economic Workers
2009 Annual Meeting

Monday, March 9, 2009
8:30 AM – 10:00 AM
Keynote Panel II: Valuation of Ecological Services and Timberland in a Volatile Environment

Manuscripts:

Appraising Timberland in a Volatile Marketplace

Samuel J. Radcliffe, Prentiss & Carlisle Management Company[1]

[1] Vice President, Prentiss & Carlisle Management Company, 8301 N. Allen Lane, Milwaukee, WI, 53217. sjradcliffe@prentissandcarlisle.com, (414) 351-5202 (voice), (414) 351-5206 (fax).

Appraising Timberland in a Volatile Marketplace

Abstract

Compared to the return on investment (ROI) in financial securities, the ROI in timberland appears to be both less volatile and consistently more positive. But timberland trades in thin private markets, so ROI's and values are not readily observable. As a result, analysts rely on value estimates provided by timberland appraisals. In a volatile market, appraisers must recognize: (1) appraisal is inherently a backward looking process that by its nature tends to miss shifts in trends, and; (2) timberland valuation models depend on inputs with short-term volatility, but the appraisal problem is to value a long-term asset. These issues surface in all three of the standard real estate appraisal approaches: market, cost and income. Timberland appraisers can adopt a variety of strategies for minimizing the impact of these process shortcomings.

Keywords: Timberland **v**aluation, appraisal, volatility, rate of return

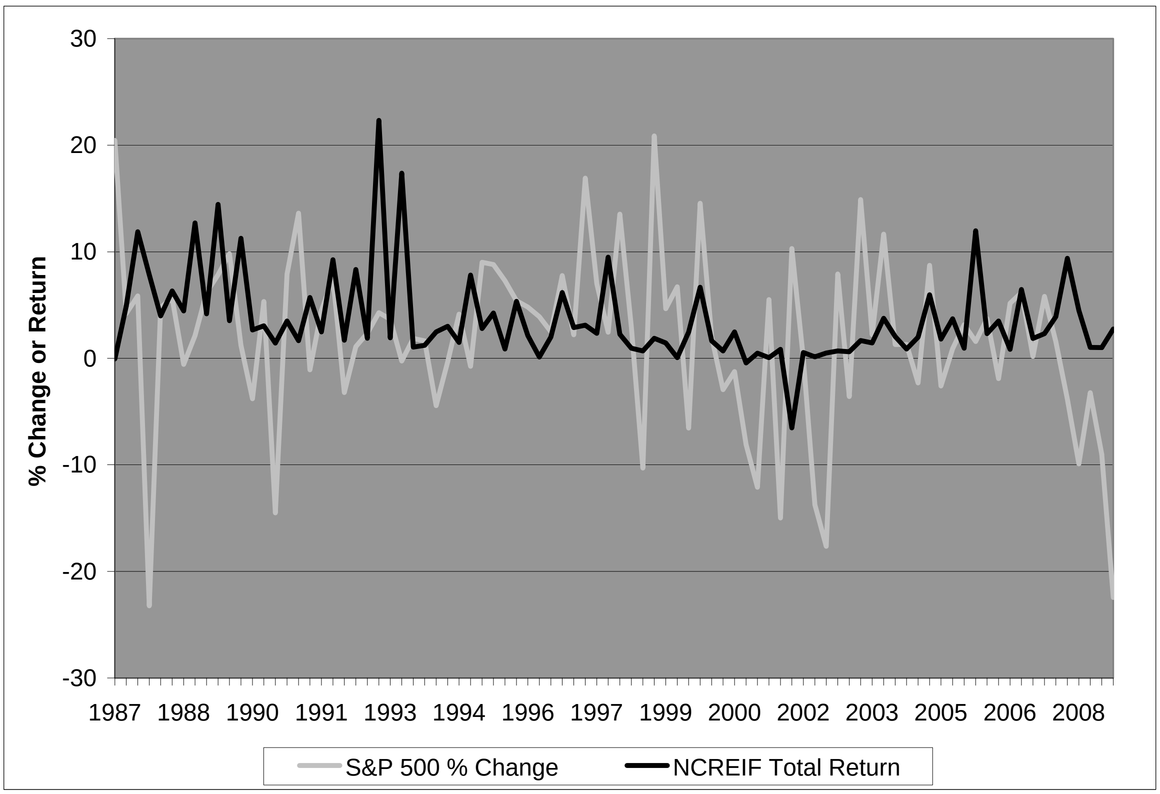
Introduction

During the 2008-09 period of extreme volatility in values and investment returns for financial securities and real estate assets, many in the timber business have proudly pointed to the steady performance of timberland investments. After all, as the story goes, trees keep growing regardless of what happens in the economy. Figure 1 seems to support that story, as timberland returns over the last 20 or so years showed some volatility but not nearly as much as the stock market. More importantly, timberland returns were rarely negative during this period.

How do we know how well timberland is doing? Compared to financial assets, or even to other types of real estate, investment grade timberland trades in a pretty thin and private market. We do not have a timberland ticker tape. Our understanding of changes in values and return on investment depend to a great extent on appraisals because there simply are not many transactions to provide a more reliable guide. In fact, the most widely known timberland price index, published by the National Council of Real Estate Investment Fiduciaries (NCREIF, 2009), is heavily based on appraisals rather than actual transactions.

So it's an appropriate time to examine the characteristics of the timberland appraisal process that affect appraisers' ability to accurately estimate timberland values in a time of economic change and volatility.

Figure 1. NCREIF Timberland Index (Total Returns, All Regions) Compared to Quarterly Change in Value of the S&P 500.



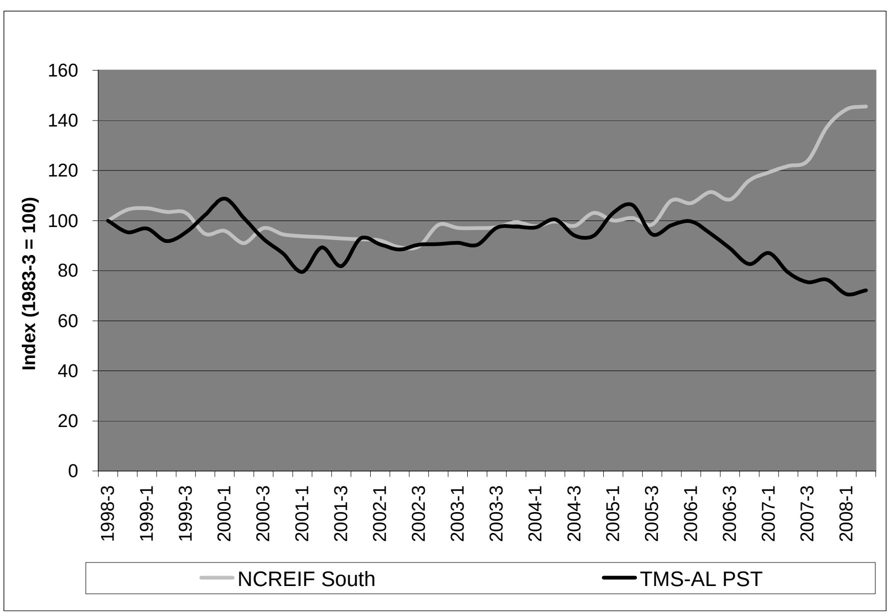
Valuation Concerns

With respect to shifting and volatile markets, two timberland appraisal issues arise: (1) appraisal is inherently a backward looking process that by its nature tends to miss shifts in trends, and; (2) timberland valuation models depend on inputs with short-term volatility, but the appraisal problem is to value a long-term asset.

We can see one or both of these issues in each of the three standard appraisal approaches:

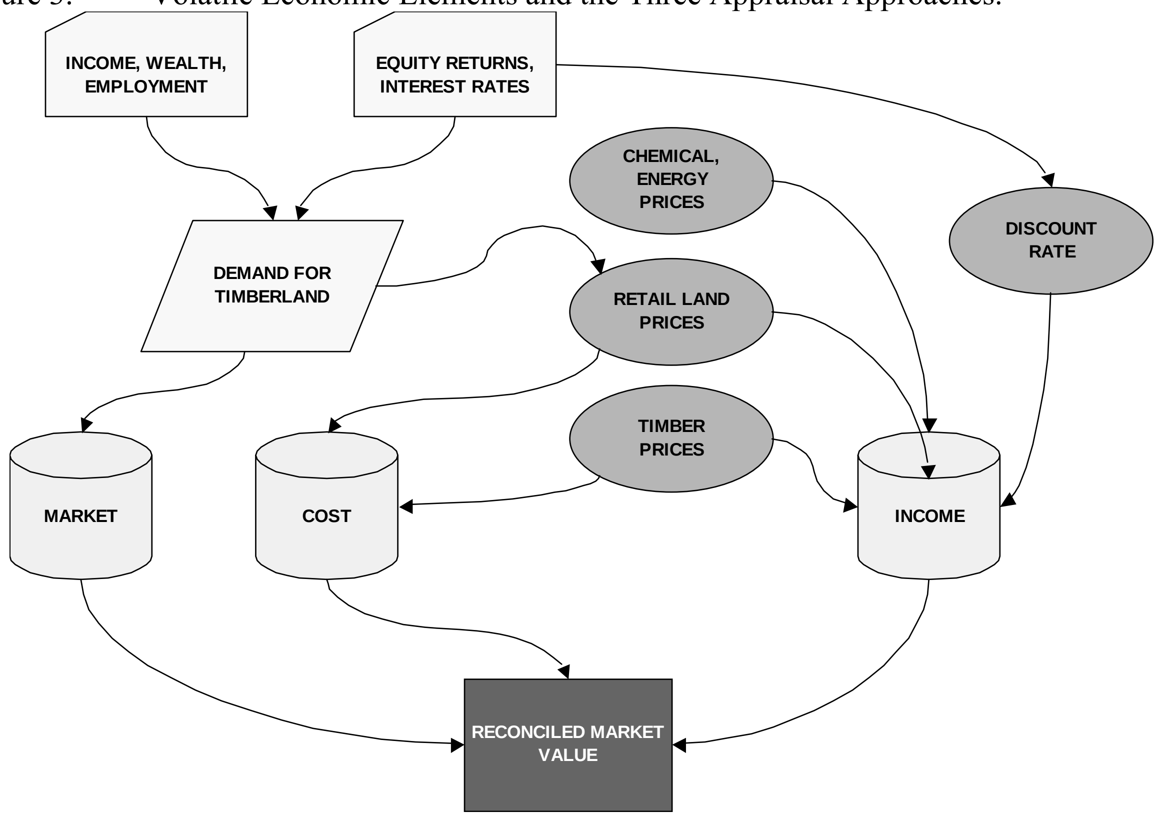
- Market approach
  The market or comparable sales approach uses transaction data to indicate what properties are selling for in the marketplace. This is the most backward looking approach because in this thinly traded market, appraisers may have to utilize transactions that are as much as two or three years old. The comparability problem is compounded because transactions are becoming increasingly complex, often involving conservation easements, timber supply agreements, and/or subsidized financing.
- Cost approach
  The cost approach is based on a summation of component values (land, premerchantable timber, merchantable timber). As such, it is heavily driven by contemporary timber prices. Because timber prices can be quite volatile in the short term (see for example Prentiss & Carlisle, 2008), issues can arise if current prices are in a cyclical peak or trough. This gets even more complicated as the relationship between timber prices and timberland prices changes (Figure 2). Bare land values that are input to this approach are usually based on an analysis of timberland transactions, so they suffer the backward-looking problem of the comparable sales approach.

Figure 2. Relationship between Southern Timberland Per Acre Values Reflected in the NCREIF Index and Southern Pine Sawtimber Stumpage Prices.



- Income approach
  The income approach is based on a projection of cash flows for the subject property, discounted back to estimate net present value. This is obviously a forward-looking approach, but it too depends on model inputs that can be quite volatile – timber prices, interest rates, fuel prices, etc. (see Figure 3). Embedded in this approach is a timber management model that may not incorporate options that respond to economic volatility (for example an inflexible harvest schedule).

Figure 3. Volatile Economic Elements and the Three Appraisal Approaches.



Appraisal Strategies

In order to deal with these inherent process shortcomings, appraisers need to be creative and should make a special effort to:

- Understand current buyer/seller mentality. Have market participants adjusted their thinking and expectations for the asset class? How are these changes in expectations reflected in price formation? What are current hurdle rates of return?
- Recognize the current state of markets and structure the valuation analysis accordingly. Are prices in cyclical peaks, troughs, or on the long-term trend?
  - timber
  - fuel, chemicals, etc.
  - timberland
  - capital markets

- Utilize alternative methods of estimating model inputs and projecting those inputs into the future. For example, one could start with current "off-trend" timber prices and develop a projection as to when those prices will reach a stable "normal" level, or one could start with a more "normal" price level and not project any severe change. Either of these approaches could be justified, depending on how buyers and sellers would be expected to think about the specific subject property.
- Perform sensitivity analysis on all of the key variables – timber prices, discount rates, expense levels, sale adjustments, valuation multipliers, etc.
- In reconciling the values indicated by each of the three appraisal approaches, special consideration should be given to:
  - the age and volatility of data analyzed within the approaches
  - the applicability or suitability of the approaches based on how sensitive they are to volatile inputs

Real estate appraisal is often described as part art and part science. In these volatile times, that observation has probably never been more true.

Literature Cited

National Council of Real Estate Investment Fiduciaries. 2009. Timberland Index -- Total Returns. http://www.ncreif.com/indices/timberland.phtml

Prentiss & Carlisle. 2008. Update, 4th Quarter 2008. Bangor, ME. http://www.prentissandcarlisle.com/assets/PCnwslttr_4QTR-08.pdf

Southern Forest Economic Workers
2009 Annual Meeting

Monday, March 9, 2009
10:30 AM – 12:00 PM
Session A: Investments

Manuscripts:

Global Forest Plantation Investment Returns in 2008 – Frederick Cubbage et al.

Global Forest Plantation Investment Returns in 2008

Frederick Cubbage[1], NC State University, Raleigh, NC, USA; Patricio Mac Donagh, Universidad Nacional de Misiones (UNAM), Eldorado, Misiones, Argentina; Gustavo Balmelli, Instituto Nacional de Investigación Agropecuaria (INIA), Tacuarembó, Uruguay; Rafael Rubilar, Universidad de Concepción, Concepción, Chile; Rafael de la Torre, CellFor, Atlanta, Georgia, USA; Vitor Afonso Hoeflich, Universidade Federal do Paraná (UFPR), Curitiba, Brasil; Mauro Murara, Universidade do Contestado, Santa Catarina, Brasil; Heynz Kotze, Komatiland Forests (Pty) Ltd, South Africa; Ronalds Gonzalez, Omar Carrero, Gregory Frey, and Sadharga Koesbandana, NC State University, Raleigh, NC, USA; Virginia Morales Olmos, Weyerhaeuser Company, Melo, Uruguay; Thomas Adams and James Turner, Scion Research, New Zealand Roger Lord, Mason, Bruce, & Girard, Portland, Oregon, USA; Jin Huang; Abt Associates, U.S.A., Robert Abt, NC State University, Raleigh, NC, USA

[1] North Carolina State University, Raleigh, NC, 27695-8008, (706) 515-7789, fredcubbage@yahoo.com

Global Forest Plantation Investment Returns in 2008

Abstract

Industrial timber plantations have formed the basis for an increasing forest-based manufacturing and export sector in many countries. We estimated financial returns for timber investments in exotic timber species for 2008 for selected species in Argentina, Uruguay, Colombia, Venezuela, Paraguay, Chile, Brazil, China, South Africa, New Zealand, Indonesia, and the United States. Excluding land costs, returns for exotic plantations in almost all of South America—Brazil, Argentina, Uruguay, Chile, Colombia, Venezuela, and Paraguay—were substantial, with an internal rate of return (IRR) of more than 15%. *Eucalyptus* species returns were generally greater than those for *Pinus* species, with most having IRRs of 20% or more, as did teak. *Pinus* species in South America were generally closer to 15%, except in Argentina, where they were 20%. The land expectation values (LEVs) varied more, and they are the best criterion for capital budgeting given a known discount rate. Using LEV, *eucalypts* and teak in South America still had the best returns, but with more variation. Internal rates of return were less, but still attractive for plantations of coniferous or deciduous species in China, South Africa, New Zealand, Indonesia, and the United States, ranging from 7% to 12%. New Zealand, the United States, and Chile had the lowest rankings for risk from political, commercial, war, or government actions. Conversely, Venezuela, Indonesia, Colombia, and Argentina have high-risk ratings. Brazil, South Africa, and Uruguay had intermediate risk ratings. New Zealand was ranked as the easiest country in the world to do business in, and the U.S. was second, and Chile and Colombia ranked well. Brazil, Indonesia, and Venezuela were ranked as among the more difficult countries in the world for ease of business. Investors must consider tradeoffs of greater potential returns, forest regulations, risk, and business security in making capital allocation decisions.

Keywords: timber, plantations, investment returns, world, capital budgeting

Introduction

Forest plantations in the world have increased in area and provide the principal source of timber for sawtimber and panels, as well as the production of pulp and paper in many countries. Plantations for industrial wood are projected to provide as much as two-thirds to 80 percent of the world's industrial wood supply by 2030 (Carle and Holmgren 2008). This increase in forest plantations is based on many factors, including timber investment returns, government policies, and investment risks. We analyzed these factors to assess the comparative advantage among many of the principal countries in the world that produce industrial forest plantations.

Methods

In this research, we developed new analyses of timber plantation investment returns for the principal plantation countries and reviewed selected country risk and business climate estimates. Estimates of returns to forest plantation investments were made for typical forest species and average forest productivity rates were determined based on the knowledge of the authors in interviews and consultations with other experts in each country. This approach drew from prior research by Cubbage et al. (2007) and Sedjo (1983, 1999), which estimated plantation and natural stand investment returns based on representative stands and management regimes for important timber producing countries in the world, we used 2008 as a base year for comparison—before the recent global financial recession.

Investment returns were calculated assuming typical forest management practices with good sites and good management. Better sites and management could yield significantly higher growth rates than those that we used as our base case, and vice versa. The base case timber investment returns were made without any land costs—simply assuming that landowners already had purchased forestland and needed to make reinvestment decisions. Nor were taxes or other government policy interventions included in the base case. The calculations reported here only include the base factor costs, production rates, and timber stumpage prices. This then provided a base investment return calculation per hectare of planted land. We did not use land prices to make sure that the timber investment returns were as comparable as possible among countries based on timber productivity and factor costs and prices.

We analyzed the returns to these timber investments using standard capital budgeting techniques and criteria, including net present value (NPV), land or soil expectation value (LEV, SEV, or the Faustman formula), and internal rate of return (IRR), with an 8% discount rate as a common metric for analyses.

Various sources provide estimates of country risk from political or economic hazards. For consistency, this study used data from the Belgium Export Credit Agency (ONDD 2009), which is clear and concise. This source rates countries for their political risk related to export transactions and for direct investment, on a scale ranging from 1 (very safe) to 7 (very dangerous). We also collected data from the World Bank on the ease of doing business, which ranked all the major countries in the world from 1 to 181 in order for several factors. These provide measures of business climate and security, which may be more important than potential high rates of return in some countries.

Results

Timber Plantation Investment Returns.— Timber growth and yield, forest establishment and management costs, and timber prices determined the rates of return for investments in the countries we examined. Table 1 summarizes capital budgeting criteria for the principal plantation species in the southern hemisphere and in the United States and China in 2008. Establishment costs excluding the price of land among countries varied moderately, averaging about $957 per ha, with a standard deviation of $373. Establishment costs ranged from $500 per ha at the least—for *Eucalyptus globulus* in Uruguay, *Gmelina arborea* in Venezuela, *Pinus radiata* pulpwood in Chile—to $1300 per ha for Douglas fir in the United States and $1800 per ha for *Pinus tecunumanii* and *Eucalyptus* in Colombia. Timber prices varied more by species and country, with stumpage prices for pulpwood varying from about $5 to $20 per m^3 in most cases, chip-n-saw ranging from $25 to $50 per m^3, and small sawtimber ranging from $22 to $55 per m^3. Teak (*Tectona grandis*) prices were much greater than this, at up to $220 per m^3 in Venezuela (with a 21 year rotation) or $900 per m^3 (with a 60 year rotation) in Indonesia—with the difference due to better quality of wood in Indonesia.

Excluding land costs, exotic plantations in almost all of South America—Brazil, Argentina, Uruguay, Chile, Colombia, Venezuela, and Paraguay—were quite attractive, with an internal rate of return (IRR) of more than 15%. *Eucalyptus* species returns were generally greater than those for *Pinus* species, with most having IRRs of 20% or more, as did teak. *Pinus* species in South America were generally closer to 15%, except in Argentina, where they were 20%. Almost all of these IRRs were greater than found by Cubbage et al. (2007) based on costs and prices in 2005.

The land expectation values (LEVs) varied more, and they are the best criterion for capital budgeting given a known discount rate. Using LEV, *eucalyptus* and teak in South America still had the best returns, but with more variation. Internal rates of return were less, but still attractive for plantations of coniferous or deciduous species in China, South Africa, New Zealand, Indonesia, and the United States, ranging from 7% to 12%. These IRRs are less than the excellent ones calculated for South America, but are still attractive compared with other asset classes, especially compared with returns for other asset classes in late 2008 and early 2009. Timber prices have decreased in 2008 and 2009 as well, but total land and timber market values remained at historically high levels at least in the United States.

Net present values (NPV) and land expectation values (LEV) at the 8% discount rate tracked these results. Brazil generally had the greatest LEVs—an indicator of what one could pay for bare land and make a return equal to or better than the discount rate. *Eucalyptus grandis* sawtimber had an LEV approximately $8300 per ha; *Pinus taeda* $5000/ha; *Pinus eliottii* $2900/ha. Colombia had the next highest LEVs, at $5300 for *Eucalyptus* and *Pinus tecunumanii* and $4100 for *Pinus maximinoi*. Argentina had the next highest LEVs as a whole for the country, at about $3200 per ha for *Pinus taeda* and *Eucalyptus grandis*. Chile had high LEVs for the best sites and valuable *Pinus radiata*, at $2700 per ha, but poorer sites with pulpwood had lesser LEVs, at $600 per ha. Venezuela and Paraguay also had quite large LEVs, ranging from $1500 to $4000 per ha, except for teak, at $9800 per ha. Uruguay and South Africa had ranging from about $1000 per ha to $3000 per ha. Meanwhile, China, New Zealand, and the two U.S.

regions barely met or were less than the 8% rate of return for timber investments, without any land costs, so they had small or slightly negative LEVs.

Table 1. Financial Returns to Selected Forest Plantations in the World, 8% Discount Rate, 2008

Country	**Species**	**Net Present Value ($/ha)**	**Land Expectation Value ($/ha)**	**Internal Rate of Return (%)**
Argentina	*Pinus taeda* – Misiones	2401	3202	20.0
	Eucalyptus grandis	2176	3178	18.2
Brazil	*Pinus taeda*	3590	5242	20.8
	Pinus eliottii	2389	2928	16.3
	Eucalyptus grandis	5690	8311	25.5
Chile	*Pinus radiata* – sawtimber, good sites	2270	2782	15.6
	Pinus radiata – pulpwood, poor sites	633	894	13.1
China	*Pinus massoniana*	73	92	12.1
Colombia	*Pinus maximinoi*	3189	4125	14.7
	Pinus tecunumanii	4133	5353	15.5
	Pinus patula	1225	1594	11.2
	Eucalyptus grandis or *E. saligna*	4133	5380	16.6
Indonesia	*Tectona grandis* – government set price	-95	-96	7.8
	Tectona grandis – market price	1833	1851	11.2
New Zealand	*Pinus radiata*	-204	-230	7.6
Paraguay	*Pinus taeda* – Parana Basin	1294	1648	12.0
	Eucalyptus grandis – Parana Basin	2552	4233	21.4
	Eucalyptus camaldulensis – Parana B.	1207	2002	15.4
S Africa	*Pinus patula*	1677	1862	11.1
	Eucalyptus grandis	2256	2872	12.4
Uruguay	*Eucalyptus grandis*	984	1389	13.9
	Eucalyptus globulus	1179	2358	22.9
	Pinus taeda	883	1048	12.8
U.S.A.	*Pinus taeda* – U.S. South	151	171	8.5
	Pseudotsuga menziesii – Pac. Northwest	-28	-29	8.0
Venezuela	*Eucalyptus grandis* x *urophylla*	1075	2095	22.4
	Gmelina arborea	460	1439	18.8
	Pinus caribaea – western Venezuela	1510	2504	15.0
	Tectona grandis	7693	9600	21.2

The results are interesting, because they indicate large potential returns are possible in countries that have not had much external timber plantation investments to date, such as Colombia, Venezuela, and Paraguay, compared to countries with large plantation areas such as the U.S., New Zealand, South Africa, and Uruguay that appear to have slightly lower, albeit attractive rates of return. This suggests that factors such as low risks and good business climates still are the most important factors in extended, enduring industrial wood plantation programs. This makes sense given the long term nature of forestry investments. Brazil seems to combine the best timber investment rates of return with the strongest markets throughout the country for an extended period of time. In all countries, proximity to markets also remains important, since forest products still have relatively low value to weight ratios, and land transport and ocean shipping costs are significant. Other challenges influence timber investments, as noted below.

Political and Economic Risk.—Perceived and actual financial and political risks are perhaps some of the most important factors affecting timber and forest products investments. Two data sources used to estimate financial and political risk (financial, regulatory or political events that contribute to a company's operational risks) by country are summarized below.

Export Transactions and Direct Investments.—The Belgium Export Credit Agency (ONDD 2009) provides a clear rating of countries for their political risk related to export transactions and for direct investment, on a scale ranging from 1 (very safe) to 7 (very dangerous), or A (best) to C (worst). Six criteria for risk are summarized in Table 2 for each country in our sample.

Table 2. Country Risk Ratings for Selected Countries, 2009

	Export Transactions				Direct Investments		
Country	Political Risk – Short Term	Political Risk – Long Term	Commercial Risk		War Risk	Risk of Expropriation/ Government Action	Transfer Risk
Argentina	4	7	C		3	4	6
Brazil	2	3	C		2	2	3
Chile	2	2	A		1	1	2
China	1	2	C		2	4	2
Colombia	2	4	C		5	3	4
Indonesia	2	5	C		2	5	3
New Zealand	1	1	B		1	1	1
Paraguay	3	5	C		3	4	5
South Africa	3	3	C		2	2	3
United States	1	1	C		1	1	1
Uruguay	3	4	B		2	2	4
Venezuela	4	6	C		4	7	5

Source: ONDD 20096

For export transactions (ONDD 2009), the short term political risk in each country was small to medium, with developed countries in the northern hemisphere having the least risk (1), and Argentina and Venezuela having the greatest (4). Long term political risk, which is important for forestry investments, was generally greater for each non-northern developed country except Chile, which remained low (2). In fact, Argentina (7) and Venezuela (6) had the greatest political risks, perhaps due to fears of more export bans or large export taxes such as occurred in Argentina in 2008. Chile had the best commercial risk ratings of all countries selected, with an A grade. The United States, New Zealand, and Uruguay had a commercial risk rating of B, and the rest had a C rating.

For direct investments, war risk was rated highest in Colombia (5) and Venezuela (4). Venezuela was the most risky for risk of expropriation and government action (7), and in fact just expropriated 1500 ha of forest industry land in March, 2009. Venezuela is followed by Indonesia (5), and Argentina, Paraguay, and Russia (4). The United States, Chile, New Zealand, and Finland as having the least risk of expropriation (1), and South Africa and Brazil were ranked with a 2. The transfer risk was greatest in Argentina, Venezuela, and Paraguay.

Ease of Doing Business.—The World Bank (2009) rated the ease of doing business in the same countries. Out of 181 countries, New Zealand is ranked as the second best country in the world in terms of ease of doing business, and the United States is ranked third. South Africa (32), Chile (40), and Colombia (53) also are ranked highly, followed by China (83) in the selected forest plantation countries. Conversely, Venezuela (174), Indonesia (129), and Brazil (125) are among the lower third of the ranked countries in the world.

Starting a business was ranked as very difficult in Indonesia, China, Venezuela, Argentina, and perhaps Brazil. Registering property was actually better in most countries, although Uruguay Brazil, and Indonesia were in the bottom half of the rankings. Venezuela was ranked the worst by far at protecting investors, and most of the developing countries except Chile were ranked as difficult in terms of paying taxes. Trading across borders was easier in developed countries, and ranked as difficult in most developing countries. Enforcing contracts was ranked best in the United States and New Zealand and worst in Colombia and Indonesia. Last, a little known problem with businesses is the ability to close them legally, which was ranked as very hard in Venezuela, Indonesia, and Brazil, and best in the developed countries.

Experience indicates that these deceivingly neutral rankings imply a large amount of difficulty in the countries that have large numbers. Not to single out any country, but ranks above 100 generally imply considerable difficulty and expense and time in their category, and ranks in the upper quartile of 135 or more infer large difficulties and perhaps high risks of failure to perform the desired business activity. Conversely of course, small numerical ranks in the lower quartile of less than 45 indicate countries and business activities with relative security and confidence that can be performed at comparatively modest effort and cost. While many of the developed northern hemisphere countries, as well as New Zealand and South Africa, timber investment returns are less, the costs of doing business may make net returns much closer, and the exposure to risk of loss much less.

Discussion and Conclusions

The results indicate that based on large biological productivities, reasonable input costs, good timber prices, and strong timber and product markets, Brazil usually maintains comparative financial advantages in the forest products sector, at least without considering land costs and the other business investment factors. Three other Latin American countries have expanded timber production capacity substantially in the last four decades, including Chile, Argentina, and Uruguay, in that order of timber plantation area. In fact, since 1960, Latin America has increased its share from 3% to 10% of the world industrial wood production (Gonzalez et al. 2008). The rates of return are high for vertically integrated forest products firms; domestic markets have increased moderately; and production is often close to export markets while infrastructure is improving. Carle and Holmgren (2008) also concluded that South America and Asia have the most promise for increased plantation area in their analysis of future plantation scenarios.

However, Brazil and Chile at least have substantial environmental rules and regulations affecting forest operations, and substantial enforcement agencies, albeit not always consistent implementation. Furthermore, Brazil is ranked as the hardest country in the Americas to start a business in terms of number of days and number of procedures (World Bank 2007), and has a challenging system of business, environmental, tax, and other laws, which require high transaction costs and close attention to details.

As an excellent example, Leal (2008) noted that the type of legal vehicle—real estate fund, investment fund, or company/corporation—determined the best tax treatments in Brazil, with the best system depending on the size of the investment. Brazil has a dual tax regime for corporations; the effective tax rate depends not only on profits but also on revenues; and the stability of tax law depends on the organizational model; which in turn affects whether it is better to sell stumpage or delivered wood. The effective tax rate may vary between as little as 5% to 34% depending on how an investment deal is structured, and the tax regime and legal set up should be defined for each investment.

Leal (2008) also noted that social responsibility is a passport to success in Brazil. Local community support is an enabler of regulatory licenses, helping prevent problems, accelerate licenses, and reducing possibility of theft, strike, and labor claims. The poorer the region, the more important social responsibility becomes to the return on investment. Similarly, Daniels and Caulfield (2008) stressed the advantages of forest certification for timberland investors in Latin America. In the countries where the laws or the enforcement are weak, certification provides investors certainty that their timberlands are managed to high standards. Forest certification does have costs, but can provide access to international financing and bank loans for developing countries. And in some cases, wood can be sold only if it is certified.

Chile and perhaps Uruguay seem to have more stable, efficient, and transparent business laws, particularly for foreign investors. Argentina has excellent land and growth rates and moderate environmental laws, but has a populist government that defaulted on the national debt in 2001; instituted large taxes on exports of agricultural products in 2008; and forbade timber exports to Uruguay from the bordering Entre Rios province, which have contributed to a higher political risk rating. On the other hand, Argentina has some of the most competitive free markets for timber in Latin America, with hundreds of small sawmills and many small landowners in its Northeastern wood basket provinces of Misiones and Corrientes. Chile lacks much available land for new forest investments, and has some of the strictest forest laws in Latin America. Uruguay has land purchase opportunities, but they are becoming scarcer and land prices have increased considerably. Uruguay has a smaller market for sawlogs to date, but like many other countries, has increasing potential for biomass facilities.

Smaller countries such as Colombia, Paraguay, and Venezuela all seem to have potentially attractive financial returns, and their opportunities will be defined mostly by political and safety considerations. The ascension of Hugo Chavez and no term limits in Venezuela will deter most external and even internal investors. Paraguay could attract more foreign direct investment if the government follows the centrist socialist path such as Uruguay. And Colombia appears quite attractive if the government can continue to maintain and enhance security of investments and investors in the country. Higher political risk factors in these countries must decrease to attract foreign direct investment, but Colombia at least also has some internal capacity to generate capital.

In the more developed countries in other parts of the Southern Hemisphere—South Africa and New Zealand, and perhaps Australia—the rates of timber investment returns are moderate, and delivered industrial wood costs should be slightly greater than in South America, but still attractive. New Zealand had the second best business climate in the world, which has attracted a large amount of capital to their forest sector. Each country does have moderate environmental regulations, and a large amount of certified forests as a share of the area. But they have less land available for new investments as well. Temperate timber plantation investments on existing forest land, such as in New Zealand, the United States, and China, achieve about a 8% real internal rate of return, which still look quite attractive compared to other sector's investments as of 2009. The business climate in the U.S. was ranked highly, as is China's.

Other government interventions and infrastructure may affect investments as well, which we did not examine here. Some countries still have subsidies for forest plantations, at least for small landowners, such as Chile and Argentina. Infrastructure such as roads, phytosanitary regulations, and fire control may have large effects on security as well as market access. Government support for education, research, exports, and business development differ as well. These factors also affect forest investment returns and risk, which should be considered.

The results provide new insights about planted timber investment returns for a wide range of major countries in the world. They are limited by reasonable assumptions, most notably not including land as a factor cost. Land prices were considered too variable within countries, and good data also is lacking. At the very least, land costs would reduce the high internal rates of return and land expectation values, unless it appreciated at rates greater than the IRR or discount rate, respectively. Cubbage et al. (2007) performed some sensitivity on land prices and environmental regulations on a similar 2005 data set, and found that they did tend to reduce returns in Brazil most, and in Uruguay and the U.S. the least, making net returns more comparable. On the other hand, increases in factor costs or stumpage prices also could change returns, with Brazil and Chile having the most "upside" potential. In fact, returns in Brazil in this study increased the most since 2005 based on higher stumpage prices.

The market structure among different countries also will influence timber investment returns greatly. The U.S. has relatively competitive open markets for stumpage, and indeed vertically integrated forest product firms no longer exist. With one exception, major wood manufacturers now rely almost completely on market wood, although they often do have long term timber purchase agreements. Thus stumpage and delivered prices in the U.S. reflect reasonable interaction among supply and demand from many competitors. Conversely, in Latin America, New Zealand, and South Africa, almost all of the plantations were initially planted just to provide wood for integrated timber lands and manufacturing facilities, at a minimum cost. The open markets have developed slowly afterwards and are often still quite thin. Open market stumpage or delivered to mill prices reflect probably only 25% or so on most areas in Latin America and Indonesia, so the prices are less reliable, except for Argentina, which has very competitive markets. Thus good locations for plantations, careful business arrangements, and perhaps some optimism, are required for an investor to actually achieve the high rates of return found in our research. This situation may change as more investors buy and plant timberland in these countries, such as Uruguay and Argentina, but still requires some faith that good markets and associated public policies will occur in the future at time of harvest.

The results help explain why secure investments with seemingly moderate rates of return remain attractive, such as in the U.S. South, New Zealand, and South Africa. Simply put, low risk and good business climate appear to be at least as important as potential returns for attracting long term investments for large plantation areas in these countries. They suggest that the same can be true for developing countries, as has occurred in the four major Southern Cone countries to some extent, and is in process in China. Achieving such stability will be the key for other countries to attract foreign and domestic capital. The recent economic turmoil in late 2008 surely will affect relative comparative advantages among countries in the future, but the results of this research should be relatively robust and relevant at least until a return to global economic prosperity occurs.

Acknowledgments

Partial funding for this research was provided by the Southern Forest Resources Assessment Consortium (SOFAC); U.S. McIntire-Stennis funds; as well time provided by the organizations that each co-author is employed by.

Literature Cited

Carle, Jim and Peter Holmgren. 2009. Wood from planted forests: A global outlook 2005-2030. Forest Products Journal 58(12):6-18.

Cubbage, Frederick, Patricio Mac Donagh, José Sawinski Júnior, Rafael Rubilar, Pablo Donoso, Arnaldo Ferreira, Vitor Hoeflich, Virginia Morales Olmos, Gustavo Ferreira, Gustavo Balmelli, Jacek Siry, Mirta Noemi Báez, and José Alvarez. 2007. Timber investment returns for selected plantation and native forests in South America and the Southern United States. New Forests 33(3):237-255.

Daniels, C. and J. Caulfield. 2008. Timberland investing in South America. Presented at: Timberland Investing Latin America Summit. São Paulo, Brazil. March 3-4.

Gonzalez, Ronalds W., Daniel Saloni, Sudipta Dasmohapatra, and Frederick Cubbage. 2008. South America: industrial roundwood supply potential. BioResources 3(1):255-269.

Leal, Jose. 2008. How to maximize gains and diversify risks in forest investments in Brazil. Presented at: Timberland Investing Latin America Summit. São Paulo, Brazil. March 3-4.

ONDD. 2009. OND/ NDD – Country risks synthesizing chart. The Belgian Export Credit Agency. Accessed at: http://www.ondd.be/webondd/Website.nsf/HomePageEn(Visitor)?OpenForm. 26 February 2009.

Sedjo, R.A. 1983. The Comparative Economics of Plantation Forestry: A Global Assessment. Resources for the Future/Johns Hopkins Press. Baltimore. 161 p.

Sedjo, R.A. 1999. The potential of high-yield forestry for meeting timber needs. New Forests 17:339-359.

World Bank. 2007. World Development Indicator. Accessed at: www.devdata.worldbank.org. 27 July 2007.

World Bank. 2009. Ease of Doing Business – Spreadsheet. Accessed at: http://www.doingbusiness.org/economyrankings/?direction=Asc&sort=0. 26 February 2009.

Paper for the proceedings of Southern Forest Economics Workers Meeting (SOFEW); March 9-10, 2009, Chapel Hill, North Carolina; To be posted at: http://sofew.cfr.msstate.edu/, and for presentation at the World Forestry Congress, Buenos Aires, Argentina, October 24-30, 2009.

SOFEW_2009_Plantation_Investment_Returns_V6

Southern Forest Economic Workers

2009 Annual Meeting

Monday, March 9, 2009

10:30 AM – 12:00 PM

Session B: Bioenergy I

Manuscripts:

Economy-Wide Impacts of Forest Bioenergy in Florida: A Computable General Equilibrium Analysis – Ming-Yuan Huang, Janaki R.R. Alavalapati, and Onil Banerjee

Economy-Wide Impacts of Forest Bioenergy in Florida: A Computable General Equilibrium Analysis

Ming-Yuan Huang, University of Florida[1], Janaki R.R. Alavalapati, Virginia Polytechnic Institute and State University, and Onil Banerjee, RMGEO Consultants

Acknowledgments

Funding for this study was provided by the United States Department of Energy and Department of Agriculture through Biomass Research Development Initiative Project. Authors acknowledge Alan Hodges at University of Florida for his help in conducting data.

---

[1] Ph.D. Candidate, School of Forest Resources and Conservation, Newins-Ziegler Hall, University of Florida, PO Box 110410 Gainesville, FL, 32611. Myhuang2@ufl.edu. (352)846-0902

Economy-Wide Impacts of Forest Bioenergy in Florida: A Computable General Equilibrium Analysis

Abstract

Florida has high potential to produce forest biomass as a source of renewable energy because of favorable climate. The Florida government has developed renewable bioenergy programs and policies to reduce the cost of biofuel and to compete with fossil fuel, such as the Florida Renewable Energy Technologies & Energy Efficiency Act. The main purpose of this paper is to investigate the economy-wide and welfare effects of select bioenergy polices in a computable general equilibrium (CGE) modeling framework. This study simulated two scenarios: the implementation of an incentive for the production of second generation bioenergy and a scenario anticipating technological gains in forest bioenergy production. The modeling experiments resulted in increased welfare and gross state product, and land shifting from agriculture to forestry. Results indicate that an incentive for the second generation bioenergy sector and investment in technology would result in overall positive outcomes for Florida´s economy and household welfare.

Keywords: Renewable energy; Computable general equilibrium (CGE) model; Forest bioenergy; biofuels; economy impacts

Introduction

The trend of energy consumption in the United States (US) has been on the rise. Given declining domestic production of crude oil, increased demand for energy is anticipated to be met to a large degree with significant growth in imports. About 58% of the current oil consumption is imported indicating a high level of dependency on foreign oil (EIA, 2008a). National security concerns associated with dependency on foreign oil are prompting policy-makers to look for alternatives. Meanwhile, the US greenhouse gas (GHG) emissions in 2007 were about 7,282 million metric tons of carbon dioxide equivalents[1]. Fossil fuel combustion was responsible for 82.3% of these emissions (EIA, 2008b) which is the largest source of anthropogenic GHGs (IPCC, 2001). Unlike fossil fuel, bioenergy is thought to be environmentally benign, socially desirable, and even economically competitive. According to the EIA (2008c), liquid biofuel production is expected to grow by 3.3% per year until 2030 in the US, though fossil fuel will still supply 79% of total energy use in 2030.

Bioenergy produced from grain-based materials, such as corn and wheat is known as first generation bioenergy. Some studies have shown that the energy content of grain-based bioenergy is lower than conventional energy and may compete with food and feed crops for land, water and other inputs (Childs and Bradley, 2007; Kojima *et al*., 2007; Fargione *et al*., 2008). These findings have driven research into second generation bioenergy, which is produced from cellulosic materials. Recent research has identified a number of advantages of second generation bioenergy over its predecessor. Second generation bioenergy can reduce competition between crops destined to food and those designated to fuel production; second generation biofuels have a greater net energy balance; second generation bioenergy leads to greater reductions in GHG emissions (Hill et al., 2006; Marshall and Greenhalgh, 2006; Dwivedi and Alavalapati, 2009); the use of logging residues to produce electricity can be highly cost-effective when coal-fired electricity plants are assessed emissions taxes (Gan and Smith, 2006); and, the removal of small diameter forest biomass (which may be used to produce fuel), can improve forest health, enhance biodiversity, and reduce wildfire risk (Polagye *et al*., 2007).

In 2007, the US government established the Energy Independence and Security Act setting a goal to produce 36 billion gallons of biofuels by 2022. Of that, corn ethanol production is capped at 15 billion gallons per year starting in 2015, and the remainder is anticipated to be met by cellulosic-based biofuels. This policy is expected to stimulate new market opportunities for forest biomass. At the same time, the Florida government has also initiated bioenergy programs and policies to promote bioenergy. One such policy is the issuance of tax credits for energy efficient products through the Florida Renewable Energy Technologies & Energy Efficiency Act of 2006. Meanwhile, Florida has more than 16.5 million acres of forestland that have a high potential for producing forest biomass that can be utilized to produce liquid biofuels or to generate electricity through co-firing.

This study applies a computable general equilibrium (CGE) model (Lofgren *et al.,* 2002; Holland *et al*., 2007) since it is effective in shedding light on important inter-sectoral linkages and in capturing the economy-wide impacts of policy implementation. The CGE model has been

[1] Carbon dioxide equivalent is a metric measure used to compare the emissions from various GHGs based upon their global warming potential (GWP). Carbon dioxide equivalents can be expressed in "million metric tons of carbon dioxide equivalents (MMTCDE)" (EPA, 2008b).

applied to assess the effects of environmental policies and bioenergy issues. Kretschmer and Peterson (2008) classified three approaches, which are disaggregating bioenergy production sectors directly form a social account matrix (Taheripour *et al*., 2008), implicit approach, and latent technologies, to introduce bioenergy into the CGE modeling frameworks. The implicit approach complies with a biofuel policy target to avoid breaking up of the original model structure (Banse *et al*. 2008). The latent technologies refer to existent production technologies, which are not active in the base year, would be active in counterfactual scenarios (Reilly and Paltsev, 2007). Research has shown significant shifts in land use resulting from the implementation of US and EU bioenergy policies (Banse *et al*., 2008; Taheripour *et al*., 2008; Kancs and Wohlgemuth, 2008). Abdula (2006) showed that incentives for biofuels production result in afforestation or plantations for bioenergy production, such as switch-grass. Reilly and Paltsev (2007) found that a biofuel industry that supplies a substantial share of liquid fuel demand would have very significant effects on land use and conventional agricultural markets in the US.

Although many studies can be found which explore bioenergy issues, an economy-wide analysis in Florida or in the US Southern region is still rare. Hence, in a general equilibrium framework, this study seeks to understand the socioeconomic impacts of bioenergy policies in Florida with specific attention to the impacts on related markets such as agriculture and forestry and the trade-offs between sectors. The following section provides an overview of bioenergy policies in Florida. Section 3 presents the modeling framework, the data, and the scenarios to be implemented in the analysis. Results and discussion are provided in section 4. The paper concludes with a summary of the key findings, policy implications and future research directions.

Bioenergy policies and programs in Florida

Florida consumes approximately 9 billion gallons of fossil fuels, which makes up about 97% of total energy consumption, and it ranks third in total energy consumption and fifth in energy consumption per capita in the US. Moreover, with a growing population, Florida's electricity consumption is expected to increase by about 30% by 2016 (FDEP, 2006). Thus, Florida needs clean, affordable, and sustainable energy sources to support the future economy, maintain a high quality of life, and insure energy security. Research has indicated that Florida is the state with the highest potential to produce biomass products. Florida has approximately 16.5 million acres of forestland and its forest sector produced about 2.5 million tons of mill residues in 2007 (USFS, 2008). As such, Florida has the potential to supply over 30% of its transportation fuel demand from forest/cellulosic biomass (UF/IFAS, 2006).

While the federal government signed the Energy Independence and Security Act of 2007, the Florida state government also initiated programs to promote bioenergy. The 2006 Florida Energy Act established the Florida Energy Commission and the Florida Renewable Energy Technologies & Energy Efficiency Act. Some of the programs related to bioenergy include the Renewable Energy Grant program, the Bioenergy Grant Program, and the Renewable Energy Corporate Tax Program. The Renewable Energy Corporate Tax program includes a sales tax exemption on the sale or use of specific "clean fuels", such as biodiesel and ethanol and an investment tax credit of 75% of all capital costs, operation and maintenance costs, and research and development costs for biofuel production. The legislation also amended the Florida Power Plant Siting Act to streamline permission for new power plants and to promote the development and use of biodiesel, ethanol, hydrogen, and other renewable fuels.

In 2006, the government of Florida established the Florida Farm to Fuel Initiative to enhance the market for and promote the production and distribution of renewable energy from Florida-grown crops, agricultural waste, and wood residues. The initiative includes an education program and a comprehensive statewide information campaign to educate the public about the benefits of renewable energy and the use of alternative fuels, particularly ethanol.

Furthermore, the Florida government passed a comprehensive energy bill in 2008 that created new programs associated with bioenergy (2008 FL H.B.7135). The bill set a renewable fuel standard mandating that all gasoline sold in Florida must contain 10% ethanol by volume by the end of 2010. It established an ethanol production credit as well whereby county governments are eligible to receive waste reduction tax credits for the use of yard clippings, clean wood waste, or paper waste as feedstock for the production of clean-burning fuels. Impacts of these policies are expected to have spill-over effects on all sectors of the state economy and assessing them is critical for further decision-making.

Modeling framework

This study applies a CGE model developed by Lofgren *et al*., (2002) and customized by Holland *et al*., (2007) for compatibility with the IMPLAN (IMpact analysis for PLANning) data set to assess policy impacts. Some of the adjustments to the model include a more robust representation of transfers between institutions and the inclusion of indirect business taxes. In addition, we model that the government, investment account, and households receive income from the primary factors of production.

In the modeling framework, producers are modeled to maximize profits with a two-level production technology. At the first level, intermediate and primary inputs (labor, capital, and land) are demanded in fixed proportions to produce each unit of output. At the second level, the aggregate intermediate input is specified by a Leontief function of disaggregated intermediate inputs, while value added is captured by a constant elasticity of substitution (CES) function of the primary inputs.

The institutions in the model are: three household income classes, the state and federal government (including investment and expenditure), general investment, and the rest of world. The households receive income from the primary factors of production and transfers from other institutions; they make payments to the direct tax account, save, consume, and make transfers to other institutions. Household consumption is assumed to maximize a Stone-Geary utility function, which leads to linear expenditure system (LES) demand functions. The government collects taxes, which are at fixed ad valorem rates, and receives transfers from other institutions. Government consumption is fixed in quantity and government transfers to households and the investment account are indexed by the consumer price index (CPI). The general investment institution receives payments from the primary factors and transfers from other institutions. Investment demand is fixed and defined as the base-year quantity multiplied by an adjustment factor. Transfer payments from the rest of the world, domestic institutions, and factors are all fixed in foreign currency.

Regarding trade, domestic and imported goods are considered imperfect substitutes by the Armington assumption which applies a CES function to aggregate domestic and imported goods to produce a composite good. The demand of each sector's output is obtained by minimizing the cost of the composite good subject to the CES function. Composite commodity supply is a function of the price of imports and the price of regionally produced commodities. The export supply function is derived from a constant elasticity of transformation (CET) function. It specifies the value of exports based on the ratio of domestic and export prices. The CET function assumes imperfect substitutability between products produced for the domestic and export market by a given industry.

Equilibrium prices are endogenously determined (commodity prices, factor prices and the exchange rate) to clear the product, factor, and foreign exchange markets. The parameters of these functional forms are calibrated with the Florida SAM. With regards to factor closures, labor supply is modeled as flexible in supply and mobile across sectors within the state, capital is activity-specific and fixed, and land is fixed in supply and mobile across sectors. The foreign exchange rate is assumed flexible and the import price is a function of the world price, the import tariff and the exchange rate. Total investment is treated as exogenous with outside capital flows adjusting to equate total savings with the investment. The CPI is set to be the numeraire. The GAMS (General Algebraic Modeling System) software is used to solve the model as a mixed complementary problem by using PATH solver.

Data Base

The database is derived from 2006 Florida IMPLAN data and includes 509 sectors[1]. To simplify the model, the 509 sectors were aggregated into 11 sectors, namely: agriculture, logging, sawmill products, pulp and paper products, other wood products, conventional energy, manufacturing, transportation, first generation bioenergy, second generation bioenergy sectors, and other sectors. The sector code *151* in the IMPLAN data, *other basic organic chemical manufacturing*, represents the first generation bioenergy sector. IMPLAN does not provide explicit information on second generation bioenergy since the level of second generation bioenergy output was very low in 2006. Thus, the intermediate consumption and primary factor consumption of second generation bioenergy sector data is disaggregated from the logging, sawmill, and pulp-mill sectors by a small ratio based on the literature (Kretschmer and Peterson, 2008; Taheripour, *et al*., 2008). With regards to households, IMPLAN describes nine household-income classes. To simplify analysis, households were aggregated into three income categories, namely: low (income less than $25 thousand dollars), medium ($25~75 thousand dollars), and high (greater than $75 thousand dollars) income categories.

The policy scenarios

This research investigates two specific scenarios based on the policies discussed in section 2 to analyze the economy-wide and welfare impacts of biofuels production in Florida. The following scenarios were considered:

A. Bioenergy incentive

Since rising GHG emissions are leading a shift from fossil fuels to renewable energy sources, a price support for bioenergy or a tax on conventional energy could be used to simulate shifting preferences for clean and efficient energy sources. Currently, most ethanol subsidies are applied to grain-based ethanol, or first generation bioenergy production. To encourage the

[1] Between 1990 and 2000, IMPLAN data included 528 sectors based on the Standard Industrial Classification (SIC) system. From 2001 onward, datasets were modified to include 509 sectors based on the North American Industry Classification System (NAICS) codes.

development of forest bioenergy, a 10% fuel tax reduction is applied to the second generation bioenergy sector. This tax reduction can be considered a subsidy for cellulosic bioenergy production.

B. Technological progress

Due to the high cost of energy production from woody biomass with current technology, energy companies are still less likely to use biomass in energy production. There are a number of policy alternatives that may be implemented to increase bioenergy production. Policy incentives to reduce the cost of biomass transportation or a production subsidy would stimulate bioenergy production. Cost-sharing capital investments in constructing woody fuel bioenergy plants would lead to the reduction in the unit cost of bioenergy production. Stimulating technological gains in bioenergy production would also reduce production costs. In this scenario, anticipated technological gains are simulated as a 10% reduction in the second generation bioenergy sector's intermediate consumption of logging, sawmill products, and pulp-mill products.

Simulation results

In this section, simulation results are presented and interpreted. The results report the policy simulation effects on supply price and quantity, government expenditure and investment, factor demand, and welfare.

Supply price and quantity

The price of the second generation bioenergy commodity decreases by -0.10% while there are insignificant changes in the other sectors in the bioenergy incentive scenario (Table 1). Most of the supply prices decline with the exception of the agriculture, conventional energy, and other sectors in the bioenergy incentive scenario. For the technological progress scenario, the supply price of second generation bioenergy drops by -1.75%. The supply price of agriculture, logging, pulp-mill products, conventional energy, and other commodities increase, while sawmill products, other wood products, manufacturing, transportation, and first generation bioenergy decrease. With an increase in the price of logging and pulp-mill products in the technology scenario, we may expect landowners to increase the level and frequency of forest thinning to benefit from the price increase. Furthermore, since second generation bioenergy is a kind of alternative energy, the price of conventional energy increases slightly when the price of second generation bioenergy decline in both scenarios.

Table 1 Percent change in producer commodity prices

	Bioenergy Incentive	Technological progress
Agriculture	0.000003	0.000084
Forest products and logging	-1.35E-07	0.000194
Sawmill products	-3E-06	-4E-06
Pulp and paper products	-2.29E-09	1.87E-08
Other wood products	-1E-06	-2.3E-05
Conventional energy	1.46E-07	7.74E-07
Manufacturing	-1.23E-08	-3.46E-07
Transportation	-1.25E-07	-3E-06
Others	1.42E-07	0.000001
First generation bioenergy	-1.27E-07	-3E-06
Second generation bioenergy	-0.09592	-1.74794

Since the share of the second generation bioenergy production in total economic output is very small, it is not expected that the supply of this commodity would change much in the scenarios. What is interesting, however, is the direction of effect the policy simulations have on commodity supply. The supplies of all commodities rise in both scenarios with the exception of the agriculture sector (Table 2). The quantity of second generation bioenergy supply increases by 0.18% in the incentive scenario and by 3.49% in the technology scenario.

Table 2 Percent change in quantity of commodity supply

	Bioenergy Incentive	Technological progress
Agriculture	-2E-06	-0.00011
Forest products and logging	0.000094	0.003545
Sawmill products	0.000011	0.000194
Pulp and paper products	0.000011	0.00015
Other wood products	0.000003	0.00004
Conventional energy	4.17E-07	0.000006
Manufacturing	5.57E-07	0.000007
Transportation	0.000001	0.000018
Others	2.90E-07	0.000002
First generation bioenergy	0.000002	0.000037
Second generation bioenergy	0.18476	3.490816

Primary factor demand and the government

With a flexible labor supply, all sectors demand more labor with the exception of second generation bioenergy. This may be explained by the fact that intermediate inputs and primary factor inputs are aggregated in fixed shares. The results show that the intermediate inputs increase by 0.19% and 14.05% for second generation bioenergy in the bioenergy incentive and technological progress scenarios, respectively. Hence, with a fixed labor wage and flexible labor supply, the second generation bioenergy sector demands less labor in both scenarios. The price of capital also increases marginally for all sectors and decreases for the second generation bioenergy sector in order to clear the capital market. Both scenarios result in reduced unemployment. With fixed land supply, there is a contraction in agricultural demand for land and an increase in the logging sector's demand for land in both scenarios (Table 3).

Table 3 Percent change in demand for land

	Bioenergy Incentive	Technological progress
Agriculture	-8E-06	-0.00031
Forest products and logging	0.000118	0.004452

The impacts of the policy simulations on the government are presented in table 4. The federal government revenue increases as federal expenditure decreases; the state government revenue and expenditure increase slightly in both scenarios. Meanwhile, the federal and state governments collect more indirect business taxes in both scenarios.

Table 4 Percent change in government revenue and expenditure

	Bioenergy Incentive	Technological progress
Federal government revenue	2.75E-07	5.66E-07
Federal government expenditure	-6.26E-08	-1E-06
The state government revenue	0.000001	0.000002
The state government expenditure	0.000001	0.000002

Household and welfare impacts

Net household income increases for all household income classes in both scenarios (Table 5). Household utility increases slightly for all household classes in the bioenergy incentive scenario. However, in the technology scenario, household utility declines for low-income households and increases for medium and high-income households. Results show that some commodity supply prices increase, namely agriculture, logging, pulp-mill, conventional energy, and other products. Thus, the negative impact on low-income households may be explained by a negative substitution effect which is greater than the positive income effect.

Table 5 Percent change in household (HH) utility

	Numbers of HH (% of total HH)	Bioenergy Incentive	Technological progress
Low HH	838,866(18%)	1.35E-09	-3.12E-08
Medium HH	2,264,843(49%)	1.02E-08	6.09E-09
High HH	1,529,265(33%)	1.19E-08	1.41E-08

This study also applies the Hicksian equivalent variation (EV) as a measure of both price and income effects rather than simply a measure of change in household income. Equivalent variation is measured at the level of prices and income present prior to the implementation of a policy. It is the minimum payment the consumer would need to forgo the policy change. In other words, it is the amount the consumer would need to receive to be as well-off if the policy had been implemented. For the bioenergy incentive scenario, the EV increases for low, medium and high income classes by \$15, \$327, and \$ 269, respectively. For the technological progress scenario, the EV decreases for low income households by \$340 and increases in the case of medium and high income households by \$194 and \$319, respectively. Finally, Florida's gross state product (GSP) increases slightly in both bioenergy incentive and technological progress scenarios by \$4086 and \$1227, respectively.

Conclusions

Private forests in Florida have high potential to produce forest biomass that can be utilized to produce cellulosic ethanol or to generate electricity through co-firing. It is believed that promoting the second generation bioenergy sector can create job opportunities and stimulate economic growth. This research assessed the socioeconomic impacts of two potential cellulosic bioenergy scenarios on the Florida economy. The scenarios evaluated included a subsidy for the second generation bioenergy sector and a technological improvement in second generation bioenergy production technology. Overall, results indicate that subsidizing the second generation bioenergy sector and technological progress in second generation bioenergy production would lead to increased welfare and GSP, and land shifting from agricultural production to forest-based activities. The price of first and second generation bioenergy dropped in both scenarios. Both federal and state government revenue increased. Moreover, the technological progress scenario showed that the price of logging and pulp-mill products increased. One implication for landowners is that increasing the level and frequency of forest thinning could result in increased income. In addition, thinning can improve forest health, reduce wildfire risk and enhance biodiversity.

The implementation of incentives for the production of second generation bioenergy may generate new market opportunities for forest biomass and increase the demand for forest bioenergy resulting in overall positive outcomes for the economy. Investment in technology may reduce the cost of bioenergy production and further stimulate the production of forest bioenergy. To maximize positive policy outcomes, complimentary policies may be required to offset the small reduction in the income of low-income households.

Future research directions include the development of a dynamic CGE model to more realistically model policy scenarios and trace socioeconomic impacts through time. A regional dataset is also being constructed for the Southern US region. It would enable a regional approach to the development and implementation of bioenergy and bioenergy feedstock policies.

References

Abdula, R.D. 2006. Computable general equilibrium analysis of the economic and land-use interfaces of bio-energy development. The International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18.

Base, M., Hans, V.M., Andrzej, T., Geert W. 2008. Will EU biofuel policies affect global agricultural markets? European Review of Agricultural Economics 35(2):117-141

Childs, B., Bradley, R. 2007. Plants at the Pump: Biofuels, Climate Change, and Sustainability. World Resources Institute Report. 40 p. http://www.wri.org/publication/plants-at-the-pump. Accessed 4/23/2009

Dwivedi, P., Alavalapati, J.R.R. 2009. Stakeholders' perceptions on forest biomass-based bioenergy development in the southern US. Energy Policy 37:1999-2007

Energy Information Administration (EIA). 2008a. Energy in Brief. http://tonto.eia.doe.gov/energy_in_brief/print_pages/foreign_oil_dependence.pdf. Accessed 4/23/2009

Energy Information Administration (EIA). 2008b. Emissions of Greenhouse Gases Report. http://www.eia.doe.gov/oiaf/1605/ggrpt/index.html. Accessed 4/23/2009

Energy Information Administration (EIA). 2008c. Annual Energy Outlook 2009. http://www.eia.doe.gov/oiaf/aeo/overview.html. Accessed 4/23/2009

Florida Department of Environmental Protection (FDEP), 2006. Florida's Energy Plan. http://www.dep.state.fl.us/energy/energyact/files/2006_Energy_Plan.pdf. Accessed 4/23/2009

Fargione, J., Hill J., Tilman D., Polasky S., Hawthorne P. 2008. Land clearing and biofuel carbon debt. Science 319(29):1235-1238

Gan J., Smith C.T. 2006. A comparative analysis of woody biomass and coal for electricity generation under various CO_2 emission reductions and taxes. Biomass and Bioenergy 30:296-303

Marshall, L., Greenhalgh S. 2006. Beyond the RFS: the environmental and economic impacts of increased grain ethanol production the U.S. WRI Policy Notes No1. World Resources Institute. http://pdf.wri.org/beyondrfs.pdf. Accessed 4/23/2009

Hill, J., Nelson, E., Tilman, D., Polasky, S., Tiffany, D. 2006. Environmental, economic, and energetic costs and benefits of biodiesel and ethanol biofuels. Proceedings of the National Academy of Sciences of the United States of America. (PNAS) 103(30):11206-11210

Holland, D., Stodick, L., Painter. K. 2007. Assessing the economic impact of energy price increases on Washington agriculture and the Washington economy: a general equilibrium approach. Working Paper WP 2007-14. School of Economic Sciences, Washington State University.

Intergovernmental Panel on Climate Change (IPPC). 2001. Climate Change 2001: the Scientific Basis. Geneva, Switzerland, WMO.

Kancs, A., Wohlgemuth, N. 2008. Evaluation of renewable energy policies in an integrated economic-energy-environment model. Forest Policy and Economics 10:128-139.

Kojima, M., Mitchell, D., Ward, W. 2007. Considering trade Policies for Liquid Biofuels. The International Bank for Reconstruction and Development/ The World Bank.

Kretschmer, B., Peterson, S. 2008. Integrating bioenergy into computable general equilibrium models – a survey. Working Paper No.1473. Kiel Institute for world Economy, Germany. 22 p.

Lofgren, H., Harris, R. L., Robinson, S., Thomas, M., EI-Said, M. 2002. A standard computable general equilibrium (CGE) model in GAMS. International Food Policy Research Institute, Microcomputer in Policy Research 5. Washington, D. C.:IFPRI. 69 p.

Polagye, B.L., Hodgson, K.T., Malte., P.C. 2007. An economic analysis of bio-energy options using thinning from overstocked forests. Biomass and Bioenergy 31:105-125.

Reilly, J., Paltsev S. 2007. Biomass Energy and Competition for Land. Report series on the MIT Joint Program on the Science and Policy of Global Change. No 145.

Taheripour, F., Hertel, T. W., Tyner, W. E., Beckman, J. G., Birur, D. K. 2008. Biofuels and their by-products: global economic and environmental implications. Paper presented at the American Agricultural Economics Association Annual Meeting, Orlando, FL, July 27-29, 2008.

United State Forest Service (USFS), 2008. Timber Products Output Mapmaker 1.0. http://ncrs2.fs.fed.us/4801/fiadb/rpa_tpo/wc_rpa_tpo.ASP Accessed 4/23/2009

University of Florida, Institute of Food and Agricultural Sciences (UF/IFAS), 2006. http://www.sura.org/commercialization/docs/Feb07_Summit_White_Papers/11-UF_White_Paper_Feb07.pdf. Accessed 4/23/2009

Southern Forest Economic Workers
2009 Annual Meeting

Monday, March 9, 2009
1:15 PM – 3:00 PM
Session B: Nonindustrial Private Forest Landowners/Forest Inventory

Manuscripts:

Family Forest Owner Focus Group Perceptions of Invasive Species Control Methods' Effectiveness and Economic Feasibility – Matthew B. Howle, Thomas J. Straka, and Matthew C. Nespeca

Modeling NIPF Landowner Behavior: Developing 'A Willingness to Sell Timber' in the Future Model – Kevin Hoyt and Donald G. Hodges

Family Forest Owner Focus Group Perceptions of Invasive Species Control Methods' Effectiveness and Economic Feasibility

Matthew B. Howle[1], Thomas J. Straka[1], and Matthew C. Nespeca[2]

[1] Graduate Research Assistant and Professor, respectively, Department of Forestry and Natural Resources, Clemson University, Box 340317, Clemson, SC 29634-0317; (864) 656-4827; mhowle@clemson.edu, tstraka@clemson.edu.
[2] Regional Sales and Technical Service Manager, Nufarm Americas, Inc., 1541 Appling Drive, Mount Pleasant, SC 29464; (630) 418-6039; matt.nespeca@nufarm.com.

Family Forest Owner Focus Group Perceptions of Invasive Species Control Methods' Effectiveness and Economic Feasibility

Abstract

Focus group methodology was used to obtain qualitative data in a group discussion, field demonstration situation on the perceptions of South Carolina family forest owners relating to practice efficiency and economic feasibility of invasive species control methods. Chemical control methods were emphasized. Focus group research is common in forestry, but group interviews are rarely performed in the field. Focus group interviews took place on sites where various herbicide treatments were implemented for Chinese privet control. Discussion centered on factors that made treatments appear effective in terms of both control and cost. Focus groups were divided into two groups; one with and one without a primary timber production objective. Forest owners expressed concerns about the cost effectiveness of treatments with regards to timber value, and the possible need for expensive multiple treatments, cost-share incentives, and treatment guarantees from herbicide applicators. Field focus groups proved to be a valuable tool to gauge forest owner perceptions of chemical control methods effectiveness in terms of both perceived control results and cost. An unexpected result was a strong feeling among the forest owners that focus groups are a powerful demonstration tool.

Key Words: Herbicide, family forest, invasive species, chemical control, Chinese privet

Introduction

Family forest owners are very important to the South's economy and environmental quality. Southern forest land is primarily held in family forests (Butler 2008). The opinions, perceptions, and motivations of these family forest owners lead to forest management decisions that have great impact on the health of the region's forest land. It is crucial that family forest owners play an active role in the ever-growing problem of invasive species in the southern forest. Clearly, their perceptions on the effectiveness of various control methods, along with benefit/cost issues, will determine how active a role they play in invasive species control.

The use of focus groups in forestry research is common. We used focus groups to evaluate chemical and mechanical control methods for Chinese privet (*Ligustrum sinense*), an invasive woody shrub imported from China in the mid-ninetieth century (Miller 2003). It is an aggressive, shade-tolerant invasive, particularly in bottom-land hardwood forests, where it produces abundant seeds widely spread by birds and water drainages (Miller 2003, Langeland and Burks 1998). It survives in most environments and its tolerance to shade aids its growth (Harrington and Miller 2003, Matlack 2002). It becomes a thick layer of understory, possibly making it a factor limiting hardwood regeneration (Harrington and Miller 2003).

We were interested in what made family forest owners perceive various control methods to be effective and how they evaluated the benefit/cost relationship of each method. The focus groups met in the field at actual control sites. Use of focus groups in the field is not common in forestry, so this project presents an opportunity to evaluate focus group effectiveness in a field situation.
Focus group methodology can generate valid information important to program advancement (Grudens-Schuck et al. 2004). Focus groups do not however provide concrete quantitative data. They instead bring out shared perspectives from a combined local demographic and incite or uncover often surprising information through conversational clues and repeated words or ideas (Grudens-Schuck et al. 2004). They are common to marketing research and most often take place in a conference room indoor setting (Kruger and Casey 2000). Focus groups are not new to the forestry community and therefore details of focus group methodology will not be discussed.

Focus groups have been used in the past to look at many natural resource management issues. They were used to identify concerns of family forest owners knowing who to contact for forestry assistance in West Virginia (Kingsley et al. 1988), to develop a consensus of Arkansas family forest owners that they were land stewards concerned with protection of the environment but did not believe in land use regulations (Williams and Kluender 1998), to better understand the relationship between written forest management plans and forest certification participation in Minnesota (Leahy et al. 2008), to evaluate the impact of deer stand restrictions on participation of landowners in the Wetlands Reserve Program in Wisconsin (Forshay et al. 2005), and to study federal and state forestry incentive programs and sustainable forestry practices on family forests (Greene et al. 2006). All these focus groups employed a conventional indoor, conference room-type focus group strategy. Our focus group was different; it was in the field and developed benefit/cost focus related to actual field conditions.

Our objective was to get feedback on a specific invasive species, Chinese privet in South Carolina's bottom-land forests, but at the same time to identify the factors that forest owners use in evaluating forest management techniques like chemical and mechanical control. We also made economic feasibility a primary feedback factor. Herbicide treatments were implemented to demonstrate biologically effective control of Chinese privet; control methods and the level of control varied. Unlike the conventional indoor setting, we took participants to see varying herbicide treatments in person, walking through various levels of infestation, and stopping at strategic evaluation points. They experienced all the natural factors that affect owners' perceptions of treatment effectiveness, i.e. bugs, heat, and humidity. Participants were able to give very specific on-site perceptions of cost effectiveness and treatment efficacy.

Methods

Field focus groups require site selection and planning, participant selection, on-site focus group interviews, and data analysis. Three locations were used and relatively small blocks on each tract were appropriately treated using different methods, in demonstration fashion (Table 1). Four treatments and a control blocks were used on various locations (Table 1).

Table 1: Herbicide applications demonstrated at each location

Treatments	**Location 1 (Greenwood Co.)**	**Location 2 (Aiken Co.)**	**Location 3 (Kershaw Co.)**
4% glyphosate foliar mistblower application	√		√
4% glyphosate foliar mistblower application plus cut stem (50% glyphosate) on all stems over 6 ft. in height	√		√
1 oz./acre metsulfuron (Escort®) foliar mistblower application	√		√
8 quarts glyphosate per acre @ 20 GPA aerial application		√	
Untreated check (control)	√	√	√

Site Selection

Site selection involved locating cooperating forest owners and geographic locations that were representative of typical forest stand conditions across the state. Sites ranged from the upper Piedmont to the upper Coastal Plain. Prior to the focus group discussion the most representative examples of treatments and varying effectiveness were located on each tract and a walking path between examples (stops) were determined. Special effort was made to expose forest owners to the variability between the different treatments, the variability, if any, within each treatment, and the terminal variability where a treatment ends and non-treatment areas persist. Thus, the predetermined route which participants walked through the different treatment areas and where they stopped were crucial decisions (Figure 1). An obvious problem with field-based focus groups is the weather; we were lucky and weather was not a problem. Transportation to the sites was by van.

Figure 1: Selecting a route and determining sites at Location 2 before assembling focus group

Selecting Participants

Ten family forest owners from Greenwood and McCormick Counties were recruited for the first focus group and fifteen from Kershaw County were brought in for the second focus group. The participants were active members of county landowner organizations and were thus familiar with forestry and management practices. The groups were fairly homogenous and came from adjacent counties; this offered an advantage as often individuals will censor their ideas when around others who differ from them in education, status, or other characteristics (Grudens-Schuck et al. 2004). Similar people tend to reciprocate and share more information than dissimilar people (Fern 2001). The participants were separated into two groups by their main forestry objective, either timber production or non-timber production. They were asked to identify themselves by "timber" or "non-timber" during discussions. An incentive of a barbeque dinner and a gas card was given to each invitee who showed up as a reward for attendance and as an inducement to participate.

Interview Technique

Upon arrival participants were asked to fill out a short survey consisting of informal questions to gather demographics and to assess prior knowledge of invasive species management. A short presentation was given to explain the problems posed by invasive species and introduce Chinese privet. This ensured that even those participants who were not familiar with privet and the concept of invasive species management were informed enough to give input and participate. Most importantly, discussions taking place at each of the predetermined sites along the walking tour were directed by the moderator in a way to bring out reasoning and specific factors participants used to evaluate biological and economic effectiveness of the various herbicide treatments. The order of questioning is important (Krueger and Casey 2000). First participants were asked what they saw and how they perceived the vegetation with no knowledge of the treatment techniques or proven effectiveness. After initial discussions began to fade, an expert on herbicides explained the treatments in detail including their cost. A new round of moderator led questions focused on benefit/cost relationships and willingness to treat privet using these treatments. The moderator used specific questions in order to probe deeper into why participants said what they did (motivations). We asked them to justify the use of factors they employed in evaluation and to explain reasons for each perception of treatment.

Logistics

Focus groups in the field have the potential for a lot more problems than ones done indoors. Since we located no use of field focus groups in the literature, there were no established procedures. The task of anticipating and mitigating logistical issues was important to success of the project. Field focus group feasibility can depend on many factors. Specific measures taken to secure success of these particular interviews include: participant recruitment, transportation provisions, pre-defined paths, digital voice recordings, and expert presence. County extension agents helped tremendously in recruitment of interested landowners. Providing transportation to and from the field locations saves time and frustration. Well-planed paths through vegetation provided areas where variability could be easily observed. Voice recordings provided a copy of exact wording used during discussions and the presence of an expert on forestry herbicides facilitated technical dialogue. There are some logistical problems that are difficult to plan around. Inclement weather could prevent field focus groups from even taking place, so a rain date might be necessary. Also, when dealing with family forest owners, keep in mind that many of them are older and possibly cannot walk as far or deal with heat as well as the researchers.

Analysis

Focus group analysis can be done in various ways. Transcripts of actual word for word discussions and notes stating recurring topics, expressions, and enthusiasm should be reviewed (Krueger and Casey 2000). Links concerning land use objectives (timber, non-timber) and unexpected responses were also explored. At the time of this presentation our analysis is still in-process and our results are preliminary.

Results

The key results were identification of fundamental economic and technical factors that steer family forest management decision making. These resulting economic factors include concerns about timber investment returns, retreatment concerns, and cost-share assistance availability. Also, we found focus groups in the field to be an effective technique for finding what landowners use to determine these decision swaying issues as well as a possible demonstration technique.

Timber Investment Concerns

Multiple participants brought up and elaborated on the concerns they have about paying for Chinese privet control regardless of effectiveness. The issue was timber investment yield. Would controlling Chinese privet promote timber growth and increase future harvest values enough to justify the cost of management? The quality of timber in a potential treatment also seemed to be an important consideration. Some sort of quality timber stand seems to be necessary before an investment in privet control would be considered.

Supporting quotes come from landowner responses given, when asked whether or not they were willing to pay either 200 or 250 dollars per acre for a particular privet control treatment. Dialogue between a timber oriented forest owner and the moderator point out the importance of valuable timber when considering economic feasibility of privet control. Also, dialogue between a landowner and the herbicide expert, during the Kershaw focus group, displays the importance of the future rate of return on the investment. The dialogue below is between the moderators, the herbicide expert, timber oriented forest owners (T), and non-timber oriented forest owners (NT).

> NT: It think it's bad (privet) first of all, if I had the money I probably wouldn't mind clearing it up… from an economic stand point you have got to have some money coming in to pay for it…
> T: Well I don't believe it would be worth 250 (dollars). I don't think you would ever get that much return form it, even half that. Now if you have a beautiful stand of hardwoods, but not this type here….
> Moderator*:* So if the timber is more valuable, then it's worth treatment?
> T: Yeah, well your timber value…if you got good timber, it's valuable, you know, and it's (privet) taking a lot of plant food and moisture from the timber… if it's a stand of beautiful hardwoods, I would come near to considering it.
> NT: Has there been any studies done on how much more growth you get or how much more production you get out of the land that's been treated vs. land that hasn't been treated?
> Expert: No, not beyond just observation. I don't think there have been any growth and yield studies done."
> NT: Not gonna spend two hundred dollars if there is no guarantee I am gonna get 200 dollars more out of it.

Another situation related to future returns and growth and yield of timber surfaced concerning clear-cutting and hardwood regeneration. Often when privet becomes established in a forest situation and subsequently the overstory is removed by clear-cutting, privet grows up in a monoculture impeding all regeneration (Harrington and Miller 2008, Miller 2003). This issue was understood by a focus group participant and became a consideration of many of the landowners.

> T: Where it was clear-cut, and had the privet come back, and it pretty much taken over some tracks. So, I think, in a clear-cut situation, it may be worth it the 200 dollars…
> NT: I have a lot of observations, if you're clear-cutting this area… I think that if there is a problem then it would still be effective to do what you're talking about.
> NT: I think the price would probably be effective from the standpoint of when you reforest the area.

Retreatment Concerns

Variability was observed between and within the treatment areas. Some sites displayed less than 100% privet control and participants noticed it. Both groups indicated that the cut and spray glyphosate treatment (most expensive treatment) was very effective due to its open appearance and its low expectancy for retreatment. The discussion produced the sentiment that landowners would rather pay more up front to cut and spray than possibly pay again for follow up treatments. Forest owners expected to have to retreat areas associated with both spray-only treatments. In Greenwood County, the focus group session began by discussing an area treated using the spray-only glyposate method. Next they moved on to observe a cut and spray glyposate treatment area. They were asked about their willingness to pay more for cut and spray than spray-only. They were informed about possible retreatment needs and costs associated with each treatment.

> Moderator: So, 200 (dollars) once and 100 down the road or 250 here, that's what we are comparing. Show of hands, yes or no?
> Majority: Yes
> T: If you got to pay 300 back there, I would pay 250 for this.

In light of the retreatment concerns, mainly due to incomplete herbicide control, a consensus was formed by the groups. They stated a need for negotiation and contractual guarantees from hired herbicide applicators to avoid high retreatment cost and low biological effectiveness. The following dialogue between participants and the herbicide expert documents the group sentiment.

> NT: You have got to negotiate with the guy who is applying it… come back and get it and I am not gonna pay him anything.
> Expert: So, warranty is important?
> NT: Exactly, you better negotiate with the guy because if he is just going to spray the bottoms and the tops are gonna come back and you're gonna have to pay him again. Nuh uh not this old man.
> T: You got to watch the guy you're working with and have a contract.

Cost-Share Availability

Due to the nature of invasive species management, it is conceivable that state or federal cost-share would be available to private forest owners in order to assist them financially in combating non-native plant invasions. Forestry management incentive programs were originally designed to assist forest owners in becoming dynamic timber managers (Green et al. 2006). Today, cost-share assistance programs exist that promote biodiversity and environmental quality. Participants from each focus group brought up cost-share assistance and asked about availability. One focus group came to a consensus agreeing that availability of some form of cost-share assistance would be a decision making factor with regard to privet control. One landowner states, "It would be the availability of maybe some cost-share funds through… to cut down the cost of doing this with landowners?" Another group also asked about cost-share options. They expressed interest in using cost-share to implement the cut and spray glyposate method.

> Moderator: … the government was going to 50% cost-share, and it cost 250 dollars, how many of you would probably do it with cost share, but probably wouldn't without cost-share? Get a show of hands for that.

Eight out of 15 participants raised their hand indicating they would treat with cost-share but not without. One of the interesting, surprising results that surfaced in the data came only from the December focus group which took place shortly after federal bailouts were announced for the banking and auto industries. A couple of individuals were against federal government assistance in light of those recent events.

> NT: I like cost share, I'm not opposed, it just doesn't seem to be the right time for it as far as the government is concerned. You know, I think you take care of yourself.
>
> NT: I just don't think that the government needs to be doing that right now, you know they're in a hell of a mess…
>
> T: I don't think they should be helping us now with the situation the economy is in.

Positive Outcomes

Much like the negative feeling toward cost-share another surprising result surfaced from the data. As a positive externality, from the focus group exercise itself, we found that the field focus groups were perceived as highly effective demonstrations. We found consistently and enthusiastically that participants felt the focus group was a great invasive species management and herbicide demonstration. When asked about the focus group's effectiveness as a demonstration, responses included the following quotes.

> NT: perfect
>
> NT: It turned out very well
>
> Moderator: Was there a better way to get this information?
>
> Most: No

This was certainly not expected. The focus groups were not intended to be demonstrations. However, participants did gain information. Data flowed from the participants to the researchers, and also to each other, before expert information was communicated to them. This aspect could be utilized in an extension setting.

Conclusions and Recommendations

Field focus groups were a successful way to gain insight into the perceptions of South Carolina family forest owners, with regard to invasive species management practices. Through discussions about herbicide treatment efficacy, decisive factors were brought to light that forest owners consider when weighing management options. While unconventional, and potentially difficult, in-field focus groups are possible. They offer a setting which puts participants in contact with each other and all physical specific characteristics that affect perceptions of management applications. Extension agencies could benefit from some of the techniques used for in-field focus groups, because of their demonstration benefits.

Specifically, it surfaced that cost-share incentives and control guarantees from contracted herbicide applicators are determining factors related to the feasibility, affordability, and willingness for forest owners to engage in large scale herbicide treatment for Chinese privet control. This relates to concerns about perceived lack of increased timber returns following control measures and concerns about retreatment costs. Perceived low timber value, lack of growth and yield projections, and the possibility of mediocre treatments requiring costly follow-up treatments could discourage family forest owners from participation in invasive species management.

Literature Cited

Butler, B.J. 2008. Family forest owners of the United States, 2006. USDA For. Serv. Gen. Tech. Rep. NRS-27. 72 p.

Fern, E.F. 2001. Advanced focus group research. Sage Publications, Inc., Thousand Oaks, CA. 254 p.

Forshay, K.J., H.N. Morzaria-Luna, B. Hale, and K. Predick. 2005. Landowner satisfaction with the wetlands reserve program in Wisconsin. Environ. Manage. 36(2):248-257.

Greene, J.L., M.A. Kilgore, M.G. Jacobson, S.E. Daniels, and T.J. Straka. 2006. Existing and potential incentives for practicing sustainable forestry on non-industrial private forest lands. P. 174-187 in Proc. 2006 Southern For. Econ. Workshop.

Gurdens-Schuck, N., B.L. Allen, and K. Larson. 2004. Focus group fundamentals. Iowa State Univ. Ext. Methodology Brief PM 1989b. 6 p.

Harrington, T.B. and J.H. Miller. 2005. Effects of application rate, timing, and formulation of glyphosate and triclopyr on control of Chinese privet (Ligustrum sinense). Weed Technol. 19(1):47-54.

Kingsley, N.P., S.M. Brock, and P.S. DeBald. 1988. Focus group interviewing applied to retired West Virginia nonindustrial private forest landowners. Northern J. Appl. For. 5(3):198-200.

Krueger, R.A. and M.A.Casey. 2000. Focus groups, third ed.. Laughton, D.C., and D.E. Axelsen, eds. Sage Publications, Inc., Thousand Oaks, CA. 208 p.

Langeland, K.A. and K.C. Burks. 1998. Identification and biology of non-native plants in Florida's natural areas. Univ. Florida IFAS Publ. SP 257. 165 p.

Leahy, J.E., M.A. Kilgore, C.M. Hibbard, and J.S. Donnay. 2008. Family forest landowners' interest in and perceptions of forest certification: Focus group findings from Minnesota. Northern J. Appl. For. 25(2):73-81.

Matlack, G.R. 2002. Exotic plant species in Mississippi, USA: Critical issues in management and research. Nat Areas J. 22(3):241-247.

Miller, J.H. 2003. Nonnative invasive plants of southern forests: A field guide for identification and control. USDA For. Serv. Gen. Tech. Rep. GTR-SRS-62. 93 p.

Williams, G.A. and Krueger R.A. 1998. Perspective of Arkansas' non-industrial private forest land owners concerning their forested property. P. 54-59 in Proc. 1998 Southern For. Econ. Workshop.

Modeling NIPF Landowner Behavior: Developing "A Willingness to Sell Timber" in the Future Model

Kevin P. Hoyt[1] and Donald G. Hodges[2]

[1] Kevin P. Hoyt, Sr. Natural Resource Analyst, PO Box 1104, Spring City, Tennessee 37381, (423)452-7114, kevin.hoyt@huber.com
[2] James R. Cox Professor and Director, University of Tennessee Natural Resource Policy Center

Modeling NIPF Landowner Behavior: Developing "A Willingness to Sell Timber" in the Future Model

Abstract

The Cumberland Plateau in Tennessee currently is experiencing wide-spread forest parcelization and changes in species composition as a result of changes in land use and ownership. These changes can be attributed partially to industrial forest land divestiture and the lingering effects of the 1998 – 2002 Southern Pine Beetle (SPB) epidemic. A random sample of 1600 NIPF landowners owning 40 or more acres of land were surveyed to determine their willingness to sell timber in the future. Forty-five percent of all respondents indicated that they had previously sold or harvested timber, but only 30 percent indicated they intended to sell timber in the future. Logit regression and factor analysis were used to model owner willingness to sell timber in the future. Landowners most willing to consider a future timber sale on their property had sold timber in the past, tended to own their land for timber production, had received forest management advice in the past, and had a high interest in maintaining the health of their forest. Factor analysis revealed that landowners most likely to consider selling timber in the future would fit into one of three categories: 1) Improvers; 2) Investors; 3) or Legacy owners.

Keywords: Cumberland Plateau; Nonindustrial Private Forest Landowner; timber harvesting, logit regression, factor analysis

Introduction

Forest land investments are unique in that they are both a productive enterprise with the ability to produce income from timber sales, and a consumptive good providing direct utility to owners through recreation, aesthetics, and other non-timber amenities. Therefore, a landowner is faced with multiple management decisions regarding how harvesting timber could impact the land's ability to produce other non-timber related activities. Although NIPF timber is sold and harvested on a daily basis throughout the southeastern United States, it is many times a one-time activity in the life of the landowner. Moreover, Bulter (2008) suggests that timber production is not the prime objective of many NIPFs, which gives rise that the timber sale decision might be related more to financial need, than a long-term timber management strategy.

Wells (1977) studied the "Willingness to Sell" as a variable affecting timber availability in a middle Tennessee wood basin. He reported the market withholding of timber may be based on: the timeliness of financial needs of the owner; other non-timber objectives of the owner; and past experiences with timber sales and/or timber management experiences. Similarly, Hickman (1984) conducted a study of NIPF owners in the east Texas "Piney Woods" region in an attempt to model landowner motivation to sell timber. He noted they are primarily interested in the income-producing potential as opposed to consumptive use of their woodlands and almost without exception; interest in timber harvesting is positively related to the amount of forest land owned.

Binkley (1981) contends NIPF forest landowners derive utility from the consumption of non-timber land outputs, such as recreation and aesthetics, and the owner's decision to harvest timber is subject to two constraints. First, expenses cannot exceed timber sale income. Second, the combinations of timber and non-timber outputs are limited to those technically feasible. Wear and Flam (1993) linked landowner utility with a timber supply model based on NIPF ownership classifications, and reported the greater the tract size, the greater the probability timber harvesting will rank high as a main ownership objective.

The purpose of this paper is to develop a "willingness to sell" model using logit regression and factor analysis that can be used by natural resource managers, extension personnel, policy makers, and industrial foresters to select NIPF landowners who would most likely harvest timber in the future. Models were developed to predict the probability of NIPF landowners harvesting timber from their lands in the future using demographic characteristics, forestland tract variables, management objectives, and their opinions and attitudes concerning hypothetical scenarios.

Methods and Procedures

Data for the study were collected via a mail survey following Dillman's (2000) Tailored Designed Method. The targeted population for the study was all NIPF landowners owning 40 acres of land on the Cumberland Plateau (16 counties). At least 10 acres of the ownership had to consist of forest cover. An ownership list was compiled using property tax records for the 16 counties. The University of Tennessee Department of Forestry, Wildlife and Fisheries Human Dimensions Research Lab reformatted the lists and randomly selected a sample of 100 landowners in each of the 16 counties, for a total of 1,600 potential respondents. Questionnaires were mailed to all 1600 in the sample.

Likert-scale questions were formulated to assess the opinions and attitudes of NIPF owners concerning their forest management objectives. The questionnaire was comprised of 33 questions designed to capture NIPF landowner demographics, landownership history, reasons for ownership, and management objectives. The respondent's hypothetical reasons for considering a future timber sale were investigated. Logit regression and factor analyses were used to build comparison models to predict the respondent's willingness to sell timber in the future.

Future harvest (FH) was the dependent variable, defined as the participant's binary "yes/no" response on the survey question: "Are you planning to harvest timber from your *forest land* in the future?" FH was created by assigning a value of 1 to any respondent who indicated that they were considering a future timber sale on their forestland. If the respondent indicated they were not planning to harvest timber in the future, 0 was assigned.

Results

Two hundred and forty-six individuals were deemed to be ineligible for the survey (163 indicated they did not own forest land, 6 did not own land on the Plateau, 9 were deceased, 6 had sold their land, and 62 were undeliverable as addressed). This brought the eligible target population to 1,354. A total of 528 individuals returned questionnaires for a total response rate of 39 percent. This response rate was consistent with those by Hickman (1984), Walkingstick et al. (2001), and Measells et al. (2005) for similar NIPF landowner studies.

Twenty-six independent variables were evaluated by the logit model: sold timber in the past (ST), acres owned (AO), multiple tracts (MT), financial investment (FI), timber production (TP), enjoy scenery (ES), for peacefulness (FP), residence on tract (RT), management advice (MA), selling price (SP), forest health (FH), logger reputation (LR), timber stand improvement (TS), hunting lease (HL), past experience with timber sales (PE), water quality (WQ), poor wood utilization (PW), beauty affected (BA), wildlife habitat (WH), enhance for birds (EB), company payment (CP), NIPF associations (NA), NIPF workshops (NW), talk with forester (TF), education level (EL), and age categories (AC) . Eighteen of the 26 theoretical independent variables were eliminated prior to further model iterations because they did not meet the minimum significance level of $\alpha < .05$, yielding a total of eight independent variables. No VIF for the selected independent variables exceeded 5.0, so all were retained for the reduced logistical regression model run. The reduced model with the eight significant independent variables was defined as: Future Harvest (FH) = -.884 + .977ST + .999TP - .537FP + .585MA - .239PE + .695FH - .386PW - .411AC, ($R^2_{N} = .508$)

Field (2005) defines the Exp β as the indicator of change in odds resulting from a unit change in the predictor in logistic regression: if the value is greater than 1 then it indicates that as the predictor increases, the odds of the outcome occurring increases. An Exp β value less than 1 indicates that as the predictor increases, the odds of the outcome occurring decreases, and the farther the odds ratio (Exp β) from 1, the more influential the predictor variable (Brown 2004).

The Hosmer and Lemeshow test results were .907 indicating that the model adequately fits the data and that all eight of variables were significant at the $\alpha < .05$ level.

The reduced model (Table 1.) indicated that ST:β = 2.657, α = .001, TP:β = 2.715, α <.000, FP:β = .585, α < .000, MA:β = 1.795, α = .054, PE:β = .788, α = .023, FH:β = 2.003, α < .000, , PW:β = .680, α = .004 and AC:β = .663, α < .000. Thus, NIPF landowners who actually have sold timber in the past were 2.7 times more likely to harvest timber in the future. Those NIPF landowners with timber production as a primary ownership objective were 2.7 times more likely to harvest timber in the future than those with other objectives. Those NIPF landowners who had received forest management advice in the past were 1.8 times more likely to harvest timber in the future than those who had not. Finally, those interested in improving the forest health of their forestland were 2.0 times more likely to harvest timber in the future than those with other objectives. The final iteration of the reduced model correctly classified 80.6 percent of the 438 observations as opposed to 66.2 percent without the predictors in the model.

Table 1. Analysis of maximum likelihood estimates for the reduced logistical regression model for Cumberland Plateau NIPF landowners

								95.0% C.I.for EXP(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1	ST	.977	.295	10.941	1	.001	2.657	1.489	4.741
	TP	.999	.128	61.242	1	>.000	2.715	2.114	3.486
	FP	-.537	.131	16.891	1	>.000	.585	.453	.755
	MA	.585	.303	3.723	1	.054	1.795	.991	3.253
	PE	-.239	.105	5.165	1	.023	.788	.641	.968
	FH	.695	.153	20.641	1	>.000	2.003	1.484	2.703
	PW	-.386	.133	8.487	1	.004	.680	.524	.881
	AC	-.411	.112	13.562	1	.000	.663	.533	.825
	Constant	-.884	.812	1.185	1	.276	.413		

$R^2_N = .508$

Bartlett's Test results indicated a p-value = .000 < .05, such that factor analysis was appropriate for the 35 variables being evaluated (Table 2.). Principle Component Analysis (PCA) was used to extract the significant eigenvalues that had a variance > 1.0, which determined the significant factors for further investigation. Principle components were then ranked from largest to smallest in terms of variance. Varimax rotation was selected for the analysis.

Table 2. Independent variables of Cumberland Plateau NIPF landowners used for factor analysis modeling

	.Component							
	1	2	3	4	5	6	7	8
For peacefulness and tranquility	.881							
To enjoy scenery	.857							
It connects me to nature	.829							
For privacy	.751							
To preserve nature	.662							
Enjoy working on the land	.583							
Using partial cut harvesting methods		.737						
Following Best Management Practices		.718						
TN Master logger harvests timber		.665						
Getting a timber appraisal		.600		.466				
Negotiating directly with a buyer		.592						
Past experience with timber sales		.542						
For timber stand improvement			.785					
For forest health			.769					
For wildlife habitat improvement			.735					
The reputation of the logger								
Using a sealed bid process				.686				
Using clear cut harvesting methods				.642				
Professional forester administers sale		.428		.632				
Selling timber on lump sum basis				.562				

To convert from hardwood to pine				.423				
To clear land for farming					.758			
For grazing and livestock					.653			
An urgent financial need					.568			
Part of farm or home site	.474				.487			
For real estate development					.425			
For hunting and fishing						.793		
For wildlife management						.669		
For other recreation	.445					.563		
For financial invest.							.750	
For timber production							.706	
Motivated by price							.554	
Inherited the land								.825
It connects me to the past	.413							.700
Pass on to heirs								.453

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 9 iterations.

The full regression model with the eight significant independent components is defined as (Table 3.):

Future Harvest (FH) = $-.0991 - .621PR + .133T1 + .748IM - .201T2 + .167AG + .211RE + 1.143IV + .371LO$, ($R^2_N = .396$)

where PR = preservers, T1 = timber1, IM = improvers, AG = agrarian, RE = recreation, IV = investors, and LL = legacy owners.

The full logit regression model indicated only four components were significant at the α=.05 level. The four following independent components were retained for the reduced logit regression model run; PR (independent component loaded on variables associated with NIPF objectives towards preservation of their forest land):β = .551, IM (independent component loaded on variables associated with NIPF objectives towards improvement of their forest land):β = 2.005, IV (independent component loaded on variables associated with NIPF objectives towards investment as an ownership objective):β = 3.104 and LO (independent component loaded on variables associated with NIPF objectives of leaving a legacy for their heirs):β = 1.435.

For peacefulness, to enjoy scenery, connects me to nature, for privacy, to preserve nature, and enjoy working the land were identified with the factor associated with the "preserver" component; Timber stand improvement, forest health, and improving wildlife habitat were identified with the factor associated with the "improver" component; financial investment, timber production, and motivation by price were identified with the factor associated with the "investor" component; and forest land inheritance, ownership connects me to the past, and pass onto heirs were identified the "legacy owner" component.

The reduced logit regression model with the four significant independent components is defined as (Table 4.):

Future Harvest (FH) = -.958 - .596PR + .720IM + 1.133IV +.361LO, (R^2_{N} = .318)
where PR = preservers, IV = investors, LL = legacy leavers, and IM = improvers.

The reduced logit regression model run outcome indicated that;
PR:β = .551, α < .000, IM:β = 2.055, α < .000, IV:β = 3.104, α < .000, and LO:β = 1.435, α = .008. The reduced model indicates that NIPF landowners those who indicated an improver component were 2.0 times more likely to harvest timber in the future than those who do not have an improver component. Those NIPF landowners with an investment component were 3.1 times more likely to harvest timber in the future than those who do not have an investment component. Those NIPF landowners who had indicated a legacy owner component were 1.4 times more likely to harvest timber in the future than those who do not have a legacy leaver owner.

Comparatively, those NIPF landowners who indicated a preserver component were .551 times as likely to harvest timber in the future. The final iteration of the reduced model correctly classified 76.5 percent of the 344 observations as opposed to 66.6 percent without the predictors in the model.

Table 3. Factor Analysis - Full Logit Regression Model for Cumberland Plateau NIPF landowners

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1(a)	Preservers	-.621	.147	17.764	1	>.000	.538[a]
	Timber1	.133	.145	.847	1	.358	1.143[a]
	Improvers	.748	.160	21.717	1	>.000	2.112
	Timber2	-.201	.135	2.227	1	.136	.818[a]
	Agrarian	.167	.139	1.435	1	.231	1.182[a]
	Recreation	.211	.138	2.347	1	.126	1.235[a]
	Investors	1.143	.165	47.872	1	>.000	3.136
	Legacy Owner	.371	.140	7.077	1	.008	1.450
	Constant	-.991	.150	43.734	1	>.000	.371[a]

a Variable(s) entered on step 1: Preservers (PR), Timber1 (T1), Improvers (IM), Timber2 (T2), Agrarian (AG), Recreation (RE), Investors (IV), Legacy Owner (LO)
$R2_N$ = .396

Table 4. Factor Analysis – Reduced Logit Regression Model for Cumberland Plateau NIPF landowners

	B	S.E.	Wald	Df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
							lower	Upper
PR	-.596	.144	17.139	1	>.000	.551	.415	.731
IM	.720	.156	21.450	1	>.000	2.055	1.515	2.788
IV	1.133	.163	48.546	1	>.000	3.104	2.257	4.269
LO	.361	.136	7.055	1	.008	1.435	1.099	1.873
Constant	-.958	.146	43.126	1	>.000	.384		

a Variable(s) entered on step 1: Preservers (PR), Improvers (IM), Investors (IV), Legacy Owner (LO)
$R2_N$ = .374

Conculsions

The results of this research corroborate previous research findings that the majority of NIPF landowners do not rank timber production as the highest management objective. Based on the logistic regression model, those Plateau NIPF landowners most willing to harvest timber in the future had harvested timber in the past, favored timber management as a top ownership objective, received forest management advice in the past, and would consider harvesting timber if it improved the health of their forestland. Factor analysis revealed landowners most likely to consider selling timber in the future would fit into three main component groupings: 1) Improvers; 2) Investors; 3) or Legacy Owners.

Literature Cited

Binkley, Clark Shepard, 1981. Timber Supply from Private Non-industrial Forests – A Microeconomic Analysis of Landowner Behavior. Yale University: School of Forestry and Environmental Studies. Bulletin No. 92. New Haven: Yale University. 97 p.

Brown, Jack W. 2004. Techniques of Multivariate Data Analysis – A Student Primer http://www.iejs.com/Statistics/PDF/MDA.pdf. Date of retrieval 2008.

Butler, Brett J. 2008. Family Forest Owners of the United States, 2006. A Technical Document Supporting the Forest Service 2010 RPA Assessment. USDA-Forest Service. Northern Research Station. General Technical Report NRS – 27. June 2008.

Dillman, D.A. 2000. Mail and Internet Surveys-The Tailored Design Method. John Wiley and Sons, New York, NY. 464 p.

Field, Andy. 2005. Discovering Statistics Using SPSS. Sage Publications. London. 779 p

Hickman, Clifford A. 1984. Socio-Economic Characteristics of Prospective Nonindustrial Private Timber Sellers in East Texas. U.S.D.A. Forest Service. Southern Forest Experiment Station. SO-308. 4 p.

Measells, Marcus K. et al. 2005. Nonindustrial Private Forest Landowner Characteristics and Use of Forestry Services in Four Southern States: Results from a 2002 – 2003 Mail Survey. Southern Journal of Applied Forestry 29(4):194-199.

Walkingstick et al. 2001. A Characterization of Nonindustrial Private Forest Land Owners of Arkansas. Proceedings of the Symposium on Arkansas Forest: A Conference on the Results of the Recent Survey of Arkansas. General Technical Report SRS 41. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 125 p.

Wear, David N., and Richard Flamm, 1993. Public and Private Forest Disturbance Regimes in the Southern Appalachians. U.S.D.A. Forest Service. Southeastern Experiment Station. Volume 7 – Number 4. 19 p.

Wells, John Lee. 1977. Economics of Timber Availability in a Tennessee Watershed. The University of Tennessee-Knoxville. 94 p.

Southern Forest Economic Workers

2009 Annual Meeting

Monday, March 9, 2009
1:15 PM – 3:00 PM
Session C: Urban Forestry

Manuscripts:

Impact of Urban Trees and Landscaping on Tourism and Sustainable Development – Bin Zheng et al.

Factors Influencing Current Interests and Motivations of Local Governments to Supply Carbon Offset Credits from Urban Forestry – Neelam C. Poudyal, Jacek P. Siry, and J. M. Bowker

Impact of Urban Trees and Landscaping on Tourism and Sustainable Development

Bin Zheng[1], Yaoqi Zhang[1*], Jeff Sibley[2], Jingyang Deng[3] , and Carolyn Robinson[2]

[1]School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL *Email: yaoqi.zhang@auburn.edu
[2]Department of Horticulture, Auburn University, Auburn, AL
[3]Division of Forestry, West Virginia University, Morgantown, WV

Impact of Urban Trees and Landscaping on Tourism and Sustainable Development

Abstract

It is widely recognized that urban trees and landscapes can increase city amenities, but their role in tourism has rarely been examined. This study assesses the roles of urban trees and landscape design as attractive attributes for city beautification and tourism. The data used in this study is collected from a city beautification survey and Principle Component Analysis method is applied. The results indicate urban trees and a well-structured landscape design are essential for a beautiful image of a city. Our findings help decision makers better understand the role of urban trees, flowers and green space in city beautification, and contribute to a sustainable development in city tourism.

Key Words: City Beautification, Landscape Design, Green Space, Principle Component Analysis

Introduction

Tourism is one of the main drivers for metropolitan economics. Cities such as Las Vegas, Los Angeles, Orlando, New York City, Washington D.C., and San Francisco are visited by millions of international and domestic tourists annually (Law, 2002). Also, tourism has been regarded as an economic development tool for rural America since the late 1970s (Gartner, 2004). Many small towns and rural communities are trying to acquire a share of the growing tourism industry (Galston and Baehler, 1995). In order to attract more business and tourism, city and community leaders are increasingly looking for ways to beautify their living places and make them more attractive for tourists (Leston, 2001).

A beautiful image of a city is one of the most important requirements for tourism. Trees and green space in urban and community areas can create a positive image and provide an aesthetically pleasing experience for both residents and tourists. Law (2002) listed [tree related] festivals, parks, and green areas among others as primary elements for an urban tourism system. For example, the National Cherry Blossom Festival (NCBF) that has been held annually in Washington, D.C. since 1912 has become "bigger and bigger every year", according to the Mayor Anthony A. Williams (Holly, 2006).

Thus, trees/forests and green areas play a critical part in enhancing a city's image, attracting tourists and increasing their tourism experiences. It is evident that linking urban forests and tourism is a very important topic that is gaining national recognition (Neamtzu, 2003). However, most previous studies focus on individual's preferences of scenic beauty of natural environment (Porteous, 1996); with relatively fewer studies focused on trees and urban forests. In fact, Buhyoff et al. (1984) stated that "perhaps because it is so well accepted that people like trees, very little research has been conducted regarding the visual aesthetic values of urban trees and forests" (p.71).

In this study, three steps were taken to explore the impact of urban trees and landscaping on tourism: 1) First, with a survey, we explored "what attracts tourists in Alabama?" 2) Second, we posted the question: "What contributes to city beautification?" using a Principle Component Analysis (PCA) method. Eleven alternatives are examined, with gardeners and other residents analyzed separately. 3) Third, we provided survey respondents with sketches of how different tree characteristics contribute to city beautification and asked for responses to the sketches.

Data

The data used in this study was collected from a city beautification survey supported by the Alabama Agricultural Experiment Station and Alabama Cooperative Extension system. Both onsite surveys and online surveys were used. The onsite survey was conducted at highway (along Interstate 85) welcome centers and rest areas mainly located in Georgia and Alabama. The survey explored what attracts tourists to Alabama, how urban trees and landscapes contribute to city beautification, and the importance of city beautification to tourism.

In a total, 369 respondents took this survey (onsite and online). Sixty two observations with missing value were deleted. Thus, the data in this study includes 307 valid observations. The only background information collected from the respondents is the working position. Thirty percent of the respondents were master gardeners, nine percent of respondents were garden club members, seven percent of respondents were visitors to Alabama, and fifty percent of the respondents just clarified themselves as residents.

Method

To explore the inner relationship between the highly correlated eleven variables regarding city beautification, Principle Component Analysis (PCA) was used. PCA is a multivariate statistical technique used to reduce the number of variables in a data set into a smaller number of 'dimensions' (Vyas and Kumaranayake, 2006). We assume the following model where:

$$PC_1 = a_{11}X_1 + a_{12}X_2 + \cdots + a_{1n}X_n \qquad n = 11$$
$$\vdots \qquad (1)$$
$$PC_m = a_{m1}X_1 + a_{m2}X_2 + \cdots + a_{mn}X_n$$

where a_{mn} is the weight for the m_{th} principle component and the n_{th} variable. In this way, we try to reduce the n dimensions of variables to m principle components (PC).

In this study, the Likert-scale variables are naturally non-normal. Thus we prefer to use a Principle Component Method rather than Factor Analysis which requires a normality assumption. SAS 9.0 was used for PCA.

Results

What attracts tourists?

In this survey, individuals were asked to confirm the importance level of five specified factors regarding attractions for tourism. The results in Figure 1 suggest that Resorts and Golf courses, Botanical Gardens, Advertisement and other recreation activities were all attractive to tourists. Specifically, more than eighty percent of respondents confirm City Beautification as an important factor for attracting tourists. In the next step, we explored the factors which contribute to city beautification.

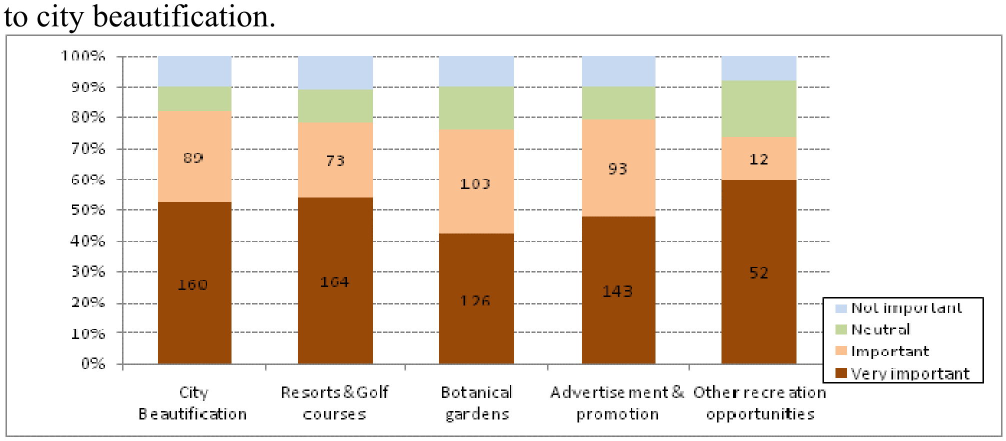


Figure 1 Importance level of factors attracting tourists.

What contributes to city beautification?

To find out "What contributes to city beautification?" this survey gave eleven alternatives (Table 1) and asked people to rate each alternative from 1 to 5 based on their preference. From the mean value of the ratings, we find that the highest values were: “To keep streets/towns well-landscaped”, “To have city parks and more green space” and “To select right trees for the right place”. Thus, trees and on-purpose design/landscape is critical.

Table 1 Descriptive statistics of eleven alternatives to city beautification

Variables	Mean	Std.Dev
A). To increase tree canopy by planting more trees	4.14	1.29
B). To select the right trees for the right places	4.39	1.13
C). To keep trees pruned and maintained	4.30	1.21
D). Public buildings (city halls, schools)	4.10	1.21
E). To have botanical garden and/or arboretum	4.02	1.32
F). Keep more naturalized areas	4.10	1.29
G). Use more structured landscape design	3.75	1.25
H). A good mix of conifers and deciduous trees	3.88	1.34
I). Flowering shrubs, perennials, and/ or annuals	4.32	1.13
J). To keep streets/towns well-landscaped	4.43	1.10
K). To have city parks and more green space	4.40	1.20
Total # of respondents	307	

A further examination of the correlation matrix indicates that some variables within these eleven alternatives are highly correlated. PCA is used to reduce the dimension and find the inner relationship between them. More specifically, since almost 40% of the respondents have working experience as gardeners, we doubt that gardeners have different preferences for the influential factors compared to other residents. The respondents were divided into two groups: gardeners and other residents. The plot of the first PC score vs. second PC score in Figure 2 also suggests two potential groups. Therefore, Firstly a PCA was conducted to all respondents and then two PCA were applied separately to gardeners and other residents.

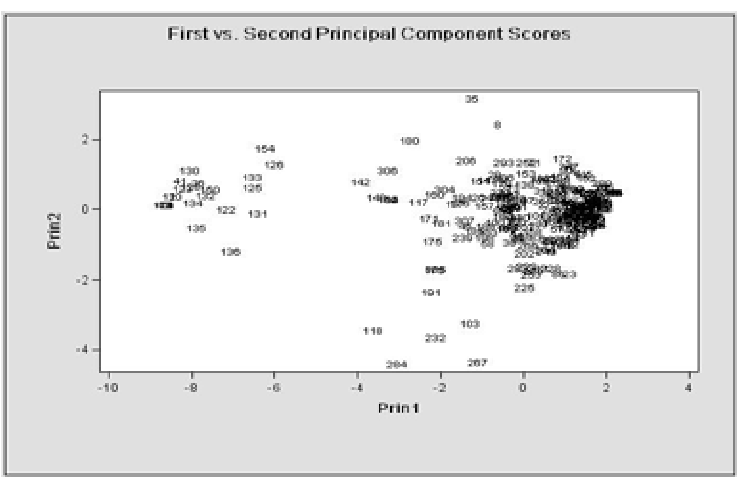


Figure 2 First PC score vs. Second PC score.

PCA results are shown in Table 2. The results of all respondents indicated that the first three PCs keep almost 77% of the information in the original data. And for gardeners, the first two PCs accounts for 72% variation of the original data. Also, we keep the first two PCs for residents, and overall they explain 87% variation in the original data.

Table 2 PCA results

	All respondents			Gardener		Other residents	
	PC1	PC2	PC3	PC1	PC2	PC1	PC2
A.) To increase Tree Canopy by planting more trees	0.29	-.17	-.14	0.26	0.15	0.30	-.20
B.) To select the right trees for the right places	0.33	-.31	-.04	0.33	-.27	0.31	-.29
C.) To keep trees pruned and maintained	0.31	-.33	0.07	0.30	-.30	0.31	-.31
D.) Public buildings (city halls, schools)	0.29	0.26	0.17	0.33	0.18	0.28	0.22
E.) To have botanical garden and/or arboretum	0.27	0.38	-.19	0.31	0.06	0.29	0.61
F). Keep more naturalized areas	0.28	0.32	-.49	0.31	0.21	0.29	0.42
G). Use more structured landscape design	0.26	0.58	0.45	0.23	0.57	0.28	0.29
H). A good mix of conifers and deciduous trees	0.27	-.19	0.64	0.25	-.47	0.29	-.07
I). Flowering shrubs, perennials, and/ or annuals	0.34	-.07	-.08	0.34	-.16	0.31	-.11
J). To keep streets/towns well-landscaped	0.33	-.26	-.08	0.31	-.23	0.32	-.24
K). To have city parks and more green space	0.33	-.01	-.18	0.33	0.34	0.33	-.18
λ (Amount of information contained)	0.65	0.07	0.05	0.62	0.10	0.84	0.03

First, from the results of PCA of all respondents, we find that the effects of the variables in the first PC are average. There is no obvious index in the first PC for all respondents. Each attributes accounts for 20% to 30% of the variation. Specifically, attributes I, K B and J play a relative more important role. These results confirm that trees/flowers are an important factor in city beautification, and also identify the positive contribution of tree related green space, parks and well-designed streetscapes for city beautification.

In the second PC, variable G "Use more structured landscape design" receives the highest positive weight, which confirms the important role of landscape design. That is to say, most people believe that a good landscape design is very important for city beautification. There is a tradeoff between attribute B, C and attributes E, F in the second PC. The presence of a botanical garden or an arboretum makes positive contributions. On the other hand, the selection of trees and maintenance of trees contribute to city beauty in a negative way. So we can see that individual are more concerned about the overall look of the landscape design and the output of the design, but they don't care too much about the detailed process (e.g. how the trees were planted). This makes sense because the public usually takes the image of a city as a whole and will not pay much attention to the detail. However, it does not necessarily mean that trees are not important, because the selection and maintenance of trees are essential in landscape design and make contributions to the whole image of a city.

Further, we compare the analysis results between gardeners and other residents. The results in Table 2 indicate that these two groups have different concerns. In the second PC, the structured landscape design is a vital attribute from gardeners' perspectives. But for other residents, they prefer more botanical gardens and more naturalized areas. These amenities provide them opportunity for family recreation. That is to say, gardeners have some professional concerns about design and landscaping, while the public usually thinks from a practical way.

What tree characteristics contribute to city beautification?

Respondents were asked to select important tree characteristics with regard to city beautification. The results in Figure 3 indicate that the tree characteristics being more important for beautification are Seasonal color, Trees species and Trees symbolic of an area. Growth rate of the tree is considered less important than other characteristics in city beautification.

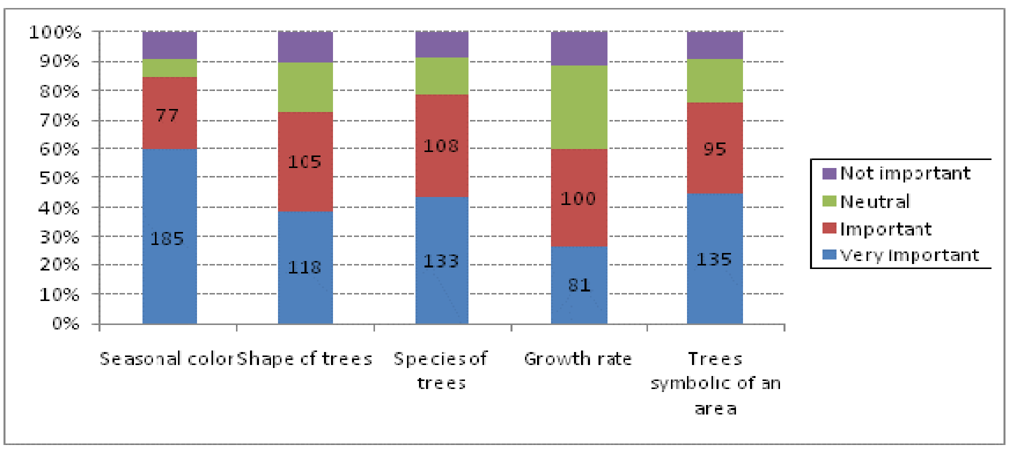


Figure 3 Importance level of tree characteristics to city beautification.

Conclusions and Discussion

The beautiful image of a city is a name card for the tourism industry. This study explores the impacts of urban trees and landscaping for city beautification using a PCA method. Our findings indicate that urban trees, city building, culture heritage and other amenities such as botanical gardens share an average importance contributing to city beauty. However, a combination of trees in a well structured landscape design is critical in enhancing the beautiful image of a city. More specifically, seasonal color, species and symbolic trees are important in city beautification. Our further studies on two groups suggest that gardeners care more about the landscape design itself. Other residents view the image of the city as a whole and put more concerns on the outputs (e.g. beautiful look, recreation opportunity).

As a summary, urban tree can improve tourism attractions in the form of urban parks, botanical gardens and arboreta. Trees are also the essential for landscaping design. Trees planted to beautify streetscapes or the whole cityscape, though not for the purpose of tourism promotion, can also increase individual's tourism experience, also helping to generate a positive image of the city, and affect the tourists' consumption behaviors and visitation intention.

Land use in cities is highly competitive. Trees, parks and green areas are always under pressures for commercial development (More et al., 1988). Information of the value of urban trees, flowers and green space in city beautification and tourism can help decision makers better understand the trade-offs associated with different choices. It is also important to let the public know how trees contribute to the image of the city. For example, letting the public be involved in tree planting activities is a good way to develop a sustainable community and city.

References

Buhyoff, G.J., Gauthier, L., and Wellman, J.D. 1984. Predicting scenic quality for urban forest using vegetation measurements. Forest Science, 30, 71-82.

Galston, W.A., and Baehler, K. J. 1995. Rural development in the United States: Connecting theory, practice, and possibilities. Island Press, Washington, D.C.

Gartner, W.C. 2004. Rural tourism development in the USA. International Journal of Tourism Research, 6, 151-164.

Holly, D. 2006. Weekend travel: Catch the cherry blossoms: Nation's capital blushes with festivities as pink flowers set to bloom. http://abcnews.go.com/US/Springtime/story?id=1728021&page=1&CMP=OTC-RSSFeeds0312. Accessed 11/07/06.

Law, C.M. 2002. Urban tourism: The visitor economy and the growth of large cities (2nd ed.). Continuum, New York.

Leston N. 2001. Urban forestry grants available. http://www.aces.edu/dept/extcomm/newspaper/june7a01.html. Accessed 11/07/06.

More, T.A., Stevens, T., and Allen, P.G. 1988. Valuation of urban parks. Landscape and Urban Planning, 15, 139-152.

Neamtzu, C. 2003. Oregon urban forestry on the map. Oregon Community Tree News, 13(2), 1-12.

Porteous, J. D. 1996. Environmental aesthetics: ideas, politics and planning. Routledge, London, United Kingdom.

Vyas S. and Kumaranayake L. 2006. Constructing socio-economic status indices: How to use principle components analysis. Advance Access publication, October 9, 2006.

Factors Influencing Current Interests and Motivations of Local Governments to Supply Carbon Offset Credits from Urban Forestry

Authors: Neelam C. Poudyal, University of Georgia, Jacek P. Siry[1], University of Georgia, and J. M. Bowker, USDA Forest Service

[1] Daniel B. Warnell School of Forestry & Natural Resources, University of Georgia, Athens 30602, Email: jsiry@warnell.uga.edu

Factors Influencing Current Interests and Motivations of Local Governments to Supply Carbon Offset Credits from Urban Forestry

Abstract

This study conducted a nationwide survey of municipal governments in the United States to assess their motivations, willingness, and technical as well as managerial capacities of cities to store carbon and sell carbon offsets. The analysis reveals that cities are fairly interested in selling carbon offsets and their interest in carbon trading is driven by the degree of urbanization, the awareness and interest of their voting constituents, and the need for additional revenues that can be generated from carbon offset sales. An understanding of urban forest carbon sequestration and familiarity with carbon market institutions such as the Chicago Climate Exchange (CCX) significantly increased the likelihood of a city wanting to sell urban forest carbon offsets. While a majority of cities currently have technical and managerial capacities to begin a carbon trading project, there appears to be a fundamental disconnect to market participation.

***Keywords*:** Urban Forestry, Carbon Credits, Supply, Municipalities

Introduction

Recent studies reported that global air temperature at the earth's surface increased by as much as 0.6° C since late 1800s (Nowak and Crane 2002). In the future, the dynamics of global climate will probably be further affected by the growing world population and associated human activities. Scientists have also argued that climate change has already affected the forests in the United States. For example, recent studies have linked warming temperature and early snowmelt to numerous forest management issues such as forest fires (Bosworth et al., 2008), and bark beetle outbreaks and higher tree mortality (Breshears et al., 2005).

A key mitigation initiative taken so far is to use the offset mechanism to compensate the concentration of Green House Gas (GHG) in the atmosphere. For example, the Kyoto Protocol recognizes a variety of emission reducing projects including forestry. Since trees absorb atmospheric carbon in the form of carbon dioxide in the photosynthesis process, the idea of trees as a sink for atmospheric carbon has widely been recognized (Sedjo et al., 2001; Van Kooten, 2007; Bigsby, 2009). Research suggests that the forests in the United States alone sequestered more than 750 million tons of carbon dioxide in 2003 (US EPA, 2005).

With growing public concern about global warming, markets for carbon offsets are emerging. Companies can purchase certified emission reductions or carbon offsets from other entities, such as those generated by urban forests, which capture atmospheric carbon dioxide and safely store it. The Chicago Climate Exchange (CCX) is an example of an offset trading system in the North America, where interested sellers and buyers of carbon credits participate in a voluntary, but legally binding, scheme to trade carbon offsets (Chicago Climate Exchange, 2009).

Several previous studies have examined carbon sequestration in urban forests. Nowak and Crane (2002) estimated that urban forests in the conterminous United States can absorb 22.8 million tons of atmospheric carbon annually, which was equivalent to $460 million in revenue at current prices from selling carbon offsets. These figures provide the evidence that urban trees in the United States potentially could serve as an important carbon sink. In addition, there has been an increasing interest among urban managers in participating in climate change mitigation initiatives, including carbon trading. For example, 8 municipalities, 3 counties, and 2 states have already enrolled in the carbon trading program of CCX.

To date, most forest carbon sequestration studies have focused on measuring the amount of carbon stored in urban forests and evaluating ecological aspects of sequestration (Birdsey 1992, Hoover et al. 2000, Smith et al. 2004, Myeong et al. 2006, Pouyat et al. 2006, and Smith et al. 2006, Rowntree and Nowak 1991, McPherson 1998, Jo and McPherson 2001, Brack 2002). Others have also examined the economic and marketing aspects of forest carbon offsets (Birdsey 2006, Call and Hayes 2007, Cathcart 2000, Sedjo and Marland 2003, Esuola and Weeksink, 2006). None of the previous studies, however, have examined the interests and motivations of local cities and municipal governments in supplying carbon offsets based on carbon stored in urban trees. To fill this gap, this study develops an econometric framework for explaining factors that influence the likelihood of government participation in carbon offset trading.

Methods

A web-based survey was implemented between November 2007 and January 2008 to determine the willingness, motivations, and ability of cities and municipal governments to participate in carbon offset markets. Urban foresters, arborists, and other individuals responsible for the management of urban trees were identified and invited to participate. The survey consisted of questions about their current urban forest information and management practices, their interests and activities in climate change mitigation, and participation in voluntary carbon reduction schemes. They were also asked to report their city's characteristics such as land area and population. Some questions solicited responses in categorical or open-ended format, whereas other questions were about the level of interest, preference or agreement utilized Likert scales of various points (Likert, 1932).

A conceptual model was developed, based on the idea that motivations of local governments to participate in carbon trading depend on their knowledge of carbon sequestration and markets, current climate change mitigation activities, supplemental income needs, and social and political characteristics. The willingness to participate in urban carbon credit trading was represented by a discrete choice variable, which indicated whether the city was currently interested in selling carbon. A five-point Likert scale was converted into a binary variable, recorded as 1 if a city was currently interested or very interested in selling carbon, 0 otherwise. A bivariate Probit model (Greene, 2003) was used to explain this dependent variable as a function of nine explanatory variables. Those included: (1) awareness, which was the respondent's reported rating (5 = very familiar, to 1= not at all familiar) of their level of knowledge of carbon sequestration prior to reading the survey; (2) revenue, which captured the importance of income from expected sales of carbon offsets (5 = extremely important, to 1 = extremely unimportant); (3) market information dummy, which took a value of 1 if the city is familiar or has used the Chicago Climate Exchange (CCX), 0 otherwise; (4) green house gas reduction goal dummy, which took a value of 1, if the city has a goal of reducing GHG, 0 otherwise; and (5) voluntary participation dummy, which took a value of 1, if a city had already participated in any kind of voluntary actions to help mitigate global warming. Subsequent variables captured the characteristics of a city, and included: (6) population density; (7) cost of living; (8) education level of city residents; and 9) forest area, which captured the amount of forest area within the immediate city's surroundings. City level data representing population density, cost of living and education were obtained from the U.S. Census Bureau, whereas the proxy for forestland was obtained from the National Outdoor Recreation System database (NORSIS) (Cordell and Betz, 1997).

Results

A total of 150 completed surveys were returned yielding an effective overall response rate of 54%. Respondent cities were uniformly distributed in terms of their population size and geographical location. Cities were fairly aware of a range of climate change mitigation options. Some of them had actively engaged in climate change mitigation activities. About 26% of respondents reported that reducing their carbon emissions is a priority program of their city.

Another 11% reported that it is one of the goals but has not been in priority yet. Similarly, 17% had discussed reducing their carbon emissions even though they did not have a defined goal. Respondents were also asked about their knowledge of carbon sequestration and credits. Approximately one-third (32%) were familiar or very familiar with carbon sequestration before reading the survey. However, nearly half (45%) were either not familiar with, or unsure about, carbon sequestration. Similarly, less than a third of respondent cities (21%) were familiar with carbon market institutions such as CCX, which is currently the largest market platform in the United States for carbon trading. Very few (1%) of had actually used CCX for carbon trading purposes. However, about one-third (34%) reported never hearing of CCX, whereas another 44% were unsure about their knowledge of CCX. Regarding interest in selling carbon offsets, 29 out of 150 cities noted that they were currently interested or very interested in carbon trading.

Data fit quite well into the Probit model designed to explain the current willingness of local governments to sell carbon offsets from urban forests. Most of the explanatory variables were significant and had expected signs. Local governments' knowledge about carbon storage before reading the survey was positively related ($p=0.02$) to their willingness to participate in carbon trading. Similarly, the revenue variable, which captured the local governments' rated importance of income from expected sales of carbon credit was also positively associated ($p<0.01$) with their interest to participate in carbon trading. As expected, the coefficient on the variable capturing market information variable was positive and statistically significant ($p=0.03$).

Variables capturing a city's characteristics also significantly explained local governments' interests in selling carbon. Population density, which measured the level of congestion was positively related ($p=0.04$) with the city's interest in engaging in carbon trading. On the other hand, the variable capturing the cost of living in the city, was negatively associated with the city's willingness to sell carbon ($p<0.01$). Likewise, the education level of residents had a positive effect ($p<0.01$) on the city's willingness to participate in carbon trading. Even though the sign of coefficient for forest area variable was consistent with our hypothesis, it was not statistically significant. This is probably because we used the forest area of the county in which the city was located as a proxy to represent the city's vegetative coverage.

Discussion and Conclusion

Overall, the results indicate that the local governments in the United States are fairly interested in selling carbon. Nevertheless, their willingness to participate in carbon trading was influenced by various factors. Cities located in densely populated areas and with a higher proportion of college-educated residents were more likely to participate in carbon trading. This in turn implies that their willingness to participate in carbon markets was likely driven by the degree of urbanization, and the awareness and interest of their voting constituents. Their willingness to participate in carbon selling also depended on their understanding of urban forest carbon sequestration, familiarity with carbon market institutions (e.g., CCX), and importance of revenue from expected carbon offset sales. The negative effect of cost of living on their willingness indicate that governments located in less affluent neighborhoods appear more interested in carbon trading schemes; this may be explained by the need for revenue.

Future increases in market prices of offset credits possibly resulting from a passage of mandatory regulations may further increase their motivations. However, the fact that only one-third of cities are currently familiar with the carbon sequestration and carbon offset trade, and more than two-thirds of them were unaware or had no market information, indicates the presence of an information barrier and fundamental disconnect to market participation. While agencies interested in promoting markets for carbon credits can have little or no control over the characteristics of the city, policy instruments could be devised to influence the willingness of potential suppliers to enter the market. For example, developing new or revising existing urban forestry extension programs could help local governments better understand the costs, benefits and technical details of urban forest carbon storage.

References

Bigsby, H. 2009. Carbon banking: Creating flexibility for forest owners. Forest Ecology and Management 257: 378-83.

Birdsey, R. A.1992. Methods to estimate forest carbon storage.P.255-261 in Forests and Global Change Volume 1: Opportunities for increasing forest cover. American Forests

Birdsey. R. A. 2006. Carbon accounting rules and guidelines for the United States forest sector. Journal of Environmental Quality 35: 1518-1524.

Bosworth, D., R. Birdsey, L. Joyce, and C. Millar. 2008. Climate change and the nation's forests: Challenges and opportunities. Journal of Forestry 106 (4): 214-221.

Brack, C. L. 2002. Pollution mitigation and carbon sequestration by an urban forest. Environmental Pollution 116: 195-200.

Breshears, D. D., N. S. Cobb, P. M. Rich, K. P. Price, C. D. Allen, R. G. Balice, W. H. Romme, J. H. Kastens, M. L. Floyd, J. Belnap, J. J. Anderson, O. B. Myers, and C. W. Meyer. 2005. Regional vegetation die-off in response to global change type drought. Proceedings of the National Academy of Science 102 (42): 15144-15148.

Call, J., and J. Hayes. 2007. A description and comparison of selected forest carbon registries: A guide for states considering the development of a forest carbon registry. General Technical Report SRS-107. United States Department of Agriculture, Forest Service. Southern Research Station, Asheville, NC.

Cathcart, J. F.2000. Carbon sequestration. Journal of Forestry 98 (9): 32-27.

Chicago Climate Exchange, 2009. CCX offset report, Volume 1, Number 1. Chicago Climate Exchange, Chicago, IL.

Cordell, H. K. and C. Betz.1997. NORSIS 1997: Codebook and documentation. USDA, Forest Service, Southern Research Station. Available online at www.srs.usda.gov/trends/norsiscode.pdf

Esuola, A. G., and A. Weeksink.2006. Carbon banks: An efficient means to exchange sequestered carbon. Journal of Environmental Quality 35: 1525-1532.

Greene, W. H., 2003. Econometric Analysis (5th edition). Upper Saddle River, NJ. Prentice Hall, Inc.

Hoover, C. M., R. A. Birdsey, L. S. Health, and S. L. Stout. 2000. How to estimate carbon sequestration on small forest tracts. Journal of Forestry 98 (9): 13-19.

Jo, H. K., E. G. McPherson. 2001. Indirect carbon reduction by residential vegetation and planting strategies in Chicago, USA. Journal of Environmental Management 61: 165-177.

Likert, R., 1932. A technique for the measurement of attitudes. Archives of Psychology 140: 1-55.

McPherson, G. E., 1998. Atmospheric carbon dioxide reduction by Sacramento's urban forest. Journal of Arboriculture 24(4): 215-223.

Myeong, S., D. J. Nowak and M. J. Duggin. 2006. A temporal analysis of urban forest carbon storage using remote sensing. Remote Sensing of Environment 101: 277-282.

Nowak, D. J., and D. E. Crane. 2002. Carbon storage and sequestration by urban trees in the USA. Environmental Pollution 116: 381-389.

Pouyat, R. V., I. D. Yesilonis, and D. J. Nowak. 2006. Carbon storage by urban soils in the United States. Journal of Environmental Quality 35: 1566-1575.

Rowntree, R. A., and D. J. Nowak. 1991. Quantifying the role of urban forests in removing atmospheric carbon dioxide. Journal of Arboriculture 17 (10): 269-275.

Sedjo, R. A., and G. Marland. 2003. Inter-trading permanent emissions credits and rented temporary carbon emissions offsets: Some issues and alternatives. Climate Policy 3: 435-444.

Sedjo, R. A., G. Marland, K. Fruit. 2001. Renting carbon offsets: the question of permanence. Resources for the Future. Washington, DC.

Smith, J. E., L. S. Heath, K. E. Skog, and R. A. Birdsey. 2006. Methods for calculating forest ecosystem and harvested carbon with standard estimates for forest types of the United States. General Technical Report, NE-343. USDA Forest Service, Northeastern Research Station, Newtown Square, PA.

Smith, J. E., L. S. Heath, and P. B. Woodbury. 2004. How to estimate forest carbon for large areas from inventory data. Journal of Forestry 102 (5): 25-31.

US Environmental Protection Agency (EPA). 2005. Greenhouse gas mitigation potential in U. S. forestry and agriculture. EPA 430-R-05-006. Office of Atmospheric Programs, Washington, DC.

Van Kooten, G. C., and B. Sohngen. 2007. Economics of forest ecosystem carbon sinks: A review. International Journal of Environmental and Resource Economics 1: 237-269.

Southern Forest Economic Workers

2009 Annual Meeting

Monday, March 9, 2009

3:15 PM – 5:00 PM

Session A: Bioenergy II

Manuscripts:

Changes in the Fuel Pellet and Briquette Industry in the Lake States Region: 2005 to 2008

William Luppold et al.

Changes in the Fuel Pellet Industry in the Lake States 2005 to 2008

William Luppold[1], Terry Mace[2], Anthony Weatherspoon[3], and Keith Jacobson[4]

[1] Economist, USDA Forest Service, Northern Research Station, 241 Mercer Springs Rd., Princeton, WV 24740; Email: wluppold@fs.fed.us 304.431.2700 (v): 304.431.2772 (fax)

[2] Utilization and Marketing Specialist, Wisconsin Department of Natural Resources
One Gifford Pinchot Dr., Room 130, Madison WI 53726; Email Terry.Mace@Wi.Gov 608.231.9333 (v): 608.231.9592 (fax)

[3] Forest Products Technical Services Specialist, Michigan Department of Natural Resources, Stevens T. Mason Bldg., P.O. Box 30452, Lansing, MI 48909-7952; Email weathera@michigan.gov 517.373.1275 (v): 517.373.2443 (fax)

[4] Forest Products U&M Program Leader, Division of Forestry, Minnesota Department of Natural Resources, 500 Lafayette Rd., St. Paul, MN 55155-4044; Email keith.jacobson@dnr.state.mn.us 651.259.5270 (v): 651.296.5954 (fax)

Changes in the Fuel Pellet Industry in the Lake States 2005 to 2008

Abstract

Premium fuel pellets are popular for home heating fuel and standard fuel pellets are finding increased use for electrical generation. In 2005, 41 percent of the fiber feed stock used to produce pellets in the Lake States was wood residue, 27 percent waste paper or agricultural residue, and 32 percent multiple or unspecified fiber feed stocks. Between 2005 and 2008, the number of wood pellet processing facilities in the region nearly doubled and this expansion required an additional 592 thousand dry tons of fiber feed stock. Currently, two facilities producing 67 thousand tons of pellets are under construction and four plants slated to produce an additional 600 thousand tons of product are in the planning stage. The primary product manufactured in these new or planned facilities will be commercial fuel pellets and the primary feed stock will be roundwood or harvest residues and paper and agriculture waste. The potential increase in the demand for lower quality roundwood by these new facilities could replace the declining demand for this material by the paper industry. However, if the fuel pellet industry continues to expand, it could bid roundwood away from the remaining pulp and paper mills.

Key Words: Fuel pellet, wood energy, roundwood consumption

Introduction

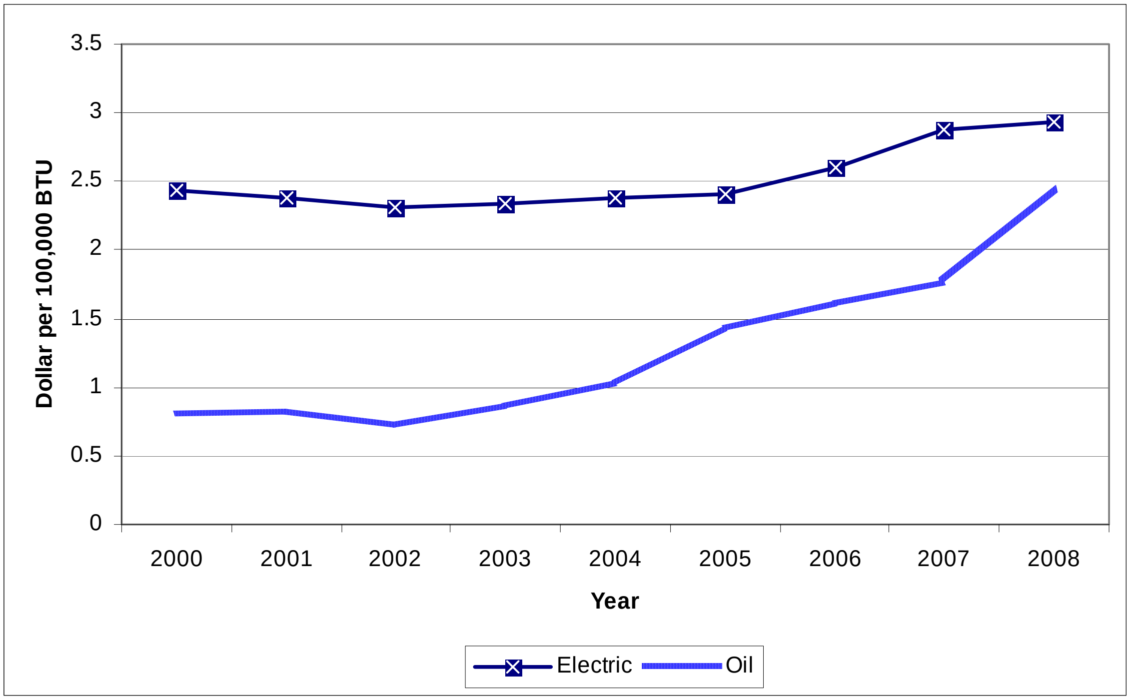
In the 19^{th} century, an estimated 90-percent of Americans burned wood to heat their homes (USDE 2008). By 1970, the consumption of wood for fuel had steadily declined to approximately 1 percent (USDE 2008). In the fall of 1973, the oil producing Middle Eastern nations stopped the export of oil to the United States and other nations that supported Israel during the Yom Kippur War (Jordan et al. 1977). The resulting surge in oil prices caused interest in wood heating to reemerge primarily through increased use of wood stoves (USDE 2008). Another product that entered into the market during this period was the pellet stove (USDE 2008). These stoves burned pellets made from compressed dried wood or other biomass wastes. Pellet stoves are superior to many other sources of wood heat because their emissions are considerably less than other wood heat sources (EPA 2008). These stoves also were cleaner to operate and produced less creosote (USDE 2008).

As energy prices declined over the next several years, so did interest in pellet stoves. Many of the pellet manufacturers that survived produced pellets for animal sanitation applications. In 2005, a number of important market factors including Hurricane Katrina's damage to Gulf Coast petroleum production and refining infrastructure reduced supplies and increased prices of fuel oil (Fig. 1). As a result, wood fuels were again a field of interest. Between the late 1970s and 2005, the residential pellet stove industry developed high efficiency, low emission stoves requiring premium quality pellets with low ash content. These stoves have a combustion efficiency rating of up to 85 percent (compared to 72 percent combustion efficiency of a catalytic wood stove) and can be vented through an outside wall versus a chimney (USDE 2008).

Pellet manufacturers are building new plants is the Lake States of Minnesota, Wisconsin, and Michigan. In 2005, this region contained nine plants that use wood, paper, and agricultural residue to manufacture pellets. The continued increase in energy prices between 2005 and 2008 (Fig. 1) fostered a 300-percent increase in fuel pellet production (Table 1). By the end of 2009, another 67 thousand tons of industrial fuel pellets will be manufactured by facilities under construction. Four plants currently seeking permits could produce an additional 600 thousand tons of pellets.

The objective of this paper is to examine the growth and changes in the fuel pellet industry in the Lake States, to estimate the current and potential volume of products manufactured by this industry, and to examine changes in the type of fiber feed stock used by this industry. We chose the Lake States because of the diverse sources of fiber feed stock and the growth of pellet manufacturing in this region. Before proceeding with the analysis, we will describe the properties of the various types of pellets and related products, enumerate the types of feed stock used to manufacture these products, and discuss the manufacturing process.

Figure 1 – Cost of electricity and fuel oil in Midwest urban areas in dollars per 100,000 BTU from 2000 to 2008.



Source: USDL 2008

Table 1- Changes in the number of Lake States pellet and briquette plants and production volume between 2005 and 2008 and projected future changes.

	2005		2008		Under construction or planned	
Product	Plants	Production	Plants	Production	Plants	Production
	Number	(000 tons)	Number	(000 tons)	Number	(000 tons)
Residential fuel	0	0	5	222[1]	0	0
Industrial fuel	5	109	7	216	3	467[2]
Pet and animal products	3	28	2	26	0	0
Multiple products[3]	4	56	9[4]	321	2	200
Total	12	193	23	785	5	667

[1] Includes residential fuel pellet expansion of multiple product facilities.
[2] Volume includes expansion of an existing plant.
[3] These manufacturers produce multiple products including residential pellet, commercial/industrial pellets, pet and animal products, briquettes, wood flour, mulch, chips, and shavings.
[4] Includes an existing plant that was idle in 2005.

Pellets and Related Products

As previously stated, pellets and related products fall into four broad categories: premium fuel pellets, standard fuel pellets, briquettes, and animal sanitation products. Super premium and premium fuel pellets are for use in high efficiency stoves with catalytic converters and account for 95 percent of residential pellet consumption (Pellet Fuel Institute 2008). Super premium pellets are defined by the Pellet Fuel Institute (PFI) as having an ash content of 0.5 percent or less and moisture content of 6 percent or lower; premium pellets have an ash and moisture content of 1.0 and 8.0 percent or less, respectively[1]. Low ash content reduces the potential of incombustible "clinkers" occurring in the fire pot. While there is no required value of range for heating value for pellets in the PFI specification, the BTU value of premium grade pellets tends to range from 7900 to 8500 per pound, depending on the manufacturer and fiber feed stock used.

Most standard fuel pellets produced in the Lake States are used in house or are sold as boiler fuel (primarily to electrical generation facilities). Although the PFI does have a specification for standard grade pellets, these pellets may be manufactured following the specifications of an individual. Fuel briquettes are primarily used for boiler fuel and less expensive to manufacture. Briquettes also can be manufactured for use in home fireplaces, but no Lake State facilities currently manufacture this product.

A broad array of wood-based pellets is made for animal sanitation purposes such as equine bedding and kitty litter. Pellets are an efficient way to control animal waste because the soiled areas are easy to identify and remove. These products may contain aromatic wood species such as pine or cedar, but aspen is the most preferred species for most applications (Peterson 2009). These manufacturers also can produce chips and other wood products such as hamster bedding or kitty litter. Pellets manufactured for animal and pet sanitary purposes are normally priced higher per ton than premium fuel pellets and are sometimes manufactured using proprietary processes and feed stock mixtures. These products also can contain bark because ash content is not a critical consideration. While the markets for animal products and fuel products are distinct, many manufacturers of animal sanitation products also produce premium fuel pellets.

Fiber Feed Stock and Manufacturing Process

Wood residues such as green or dried sawdust, wood chips, and shavings have been preferred in the production of super premium and premium fuel pellets. Standard pellets can be manufactured from wood residue, roundwood, logging residue, seed shells, corn stocks, waste paper, and nearly any other fibrous products that are dry or can be dried easily. In recent years, the production of wood-based pellet and related products in the Lake States has increased faster than the availability of wood residues in many areas of this region. This change has resulted in the

---

[1] Four types of fuel pellets are defined by the Pellet Fuel Institute (PFI). All pellets defined by the PFI are less than 1.5 inches in length and .25 to .285 inches in diameter but vary in density, durability, inorganic ash, and moisture content. The specification for standard fuel pellets produced by Lake State manufacturers can vary from these specifications.

direct consumption of roundwood or chips manufactured from roundwood. Therefore, many of the newly built or proposed pellet facilities employ or contract loggers.
The manufacturing of pellets and related products is affected by the feed stock source and the moisture content of this material. However, all processes involve high-pressure extrusion of a dried and ground feed stock material through a die. In the case of wood pellets, the extrusion process causes lignin within the wood to heat up and act as a binding agent. The resulting pellet is 100 percent wood or fiber based. Production of pellets from sawdust produced from kiln dried lumber may require only high pressure extrusion while pellets produced from green sawmill waste or chips require drying and grinding steps before extrusion. The manufacturing process for briquettes differs from pellets in that briquettes are made by a compression, not an extrusion process.

Data Development

The data used for this study were collected from Lake States utilization foresters through documents associated with the environmental permitting process, conversations with pellet manufacturers, press releases, and home pages of these manufacturers. In this paper we will report only changes in the region to keep from disclosing information of individual firms. Information for one pet sanitation product firm could not be obtained and was estimated by the authors.

Changes in the Lake States Pellet Industry

At the beginning of 2005, there were 12 pellet plants operating in the Lake States and one plant that was idle (Table 1). The combined pellet production from these plants was estimated to be 193 thousand tons with at least 28 thousand tons of pet and animal products. While four plants manufactured premium residential fuel pellets, these plants also manufactured other products including pet products, wood flour, mulch, shavings, and chips. The combined pellet production for these multi-product facilities was 56 thousand tons in 2005. Although wood residue was the most commonly used feed stock in 2005 at 41 percent, nearly 27 percent of pellets were made from waste paper or agricultural residue and an additional 32 percent were manufactured from multiple or unspecified fiber feed stocks (Table 2).

On a volume basis, commercial industrial pellets were the most important product manufactured in the Lake States in 2005 (Table 1). All waste paper or agricultural residue used in pellet manufacturing was consumed by these facilities. Two of these manufacturing facilities used waste paper products generated in a manufacturing process or post consumer waste paper; the third consumed agricultural residue.

The steep increase in the price of fuel oil from 2000 to 2008 (Fig. 1) caused people to reexamine wood and wood pellet stoves. International demand for wood pellets for electricity production also provided an expanding market for standard grade pellets. The renewed interest in wood based fuels caused in some existing facilities to increase capacity, one idled facility to reopen, and 11 new plants to be constructed. As a result of these capital investments, pellet production increased by 300 percent between 2005 and 2008. Four of the new plants produced premium fuel pellets from wood residue and a fifth plant produced standard fuel pellets for home use from agricultural waste.

Table 2- Changes in the volume of fiber feed stock consumed by the Lake States pellet and briquette industry between 2005 and 2008 and projected future changes in dry tons.

Fiber feed stock	2005	2008	Building or planned
	(000 tons)	(000 tons)	(000 tons)
Primarily wood residue	79	336	7
Primarily paper and/or ag residue	53	161	300
Primarily chips manufactured from roundwood	0	80	200
Primarily chips manufactured from roundwood and residue	0	70	160
Multiple or unspecified fiber feed stock	61	138	0
Total	193	785	667

Two new plants with a combined capacity of 107 tons were constructed to manufacture commercial/industrial fuel pellet and briquettes for power production. While one of these plants produces pellets from wood waste, the other plant manufactures briquettes using paper waste, agriculture residue, and potentially some wood residue. Five plants with a combined capacity of 265 thousand tons were constructed to produce multiple products. One small facility that produced animal sanitary products closed between 2005 and 2008, most likely because of increased production of these products at the facility manufacturing multiple products.

The construction of 11 new and expansion of several existing pellet and briquette facilities required an additional 592 thousand dry tons of fiber feed stock. Forty-three percent of the additional feed stocks were wood residue in the form of dust, chips, and shavings. An additional 25 percent were roundwood, chips made from roundwood, and wood residue. Facilities that used agricultural residue accounted for 18 percent of the new feed stock and multiple feed stock facilities accounted for 13 percent.

Perhaps the greatest change in the Lake States pellet industry is yet to come with one plant under construction, another adding capacity, and four other plants being planned. The combined production capacity that may result from these activities is 667 thousand (Table 1). Nearly 70 percent of the planned increased production is solely industrial fuel as increased emphasis on green energy sources is causing some traditional coal fired power plants to combine pellets or briquettes with coal. Although these plants could use wood residue, they are being designed to use softwood and hardwood roundwood, paper waster, agricultural residue, or unspecified biomass residue. Two of the four planned plants will produce multiple products including premium fuel pellets. The other four plants are being built or designed to produce industrial pellets or briquettes for power production.

If all the plants that are under construction or planned go into operation, the combined capacity of all pellet and briquette plants in the Lake States will exceed 1.4 million tons per year. This would be a 1.3 million ton (650 percent) increase over the 2005 level. Although premium fuel pellets may be the most visible part of the Lake States pellet and briquette industry, industrial fuel is now the fastest growing part of this industry.

The 600 thousand ton increase in fiber feed stocks demand that could result after the construction of the four planned plants will primarily be supplied by roundwood or by combining several sources of fiber feed stock. It is unlikely that traditional primary and secondary wood residues will be a major source of fiber feed stock for these planned operations because of the existing demand for this material from existing operations that produce higher value premium, super premium, and animal sanitary pellets.

In the current market of 2009, many of the existing users of wood residue feed stock are finding it difficult to obtain because of the decline in primary and secondary timber and wood processing. This slowdown of activity also is causing pulp mills to close or reduce production. The potential increase in the demand for lower value roundwood by new pellet manufacturing facilities could replace the declining demand for this material from the paper industry. However, if the industry continues to expand, it could bid roundwood away from the remaining pulp and paper mills and other timber using industries.

Conclusions

Although the market for premium fuel pellets for use by residential customers has increased dramatically in the Lake States since 2005, this increase is dwarfed by the increases in combined production of commercial/industrial pellets and plants that produce numerous products but appear to specialize in fuel products. Furthermore, while premium fuel pellet manufacturers rely on sawdust and other clean wood waste for feed stock, the large plants producing briquettes and commercial/industrial pellets plan to obtain a major portion of the feed stock from low-grade roundwood and slash.

One factor that could influence the future of the pellet and briquette industry is whether costs of obtaining feed sock and producing and transporting pellets resulting from increased fuel prices will be offset by increased price for pellets. Given the divergence in prices shown in Figure 1, pellet manufacturers probably will be able to raise their prices as prices of other competing fuels increase. Producers of wood briquettes also may be able to raise prices if environmental regulations on coal fire generating facilities are expanded. Because the planned plants have not started construction, the long-term impact of increased production of fuel pellet and briquette products remains to be seen. The potential increase in the demand for low-value species often left in the woods could improve the quality of Lake States timber in the long term. However, if the pellet industry continues to expand and the pulp and paper industry increases production to previous levels, there could be local and regional shortages in timber supply.

Literature Cited

EPA. 2008. Cleaner burning wood stoves and fireplaces. Washington, DC: U.S. Environmental Protection Agency. http://www.epa.gov/woodstoves/refp.html

Jordan J., A. Blaustein, and A. Higgins (editors). 1977. The Arab Oil Weapon. Oceana Publication, Dobbs Ferry, N.Y., 370 p.

Pellet Fuel Institute. 2008. PFI standard specification for residential/commercial densified fuel, 18-June-2008. http://www.pelletheat.org/2/StandardSpecificationForResidentialCommercialDensifiedFuel-June.pdf

Peterson, D. 2009. Personal conversation. Renewable Resource Solutions, LLC, Crystal Falls, MI.

USDE. 2008. Energy saver, your home, wood and pellet heating. Washington, DC: U.S. Department of Energy. http://www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12570

USDL Bureau of Labor Statistics. 2008. Producer price index commodity data. Washington, DC: U.S. Department of Labor. http://data.bls.gov/PDQ/outside.jsp?survey=wp

Southern Forest Economic Workers
2009 Annual Meeting

Monday, March 9, 2009
3:15PM – 5:00 PM
Session C: Trade

Manuscripts:

Exports and Growth of Forest Industries – Sijia Zhang and Joseph Buongiorno

Competition of Imported Wooden Bedroom Furniture in the United States – Yang Wan, Changyou Sun, and Donald L. Grebner

Exports and Growth of Forest Industries

Sijia Zhang[1] and Joseph Buongiorno, Department of Forest and Wildlife Ecology, University of Wisconsin, Madison.

Acknowledgements:

The research leading to this paper was supported in part by McIntire-Stennis grant 4979 and by the USDA Forest Service, Southern Forest Research Station. We thank Jeff Prestemon and Dave Wear for their support and collaboration.

[1] Research Associate, Department of Forest and Wildlife Ecology, University of Wisconsin-Madison. 1630 Linden Drive Room A141, Madison, WI 53706. sijiazhang@wisc.edu, (608) 263-5574 (o).

Exports and Growth of Forest Industries

Abstract:

This paper investigates whether exports are the engine of production growth in forest industries in three countries. A bivariate autoregressive distributed lag model of production and exports was estimated with data of eleven forest industries from China, Finland, and the United States. Inferences were based on the short-run and long-run partial multipliers from exports to production by industry. The results show that in Finland, there was strong support for the exogenous growth hypothesis, while there was less support in the cases of China and the United States.

Key words: International trade, forest products, China, Finland, the United States.

Introduction

Different theories explain the relationship between exports and domestic production (Stern, 1989). According to the exogenous growth hypothesis, exports are the engine of domestic growth (Stern, 1989; Riezman et al, 1996). The exogenous growth hypothesis suggests that measures to directly stimulate exports, including more open trade, will accelerate domestic growth,

> Export expansion generates foreign exchange earnings, investment capital and intermediate imports, which induce more production (Bhagwati, 1978; Krueger, 1978). By exporting more, an economy may increase productivity with better resource allocation and technological innovation, with development of indigenous entrepreneurship and exploitation of scale economies (Jung and Marshall, 1985). The exogenous growth hypothesis seemed initially to have been vindicated with the success of East Asia's miracle economies, which achieved extraordinarily high growth between the early 1960s and mid-1990s, through export promotion (World Bank, 1993). However, after the Asian crisis in the late 1990s, doubts have been expressed for the effectiveness of export promotion to stimulate growth (Medina-Smith 2001; Felipe 2003).

Recent empirical studies have found mixed results for exogenous growth hyphothesis. Riezman et al. (1996), Kwan et al. (1996), Islam (1998), Mamun and Nath (2005) found weak support for the export-led growth hypothesis, while Jin and Yu (1996), Yamada (1998), and van Rensburg and Naude (1999) find no relation between exports and domestic growth. As these studies use different methods, data, and country groups, a general conclusion is still elusive (Ahmad 2001).

Most of past studies used macroeconomic data on total exports and GDP. Studies at sector or industry level appear to be rare. Chao and Buongiorno (2002) use error correction models (ECM) to study the relation between exports and domestic production of the pulp and paper industries, with pooled time-series across countries. Here, we concentrate on production and export data from the United States, Finland and China, and examine all the forest industries, some of which, such as wood-based panels, have grown much more rapidly than others, such as sawnwood (Turner et al. 2006). Comparison of these three countries may shed light on the effect of the development stage of a country, and of the importance of exports relative to production, on the relationship between the two.

Methods and data

Time series models

The effect of exports on production was analyzed with time-series models. It is known that simple time-series non-structural models forecast as well as structural models (Diebold 1998). Zellner and Palm (1974) have shown that dynamic structural models are special cases of multivariate time-series processes. Nevertheless, a time-series approach to study the relation between production and exports, with both variables assumed to be endogenous does allow the determination of the dynamic net effect of exports on production, implicitly assuming the adjustment of all other relevant variables. The results can therefore be interpreted as describing the path of change of production and exports in a general equilibrium framework.

Accordingly, the relation between a country's exports, X_t, and production, Y_t, of a particular product was described with a bivariate time-series model based on a general autoregressive distributed lag (ADL) structure (Stock and Watson 2003, p. 446). Both X_t and Y_t are treated as being endogenous. As is standard practice, to facilitate the interpretation of the coefficients as elasticities, the logarithmic transforms, $\ln X_t$ and $\ln Y_t$, were used in the models:

$$(1) \qquad \ln X_t = \sum_{j=1}^{m} a_{1j} \ln X_{t-j} + \sum_{j=1}^{m} b_{1j} \ln Y_{t-j} + u_{1t}$$

$$(2) \qquad \ln Y_t = \sum_{j=1}^{m} a_{2j} \ln Y_{t-j} + \sum_{j=1}^{m} b_{2j} \ln X_{t-j} + u_{2t}$$

where a_{1j}, a_{2j}, b_{1j} and b_{2j} are coefficients to be determined empirically. u_{1t} and u_{2t} are the residuals, which may be cross-correlated, but not autocorrelated over time. In this general form, with the same predetermined variables on the right hand side of the equations, both equations can be consistently and separately estimated by Ordinary Least Square (OLS) (Judge *et al.*, 1982: p.710).

However, in practice, several of the coefficients may be zero, and neglecting the correlation between u_{1t} and u_{2t} would lead to inefficient estimates. Judge et al. (1982, p. 711) suggest a way to still use OLS with a transformation that leads to:

$$(3) \qquad \ln Y_t = \sum_{j=1}^{m} a_{3j} \ln Y_{t-j} + \sum_{j=0}^{m} b_{3j} \ln X_{t-j} + u_{3t}$$

Judge show that equations (1) and (2) imply equation (3) with $a_{3j} = \lambda a_{1j} + a_{2j}$, $b_{3j} = \lambda b_{1j} + b_{2j}$, $j = 1, \ldots\ m$, $a_{30} = -\lambda = \mathrm{cov}(u_{1t}, u_{2t}) / \mathrm{var}(u_{1t})$. The residual u_{3t} is uncorrelated with u_{1t} and thus uncorrelated with X_t. OLS gives consistent and asymptotically efficient estimates of equation (3).

Equation (3) assumes that the data are drawn from a stationary distribution, so that the distribution of the data is independent of time (Stock and Watson 2003, p. 447). The stationarity of the exports and production series for each industry and country was tested with the Dickey-Fuller *t* test with a time trend (Dickey and Fuller, 1979). When stationarity was rejected, equation (3) was estimated with data in first differences, as first differencing led to stationary series.

The optimal values of the lag length, *m*, in equation (3) were determined with Akaike's Final Prediction Error (FPE) criterion (Hsiao, 1979). The best value of *m* minimized the FPE, but lags were added until "dynamically complete" (Wooldridge 2006, p. 401) without serial correlation was obtained. The presence of serial correlation in the residuals u_{3t} was tested with the Breusch (1978)–Godfrey (1978) Lagrange multiplier (LM) statistic for serial correlation.

Multiplier analysis

Various measures of the causal relationship between X_t and Y_t have been proposed in the literature, based on equations (1) to (3). Perhaps the most common are the "Granger-causality tests" (Granger, 1969, 1988). It simply states that a variable, say X_t, "causes" Y_t if knowledge of X_t helps better predict future values of Y_t. The measures of the relationship between production and exports used here follow the same general principles. They deal with the total effect of exports on production, whether exports precede production or occur in the same period. They take the form of short-run static multipliers, and long-run dynamic multipliers from exports to production.

Short -run static multipliers

The short-run, static, multiplier of exports on production shows the instantaneous effect of past and current changes in exports on production. In particular, b_{32} in equation (3) is the short-term impact of a change in exports in year *t*-2 on production in year *t*. The total static impact of a change in exports in any year from *t-m* to *t* on production in year *t* is then the short-run multiplier (SRM):

$$(4) \qquad SRM_{x \to y} = \sum_{j=0}^{m} b_{3j}$$

The variance of the short-run multiplier is $\mathbf{h}'V(\mathbf{b})\mathbf{h}$ where h=(1,…,1) is an *m*x1 vector, b=(b_{31}, …, b_{3m}) is the vector of parameters and *V*(b) is their variance-covariance matrix (Goldberger 1991, p. 174).

A test of the significance of the short-run multipliers (4) is in effect a test of the Granger causality between exports and production, including the instantaneous causality defined in Granger (1969) and analyzed by Geweke (1984), and Harvey (1990, p. 305) among others.

Long-run dynamic multipliers

The long-run multipliers (LRM) measured the cumulative effect over time of a permanent change in exports on production, when production is kept unchanged initially (Hamilton, 1994). The full long-run impact of a unit change in exports on production, both lagged and instantaneous, denoted by $LRM_{y \to x}$ was derived from the parameters of equation (3) (Banerjee et al., 1993, p. 54):

$$(5) \qquad LRM_{x \to y} = \frac{\sum_{j=0}^{m} b_{3j}}{1 - \sum_{j=1}^{m} a_{3j}}$$

The LRM gave information on the direction and magnitude of any long-term, persistent influences from one variable to another. The denominator of the LRM gave information on the adjustment speed. The closer the sum of *a* parameters was to unity, the slower the adjustment; the closer it was to zero, the faster the adjustment (Brorsen *et al.*, 1985).

The variance of the long-run multipliers was obtained from the variance-covariance matrix of the parameters, $V(\mathbf{c})$, where $\mathbf{c}=(b_{31},\ldots,b_{3m}, a_{31},\ldots,a_{3m})$ for equation (5), as:

(6) $$V(LRM) = \mathbf{d}'V(\mathbf{c})\mathbf{d}$$

where **d** is the vector of the partial derivatives of the LRM with respect to each parameter.

If $SRM_{x\to y}$ or $LRM_{x\to y}$ were statistically significant, we concluded that there was evidence supporting the exogenous growth hypothesis.

Data

All the data were obtained from the database of the Food and Agriculture Organization of the United Nations database (FAO 2007).

For the United States, the study used annual time series data from 1961 to 2004 of exports and production of eleven forest industries. The data for Finland were from 1961 to 2005, for the same eleven industries. For China, the data were from 1961 to 2005 for ten industries. Data of China included Taiwan and Hong Kong. The autoregressive-distributed lag models were estimated with the differenced series.

Results

Short-run and long-run multipliers

The second and third columns of Table 1 show the short-run and long-run multipliers from exports to production, derived from equation (4) and (5) with the parameters estimated from the autoregressive distributed lag model. Only the statistically significant results are reported.

For the United States, the SRMs and LRMs from exports to production were especially significant, statistically and economically for five industries out of eleven: industrial round wood, particleboard, fiberboard, recovered paper and other paper and paperboard. For Finland, all SRMs and LRMs were statistically significant at 1 percent level except for the recovered paper industry of which the result was statistically significant at 5 percent level. For China, the SRMs and LRMs from exports to production were statistically significant for five industries out of ten: plywood and veneer, particle board, fiberboard, newsprint, and printing and writing paper.

Over all industries and countries, the long-run multipliers tended to be smaller than the short-run multipliers, and the difference increased for larger multipliers.

Summary and Conclusion

The objective of this study was to test the exogenous (or export-led) growth hypothesis for forest industries. To this end eleven industries were analyzed, covering industrial round wood, sawn wood, panels, pulp, paper and paperboard, in the United States, Finland, and China.

The methods consisted of time-series analysis based on annual export and production data by country and industry, from 1961 to 2005. Autoregressive distributed lag models were formulated to predict production as a function of current and past exports, and past production. To ensure stationary series, the ADL models were formulated in terms of annual relative change. From the parameters of the ADL models, we derived short-run and long-run multipliers of exports to production, for each industry and country.

There was less support for the exogenous (export-led) growth hypothesis in China and the United States. In Finland, the multipliers were statistically significant for all but one industry. And the SRMs and LRMs of production response were a high percent of a permanent increase in exports, thus supporting the export-led growth hypothesis. Therefore, in Finland forest industries, export expansion stimulates domestic production.

Table 1. *Short-run and long-run multipliers from exports, x to production, y, by country and industry, and panel data results.*

Industry	$SRM_{x \to y}$	$LRM_{x \to y}$
United States		
Industrial roundwood	0.15(0.06)**	0.14(0.05)***
Particleboard	0.20(0.07)***	0.20(0.05)***
Fiberboard	0.30(0.13)**	0.36(0.13)***
Recovered paper	0.14(0.08)*	0.14(0.08)*
Other paper & paperboard	0.12(0.07)*	0.12(0.06)**
Finland		
Industrial roundwood	0.21(0.06)***	0.16(0.04)***
Sawnwood	1.14(0.12)***	0.82(0.06)***
Plywood & veneer	1.09(0.10)***	0.87(0.04)***
Particleboard	1.15(0.23)***	0.72(0.06)***
Fiberboard	0.70(0.17)***	0.62(0.11)***
Chemical wood pulp	0.55(0.08)***	0.54(0.08)***
Recovered paper	0.12(0.05)**	0.11(0.04)**
Newsprint	1.79(0.26)***	0.93(0.04)***
Printing & writing paper	1.09(0.15)***	0.90(0.05)***
Other paper & paperboard	0.85(0.15)***	0.76(0.07)***
China		
Plywood & veneer	0.61(0.18)***	0.50(0.13)***
Particleboard	0.16(0.09)*	0.19(0.11)*
Fiberboard	0.25(0.12)**	0.30(0.13)**
Newsprint	0.17(0.08)**	0.26(0.14)*
Printing & writing paper	0.24(0.10)**	0.22(0.09)**

***, **, *: significant at 1%, 5% and 10% level, respectively. Numbers in parentheses are standard errors.

Literature cited

Banerjee, A., Dolado, J. J., Galbraith, J.W., and Hendry, D. F. 1993. Cointegration, Error Correction, and the Econometric Analysis of Non-stationary Data*,* Oxford University Press, Oxford, United Kingdom. 352 p.

Bhagwati, J. 1978. Foreign Exchange Regimes and Economic Development: Anatomy and Consequences of Exchange Control Regimes, Ballinger Publishing, Cambridge, MA. 232 p.
Breusch, T.S. 1978 . Testing for autocorrelation in dynamic linear models. Australian Economics Paper*s*, 17:334-355.
Brorsen, B. W., Chavas, J.-P., and Grant, W.R. 1985. A dynamic analysis of prices in the US rice marketing channel. Journal of Business and Economics Statistics, 3:362-369.
Chao, W.S., and Buongiorno, J. 2002. Exports and growth: a causality analysis for the pulp and paper industries based on international panel data, Applied Economics, 34:1-13.
Dickey, D. A., and Fuller, W. A. 1979. Distribution of the estimators for autoregressive time series with a unit root, Journal of the American Statistical Association, 74:427-31.
Diebold, F.X. 1998. The past, present, and future of macroeconomic forecasting. *Journal of Economic Perspectives,* 12,2:175-192.
FAOSTAT Forest Products Database, Food and Agriculture Organization of the United Nations, Rome, 2007.
Felipe, J. 2003. Is export-led growth passé? Implications for developing Asia. Economics and Research Department Working Paper Series No. 48. December. Asian Development Bank, Manila.
Geweke, J. 1984. Inference and causality in economic time series models, pp.1102-42 in *Handbook of Econometrics*, Volume II, Z. Griliches and M. D. Intriligator (Eds). North Holland Publishing Company, New York. .
Godfrey, L.G. 1978. Testing against general autoregressive and moving average error models when the regressors include lagged dependent variables. Econometrica, 46:1293-1302.
Goldberger, A.S. 1991. A course in econometrics. Harvard University Press. Cambridge, MA. 432 p.
Granger, C. W. J. 1969. Investigating causal relations by econometric models and cross-spectral methods, Econometrica, 37:424-38.
Granger, C. W. J. 1988. Some recent developments in a concept of causality, Journal of Econometrics, 39:199-211.
Hamilton, J.D. 1994. *Time Series Analysis*, Princeton University Press, Princeton, New Jersey. 820 p.
Harvey, A. 1990. The econometric analysis of time series. 2nd Edition. MIT Press. Cambridge, MA. 401 p.
Hsiao, C. 1979. Causality tests in econometrics, Journal of Economic Dynamics and Control, 4:321-46.
Islam, M.N. 1998. Export expansion and economic growth: testing for cointegration and causality, Applied Economics, 30:415-25.
Jin, J. C., and E. S. H. Yu. 1996. Export-led growth and the U.S. economy: another look, Applied Economic *Letters*, 3:341-4.
Judge, G. G., Hill, R.C., Griffiths, W.E., Lütkepohl, H., and Lee, T.C. 1982. Introduction to the theory and practice of econometrics. John Wiley & Sons. 1062 p.
Jung, W. S. and Marshall, P. J. 1985. Exports, growth and causality in developing countries, Journal of Development Economics, 18:1-12.
Krueger, A. O. 1978. Foreign trade regimes and economic development: Liberalization attempts and consequences. Ballinger, Cambridge, MA. 310 p.

Kwan, A.C.C., Cotsomitis, J.A., and Kwok, B. 1996. Exports, economic growth and exogeneity: Taiwan 1953-88, Applied Economics, 28:467-71.
Mamun, K.A.Al. and Nath, H.K. 2005. Export-led growth in Bangladesh: a time series Analysis, Applied Economics Letters, 12:361-364.
Medina-Smith, E. J. 2001. Is the export-led growth hypothesis valid for developing countries? a cause study of Costa Rica. Policy issues in international trade and commodities study series No.7. United Nations, New York and Geneva.
van Rensburg, L., and Naude, W. 1999. Productivity and export growth in the South African manufacturing sector. South African Journal of Economic and Management Sciences, 2:269-91.
Riezman, R., Whiteman, C.H., and Summers, P.M. 1996. The engine of growth or its handmaiden? a time-series assessment of export-led growth, Empirical Economics, 21,1:77-110.
Stern, N. 1989. The economics of development: a survey, The Economic Journal, 99:597-685.
Stock, J.H., and Watson, M.W. Introduction to econometrics. Addison Wesley, Boston, 2003. 796 p.
Turner, J A., Buongiorno, J., Maplesden, F., Zhu, S., Bates, S., and Li, R., 2006. World Wood Industries Outlook: 2005-2030. Forest Research Bulletin 230, Ensis and the University of Wisconsin.
Wooldridge, J.M. Introduction to Econometrics. Thomson South-Western, 2006. 912 p.
World Bank. 1993. The East Asian Miracle: Economic Growth and Public Policy, Oxford University Press, Oxford, United Kingdom. 408 p.
Yamada, H. 1998. A note on the causality between export and productivity: an empirical reexamination, Economic Letters, 61:111-14.
Zellner, A. and Palm, F., 1974. Time series analysis and simultaneous equation econometric models. Journal of Econometrics, 2:17-54.

Competition of Imported Wooden Bedroom Furniture in the United States

Yang Wan[1], Changyou Sun[2], and Donald L. Grebner[3]

[1] Graduate Research Assistant, Department of Forestry, Mississippi State University, Box 9681, Mississippi State, MS 39762. ywan@cfr.msstate.edu. (662) 325-8357.

[2] Assistant Professor, Department of Forestry, Mississippi State University, Box 9681, Mississippi State, MS 39762. csun@cfr.msstate.edu. (662) 325-7271.

[3] Associate Professor, Department of Forestry, Mississippi State University, Box 9681, Mississippi State, MS 39762. dgrebner@cfr.msstate.edu. (662) 325-0928.

Competition of Imported Wooden Bedroom Furniture in the United States

Abstract

The United States has been increasing the import of wooden bedroom furniture from the world to meet its domestic needs. Traditional suppliers have been substituted by developing countries such as China and Vietnam over the past decade. To explain this market structure change, a dynamic Almost Ideal Demand System (AIDS) was employed to analyze this import market. Monthly import data of the top seven countries from 2001 to 2008 were collected from the International Trade Commission. The Engle-Granger cointegration test showed that the cointegration relationships existed in this demand system. Both homogeneity and symmetry properties were not rejected in the dynamic AIDS. The superiorities of dynamic AIDS were also revealed in passing several misspecification tests. The U.S. antidumping investigation on China was effective in the short-run, but the trade diversion occurred from China to Vietnam, Indonesia, and Brazil. Finally, the expenditure elasticities suggested that U.S. consumers would spend more money on the wooden bedroom furniture from Vietnam, China, and Malaysia. All the own-price elasticities were significantly negative and the cross-price elasticities indicated the competition among those suppliers. The results from this study are helpful in understanding the competition among suppliers, the consumer behavior in this market, and the impact of antidumping policy.

Keywords: Almost Ideal Demand System (AIDS), antidumping investigation, Engle-Granger cointegration, wooden bedroom furniture

Introduction

The United States has been experiencing a rapid growth in the consumption of furniture and its furniture industry has made significant contribution to the domestic economy over the last decades. Its domestic retail sales steadily grew in recent years, exceeding $100 billion in 2003 (Gazo and Quesada 2005). According to U.S. Bureau of Census (2006), the total value of shipments of furniture reached $85.6 billion in 2006, which was equal to 5.4 % of the manufacturing industries GDP.

However, an increasing share of the rising furniture demand has been met by the large import from foreign countries. The import value of wooden bedroom furniture climbed from $0.6 billion in 1996 to $3.8 billion in 2006. Traditionally, the United States imported furniture from Canada, Italy, and Taiwan, to name a few. At present, the newly developing countries such as China, Vietnam, and Malaysia have substituted the furniture from traditional suppliers and begun to dominate the U.S. furniture import market in recent years. In particular, China has been leading the wooden bedroom furniture market and accounts for 44% market share over 2001 – 2008. This trade phenomenon has led to serious threat to the furniture industry and aroused wide concerns about the future of the domestic furniture industry. To protect the furniture industry, antidumping investigation (U.S. ITC. 2004) on China was conducted during the period of 2003 and 2005. The final antidumping duties (0.83% – 198.08%) have been imposed on the wooden bedroom furniture from China, but its total import value continues to rise at present.

The objective of this study was threefold. First, the consumer behavior in the imported wooden bedroom furniture was examined in this changing market setting. Second, how different supplier countries compete in this market was analyzed. Third, the effectiveness of the antidumping investigation on China during the period of 2003 – 2005 was evaluated. To complete the above objectives, the dynamic AIDS was employed and various tests were used to examine theoretical properties and model robustness. The results from this study are helpful in understanding the competition among suppliers, the consumer behavior in this market, and the implications of the current policy.

Market Overview

The U.S. import of wooden bedroom furniture (*wbf*) has been steadily growing over the period of 1996 – 2008, as shown in Figure 1. U.S. monthly import value was about $50 million in 1996 and reached its peak value of $353.8 million in August 2005. *Bed* is one of the major products of wooden bedroom furniture as defined by the International Trade Commission (ITC). There was an upward trend over the same period. The rapid growth of imported *wbf* was largely due to the increasing import of *bed* from all over the world. In 1996, *bed*'s monthly import value was about $10 million, one fifth of *wbf*. It rapidly climbed to $100 million per month since 2004, about one third of *wbf*.

Traditionally speaking, the U.S. mainly imported the *bed* from suppliers such as Canada, Indonesia, and Italy. The newly developing Asian countries such as China and Vietnam have demonstrated their potentials to dominate the U.S. market. China has been steadily increasing its export to the U.S and become the leading supplier in the U.S. market since 2001. The import value from China was only $5.6 million in 1996, but climbed to $418 million in 2008, accounting for 35.4% market share. Although the annual export value of Vietnam was lesser than China, it still was an important supplier in the U.S. import furniture market. Vietnam began to export its *bed* to U.S. from 2001 and hit $357.80 million in 2008, closely following China.

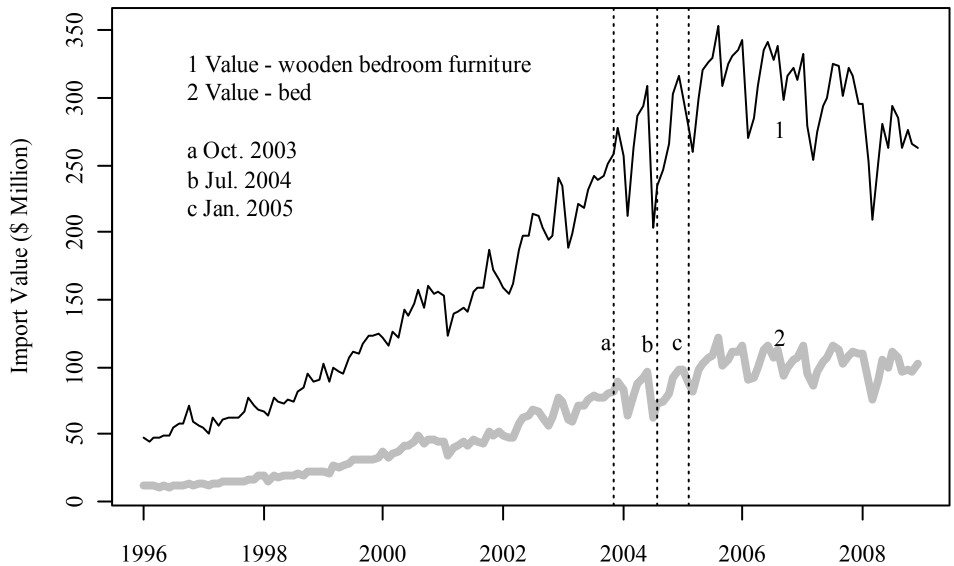


Figure 1. Monthly import value of *wbf* and *bed* from January 1996 to December 2008

Methodology

In this study, a dynamic AIDS was employed to examine the consumer behavior, evaluate the competition among different supplier countries, and assess the effectiveness of antidumping investigation in the imported wooden bedroom furniture market. The seminal AIDS created by Deaton and Muellbauer (1980) has become one of the most popular demand analysis tools for researchers over the past three decades. The frequent application of AIDS over the other demand models is largely due to its outstanding advantages.

AIDS is highly consistent with consumer theory. It can exactly satisfy the axiom of choice. AIDS is also a desirable and flexible demand system, which can take different functional forms to incorporate dynamic factors. Various function forms have been applied in the empirical demand studies so far. Anderson and Blundell (1982)first put forward the dynamic adjustment of consumers' expenditure. With the development of econometric techniques, autoregressive distributed lagged technique allows for several periods of short-run adjustments to long-run equilibrium status in AIDS.

Due to the superiorities mentioned above, dynamic AIDS has been widely used in consumer's expenditure on food (Balcombe and Davis 1996; Karagiannis and Mergos 2002), meat products (Fanelli and Mazzocchi 2002; Karagiannis et al. 2000), olive oil consumption (Duffy 2003), and alcohol market (Seale et al. 2003). It also has been employed frequently in the field of tourism demand analysis worldwide (De Mello and Fortuna 2005; Li et al. 2004)

Considering this imported *bed* market, AIDS can be derived from minimizing the *bed* expenditure function to attain a specific utility level at given prices. It can be expressed as the functions of the logarithms of prices and total expenditure in the following system:

(1) $$s_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left(x / P^*\right) + \delta_i D_i + \varepsilon_i$$

where s_i is budget share of imported *wbf* from supplier country *i* (*i* = 1,2,…,7). p_j is the price of *bed* from country *j*, *x* is the total expenditure on all of the imported *bed*. The Stone's Price Index is the linear approximation to original price index P, which usually takes the form of $\log p^* = \sum_{i=1}^{n} s_i \log p_i$. Then *x* is deflated by P^* to get the real total expenditure x / P^*. D_i (*i* = 1) is the antidumping policy dummy, and ε_i is the normal disturbance term with zero mean and constant variance.

To comply with the economic theories, the system of equation [1] is required to satisfy the properties of adding-up, homogeneity, symmetry, and negativity. The adding-up property implies that the sum of all budget shares equals to one, which requires $\sum_i \alpha_i = 1;\ \sum_i \beta_i = 0;\ \sum_i \gamma_i = 0$ Homogeneity requires $\sum_j \gamma_{ij} = 0$ and suggests that the proportional change in the expenditure and all of the prices has no impact on the quantities purchased or the budget allocation. Symmetry implies that the matrix of the price derivatives is symmetric, $\gamma_{ij} = \gamma_{ji}$.

In this study, time series property of all the variables have been investigated by Augmented Dickey-Fuller (ADF) unit root test first. The Engle-Granger (1987)cointegration and error correction techniques are integrated into the AIDS to consider both long-run and short-run consumer behavior. The dynamic AIDS (Feleke and Kilmer 2007; Karagiannis et al. 2000)can be formulated as follows:

(2) $$\Delta s_{it} = \psi_i \Delta s_{i,t-1} + \sum_{j=1}^{n} \gamma_{ijt} \Delta \ln p_{jt} + \beta_i \Delta \ln(x_t / P_t^*) + \eta_i ECT_{it} + \delta_i D_{it} + u_{it}$$

Δ is the first-difference operator and ψ measures how the habit persistence influences the current consumption. *ECT* is calculated as $ECT_i = a_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left(x / P^*\right) + \delta_i D_i - s_i$ and η measures the speed of short-run adjustment.

In the specification of above models, the adequacy of the models should be examined, especially in modeling dynamic AIDS. First, the data used in this study are time series data which are often auto correlated. The Breusch-Godfrey (BG) test is used to test the hypothesis of no serial correlation in those variables. Second, the assumption of homoscedasticity means that the variance is constant at each observation point. A failure of this assumption may result in the invalid inferences. The Breusch-Pagan (BP) test is employed to test heteroscedasticity. The assumption of normally distributed error term is tested by Jarque-Bera LM test. For the test of functional misspecification, Ramsey's Regression Specification Error Test (RESET) is adopted.

In addition, the assumption of parameter constancy is tested by cumulated sum of squares (CUSUMSQ).

Researchers and policymakers are usually interested in the expenditure elasticity, own-price elasticity, and cross-price elasticity. In this study, all those elasticities were calculated by the estimated parameters from AIDS and the average budget shares (s_i) throughout the whole sample period. The formulas are listed as follows:

(3) Expenditure elasticity: $\eta_i = 1 + \left(\frac{\beta_i}{s_i} \right)$

(4) Marshallian (uncompensated) elasticity: $\varepsilon_{ij}^M = -\delta_{ij} + \frac{\gamma_{ij}}{s_i} - \beta_i (\frac{s_j}{s_i})$

(5) Hicksian (compensated) elasticity: $\varepsilon_{ij}^H = -\delta_{ij} + \frac{\gamma_{ij}}{s_i} + s_j$

where $\delta_{ij} = 1$ if $i = j$ and $\delta_{ij} = 0$ if $i \neq j$. In addition, both long-run and short-run elasticities can be calculated by the above formula.

Data Sources and Variables

In order to analyze the consumer behavior and competition in this import market, several factors were taken into consideration in this study. First, the definition of imported wooden bedroom furniture was introduced. The subject of this study was mainly focused on the specific furniture under HTS9403.50.9040, which is defined as the wooden furniture of a kind used in the bedroom (*bed)* by International Trade Commission (ITC). Second, the time period covered from January 2001 to December 2008. One major reason was that this market structure has undergone a dramatic change during the past decade. Another important reason was that Vietnam began to export its *bed* to the United States from January 2001 and has experienced tremendous growth in this market during the period of 2001 – 2008. Hence, to analyze the current market structure and the competition among newly developing countries, this study focused on the period from January 2001 to December 2008.

After identification of the time period, major and representative suppliers need to be selected. The aggregate import value of top seven suppliers represented 85% of the total import during the period of 2001 and 2008. They were China (44.2%), Vietnam (11.7%), Indonesia (7.8%), Malaysia (6.4%), Canada (6.3%), Brazil (4.4%), and Italy (4.2%). All the other countries were aggregated into the Rest-of-world (ROW) (15.0%). Next, the monthly cost-insurance-freight (*CIF*) (dollars) and quantity (piece) data were collected from ITC to construct the variables in AIDS. The total expenditure was the total *CIF* value of *bed* imported from all over the world. The budget share of each supplier was the percentage of the *CIF* value of that supplier over the total expenditure. The import price measured by the unit value of imported *bed* was calculated as *CIF* value over quantity.

Empirical Results

Model estimation and tests

The time series properties of budget share, import price, and total expenditure were formally examined by ADF unit root test first. All the results were listed in Table 1. The null hypothesis of unit root in budget share failed to reject at 5% significance level, which suggested that all of them had unit roots over 2001 – 2008. All of the import prices were not stationary except Malaysia and Canada. Finally, the ADF test suggested that the total expenditure also had unit root. However, all the first-difference variables were stationary. These results indicated that the level of data series were integrated in order 1, but the first-difference data were zero.

The next step was to examine the long-run equilibrium relationship in the imported *bed* market by Engle-Granger cointegration test. The results in Table 2 indicated that all the equations were cointegrated at the 5% significance level. Due to the existence of long-run relationship in this market, the dynamic AIDS can be further established to consider the short-run consumer behavior. After the first-difference of all the variables, the dynamic AIDS [2] were estimated by SURE again.

Table 1. ADF unit root test of budget share, import price, and total expenditure Jan. 2001 to Dec. 2008

Variable	Level ADF					First-differenced ADF		
	T & C	Trend	None	Lag	Order	None	Lag	Order
Budget share								
s.CN	-2.54	-1.77	-0.92	12	I(1)	-1.68	11	I(0)
s.VN	-1.92	1.50	2.35	11	I(1)	-2.96	10	I(0)
s.ID	-2.22	-2.60	-1.34	10	I(1)	-3.93	9	I(0)
s.MY	-1.93	-1.34	0.22	1	I(1)	-15.81	0	I(0)
s.CA	-2.25	-2.33	-3.90	10	I(1)	-4.73	9	I(0)
s.BR	-1.73	-0.44	-1.08	8	I(1)	-5.97	7	I(0)
s.IT	-3.05	-1.21	-1.94	9	I(1)	-2.90	8	I(0)
s.ROW	-0.01	-2.08	-1.13	11	I(1)	-2.56	10	I(0)
Import price								
ln(p.CN)	-1.58	-1.96	0.53	11	I(1)	-6.28	10	I(0)
ln(p.VN)	-1.69	-1.40	-0.57	11	I(1)	-6.80	10	I(0)
ln(p.ID)	-2.41	-2.25	0.77	2	I(1)	-11.17	1	I(0)
ln(p.MY)	-4.52	—	—	3	I(0)	—	—	—
ln(p.CA)	-4.06	—	—	6	I(0)	—	—	—
ln(p.BR)	-3.20	-3.36	-0.93	7	I(1)	-6.10	6	I(0)
ln(p.IT)	-2.60	-1.53	0.60	1	I(1)	-15.48	0	I(0)
ln(p.ROW)	-3.98	-3.02	0.28	1	I(1)	-14.58	0	I(0)
Total expenditure								
ln(TotExp)	-1.49	-2.15	1.97	4	I(1)	-9.03	3	I(0)

Table 2. Cointegration test of equations in AIDS

Equation	ADF (T & C)	ADF (T)	ADF (N)	Lag	Cointegrated?
eq. China	-2.60	-2.06	-2.07	3	Yes
eq. Vietnam	-2.28	-1.19	-3.07	1	Yes
eq. Indonesia	-2.46	-2.33	-2.33	6	Yes
eq. Malaysia	-3.43	-2.70	-2.70	4	Yes
eq. Canada	-3.31	-3.04	-3.07	4	Yes
eq. Brazil	-5.54	—	—	3	Yes
eq. Italy	-4.81	—	—	9	Yes

As mentioned previously, misspecification tests were essential for the parameter explanation and further elasticity calculation. A summary of misspecification tests in dynamic AIDS were presented in Table 3. All the error terms did not have serial correlation problems at the 1% significance level by BG test. The results of BP test indicated that all the error terms have constant variance. In addition, all the functions except Italy were correctly specified at the 1% significance level. The error terms in five out of seven equations were normally distributed. The hypothesis of stable parameters failed to reject in all the equations. Therefore, the superiorities of the dynamic AIDS were further supported by passing those misspecification tests.

Demand elasticities

In this study, the long-run expenditure, own-price, and cross-price elasticities were calculated by the formula [3], [4], and [5] from the estimated parameters of equilibrium AIDS. The short-run elasticities were calculated by the coefficients of dynamic AIDS with the same formula.

Both long-run and short-run expenditure elasticities and their p-values were given in Table 4. All the long-run expenditure elasticities were positive and statistically significant at 1% significance level except Canada and Italy. The demand of *bed* from Vietnam, Malaysia, and China were elastic. Among them, Vietnam had the highest expenditure elasticity of 2.737, followed by Malaysia with 1.977 and China with 1.130. These results indicated that the more expenditure spent on the imported bed, the more *bed* would be imported from Vietnam, Malaysia, and China in the long-run. As for the short-run expenditure elasticities, all of them except Canada were also positive and statistically significant at 1% significance level. Vietnam and China were detected as the major supplier countries in the short-run.

With regard to the change of quantity in response of own-price, Marshallian own-price elasticities were calculated and listed in Table 5. Both long-run and short-run values were negative and significantly at the 1% significance level, as expected from consumer theories. All the values were elastic and sensitive to the change of its own price in addition to China. In addition, both long-run and short-run own-price elasticities of China were relatively lower than the other competitors. This result implied that trade policy in order to increase the price of bed from China would have limited impacts on its demand quantities, which was consistent the ineffectiveness of antidumping investigation on China.

Table 3. Misspecification tests of dynamic AIDS

Equation	BG	BP	RESET	J-B	CUSUMSQ
eq. China	0.01**	0.93	0.76	0.48	0.40
eq. Vietnam	0.10*	0.91	0.05*	0.00***	0.06*
eq. Indonesia	0.06*	0.11	0.02**	0.26	0.71
eq. Malaysia	0.31	0.35	0.07	0.43	0.20
eq. Canada	0.02**	0.34	0.10	0.61	0.88
eq. Brazil	0.07*	0.74	0.30	0.01**	0.78
eq. Italy	0.09*	0.32	0.00***	0.00***	0.02**

***, **, * denotes significance at 1%, 5%, and 10%, respectively.

Table 4. Long-run and short-run expenditure elasticity

Country	Long-run		Short-run	
	Estimates	p-value	Estimates	p-value
China	1.130	0.000	1.352	0.000
Vietnam	2.737	0.000	1.358	0.000
Indonesia	0.561	0.000	0.594	0.000
Malaysia	1.977	0.000	0.713	0.000
Canada	-0.636	0.000	-0.126	0.890
Brazil	0.865	0.000	0.762	0.000
Italy	-0.417	0.017	0.745	0.004
ROW	0.197	0.002	0.629	0.000

Hicksian cross-price elasticities were calculated under the assumption of keeping the utility constant. The short-run cross-price elasticities were reported in Table 6. If the price of *bed* from China went up by 1%, the imported quantities from Vietnam and Malaysia went up by 0.43% and 0.53%, respectively. The results suggested that the *bed* from China can be substituted by the import from Vietnam and Malaysia. In contrast, the 1% increase of price from Vietnam and Malaysia resulted in the 0.11% and 0.08% increase of import from China. Moreover, the degrees of substitution were asymmetric. Malaysia and Vietnam had higher cross-price elasticities than China to each of them.

Antidumping investigation effects

The purpose of antidumping policy on China was to curtail the import from China, and furthermore, to protect the furniture industry in the United States. In this study, both the long-run and short-run antidumping effects were detected in the AIDS, listed in Table 7. In the long-run, after the preliminary determination was implemented to collect antidumping duties in July 2004, the imports share of China decreased by 6.3% while the import from Vietnam, Indonesia, and Brazil increased by 3.9%, 0.9%, and 2.6%, respectively. This result indicated that the reduction of import from China diverted to the other countries such as Vietnam, Indonesia, and Brazil. In the short-run, the import from China decreased by 13.8%, but the import value from Vietnam, Indonesia, and Brazil increased by 5.4%, 2.2%, and 2.0% at the same time. There was a sharp drop of China's budget share and were sudden jumps of Vietnam, Indonesia, and Brazil.

Table 5. Long-run and short-run Marshallian own-price elasticity

Country	Long-run		Short-run	
	Estimates	p-value	Estimates	p-value
China	-0.503	0.001	-0.886	0.000
Vietnam	-2.743	0.000	-1.010	0.000
Indonesia	-1.003	0.000	-0.972	0.000
Malaysia	-1.074	0.000	-1.108	0.000
Canada	-1.041	0.000	-1.037	0.000
Brazil	-1.151	0.000	-1.025	0.000
Italy	-1.195	0.000	-1.056	0.000
ROW	-0.741	0.000	-0.909	0.000

Table 6. Short-run Hicksian cross-price elasticity

Impact on demand	Change in price of							
	China	Vietnam	Indonesia	Malaysia	Canada	Brazil	Italy	ROW
China	–	0.113	0.011	0.076	-0.021	0.017	0.023	0.069
	–	(0.001)†	(0.733)	(0.000)	(0.402)	(0.428)	(0.298)	(0.092)
Vietnam	0.427	–	0.134	-0.034	0.097	0.016	0.094	0.117
	(0.001)	–	(0.078)	(0.556)	(0.152)	(0.763)	(0.055)	(0.218)
Indonesia	0.061	0.201	–	0.068	0.241	0.043	0.007	0.305
	(0.733)	(0.078)	–	(0.386)	(0.004)	(0.546)	(0.905)	(0.009)
Malaysia	0.530	-0.063	0.084	–	0.148	0.090	0.099	0.174
	(0.000)	(0.556)	(0.386)	–	(0.063)	(0.148)	(0.072)	(0.092)
Canada	-0.150	0.180	0.298	0.148	–	0.193	-0.012	0.387
	(0.402)	(0.152)	(0.004)	(0.063)	–	(0.008)	(0.862)	(0.002)
Brazil	0.174	0.043	0.075	0.128	0.274	–	0.103	0.194
	(0.428)	(0.763)	(0.546)	(0.148)	(0.008)	–	(0.204)	(0.200)
Italy	0.249	0.265	0.014	0.151	-0.018	0.111	–	0.253
	(0.298)	(0.055)	(0.905)	(0.072)	(0.862)	(0.204)	–	(0.115)
ROW	0.202	0.091	0.159	0.073	0.162	0.057	0.069	–
	(0.092)	(0.218)	(0.009)	(0.092)	(0.002)	(0.200)	(0.115)	–

Table 7. Long-run and short-run antidumping investigation effects

Dummy	China	Vietnam	Indonesia	Malaysia	Canada	Brazil	Italy
Long-run effect							
Antidumping †	-0.063	0.039	0.009	-0.014	-0.007	0.026^{**}	-0.012
Short-run effect							
Antidumping †	-0.138^{***}	0.054^{***}	0.022^{*}	0.002	-0.004	0.020^{**}	0.000

Antidumping †: Imposed antidumping duties from July 2004.

Conclusions

The United States has been increasing the import of wooden bedroom furniture from the world to meet its domestic needs. Over the last decade, traditional suppliers have been substituted by the newly developing countries in Asia such as China and Vietnam. The antidumping investigation against China was implemented by ITC in order to protect the furniture industry in the U.S. To explain this market structure change, dynamic AIDS was employed to analyze the consumer behavior, and furthermore, evaluate the effectiveness of this antidumping investigation. Monthly disaggregate data of the top seven suppliers from 2001 to 2008 were collected from the ITC.

The empirical results in this study reached several conclusions about the consumer behavior, market competition, and antidumping effectiveness in this market. First, both consumers' long-run and short-run choices on the imported wooden bedroom furniture were detected. The expenditure elasticities disclosed that the U.S. consumers will spend more expenditure on the wooden bedroom furniture imported from Vietnam, Malaysia, and China in the long-run. Among them, Vietnam has demonstrated its great potential to be the top one supplier to the U.S. market. As indicated by the own-price elasticities, the imported quantities from most countries were sensitive to the change of its own price in both short-run and long-run. In particular, Vietnam had the highest own-price elasticity. In particular, both long-run and short-run own-price elasticities of China were inelastic, which indicated the less sensitive change in response of price and further explained the ineffectiveness of antidumping investigation.

The degrees of competition and substitution were revealed by the cross-price elasticities between those supplier countries. The degree of substitution among those pairs was not symmetric. The potential of Vietnam to dominate this market were further proved its significant cross-price elasticities in both long-run and short-run. The cross-price elasticities were relatively small, which were not elastic. The small magnitude of those cross-price elasticities implied that they were far from perfect substitutes. These results further indicated that the U.S. consumers do have different preferences on the imported wooden bedroom furniture from all over the world.

As a trade protection instrument, antidumping investigation did not work as it intended to reduce the import. The affirmative determination and imposition of antidumping duties led to 13.8% drop on the import value of China. However, the trade diversion took place from China to Vietnam, Indonesia, and Brazil at the same time, which was consistent with the discussion by Brenton (2001). Overall, the effectiveness of this antidumping policy was not obvious, which can be further evidenced by the continuous growth of total import value.

This study brings up several interesting questions. For example, the competition among domestic and imported *bed* can be further studied, which will describe a more accurate picture of this market. However, the same definition of *bed* and sales data are needed to incorporate into this demand system. Moreover, whether this market is integrated or not is also of great interest. Further examining the welfare change after the implementation of antidumping policy can improve our understanding of the benefits of domestic retailer, producers, and consumers.

Literature Cited

Anderson, G., and Blundell, R. 1982. Estimation and hypothesis testing in dynamic singular equation systems. Econometrica **50**(6): 1559-1571.

Balcombe, K.G., and Davis, J.R. 1996. An application of cointegration theory in the estimation of the almost ideal demand system for food consumption in Bulgaria. Agricultural Economics **15**(1): 47-60.

Brenton, P. 2001. Anti-dumping policies in the EU and trade diversion. European Journal of Political Economy **17**(3): 593-607.

De Mello, M.M., and Fortuna, N. 2005. Testing alternative dynamic systems for modelling tourism demand. Tourism Economics(57): 1-16.

Deaton, A., and Muellbauer, J. 1980. An almost ideal demand system. American Economic Review **70**(3): 312-326.

Duffy, M. 2003. On the estimation of an advertising-augmented, cointegrating demand system. Economic Modelling **20**(1): 181-206.

Engle, R.F., and Granger, C.W.J. 1987. Cointegration and error correction: representation, estimation, and testing. Econometrica **55**(2): 251-276.

Fanelli, L., and Mazzocchi, M. 2002. A cointegrated VECM demand system for meat in Italy. Applied Economics **34**: 1593-1605.

Feleke, S.T., and Kilmer, R.L. 2007. Analysis of the demand for imported meat in Switzerland using a dynamic specification: implications for the European Union. Agribusiness **23**(4): 497-510.

Gazo, R., and Quesada, H.J. 2005. A review of competitive strategies of furniture manufacturers. Forest Products Journal **55**(10): 4-12.

Karagiannis, G., Katranidis, S., and Velentzas, K. 2000. An error correction almost ideal demand system for meat in Greece. Agricultural Economics **22**(1): 29-35.

Karagiannis, G., and Mergos, G.J. 2002. Estimating theoretically consistent demand systems using cointegration techniques with application to Greek food data. Economics Letters **74**(1): 137-143.

Li, G., Song, H., and Witt, S.F. 2004. Modeling tourism demand: a dynamic linear AIDS approach. Journal of Travel Research **43**(2): 141-150.

Seale, J.L., Marchant, M.A., and Basso, A. 2003. Imports versus domestic production: a demand system analysis of the U.S. red wine market. Review of Agricultural Economics **25**(1): 187-202.

U.S. Bureau of Census. 2006. Annual survey of manufacturing, statistics for industry groups and industries. Washington, DC: Department of Commerce

U.S. ITC. 2004. Wooden bedroom furniture from China. Investigation No. 731-TA-1058, Publication 3667. U.S. International Trade Commission, Washington, D.C.

Southern Forest Economic Workers

2009 Annual Meeting

Tuesday, March 10, 2009

8:30 AM – 10:00 AM

Session A: Forest Products Industry/ Wood Supply

Manuscripts:

The Wood Household Furniture and Kitchen Cabinet Industries: A Contrast in Fortune – William G. Luppold and Matthew S. Bumgardner

Forest Biomass Supply for Bioenergy Production in Tennessee – Zhimei Guo, Donald G. Hodges, and Robert C. Abt

The Wood Household Furniture and Kitchen Cabinet Industries: A Contrast in Fortune

William G. Luppold[1] and Matthew S. Bumgardner[2]

[1] Economist, U.S. Forest Service, Northern Research Station, 241 Mercer Springs Road, Princeton, WV 24740; Email: wluppold@fs.fed.us 304.431.2700 (v); 304.431.2772 (fax)

[2] Forest Products Technologist, U.S. Forest Service, Northern Research Station, 359 Main Road Delaware, OH 43015; Email: mbumgardner@fs.fed.us 740.368.0059 (v); 740.368.0152 (fax)

**The Wood Household Furniture and Kitchen Cabinet Industries:
A Contrast in Fortune**

Abstract

In 1977, the value of wood household furniture shipments exceeded kitchen cabinet shipments by 170 percent; conversely in 2006, shipments of cabinets exceeded shipments of furniture by 78 percent. The most apparent reason for the decrease in domestic furniture shipments is the dramatic increase in furniture imports since 1999 whereas cabinet demand has increased due to the popularity of larger kitchens and robust investments in housing prior to 2006. However, there also are less apparent factors. Furniture is primarily sold to consumers from retail stores, whose buyers have ordered previously from manufacturers at semi-annual furniture markets. A growing volume of cabinets are designed and ordered by consumers at home improvement centers. Furniture manufacturers carry large volumes of finished products in inventory, while cabinet manufacturers carry low inventories. Furniture has become a quasi-commodity that is priced within narrow ranges whereas sale methods for semi-custom and custom cabinets' allow consumers to order the species, finishes, and features they want. The price competitiveness of the furniture industry has allowed imports to become the major source of product available to the consumer.

Key Words: Wood furniture, kitchen cabinets, inventory control

Introduction

In 1977, the deflated value of product shipments (shipments) of wood household furniture (furniture) exceeded those of wood kitchen cabinets1 (cabinets) by 170 percent (Table 1). As the decades progressed, the value of domestic furniture shipments fluctuated while shipments of cabinets trended upward. In 2002, shipments of cabinets were identical to the shipments of furniture (Fig. 1). Shipments of cabinets continued to increase over the next 4 years while furniture shipments decreased; by 2006, shipments of cabinets exceeded shipments of furniture by 78 percent (Fig.1). This change elevated cabinet producers from being a relatively minor consumer of hardwood lumber in 1977 to being the largest user of graded hardwood lumber (Luppold and Bumgardner 2008).

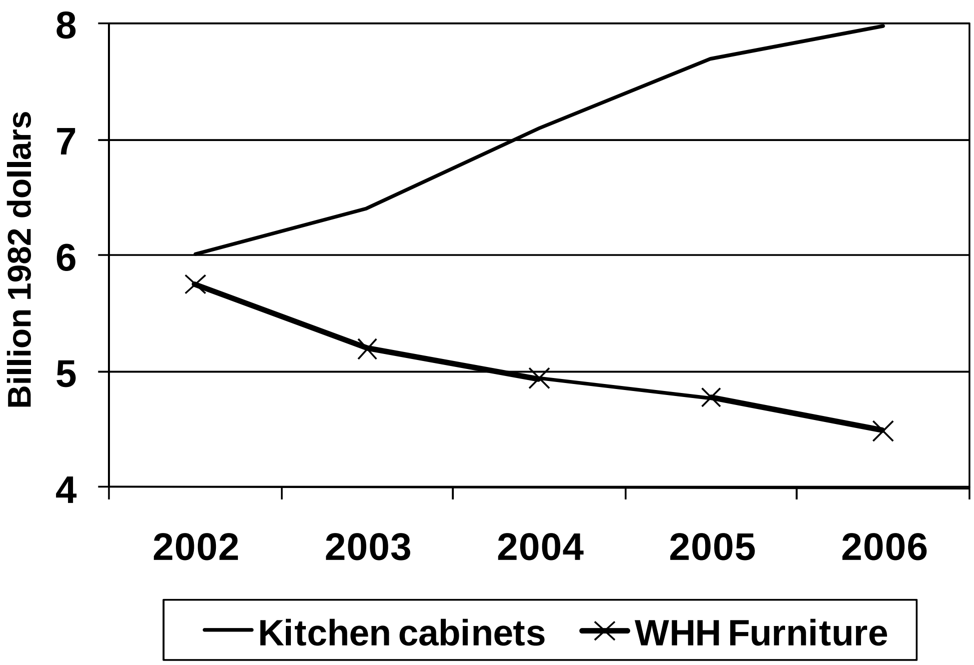
Table 1 – Value of product shipment for the wood household furniture and kitchen cabinet (excluding countertops) industries and volume of lumber consumed by these industries in 1977, 1982, 1987, 1992, 1997, and 2002.

Year	Value of product shipments		Volume of hardwood lumber consumed[1]	
	Wood household	Kitchen cabinets	Wood household	Kitchen cabinets
	---------millions of 1982 dollars[1]		---millions of board feet[2]---	
1977	5,816 [3]	2,245 [4]	1,783	288
1982	4,846 [5]	2,001 [6]	1,613	312
1987	6,360 [7]	3,844 [8]	1,781	550
1992	5,750 [9]	3,698 [10]	1,546	898
1997	6,409 [11]	4,086 [12]	1,592	1,266
2002	5,754 [11]	6,019 [12]	1,248	1,367

1 USDL Bureau of Labor Statistics. 2008. 1982 dollar. Series Id: WPU1212 for furniture and WPU08210101 for cabinets
2 Luppold and Bumgardner 2008
3 USDC Bureau of the Census 1980b
4 USDC Bureau of the Census 1980a
5 USDC Bureau of the Census 1985b
6 USDC Bureau of the Census 1985a
7 USDC Bureau of the Census 1990b
8 USDC Bureau of the Census 1990a
9 USDC Bureau of the Census 1995b
10 USDC Bureau of the Census 1995a
11 USDC US Census Bureau 2004b
12 USDC US Census Bureau 2004a

[1] In 1997 the Bureau of the Census changed the kitchen cabinet designation to include countertops. In an effort to be historically consistent, the countertop portion of the value of product shipment has been deducted from total value shipments in Table 1 and Figure 2.

Figure 1. —Value of product shipments of wood household furniture and kitchen cabinets (excluding countertops) industries from 2002 to 2006 in constant 1982 dollars.



Sources: USDC US Census Bureau 2003. Years 2000 and 2001 USDC US Census Bureau 2006a. Years 2002, 2003, and 2004 USDC US Census Bureau 2008a. Years 2005 and 2006 USDL Bureau of Labor Statistics 2008. 1982 dollar. Series Id: WPU1212 for furniture and WPU08210101 for cabinets.

The most apparent reason for decreased domestic furniture shipments is the 71- percent increase in furniture imports since 2001 (Cochran 2008). By contrast, cabinet demand has increased with new homes construction and an increase in kitchen remolding. These changes caused the value of product shipments plus net imports of kitchen cabinets (including countertops) to the exceed value of product shipments plus net imports of wood household furniture by 2006. However, less apparent factors are involved with the manufacturing and distribution processes of these products that also have contributed to the changes in their respective fortunes. The objectives of this paper are to examine the furniture and cabinet industries from 1977 to the current decade with respect to production and marketing processes, business inventories, and to discuss how these factors have interacted to influence wood-based material consumption.

Two Similar but Different Industries

While furniture and cabinets are made from comparable materials using similar equipment, the histories, manufacturing facilities, and manufacturing methods associated with these two products differ. Evidence of wooden tables and chairs can be traced back over 6,000 years to Egypt (Bridgwater and Kurtz 1963), and chests of drawers can be traced back to the middle 17th century (Blackburn 2008). By contrast, the first product expressly designed to store food and kitchen equipment was the Hoosier cabinet, initially manufactured in 1903 (KCMA 2005). The first wall mounted kitchen cabinet associated with modern kitchens was constructed in the early 1920s (KCMA 2005).

The relative age of furniture and cabinets as products and the different growth rates in the value of shipments of these products have influenced the relative age and design of manufacturing facilities. Although some U.S. furniture plants were built in the last 20 years, most of the furniture plants in the eastern United States were built before 1970. In general, furniture manufacturing facilities in the eastern United States are (or were) highly integrated with drying facilities, rough mills, plywood plants, and assembly operations located in one plant, a cluster of plants at one site, or at several plants at multiple sites. Some wood furniture operations also own particle board or other panel product manufacturing facilities.

Before WWII, most wood kitchen cabinets were produced in local shops. although larger cabinet facilities serving regional markets were built in the 1950s, most of the plants in operation today were built after 1970. Cabinet plants that manufacture lower cost stock cabinets can be similar to large furniture plants in that they purchase green lumber and fabricate cabinets in one facility or in a system of facilities. Unlike larger furniture operations, however, large cabinet manufacturers purchase most of their plywood and other panel products from outside sources. Stock cabinet plants that produce multiple product lines also tend to batch production orders into lots that can be produced in a week or less (Raymond 2009).

Plants that manufacture semi-custom and custom cabinets tend to be less integrated and purchase higher volumes of kiln dried lumber and dimension (lumber that fabricated into a rough or finished cabinet or furniture part) from outside sources. In general, the more species that a cabinet plant processes, the greater the volume of dimension purchased from wood component manufacturers. The wood component industry has developed just-in-time production and delivery processes to meet the demands of cabinet manufacturers (Raymond 2009)

The growth in cabinet demand allowed this industry to invest in plants and equipment to produce smaller lots, and new capital expenditure has increased in recent years (Fig. 2). By contrast, as imports became an important part of the product line for many domestic furniture companies in the 1990s, capital investment decreased (Fig. 2). This meant that the computer numerically controlled equipment needed to produce smaller lots of product were purchased by cabinet manufacturers but were not purchased by furniture producers (Raymond 2009).

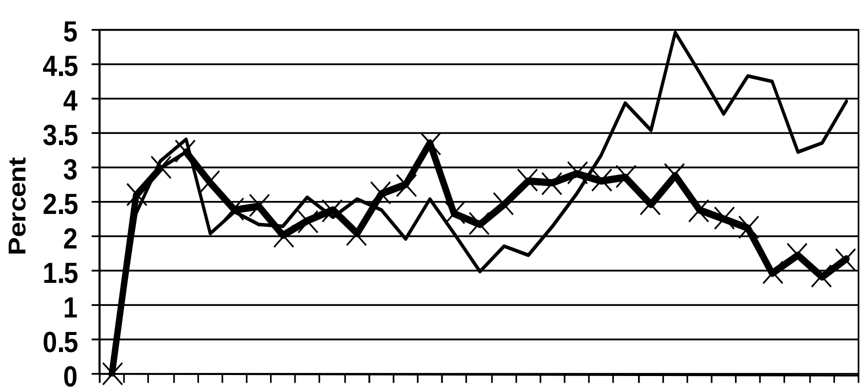


Figure 2 – New capital expenditures by the wood household furniture and kitchen

cabinets and countertop industries as a percentage of value of product shipments, 1977 to 2006

USDC Bureau of the Census 1995b. Years 1977 to 1992
USDC Bureau of the Census 1995a. Years 1977 to 1992
USDC Bureau of the Census 1998. Years 1993 to 1996
USDC US Census Bureau 2004b. Years 1997 to 2002
USDC US Census Bureau 2004a. Years 1997 to 2002
USDC US Census Bureau 2006b. Years 2003, and 2004
USDC US Census Bureau 2008b. Years 2005 and 2006
USDL Bureau of Labor Statistics 2008. 1982 dollar. Series Id: WPU1212 for furniture and WPU08210101 for cabinets.

In some respects furniture has become a commodity in that it is priced within narrow ranges (price points) depending on the level of quality. Although a small but growing amount of furniture is custom made to buyer specification as exemplified by the custom portion of the Amish furniture industry (Bumgardner et al. 2008), a large volume of furniture is sold at the furniture markets in High Point, North Carolina or Las Vegas.1 At these markets furniture prototypes are shown to retailers and wholesalers who then order the suites or pieces they think will appeal to their consumers. Sometimes domestic furniture manufacturers have a limited volume of product already manufactured, but in recent years most of the furniture has been manufactured after it has been ordered. However, because most of the wood household furniture is sold in suites, furniture manufactures have to warehouse portions of these suites until all pieces are built.

The marketing process for kitchen cabinets has evolved over time. Before to WWII, most cabinets were purchased by the home builder or the homeowner. In the 1950s, the concept of stock cabinets emerged. These cabinets are built using standardized width dimensions in 3 inch increments. Normally stock cabinets featured one species and one finish. The emergence of the stock cabinet allowed manufacturers to build and warehouse cabinets, resulting in much quicker delivery. Initially the points of sale for stock cabinets for homeowners were small shops that would install the cabinets and fabricate and install countertops. Small contractors also could purchase stock cabinets at these shops but large contractors could buy direct from manufacturers or through a wholesaler.

The distribution of cabinets began to change after 1979 when Home Depot started to redefine traditional construction supply yards into home improvement centers (KCMA 2005). Initially these centers carried a few lines of stock cabinets and later provided displays of stock cabinets with a limited number of options. Today, home improvement stores carry one or two lines of stock cabinets and several displays of semi-custom cabinets. Manufacturers of semi-custom cabinets offer numerous styles and species in a multitude of finishes. In addition, the consumer can select upgrades in box construction ranging from plastic cover particleboard to ¾ inch hardwood plywood. Orders for these cabinets go directly to the manufacturer, and the finished product is delivered to the homeowner or contractor. Cabinets also have a financial advantage over furniture because the cost of cabinets in new homes can be included in the mortgage.

[1] While many domestic and off shore manufactures sell their products at the furniture market, furniture can be sold directly to customers at company controlled stores (examples Ethan Allen and Ikea) or purchased directly by mass marketers (example Wal-Mart).

Changes in Business Inventories

An examination of business inventories provides useful information on how fast working capital moves through the production processes and where inventories tend to build up in the process (Cumbo et al. 2006). Older industrial models specify high output machinery to reduce cost, and large volumes of inventory act as a buffer in the event of a shortage disruption in the manufacturing process. Modern industrial models including just-in-time manufacturing attempt to minimize the volume of materials and products held on site in an effort to minimize the interest costs of holding such capital. Modern industrial models also allow for more flexibility in the manufacturing processes because specific material can be obtained to service a specific order. In the case of custom and semi-custom cabinet; advance inventories of finished product can not be held.

In 1977, business inventories held by furniture manufacturers were equivalent to nearly 20 percent of the value of shipments while inventories held by cabinet producers represented 13 percent of the value of shipments (Table 2). Forty percent of the business inventories held by furniture manufacturers' were finished goods compared to 25 percent for cabinet manufacturers. The relatively large volume of finished goods held by furniture manufacturers reflects the tendency of these manufacturers to warehouse incomplete suites.

Table 2 – Total inventory, inventory of finished goods, value of work in progress, and inventory of materials and supplies as a percentage of total shipments for the wood household furniture and kitchen cabinet and countertop industries, 1977, 1982, 1987, 1992, 1997, and 2002.

Year	Industry	Total business inventories	Finished goods	Work in progress	Materials and supplies
		------------------------percent of total shipments----------------------			
1977[1]	Wood household	19.8	7.9	4.7	7.3
1977[2]	Kitchen cabinets	13.3	3.3	3.3	6.7
1982[3]	Wood household	23.0	10.8	5.3	6.9
1982[4]	Kitchen cabinets	13.9	3.2	3.1	7.7
1987[5]	Wood household	19.4	8.7	4.4	6.3
1987[6]	Kitchen cabinets	10.2	2.1	2.7	5.9
1992[7]	Wood household	20.4	9.9	4.2	6.3
1992[8]	Kitchen cabinets	9.9	1.9	2.7	5.3

1997[9]	Wood household	19.1	9.1	3.8	6.2
1997[10]	Kitchen cabinets	9.4	2.3	2.3	4.8
2002[9]	Wood household	17.0	9.2	3.0	4.8
2002[10]	Kitchen cabinets	6.8	1.5	1.8	3.5

1 USDC Bureau of the Census 1980b
2 USDC Bureau of the Census 1980a
3 USDC Bureau of the Census 1985b
4 USDC Bureau of the Census 1985a
5 USDC Bureau of the Census 1990b
6 USDC Bureau of the Census 1990a
7 USDC Bureau of the Census 1995b
8 USDC Bureau of the Census 1995a
9 USDC US Census Bureau 2004b
10 USDC US Census Bureau 2004a

Between 1977 and 2002, business inventories held by furniture manufacturers relative to the value of shipments declined by approximately 15 percent (Tables 1 and 2). The decline in inventories by furniture manufacturers resulted from reductions in work in progress and in materials and supplies. However, finished furniture held in inventory in 2002 was equivalent to 9.2 percent of the value of shipments, an increase over 1977 levels but an improvement over 1982 (a recession year) levels. Inventories held by cabinet manufacturers relative to the value of shipments declined by nearly 50 percent between 1977 and 2002 (Tables 1 and 2). The decline occurred in all categories (finished goods, work in progress, and material and supplies) by a similar amount. This decline occurred as the production of semi-custom cabinets increased relative to stock cabinets and batching of stock cabinet production in smaller lots.

Conclusion

In 1977, the value of furniture shipments exceeded cabinet shipments by 170 percent, but by 2006 shipments of cabinets exceeded shipments of furniture by 78 percent. This change is surprising given that furniture and cabinets are made from comparable materials using similar production procedures. The most apparent reason for the decrease in domestic furniture shipments is the dramatic increase in furniture imports since 1999, while cabinet demand has increased due to new homes construction and an increase in kitchen remolding. However, less apparent factors are involved with the distribution and manufacturing processes associated with these industries that also have contributed to the changes in their respective fortunes.

Furniture has been produced in some form for thousands of years; the modern kitchen cabinet is less than a century old. Furniture is primarily sold to consumers from stores, which first order the products from manufacturers at furniture markets; while growing volumes of cabinets are directly ordered by consumers at home improvement centers. Furniture manufacturers carry large volumes of finished product so that complete suites of furniture are available to retailers, and they also carry relatively large inventories as work in progress and material and supplies. In 2002, cabinet producers carried 60 percent less business inventories than furniture manufacturers and 84 percent less finished goods in inventories. Because of differences in the manufacturing and distribution processes, furniture has become a commodity that is priced within narrow ranges depending on quality. The price competitiveness of the furniture industry has allowed imports to become the major source of product available to consumers. By contras, while semi-custom and custom cabinets allow consumers to order the species, finishes, and features they want.

While it is difficult to projecting the future of any wood product industry in a volatile world economy, the industrial model adopted by the kitchen cabinet industry has a higher probability of success than that of the domestic furniture industry. It allows consumers to choose what they want thus customizing their order, incorporates a flexible production process, keeps business inventories at a minimum, and facilitates just-in-time manufacturing. Still, there is hope for a reemergence of the domestic furniture industry as the Amish furniture sector demonstrates that semi-custom furniture can be built in the United States. Furniture demand may also increase in the future once mortgages are paid off or become a lower portion of the consumer income, which will allow for the purchase of higher quality or semi-custom furniture. Furthermore, as the cost of manufacturing increases in China, the cost of transporting large volumes of furniture over a great distance may facilitate greater domestic production.

Literature Cited

Blackburn, G. 2008. A short history of chests of drawers. http://www.taunton.com/finewoodworking/ProjectsAndDesign/ProjectsAndDesignAllAbout.aspx?id=3044

Bridgwater, W. and S. Kurtz (editors). 1963. Columbia Encyclopedia, third edition. New York: Columbia University Press. 2388 pp.

Bumgardner, M., Romig, R., and W. Luppold. 2008. Wood use by Ohio's Amish furniture cluster. Forest Prod. J. 57(12):6-12.

Cochran, M. 2008. Bulletin of hardwood markets statistics: 2006. Res. Note NRS-8. Newtown Square, PA: USDA For. Serv., Northern Res. Stn. 22 pp.

Cumbo, D., D.E. Kline, and M. Bumgardner. 2006. Benchmarking performance measurment and lean manufacturing in the rough mill. Forest Prod. J. 56(6):25-30.

KCMA. 2005. 50 years of defining moments, KCMA celebrates 50 memorable years of cabinetmaking. Kitchen Cabinet Manufacturers Association, Arlington, VA. 52 pp.

Luppold, W.G. and Bumgardner, M. 2008. Forty years of hardwood lumber consumption: 1963 to 2002. Forest Prod. J. 58(5): 7-12.

Raymond, A. 2009. Personal conversation. A.G. Raymond and Company, Raleigh, NC.

USDC Bureau of the Census 1980a. 1977 Census of manufactures, millwork, plywood, and structural wood members, MC77-I-24B n.e.c. Washington DC, U.S. Department of Commerce, Bureau of the Census.
USDC Bureau of the Census 1980b. 1977 Census of manufactures, household furniture. MC77-I-25A Washington, DC: U.S. Department of Commerce, Bureau of the Census.
USDC Bureau of the Census 1985a. 1982 Census of manufactures, millwork, plywood, and structural wood members, n.e.c. MC82-I-24B Washington, DC: U.S. Department of Commerce, Bureau of the Census.
USDC Bureau of the Census 1985b. 1982 Census of manufactures, household furniture. MC82-I-25A. Washington, DC: U.S. Department of Commerce, Bureau of the Census.
USDC Bureau of the Census 1990a. 1987 Census of manufactures, millwork, plywood, and structural wood members, n.e.c. MC87-I-24B. Washington, DC: U.S. Department of Commerce, Bureau of the Census.
USDC Bureau of the Census 1990b. 1987 Census of manufactures, household furniture. MC87-I-25A. Washington, DC: U.S. Department of Commerce, Bureau of the Census.
USDC Bureau of the Census. 1995a. 1992 Census of manufactures, millwork, plywood, and structural wood members, n.e.c. MC92-I-24B Washington, DC: U.S. Department of Commerce, Bureau of the Census.
USDC Bureau of the Census. 1995b. 1992 Census of manufactures, household furniture. MC92-I-25A. Washington, DC: U.S. Department of Commerce, Bureau of the Census.
USDC Census Bureau. 1998. Annual survey of manufactures, statistics for industry groups and industries: 1996. Washington, DC: U.S. Department of Commerce, Bureau of the Census. 72pp.
USDC US Census Bureau. 2003. Annual survey of manufactures, value of product shipments: 2001. Washington, DC: U.S. Department of Commerce, Bureau of the Census. 149pp.
USDC US Census Bureau. 2004a. 2002 Economic census wood kitchen cabinet and countertop manufacturing EC02-31I-337110 (RV). Washington, DC: U.S. Department of Commerce, Bureau of the Census.
USDC US Census Bureau. 2004b. 2002 Economic census nonupholstered wood household furniture manufacturing EC02-31I-337122 (RV). Washington, DC: U.S. Department of Commerce, Bureau of the Census.
USDC US Census Bureau. 2006a. Annual survey of manufactures, value of product shipments: 2005. Washington, DC: U.S. Department of Commerce, Bureau of the Census. 135pp.
USDC US Census Bureau. 2006b. Annual survey of manufactures, statistics for industry groups and industries: 2005. Washington, DC: U.S. Department of Commerce, Bureau of the Census. 340pp.
USDC US Census Bureau. 2008a. Annual survey of manufactures, value of product shipments: 2006 Washington, DC: U.S. Department of Commerce, Bureau of the Census. http://factfinder.census.gov/servlet/IBQTable?_bm=y&-ds_name=AM0631GS101
USDC US Census Bureau. 2008b. Annual survey of manufactures, statistics for industry groups and industries: 2006. Washington, DC: U.S. Department of Commerce, Bureau of the Census. http://factfinder.census.gov/servlet/IBQTable?_bm=y&-ds_name=AM0631GS101
USDL Bureau of Labor Statistics. 2008. Producer price index commodity data. Washington, DC: U.S. Department of Labor. http://data.bls.gov/PDQ/outside.jsp?survey=wp

Supply for Bioenergy Production in Tennessee

Zhimei Guo[1], Donald G. Hodges[2], and Robert C. Abt[3]

[1] Graduate Research Assistant; University of Tennessee, Department of Forestry, Wildlife and Fisheries; Knoxville, TN 37996-4563; zguo4@utk.edu; (865)-974-0611 (v).
[2] Professor and Director; University of Tennessee, Natural Resource Policy Center, Department of Forestry, Wildlife and Fisheries; 274 Ellington Plant Sciences Bldg.; Knoxville, TN 37996-4563; dhodges2@utk.edu; (865)-974-2706 (v).
[3] Professor and Co-director of SOFAC; North Carolina State University, College of Natural Resources, Department of Forestry and Environmental Resources; Raleigh, NC 27695-8008; bob_abt@ncsu.edu; (919)-515-7791 (v).

Forest Biomass Supply for Bioenergy Production in Tennessee

Abstract:

The growing interest in the utilization of forest biomass as an alternative source for bioenergy production has become a significant issue in Tennessee. This study used the Sub-Regional Timber Supply (SRTS) model to analyze the regional aggregate forest biomass feedstock potential and the impacts of additional pulpwood demand on the regional roundwood market. Two scenarios examined the impacts of building a biorefinery facility of 20 and 50 million gallons annual capacity in the state in 2015. The other two scenarios investigated the impacts of an EIA reference case. The projection results suggest that there is sufficient hardwood pulpwood supply for feedstock of a biorefinery facility of 50 million gallons annual capacity in Tennessee. It is possible to meet the demand increase rate of the EIA reference case without affecting the hardwood pulpwood market through 2030, but not in the distance future. The additional demand for softwood pulpwood would have affected the softwood market substantially. But the impacts on hardwood market are comparatively small. Hence, it is more feasible to increase use of hardwood pulpwood for renewable energy rather than softwood pulpwood. These results will be very helpful in sustainably supplying forest biomass for bioenergy production in Tennessee.

Keyword: forest inventory, projection, removals, roundwood prices, SRTS model

Introduction

In 2006, energy consumption in Tennessee totaled 2313.2 trillion Btu. Biomass supplied around 51.9 trillion Btu, or 2.2% of the state's total consumption, ranking 20th nationally (EIA 2009). In addition to the interest in agricultural biomass such as switchgrass, willow, and agricultural residues, the interest in the utilization of forest biomass as an alternative source for bioenergy production has been growing in Tennessee. With the announcement of the construction of a pilot biorefinery facility, forest biomass will be increasingly used for bioenergy in the near future.

Currently, 1.5 million green tons of harvesting residues are produced in the state annually. The Sub-Regional Timber Supply (SRTS) model projects the logging residue availability will increase slightly to 1.7 million green tons by 2030. The Energy Information Administration (EIA) reference case projected that there will be 5.2% annual growth of energy generation from wood and other biomass from 2007 to 2030 (EIA 2009). Assuming a 5.2% annual growth of biomass generation from forests, forest biomass demand will increase to over 5 million green tons in Tennessee by 2030. How will this additional demand for forest biomass influence roundwood market and sustainability of forest management and roundwood supply?

Different from other southern states, hardwood accounts for majority of the timberland in Tennessee (USDA Forest Service 2007). The hardwood growth and removals are much larger than those of softwood. Due to the impact of southern pine beetle (SPB) outbreak, the net growth of softwood was negative from 1999-2004. The softwood removals has an annual 20% decrease from 2005-2007, because some wood processing facilities have shut down. However, the quantity and percentage of decrease in hardwood removals is comparatively small, around 5%. In this situation, it is imperative to investigate how an increased use of forest biomass will affect roundwood market and explore the sustainability of roundwood and forest biomass supply.

Previous research has examined the interactions between traditional timber use and biomass supply. Industrial roundwood is considered one of the key factors determining forest biomass availability for bioenergy (Smeets and Faaij 2007). The price interactions between fuelwood and traditional wood products have been investigated and competition between biomass supply and conventional wood uses was recognized (Sedjo 1997, Ince 2007). Some studies suggest that it is unlikely to use roundwood for bioenergy because sawtimber is too expensive and competition for pulpwood will drive prices up (Hazel 2006, La Capra Associates 2006). However, this will depend on regional market conditions.

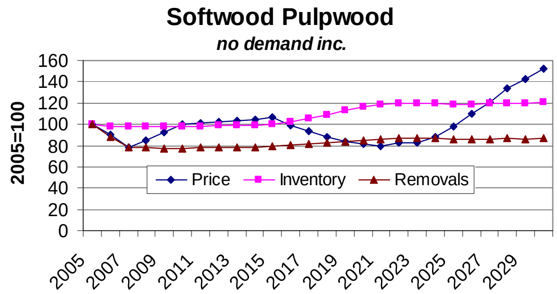
Given the growing demand for forest biomass for bioenergy in Tennessee, this study analyzed its impacts on roundwood markets as well as the sustainability of biomass supply and forest inventory in Tennessee. The specific objectives of this study were to: (1) examine the regional aggregate forest biomass feedstock potential in Tennessee; (2) investigate the impact of forest supply on the regional roundwood market; and (3) explore the possibility of sustainably supplying forest biomass for bioenergy in Tennessee.

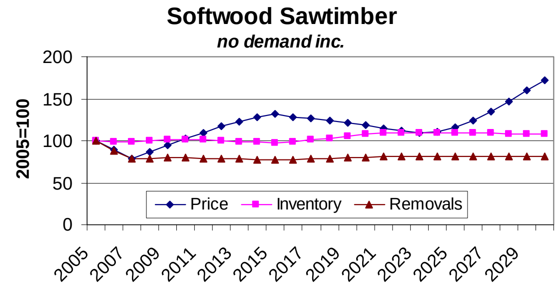
Methods

This study first predicted the roundwood market, inventory, and forest removal of the base scenario with no increase in demand for forest biomass through 2030. Four scenarios of additional forest biomass supply for bioenergy production were then examined and compared.

According to the size of currently proposed mills, one scenario examined the potential impacts of a biorefinery facility of annual capacity of 20 million gallons being built in TN in 2015. The consequences of a higher annual capacity of 50 million gallons were also investigated. Since biorefinery facilities need clean chips as feedstock, it was assumed that 200 or 500 thousand green tons of pulpwood will be used as feedstock annually under these two scenarios, based on the conversion factor of 100 gallons per green ton (Timber Mart-South 2008). As hardwood acreage and annual removals are much larger than softwood in Tennessee, this study assumed that the annual biomass consumption of the facility consists of 15% of softwood pulpwood and 85% of hardwood pulpwood.

Based on the EIA reference case of 5.2% annual growth of woody biomass demand, this study projected the impacts of 150 thousand green tons of annual pulpwood demand increase from 2009 to 2030. One scenario examined the market, inventory and removal response if





annual additional demand consists of 15% of softwood pulpwood (i.e., 22,500 green tons) and 85% of hardwood pulpwood (i.e., 127,500 green tons). The other scenario explored the possibility of increasing merely hardwood pulpwood supply for bioenergy.

SRTS was used for the analysis (Abt 2008). The demand driven mode was used, which assumed that harvest and price respond to a change in demand. The demand price elasticities are 0.5 for all roundwood products. The effect of increasing demand for pulpwood will depend on supply. The supply price elasticity was assumed to be 0.5 for all wood products, which indicated that a 1% change in price would increase harvest by 0.5%. The supply inventory elasticities were set to 1.0 for all SRTS runs. The SRTS model used the 2005 USDA Forest Service Inventory and Analysis (FIA) data for the projection.

Empirical Results

Constant Demand

The roundwood market with no demand increase for pulpwood was projected as a base case for comparison (Figure 1). It indicated that the softwood pulpwood removals will increase slightly, but remain lower than 2005 removals through 2030. The softwood pulpwood inventory will be stable through 2017 and then increase to 120% of the 2005 inventory. The softwood pulpwood price will fluctuate substantially during this period. It will be almost the same as 2005 price through 2016, then decrease by 20% due to the increase in inventory, and finally rise to more than 150% of the 2005 price. Softwood sawtimber generally follows the same trend as softwood pulpwood. The changes in inventory and removals are very small, but the fluctuation in sawtimber price will be greater than that of pulpwood. The price will increase to 130% in 2016 and over 170% in 2030.

The hardwood pulpwood and sawtimber market follow the same trend. The inventories will keep growing and the increase will be over 40% by the end of the projection. The removals will increase slightly. Since inventory is growing much faster than harvest, the prices for both pulpwood and sawtimber will continue to decline; in 2030, they will be 40% lower than 2005 prices.

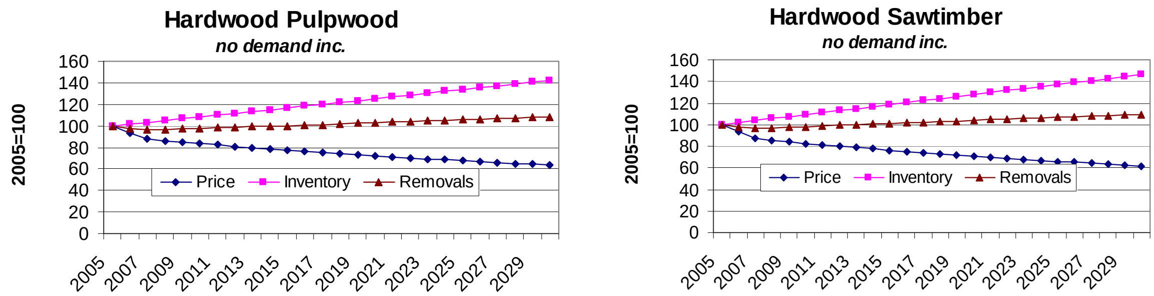


Figure 1. The projection of roundwood market with no demand increase for pulpwood.

Roundwood Market with Facility built

The market impacts of building a biorefinery facility of annual capacity of 20 million gallons in 2015 are shown in Figure 2. An annual additional demand for 30,000 green tons of softwood pulpwood increased the harvest slightly. By 2030, the removals will grow to 90% of the 2005 harvest level. The inventory had no apparent response to the additional demand for pulpwood. The softwood pulpwood price exhibited a small increase to 2016 and then a doubling of 2005 prices by 2030.

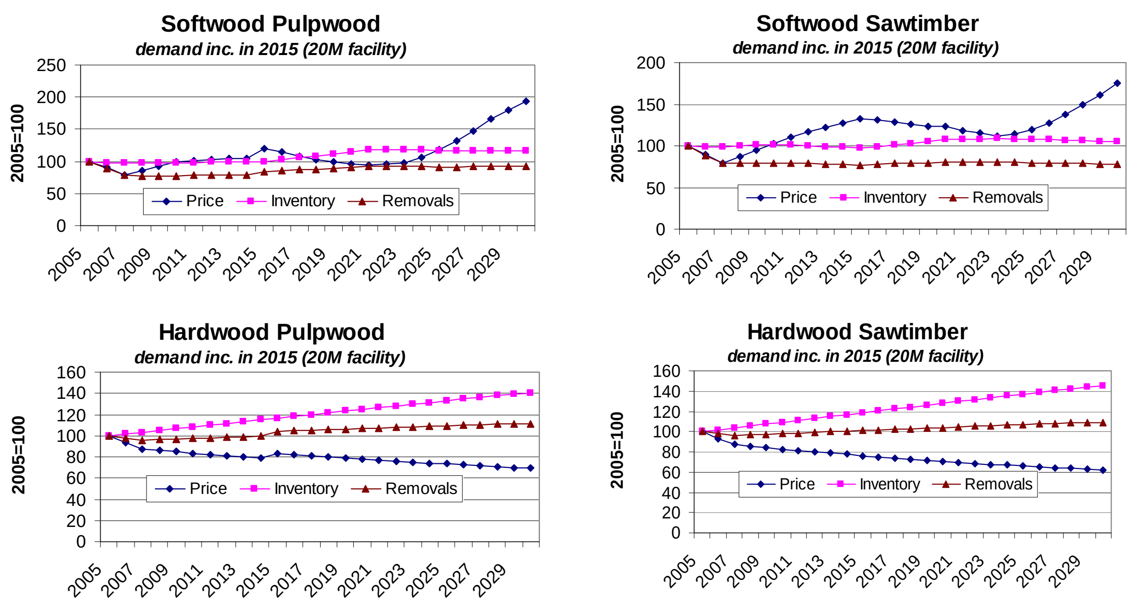


Figure 2. The projection of roundwood market with a facility of annual capacity of 20 million gallons being built in 2015.

In general, the hardwood market remained unchanged, except for the small increases in removals and price of hardwood pulpwood to 2016 due to the additional demand for 170,000 green tons of hardwood pulpwood (Figure 2). By the end of the projection, the removals and price of hardwood pulpwood were slightly larger than those with no pulpwood demand increase for biorefinery facility.

Building a biorefinery facility of annual capacity of 50 million gallons in Tennessee in 2015 produced much more significant effects, especially in the softwood market (Figure 3). The additional annual demand for 75,000 green tons of softwood pulpwood increased the harvest from 2015; as a result there is a large increase in softwood pulpwood prices (150% of the 2005 price). Due to the increase in inventory, the price fell through 2012. However it increased to over 250% of the 2005 price by 2030, because of the increase in harvest and decrease in inventory. By 2030, the removals equaled 2005 harvest levels. The projection of softwood sawtimber still follows the same trend as the base case, except for the slightly lower inventory and higher price by the end of projection relative to the no demand increase case.

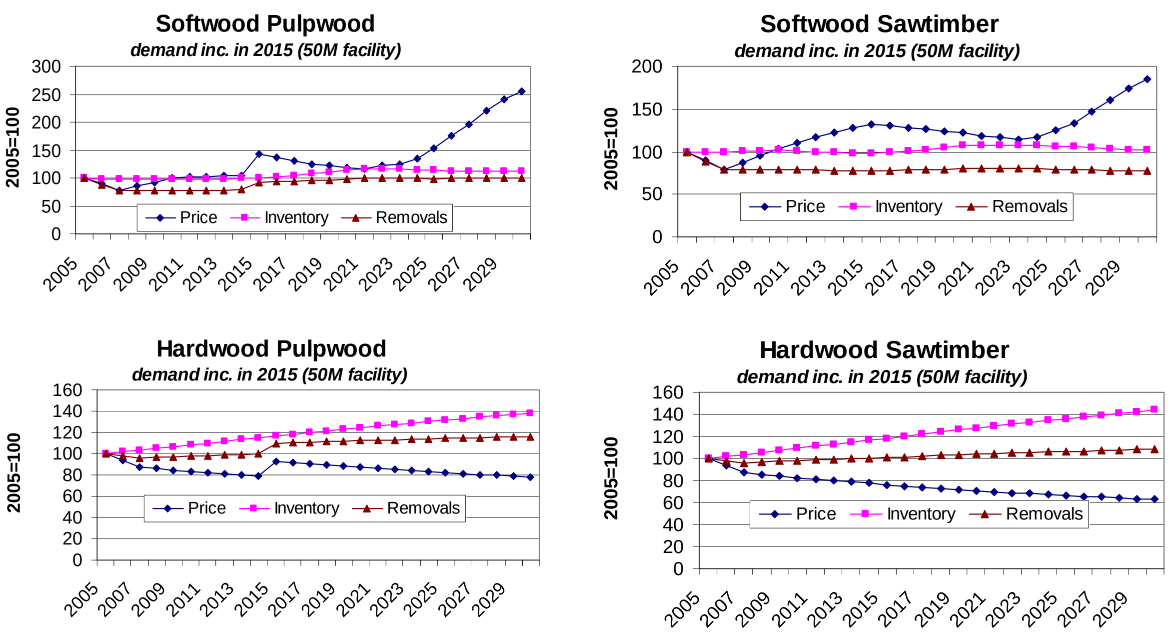


Figure 3. The projection of roundwood market with a facility of annual capacity of 50 million gallons being built in 2015.

Due to the annual additional demand for 425,000 green tons of hardwood pulpwood from 2015, hardwood pulpwood removals increased continuously through the end of the projection. As a result, prices increased to 2016, but declined after that because of the continuously increasing hardwood pulpwood inventory. By the end of the projection, the inventory of hardwood pulpwood was slightly smaller and the removals and price were slightly higher than those with no pulpwood demand increase for biorefinery facility. The impacts on the hardwood sawtimber market are little.

EIA Reference Case

The projection indicated that increasing both softwood and hardwood pulpwood demand for EIA reference case affected roundwood markets significantly (Figure 4). An annual increase in softwood demand by 22,500 green tons resulted in a continuous increase in harvest. By 2030, it exceeded 2005 removals. The inventory exhibited a very slight increase and then a decrease to close to 2005 levels. Consequently, the price of softwood pulpwood increased to more than 400% of the 2005 price. The projection of softwood sawtimber market generally followed the same trend as with no biomass demand increase. But the inventory decreased to slightly less than the 2005 inventory by 2030. The price increased to 190% of the 2005 price, higher than the base case by the end of the projection.

The removals of hardwood pulpwood continuously increased from 2009 and reached around 140% of 2005 removals, because of the 127,500 green tons of annual hardwood demand increase. The inventory continued growing, but the increasing rate was less than the base case. Since the removals increased at a faster rate than inventory, the price hardwood pulpwood continued to rise. By 2030, it equaled 110% of the 2005 price, but the impacts on hardwood sawtimber market were minimal.

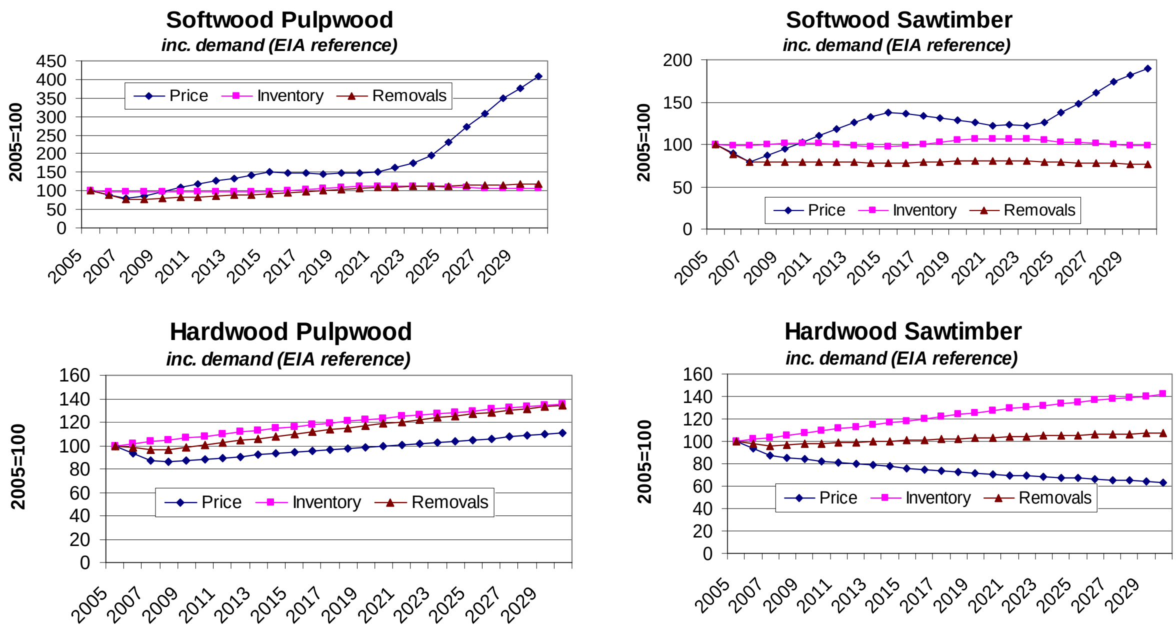


Figure 4. The projection of roundwood market in the EIA reference case (annual additional demand consists of 15% of softwood pulpwood and 85% of hardwood pulpwood).

The responses of roundwood markets to increasing merely hardwood pulpwood demand for bioenergy for EIA reference case are shown in Figure 5. The softwood market was similar to the base case except the slightly higher increase in softwood pulpwood price. The inventory and removals of hardwood pulpwood continuously increased from 2009. The increasing rate of inventory was lower than that of the base case. The removals increased at a faster rate and the removal index exceeded the inventory index by the end of the projection. As a result, the price of hardwood pulpwood continues to rise and it reached 120% of the 2005 price by 2030. The projection of hardwood sawtimber market is similar to the base case except for the slightly lower inventory index and higher price index in 2030.

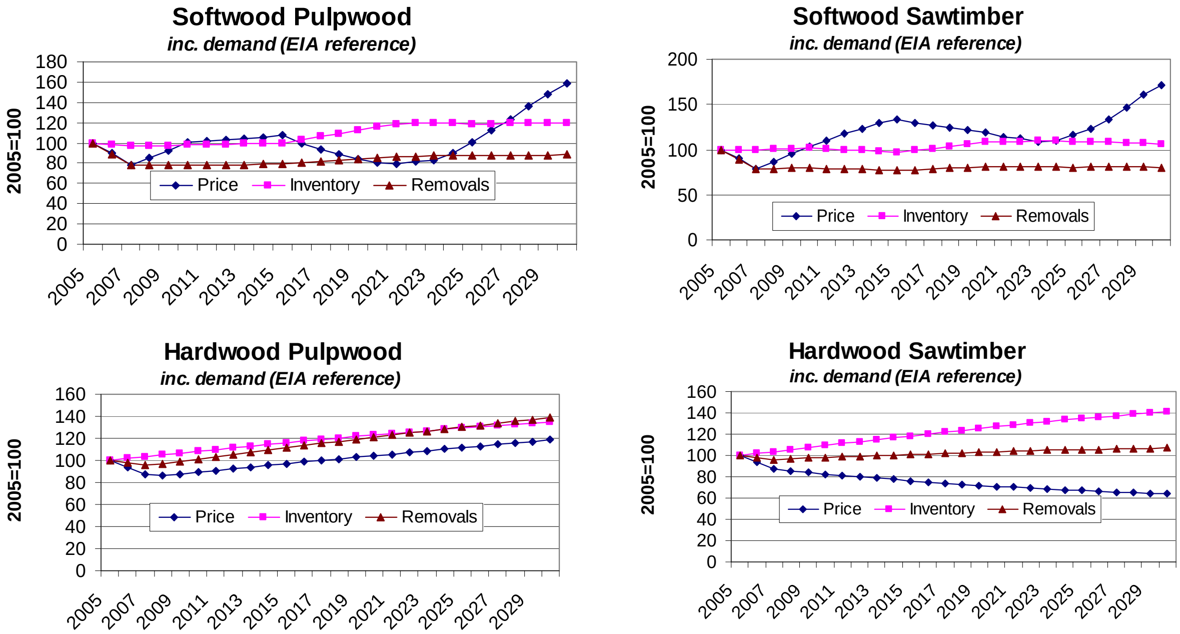


Figure 5. The projection of roundwood market in the EIA reference case increasing merely hardwood pulpwood demand for bioenergy.

Discussion

The projection of roundwood markets indicated that the softwood prices are very sensitive to market changes in Tennessee. The softwood inventory did not grow significantly during the projection period. Changes in removals can easily affect inventory, resulting in great changes in softwood prices. Both the softwood pulpwood and sawtimber prices increased by more than 50% in 2030, even with no additional demand for softwood pulpwood. This probably can be explained by the relatively small softwood acreage in Tennessee and great impact of SPB outbreak.

Comparatively, the hardwood market was insensitive to additional demand for pulpwood. The projection suggested that the hardwood inventory grows constantly and significantly through 2030. An increase in removals cannot greatly influence inventory. Therefore, hardwood prices declined through 2030 with no additional demand for roundwood. An annual hardwood pulpwood demand increase by 150,000 green tons for bioenergy will not lead to decline in inventory and high price of hardwood pulpwood in the next two decades. The impacts on hardwood sawtimber market in Tennessee are even less. The possible reason could be that the current removals of roundwood are low due to the shutting down of some wood processing industries in the past few years.

This study projected the responses of the inventory, removals, and roundwood prices on additional demand for pulpwood for bioenergy production in Tennessee. Nonetheless, the supply of pulpwood and logging residues under these four scenarios did not meet the demand for forest biomass, since the price increase dampens some of the harvest (Abt 2000). Therefore, other sources of forest biomass such as wood-processing industry residues and urban wood waste need to be considered for the demand.

Conclusion

The projection suggested that with annual additional demand for 425,000 green tons of hardwood pulpwood from 2015, the inventory still grows at a faster rate than removals. Therefore, there is potential to supply more hardwood pulpwood as feedstock for biorefinery facility. This implies that there is sufficient hardwood pulpwood supply for the feedstock of a biorefinery facility of 50 million gallons annual capacity in Tennessee.

With the 150,000 green tons of annual hardwood demand increase from 2009, the removals increased at a faster rate than the inventory (Figure 5). By the end of the projection, the removals index reached slightly higher than the inventory index. Though the hardwood pulpwood price in 2030 was only 20% higher than 2005 price, it will keep rising. Therefore, it is possible to meet the 5.2% annual growth of forest biomass demand without affecting the hardwood pulpwood market during the projection period. However, the demand increase rate of the EIA reference case cannot be met in the long term in Tennessee.

The additional demand for softwood pulpwood would have great impacts on the softwood market. An annual additional 30,000 green tons of softwood pulpwood demand from 2015 will double the price for softwood pulpwood by 2030. An annual increase in softwood demand by 22,500 green tons will result in a price increase of 400% of 2005 price. But the impacts on hardwood market are comparatively small. Hence, it is more feasible to increase use of hardwood pulpwood for renewable energy rather than softwood pulpwood in Tennessee. These results will be very helpful in sustainably supplying forest biomass for bioenergy production in Tennessee. Future study should consider the impacts of land use changes as well as markets in neighboring states on biomass supply in Tennessee.

Literature Cited

Abt, R.C. 2000. Southern forest resource assessment using the subregional timber supply (SRTS) model. *Forest Prod. J.* 50(4): 25-33.

EIA (Energy Information Administration). 2009. *Annual energy outlook 2009: with projections to 2030.* U.S. Department of Energy Tech. Rep. DOE/EIA-0383(2009). 221p.

EIA (Energy Information Administration). 2009. State energy data 2006: consumption. http://www.eia.doe.gov/emeu/states/sep_sum/html/pdf/sum_btu_tot.pdf. Accessed 2/10/2009.

Hazel, D. 2006. How will our forests be impacted by a woody biomass energy market? Presentation given at Energy from Wood: Exploring the Issues and Impacts for North Carolina, Raleigh, NC, March 13-14, 2006.

Ince, P. J. 2007. Modeling bioenergy in the U.S. Forest Service's RPA Assessment. Presentation given at the Forestry and Agriculture Greenhouse Gas Modeling Forum, Shepherdstown, WV, March 5-8, 2007.

La Capra Associates. 2006. *Analysis of a Renewable Portfolio Standard for the State of North Carolina*. North Carolina Utilities Commission. 154p.

Sedjo, R.A. 1997. The economics of forest-based biomass supply. *Energy Policy* 25(6): 559-566.

Smeets, E.M., and A.C. Faaij. 2007. Bioenergy potential from forestry in 2050: an assessment of the drivers that determine the potentials. *Climatic Change* 81: 353-390.

Timber Mart-South. 2008. Timber mart-south market news quarterly. 4th quarter 2008. http://www.tmart-south.com/tmart/news.htm. Accessed 2/10/2009.

USDA Forest Service. 2007. Forest inventory and analysis factsheet: Tennessee 2004. USDA Forest Service Southern Research Station. Knoxville, TN. 4p.

Southern Forest Economic Workers
2009 Annual Meeting

Tuesday, March 10, 2009
10:30 AM – 12:00 PM
Session B: Policy

Manuscripts:

Bird Community and Timber Responses to Mid-Rotation Management in Conservation Reserve Program Pine Plantations – Lindsey C. Singleton et al.

An Evaluation of Forest Landowners' Participation in West Virginia's Managed Timberland Forest Tax Incentive Program – Jennifer Fortney and Kathryn G. Arano

Bird Community and Timber Response to Mid-rotation Management in Conservation Reserve Program Pine Plantations

Lindsey C. Singleton[1], Department of Wildlife & Fisheries, Mississippi State University
Brandon G. Sladek, Department of Forestry, Mississippi State University
L. Wes Burger, Department of Wildlife & Fisheries, Mississippi State University
Ian A. Munn, Mississippi State University, Department of Forestry

[1] Mississippi State University, Department of Forestry, Box 9681, Mississippi State, MS 39762, USA

Bird Community and Timber Response to Mid-rotation Management in Conservation Reserve Program Pine Plantations

Abstract

Open pine-grasslands are one of the most threatened ecological communities in the Southeastern United States and provide essential habitat for many regionally declining bird species. Whereas open pine-grassland habitats have been lost, acreage of pine plantations continues to increase throughout the South, in part because of USDA Farm Bill conservation programs. As of 2007, nearly 650,000 ha of pine plantings were enrolled in the Conservation Reserve Program in 11 southeastern states. More than 409,000 ha of this acreage is in a mid-rotation (10 – 25 year old) stage. Management practices that create and maintain a pine-grassland structure in these mid-rotation plantations might provide habitat for a suite of declining early successional and pine-grassland adapted species while at the same time generating positive financial returns from increased timber growth. We tested the combined effects of selective herbicide and prescribed fire on timber, plant and bird communities in 24 thinned, mid-rotation pine stands established under the Conservation Reserve Program in Mississippi. Within each of 12 replicate sites, 2 paired 8.1-ha plots were randomly assigned to either mid-rotation management (herbicide followed by prescribed fire) or control (no management). During 2003 – 2006, we characterized the bird community by the estimated relative abundance, species richness, Total Avian Conservation Value (TACV), and density of select species. During the 4^{th} growing season post-treatment, managed stands had less hardwood midstory and foliage height density and greater ground cover of grasses and forbs than control stands. We observed a shift in the bird community from closed-canopy forest to early successional and pine-grassland adapted species. TACV increased over time following management and by the 3rd growing season post-treatment was greater in treated than control stands. Thinning, hardwood mid-story control, and prescribed burning of mid-rotation CRP pine plantations can provide habitat for some regionally declining bird species and contribute to regional bird conservation goals. Timber growth, however, was not significantly different between the control and treated plots suggesting that mid-rotation herbicide treatments in CRP plantations is not a viable method of increasing financial returns.

Keywords: breeding bird community, timber growth, Conservation Reserve Program, herbicide, imazapyr, loblolly, mid-rotation management, pine-grassland, plantation, prescribed fire.

An Evaluation of Forest Landowners' Participation in West Virginia's Managed Timberland Tax Incentive Program

Jennifer Fortney[1], West Virginia University and Kathryn G. Arano, West Virginia University

Acknowledgments: Dane R. Cunningham

[1] Graduate Research Assistant, Division of Forestry and Natural Resources, West Virginia University, P.O. Box 6125, Morgantown, WV 26506. Email: jbellars@mix.wvu.edu

An Evaluation of Forest Landowners' Participation in West Virginia's Managed Timberland Tax Incentive Program

Abstract

Preferential property tax treatment of forested land is part of legislative policy in all 50 states. West Virginia's forest land tax, Managed Timberland, is designed to promote retention of private forest land in forested use. Many individual states have been the subject of studies on both structure and effectiveness of their preferential forest tax programs. However, West Virginia's Managed Timberland Program, in effect since 1991, has not been scrutinized at the level of other states' programs. In West Virginia, private forest land owners hold 9.7 million acres of forest land, but Managed Timberland enrolled acres have remained at approximately 2 million acres since 1998. This lack of enrollment may be a cause for concern regarding the success and benefits of the program. This study analyzes participant and non-participant characteristics to identify factors that influence the choice to participate in the Managed Timberland Program and propose strategies for improving the program. Results suggest that low enrollment may be attributable to lack of knowledge, poor administration, and failure to target landowner beliefs. Landowners currently enrolled are satisfied with the program.

Keywords: preferential forest taxes, property tax, private forest landowners, land use policy, green space preservation.

Introduction

In West Virginia, the preferential property tax policy for forested land is called the Managed Timberland Program. Individual states have been the subject of several studies on both structure and effectiveness of their forest property tax programs (e.g., Baughman et al. 2003; Jacobson 2001; Rathke 1993; Wagner et al. 2002). However, the West Virginia's tax incentive program has not been scrutinized at the level of other states' forest tax incentive programs. West Virginia Division of Forestry (DOF) Director Dye (2006), in the required annual report to the legislature (Cook 2007), notes a lack of new or increased enrollment since 1998, which was preceded by a drop in enrollment starting in 1995, only four years after the Managed Timberland Program's inception. The lack of enrollment in West Virginia's Managed Timberland program since 1998 may be a cause for concern regarding the success of the policy. It has long been noted that forestry is suited to West Virginia both environmentally and economically, for timber and recreational tourism (Eke 1929; Peck 1929). The West Virginia legislature declared forest preservation to be in the public interest when passing Managed Timberland into law (WV Code §11–1C–11). Therefore it is important to understand forest landowner attitudes toward Managed Timberland in West Virginia. This study analyzes participant and non-participant characteristics to identify factors that influence the choice to participate in the Managed Timberland Program and propose strategies for improving the program.

Methodology

The data for this study were collected from a mail survey that was conducted from August 2008 to February 2009. The study population consisted of nonindustrial private forest (NIPF) landowners in West Virginia who own at least 10 acres of forest land. Managed

Timberland has a ten acre minimum acreage requirement and the study population is limited to landowners who are enrolled or who are eligible to enroll but do not. A random sample of landowners was drawn from two landowner databases. The first sample came from a list, provided by the West Virginia Division of Forestry, of landowners who are enrolled in the program. Industrial forest landowners and corporations were rejected from the sample. The second sample included landowners who have not participated in the program, as drawn from a landowner database obtained from the State Tax Assessor's Office. Businesses, landowners with less than ten acres, and landowners whose names appeared on the Managed Timberland list were rejected from the sample. A target of 400 usable responses in each group was set to achieve a 5% sampling error at a 95% confidence level. A 30% response rate was assumed, requiring a total of 1,300 landowners from each group to be included in the sample.

Dillman's (2000) Tailored Design Method was used in developing and administering the mail survey. Where available, surveys from previous forest landowner studies were consulted so that responses could be compared to other results (e.g. Birch and Kingsley 1978; Rathke 1993; Jacobson 2001; and Joshi 2007). Three mailings were sent to the potential survey respondents to ensure a high response rate: initial mailings of the survey instrument (August 2008), a follow-up mailing of a reminder letter (November 2008), and final mailing with a cover letter and another copy of the survey instrument to non-respondents (January 2009). The final total response rate was 42%.

The survey instruments collected information on three categories: 1.) property information (e.g., forest acreage, length of ownership, distance of residence); 2.) forest property tax-related questions (e.g. amount of property taxes, knowledge of the Managed Timberland Program, attitudes toward property taxation, reasons for participating or not participating in the managed Timberland Program); and 3.) landowner demographics (e.g., age, income).

Summary statistics were calculated for the variables collected from the survey. Comparison of means for the continuous variables was conducted using SAS. Frequencies and χ^2 statistics for the distribution differences between the two groups were calculated using LIMDEP.

Results

The survey instruments were mailed to a total of 2,600 potential respondents, 1,300 to each group, participants in Managed Timberland and non-participants. A total of 1, 394 surveys were returned, of which 939 were usable responses, for a total response rate of 42%. The response rates in the subsamples were 61% for participants and 19% for non-participants. The response rate for the non-participants was low so there was a concern about non-response bias. To test for non-response bias the mean number of acres from the 76 non-participant refusals was compared to the mean number of acres from the 188 usable non-participant surveys. No statistical difference was found.

While a majority (33 to 40%, depending on the activity) of participants indicated that elimination of the program would not change their management decisions, 22% said that they would be much more likely to sell all of their land if the program were eliminated. According to Dye (2006), there are approximately two million acres in the Managed Timberland Program, so while 22% is not the majority, there still exists a potential impact on an estimated 440,000 acres of forested land in West Virginia if the program were to be eliminated.

Participants in Managed Timberland were asked to rate their satisfaction with their Managed Timberland assessment and their perceived percent savings as a result of the program. The majority of participants (41%) said they were satisfied with their assessment, but 37% said they did not know if they were satisfied and 33.5% indicated that they did not know their level of tax savings. This indicates that NIPF landowners do not understand the method of valuation for Managed Timberland acres, which likely affects their overall level of satisfaction with the program and their likelihood to inform others about the program.

Most participants also said that they were satisfied with the administration of the program with 89% satisfied with the tax assessor and 93% satisfied with the DOF. Of those that were not satisfied, most reported dissatisfaction with the tax assessor because they did not understand how their forest land valuation was determined and/or the tax assessor was hostile to the program. Reasons for dissatisfaction with the DOF were primarily the annual contract renewal requirement and not understanding their property valuation, neither of which are in actuality determined by the state DOF. These are further indicators that NIPF landowners do not understand all aspects of the program, even if they are enrolled.

Both participants and non-participants were asked to rate the level to which they supported or opposed some primary aspects of the program. Most non-participants did not feel qualified to answer the question. The strongest opposition among participants strongest was against the annually renewed contract (19.82%) and tax assessor authority (17.75%). Strongest support was for the program's lack of withdrawal penalties (49.32%) and lack of public access requirements (63.05%). Table 1 summarizes the percentages for each level of scaling for each aspect of Managed Timberland for participants.

Table 1: Support and opposition from participants to aspects of the Managed Timberland Program.

	Strongly Oppose	Oppose	Neutral	Support	Strongly Support	Don't Know
Annually Renewed Contract	19.82%	15.80%	26.97%	9.09%	18.78%	9.54%
Forest Management Plan	3.15%	5.71%	25.83%	18.77%	35.29%	11.26%
DOF Approval	3.31%	5.11%	26.67%	21.80%	30.68%	11.43%
Tax Assessor Authority	17.75%	13.96%	33.08%	6.53%	8.95%	19.73%
Method of Valuation	5.71%	8.49%	37.35%	8.95%	10.19%	29.32%
10 Acre Minimum	6.53%	4.41%	29.03%	16.41%	29.94%	13.68%
No Withdrawal Penalty	3.61%	2.71%	19.55%	11.13%	49.32%	13.68%
No Public Access Req.	4.22%	1.51%	11.76%	5.88%	63.05%	13.57%
No Provision for lost Local Rev.	3.38%	2.61%	30.41%	6.91%	32.10%	24.58%

Both groups were also asked to choose from a list of suggested changes to Managed Timberland and any other changes they would like to see implemented in the program. The most frequently selected changes among participants were increase the reapplication time (51.08%), larger tax breaks (39.97%), or no change (26.59%). Many non-participants indicated that they felt unqualified to answer the question (39.18%), but of those who did answer, the most common selected changes were larger tax break (30.93%), no change (18.56%), and provide state reimbursement to local government for lost funds due to the tax break (6.19%).

The means for the two groups for distance residing from their forested property were 85.68 miles for non-participants and 108.15 miles for participants. The mean difference test showed these to not be statistically different at the .05 level. The average number of years owned for participants was 18.46 and 24.27 years for non-participants. This difference was statistically significant. Program participants tended to own more parcels and more acres at 1.83 parcels and 236.42 acres on average. These were also statistically different from non-participants who owned, on average, 1.62 parcels and 115.88 acres.

When asked to cite multiple reasons for ownership, participants chose hunting (69.3%) and timber (62.2%) over any other categories, while non-participants cited passing on to heirs (56.68%) and hunting (54.01%) more than other categories. However, when asked to choose just one primary reason, participants cited leaving to heirs (21.64%) and personal residence (18.26%) over other categories. Hunting dropped to 12.76%, but still ranking fourth and timber dropped to 18.09%, ranking third as a primary ownership reason. Non-participants also chose the same reasons, but in opposite order, with personal residence at 33.33% and leaving to heirs at 27.89%. For non-participants, hunting dropped to 7.48% ranking third as a primary ownership reason, while timber was fifth (7.48%) after land investment (8.16%). For both Managed Timberland participating and non-participating landowners, passing to heirs and having the land as the location of their personal full time residence are the most important primary reason for owning forest land in West Virginia. Hunting and timber are important multiple use objectives for both groups as well.

Most participants reported that they first heard about Managed Timberland from a professional forester (37.14%). Compare this to the non-participants' responses for reasons they are not enrolled, of which 62.21% reported that they had never heard of the program. Figure 1 summarizes the reasons non-participants reported for not enrolling.

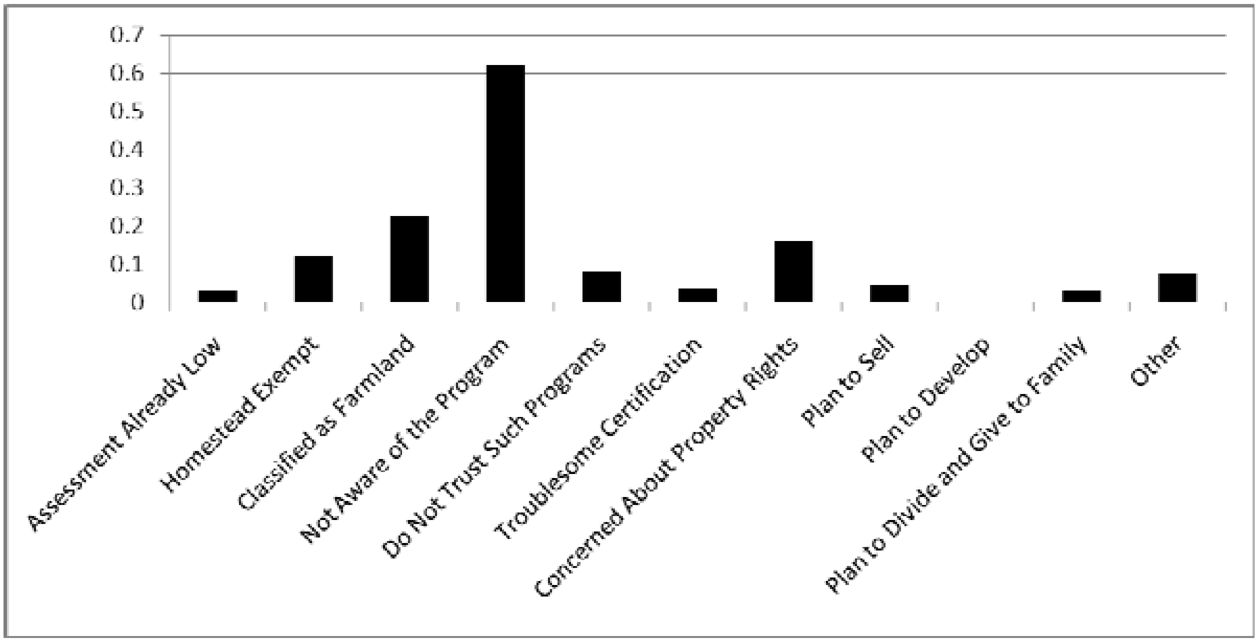


Figure 1: Reasons reported for not enrolling in Managed Timberland by West Virginia forest land owners.

All demographic characteristics from the two groups were statistically different. Participants were likely to have higher incomes and higher levels of education. Participants were more likely to describe their occupations as professional, management, white collar, or skilled trade. While non-participants were also in these groups, they made up more of the respondents who reported themselves as blue collar, farmers, or working in the service industry. Participants were more frequent in younger age classes.

The average property tax per acre between participants and non-participants was not statistically different at the .05 level, with participants paying $10.42 per acre, and non-participants paying $12.00 per acre, on average. However, unusually high Managed Timberland taxes per acre were found to be from only the same four counties, Hampshire, Berkeley, Morgan, and Monongalia. Furthermore, these four counties are all located in the eastern panhandle region (except Monongalia) and are all under severe development pressure (American Farmland Trust 2009). Removal of values over $25 per acre from the data resulted in observations from only those four counties being removed. The new mean with these values deleted was found to be $5.28 per acre, which is statistically different from the $12.00 per acre average property tax paid by non-participants.

Discussion and Conclusions

Most of those enrolled in Managed Timberland first heard about the program through a professional forester. The most commonly cited reason for not being enrolled was because the respondent had never heard of the program. Furthermore many of those not enrolled indicated that they would either consider future enrollment (24.6%) or were unsure if they would consider future enrollment (62.6%). This indicates the importance of advertising the program. If enrollment is to be the device by which program success is measured then West Virginia forest landowners need to know the program exists. Use of public friendly means, such as radio or television announcements, to communicate the presence of the program is recommended.

At the time this study was initiated, West Virginia reported a need for 44 state DOF foresters (WV Division of Personnel 2007). To improve enrollment, more foresters need to be in contact with the public. Salary and benefits packages for West Virginia state foresters should be made more attractive to encourage professional foresters to seek employment in the state. In addition, creating more forester positions within the state DOF will give foresters more time to conduct public outreach for Managed Timberland, as well as other forest management incentive programs.

Managed Timberland participants tended to have more education and income and to be employed within professional jobs over non-participants. Previous research shows that landowners with higher exogenous incomes tend to forego harvest income in favor of amenity value (Dennis 1989). A potential equity issue then arises in the preferential forest tax. Forest tax incentives may be subsidizing private non-timber amenity consumption rather than increasing timber supply. This may be especially troubling in terms of the stated policy objective of open space for social welfare when the absence of public access requirements in West Virginia's Managed Timberland is also considered.

The lack of statistical significance in the difference between the average taxes per acre of those enrolled to those who are not enrolled is also a potential indicator of problems with the policy. Removal of values over $25 per acre from the data resulted in observations being removed from only four counties, Monongalia, Hampshire, Morgan, and Berkeley. Removal of these unusually high assessments resulted in a significant difference in taxes paid per acre between program participants and non-participants. Hampshire, Morgan, and Berkeley counties are listed by the American Farmland Trust as areas of prime farmland that is under threat of severe development pressure. Monongalia County is the location of Morgantown and West Virginia University, and can also be considered a development pressure area. The implication of this result is that lands most in need of the policy effect of increased tax savings to retain ownership are not receiving the intended benefit.

Other areas of the state can also be considered to be under development pressure, for example many counties in the west along the Ohio River are listed by the American Farmland Trust as being prime farmland under development threat. However, none of these counties' observations were removed from the data for having unusually high assessments. The high assessments only occurred in eastern panhandle counties, consistently. There is some evidence that this may be locally politically motivated. Several respondents reported in comments on the survey that their assessor was hostile to the Managed Timberland Program. Jefferson County, which neighbors Berkeley County, was the location of a recent development zoning battle that went all the way to the West Virginia Supreme court twice. In the first case, Corliss et. al. v. Jefferson Co. Zoning Board of Appeals, 2002, the Supreme Court ruled that local zoning authorities had ultimate jurisdiction and had the right to decide on special permits and other ordinances. This decision was in the favor of the developer. In Faraway Farms v. Jefferson Co. Board of Zoning Appeals, 2008, the Supreme Court overturned its own precedent from Corliss and ordered the county zoning authority to issue a special permit for subdivision and development to Faraway Farms.

The legislative intent of Managed Timberland is to provide a tax policy that encourages private owners to preserve forest land and enhance future forest quality (WV Code §11-1C-11(a)). So the objective of the policy is prevention of conversion of forested lands to more developed uses. An important question to address when analyzing a policy is: Are the policy's methods consistent with the policy's intent? According to Hibbard et al. (2003 and 2001), in order for a policy to be capable of achieving its objective, the methods employed should be consistent with the stated goal. Since the policy goal is prevention of land conversion, perhaps current use systems based on timber market productivity principles are not the best system for assessment. Another potential problem with timber market criteria for assessment and compliance is that timber is not consistent with assessed landowner objectives. In West Virginia, landowners report bequest motives and a place to live to be their reasons for ownership. Timber is only important in a multiple use context, as reported by the survey respondents. The assessment of forest lands for Managed Timberland should therefore be based on a system that is consistent with the policy objective and salient landowner beliefs.

This further leads to questioning of enrollment numbers as a measure of success. Since the goal of the policy is forest land preservation, a more appropriate measure would be number of acres preserved, or perhaps more importantly, the location of the acres preserved. Tabulating percent of total enrollment from the survey responses by county shows that Hampshire County, located in the eastern panhandle, ranks first. Of respondents enrolled in Managed Timberland, 29% report that their forest parcels are located in Hampshire County. Morgan and Mineral Counties, also both located in the eastern panhandle rank 2nd and 3rd respectively. This means that most of the Managed Timberland parcels in the state are located in high development counties, so the policy has reached targeted areas. Compare this to Brockett and Gebhard's (1999) Tennessee study in which they found that most Greenbelt participation occurs far away from development pressure areas. However there is still a problem with Managed Timberland participants receiving unusually high assessments for a forest tax incentive program in these counties. Another issue that should not be overlooked is the possibility that land speculators could be using the program as a tax shelter in these counties. This concern was raised in the Managed Timberland report prepared by the DOF for the legislature (Dye 2006).

Participants seem to be unclear about their assessments. On two separate questions on the survey more that 30% of program participant respondents indicated uncertainty about tax savings and satisfaction with assessment. Some comments from respondents echoed this concern with statements either declaring the assessment method to be confusing or asking for it to be explained. Some respondents asserted that their taxes went up after enrolling in Managed Timberland. Others made statements that their local assessor was uncooperative, unresponsive, or seemed hostile to the program.

The success of Managed Timberland hinges on assessment being equitable, efficient, simple, stable, and visible (Hibbard et al. 2001). It is possible that the program could be improved by outreach and education to county tax assessors, as indicated by participant comments and uncertainty about assessment. Respondent comments are anecdotal in nature, so future research on managed Timberland should include an assessment of county tax assessors' knowledge and attitudes about the program.

Based on landowner responses to suggested changes to the program, increasing the amount of time between reapplication may improve enrollment. Nearly 20% of participants oppose renewal annually. Landowners included comments that they found the annual renewal requirements onerous. Some complained about having to obtain a notary stamp from each county in which they owned land rather than one per year. A small percentage (3.49%) of those not enrolled indicated that the certification process was too difficult and time consuming as their reason for not being enrolled.

In summary, possible reasons for low enrollment include lack of knowledge about the program, possible poor administration of the program, and failure of the policy to target salient landowner beliefs in its methods. These short-comings of the program are consistent with results from other studies (e.g. Kilgore et al. 2007; Hibbard et al. 2003; Jacobson and McDill 2003; Young and Reichenbach 1987). Measures to improve enrollment in Managed Timberland should focus on solutions to these problems. Further study of Managed Timberland is needed. Research should assess the attitude of tax assessors. Welfare analysis is needed to determine if social benefits outweigh the costs of administering the program. The lack of withdrawal penalties, concerns expressed by the DOF to the legislature (Dye 2006), and the high concentration of enrollment in rapidly developing counties indicate that the degree to which the program is used as a tax shelter by developers needs investigation.

In spite of problems with the program, overall landowners that are enrolled are pleased with the tax treatment. It would not be wise to eliminate the Managed Timberland Program. A significant amount of landowners indicate that elimination of the program would cause them to have to make socially undesirable (according to policy intent) land use choices. To make the policy more effective a larger tax break may be necessary. As with most policies of this nature, once enacted, there is seldom any going back.

Literature Cited

American Farmland Trust 2009. "Farming on the Edge." Map available at: http://www.littlekanawha.com/map_westvirginia300.jpg

Baughman, M. J., K. Updegraff, and J.C. Cervantes. 2001. "Motivating Forest Landowners in the North Central United States." Unpublished, University of Minnesota. Available at http:www.regional.org.au/au/infro/2001/Baughman.htm.

Birch, T.W. and N.P. Kingsley. 1978. *The Forest Landowners of West Virginia*. U.S.D.A. Forest Service, Resource Bulletin NE-58.

Brockett, C. D., and L. Gebhard. 1999. "NIPF Tax Incentives: Do They Make a Difference?" *Journal of Forestry*. April: 16-21.

Cook, G. 2007. Deputy Director of the West Virginia Division of Forestry. Telephone interview. October 10.

Dennis, D.F. 1989. "An Economic Analysis of Harvest Behavior: Integrating Forest Ownership Characteristics." *Forest Science* 35: 1088-1104.

Dillman, D.A. 2000. *Mail and Internet Surveys- The Tailored Design Method*. John Wiley and Sons, New York. 464p.

Dye, C.R. 2006. *Report on Managed Timberland Program*. West Virginia Division of Forestry, December.

Eke, P. A. 1929. "The Community as a Factor in Classifying Land for Agricultural and Forestry Utilization in the West Virginia Appalachians." *Journal of Farm Economics*, July (11), 412-421.

Hibbard, C. M., M. A. Kilgore, and P. V. Ellefson. 2001. "Property Tax Programs Focused on Forest Resources: A Review and Analysis." Staff Paper. University of Minnesota.

Hibbard, C. M., M.A. Kilgore, and P.V. Ellefson. 2003. "Property Taxation of Private Forests in the United States." *Journal of Forestry*, April/May: 44-49.

Jacobson, M., and M. McDill. 2003. "A Historical Review of Forest Property Taxes in Pennsylvania: Implications for Special Forestland Tax Programs." *Northern Journal of Applied Forestry* 20: 53-60.

Jacobson, M. 2001. "Taxes and Laws: Do They Change Landowner Behavior for the Better?" Unpublished, Pennsylvania State University. Available at http:www.regional.org.au/au/infro/2001/jacobson.htm.

Joshi, S. 2007. "Nonindustrial Private Landowner's Characteristics and Their Forest Management Decisions." M.S. Thesis, Division of Forestry and Natural Resources. West Virginia University.

Kilgore, M. A., J. M. Schertz, S. A., Snyder, and S. J. Taff. 2007. "Family Forest Owner Perceptions and Attitudes: Minnesota's Sustainable Forest Incentives Act." A report to the Blandin Foundation, University of Minnesota.

Peck, M. 1929. "Farm or Forest in the West Virginia Appalachians?" Journal of Farm Economics, July (11), 422-435.

Rathke, D. M. 1993. "An Evaluation of Minnesota's Timberland Property Tax Laws." M.S. Thesis, University of Minnesota.

Wagner, J.E., C.J. Davis, D.E. Roczen, and L.P. Herrington. 2002. "Combining Zoning Regulations and Property Tax relief to Retain Forestland and Promote Forest Management." *Northern Journal of Applied Forestry* 19: 59 -67.

WV State Division of Personnel 2007. State Employment Website. Available at: http://www.state.wv.us/admin/personnel/default.htm. Accessed October 30, 2007

W.V. State Legislature. *West Virginia Code § 11*. "Taxation."

Young, R. A., and M. R. Reichenbach. 1987. "Factors Influencing the Timber Harvest Intentions of Nonindustrial Private Forest Owners." *Forest Science*. 33:2: 381-393.

Southern Forest Economic Workers
2009 Annual Meeting

Tuesday, March 10, 2009
1:00 PM – 2:30 PM
Session A: Ecosystem Services

Manuscripts:

Impacts of FSC and PEFC Forest Certification in North and South America – Frederick Cubbage et al.

Impacts of FSC and PEFC Forest Certification in North and South America

Frederick Cubbage[1], Susan Moore, and Kelley McCarter, North Carolina State University, North Carolina, USA; Diana Diaz, Instituto Nacional de Tecnología Agropecuaria, Entre Rios, Argentina; Francis Dube, Universidad de Concepción, Chile

[1] North Carolina State University, Raleigh, NC, 27695-8008, (706) 515-7789, fredcubbage@yahoo.com

Impacts of FSC and PEFC Forest Certification in North and South America

Abstract

We conducted surveys of firms that had received Sustainable Forestry Initiative (SFI) forest management certification in the U.S. and Canada, and Forest Stewardship Council (FSC) forest management certification in the United States, and American Tree Farm System (ATFS) in the United States, and interviewed a sample of firms in Argentina and Chile that had received Forest Stewardship Council or Certificación Forestal (CERTFOR). SFI, CERTFOR, and ATFS are endorsed by the Programme for the Endorsement of Forest Certification (PEFC) system; FSC has a unified world governance system.

All firms improved many practices in forest management, environmental protection, community relations, public affairs, economic, and environmental management systems in order to receive certification, and most received several conditions or corrective action requests as well. On average, firms changed between 14 to 16 forestry, environmental, social, and economic and system practices in order to obtain or maintain forest certification for FSC and SFI in North America, and 26 practices in South America. Private landowners certified under the ATFS system made fewer changes, with 2.76 per certified owner.

Organizations in North America that received SFI forest certification made more changes in economic and system components of their forest management practices—an average of 6.8 per organization for SFI vs. 3.9 for FSC. Organizations that received FSC forest certification made slightly more changes in forest management and environmental practices—6.8 vs. 5.9 for SFI, and more changes in social and community components—2.4 vs. 1.4 for SFI. ATFS owners made the most changes in forest management, best management practices (BMPs), and planning (1.96), followed by economic and system (0.77), and social and legal (0.04).

The number of changes in South America depended more on the size of the firms than on the forest certification system, with the three large firms in Chile (both FSC and CERTFOR) making more changes than the much smaller firms in Argentina. The average of 26 changes made by firms in Argentina and Chile were distributed very evenly among environmental, social, and economic components of certification standards.

Most organizations stated that they would definitely or probably maintain forest certification, with 90% of SFI, 84% of ATFS, and 69% of FSC in the U.S.A, and 90% of the firms surveyed in South America. A majority of firms in all systems and countries felt certification benefits exceeded their costs, and met the initial objectives of the organization. Firms in South America seemed more enthusiastic regarding the merits of certification, but much fewer are certified.

Introduction

Forest certification provides a means to ensure that forests are managed to achieve economic, environmental, and social goals that are the foundation of sustainable forest management and sustainable development. We collected data through email and direct mail questionnaires and personal interviews about the major forest certification systems in the Americas, including the Forest Stewardship Council (FSC) in Argentina, Chile, and the United States, the Sustainable Forestry Initiative (SFI) in the United States and Canada, the American Tree Farm System (ATFS) in the United States, and Sistema Chileno de Certificación Forestal (CERTFOR) in Chile. These surveys provided a means to assess various factors regarding the effectiveness, implementation, impacts, and organizational attitudes regarding forest certification. This paper summarizes the preliminary results of that research.

Certification Systems and Extent

Forest certification is a non-state market-based policy approach, aimed at greater efficiency in forest resource use through (expected) consumer preference and demand for sustainably produced forest products (Cashore et al. 2004). The basic process of certification encompasses an independent assessment of the quality of forest management in relation to predetermined standards or requirements related to the management system. Standards generally govern forest practices such as harvesting, tree planting, and chemical use; economic, management, and planning systems; stakeholder, community, and worker interactions; environmental protection, biodiversity, high conservation value forests, and aesthetics; and laws, regulations, and monitoring and continuous improvement. Independent auditors assess forest management against these standards, and if management meets or exceeds them, the certifying body provides 'written assurance' that the management system or products conform to certification standards.

The two largest schemes that operate at the global level today are the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC). The FSC system certifies individual forests, whereas the PEFC endorses national-level and other certification schemes that, in turn, certify individual forests. The standards for forest certification of the FSC and the PEFC differ to some degree, particularly as the PEFC encompasses many certification schemes, rather than consisting of a single unified set of standards. As its name indicates, PEFC is an umbrella organization that endorses individual schemes developed in separate countries, which are somewhat different, as is the case with SFI, ATFS, and CERTFOR. FSC employs a global certification system based on unified principles and criteria of sustainable forest management, but with variations among individual country standards based on those common principles (Humphreys 2006).

As of 2008, about 323 million ha (8%) of the world's 3.9 billion ha of forests were certified. Of this, PEFC (2008) had enrolled about 63% (202 million ha) in forest management certification through participating programs, including 57 million ha in Europe and 137 million ha in the Americas. By 2008, FSC had certified about 104 million ha of forests around the world (32% of total certified forest area).

Certification Impacts, Benefits, and Costs

Many efforts have examined the impacts, benefits, and costs of forest certification, which are too extensive to review in their entirety here. Three recent review articles are paraphrased for reference to the broader body of literature. Auld et al. (2008) reviewed the existing literature and examined the direct and indirect impacts of certification schemes on forest and forestry in the world. They noted that the area of land certified and the number of chain-of-custody certificates have increased dramatically in the last 15 years. They concluded that while audits have ensured that certified forests change practices, patterns of adoption initially seemed somewhat more focused on internal monitoring and system changes rather than on forest management, environmental, and social changes.

Rickenbach and Overdevest (2006) assessed certification expectations and satisfaction with FSC certification in the U.S. They found that certification participants had the greatest expectations for market benefits, such as higher prices or increased market share, but their satisfaction did not meet expectations, particularly in terms of increased prices for certified products. "Signaling" benefits of increased recognition for one's forest practices and public relations did not garner as high expectations, but ranked highest in terms of participants' satisfaction with certification. In many cases, satisfaction with signaling benefits exceeded expectations. "Learning" about new forest management practices - finding better forest management, environmental, social, and economic practices through certification - ranked third in terms of expectations, but organizations were more satisfied than anticipated with this component of certification.

Cubbage et al. (2008) surveyed opinions about benefits of forest certification, classing responses into corporate strategy, markets, signaling, or learning categories in the Americas, including the systems in discussed here in the United States, Canada, Brazil, Argentina, and Chile. Respondents generally classed the benefits of firm strategic or management reasons highest, organizational learning factors second, signaling stewardship to external groups third, and improved prices or markets last, but all broad groups were considered important benefits of certification. The largest perceived disadvantages of forest certification were its time and audit costs, and no other disadvantage was rated more than somewhat important. Certified forest firms had relatively evenly mixed opinions about whether certification benefits exceeded costs, but a large majority stated that they would continue forest certification in the future.

Cubbage et al. (2008) also examined the costs of forest certification in the Americas. Average total costs varied considerably depending mostly on forest ownership size, but not certification systems or country. Median average total costs ranged from \$6.45 to \$39.31 per ha per year for small tracts of less than 4,000 hectares. The large ownerships of 400,000 ha or more had median costs of \$0.07 to \$0.49 per ha per year.

Survey Results

Table 1 summarizes the survey statistics and data from all our surveys and interviews by country and system. Table 2 summarizes the average number of changes made by each organization or owner for these systems.

Table 1. Forest Certification Systems, Number of Certified Owners, Number Surveyed, and Response Rates for Surveys and Interviews of Forest Certification in the Americas

System/Country	**Valid Address Sample Size (Number Certified Owners)**	**Completed Surveys/ Interviews**	**Percentage of Owners/Sample Surveyed**
SFI – Forest Management USA & Canada	66	41	62%
SFI – Wood Procurement USA & Canada	26	14	54%

FSC – Forest Management USA	98	56	57%
ATFS – USA	1240 (~70,000)	471	38%
FSC – Argentina	12	7	58%
FSC and CERTFOR – Chile	~18	3	17%

We had very good response rates to our surveys of forest certification impacts in all cases, although the percentages did vary somewhat. This included 54% to 62% of our email survey of the forest certification certificate holders in the SFI and FSC samples in the United States and Canada. We had a lesser response rate for ATFS, but 38% is still quite good for a mail survey with such a large sample. In Argentina we actually interviewed 7 of the 12 FSC certificate holders at the time; in Chile we interviewed only the three largest certified forest owners, but they owned 90% of the certified forest land in the country.

Table 2. Average Number of Management Changes per Owner with Forest Certification by Type and System for Forest Certification Systems in the Americas

System/Country	**Average Number of Changes per Owner**	**Number of Changes by Type**		
		Environmental and Forest Management	**Social and Legal**	**Economic and System**
SFI – Forest Management USA & Canada	14.1	5.9	1.4	6.8
SFI – Wood Procurement USA & Canada	13.0	3.3	1.8	7.9
FSC – Forest Management USA	12.9	6.8	2.4	3.7
ATFS – USA	2.76	1.96	0.17	0.63
FSC and CERTFOR Argentina and Chile[1]	25.8	9.4	8.4	8.0

[1]Argentina and Chile (FSC and CERTFOR) responses combined to protect firm confidentiality

SFI and FSC certified land owners in the U.S. and Canada made an average of about 13 to 14 changes in their environmental, forest management, social, legal, economic, and system practices in order to obtain and maintain forest certification. ATFS members, who are predominantly small family landowners, made fewer, averaging only 2.76 per owner. Forest owners in Argentina and Chile made many more changes, averaging 26 changes. The FSC organizations in South America averaged only 7 corrective action requests (CARs), so the total number of changes actually made was about three times more than the CARs for FSC. U.S. Organizations receiving SFI certification made mostly environmental, forest, economic, and system changes. Organization receiving FSC had proportionately more environmental and social changes. ATFS member changes focused the most on forest management, with some on economic components. The Argentina and Chile FSC and CERTFOR system led to more changes for all components of forest practices than the U.S. systems in order to receive forest certification, and these were distributed well across all components of certification.

Tables 3, 4, and 5 summarize some of the most notable changes made for forest management, social and legal, and economic and system components of forest certification, respectively. As

Table 3 indicates, there were differences among systems regarding which components of environmental or forest management were changed the most in order to obtain forest certification. The preparation of the forest management plan was a required change most often for FSC and ATFS and Argentina/Chile forest owners. SFI generally certified large industrial or government owners, many of whom probably already had forest management plans. Other common changes in practices for SFI certificate holders included implementation/effectiveness monitoring, allowable cut/adjacency constraints, meeting green-up standards, use and monitoring of BMPs, special site reserves, determining clearcut size, and geographic information systems.

The most FSC changes in the U.S. were made for implementation/effectiveness monitoring, forest inventory programs, GIS and sustained yield constraints, special site reserves, prevention of exotic invasives, chemical use, and BMP use. ATFS landowners in general did not make as many changes other than forest management plans, but notable ones included BMP use, forest health protection, inventory programs, prevention of exotic invasives, and allowable cut constraints. For Argentina and Chile, the most frequent changes included chemical use, the forest plan, endangered species protection, biological diversity, and old growth/high conservation reserves, special sites, and soil and inventory maps. Eliminating genetically modified organisms (GMOs) was not important under any system to date—because there were few in ATFS cases and Argentina—and they are not prohibited in the PEFC systems.

Per Table 4, program reporting was the social or legal practice that had the greatest change for SFI certified organizations in the U.S. and Canada, followed by legal planning and record keeping and public relations and education. Outreach and extension, public and stakeholder meetings also were important, but still required changes by less than a quarter of the firms. Public release of the management plan was the most common change reported by FSC organizations in the U.S., followed by program reporting, public relations/education, and consulting with communities/neighbors. The ATFS landowners have fewer social and legal requirements, so made very few changes other than program reporting or outreach and extension. The firms in Argentina and Chile actually changed a large number of social and legal practices, with more than half the firms changing outreach and extension activities, public relations/education, legal planning and record keeping, public meetings, social impact analyses, community grants and support, and compliance with environmental laws. In contrast, only one practice—program reporting for SFI—led to more than half the firms making changes for SFI or FSC, and no change in practice was adopted by more than 10% of ATFS owners, and most were less than 0.01%.

Table 3. Number of Changes Required in Forest Management and Environmental Protection Practices by System and Country

Change in Environmental or Forest Management Practice Required?	**SFI For Mgt USA & Canada**	**FSC USA**	**ATFS USA**	**FSC& CERTFOR Argentina & Chile**
Number of responses	***41***	***56***	***471***	***10***
	-- Number of Yes Responses --			
forest inventory programs	7	24	55	4
soils and inventory maps	10	16	40	5

growth and yield calculations	7	19	44	2
geographic information systems (GIS)	13	20	22	5
sustained yield/allowable cut/adjacency constraints	15	20	40	2
forest management plan	10	43	133	8
reforestation/afforestation	7	7	72	4
chemical safety, reduction, disposal	9	19	14	8
site productivity protection	4	10	25	3
forest health protection	4	4	63	0
use and monitoring of BMPs	23	19	78	6
implementation/effectiveness monitoring	25	30	58	4
threatened species protection	11	17	38	7
biological diversity planning	16	17	28	6
old growth/ high conservation reserves	10	31	31	6
special sites reserves	15	20	30	5
prevention of exotic invasives	10	20	56	7
determining clearcut size	14	11	32	3
meeting green-up standards	20	10	17	2
meeting plantation guidelines	4	5	27	4
reduced forest type conversions	4	6	9	3
eliminating GMOs	0	3	8	0
Total of Yes Responses	238	379	920	94
Average Per Owner for Class	5.80	6.77	1.95	9.40

As summarized in Table 5, many economic and system changes were prompted by SFI certification, with more than half the organizations reporting changes in program implementation committee duties, logger/supplier training, internal program monitoring/auditing, management review systems, and continuous improvement. Natural heritage planning, chain of custody, wood procurement practices, and customer inquiries also changed often. FSC certification also prompted numerous changes, with chain of custody implementation, internal program monitoring/auditing, and natural heritage planning requiring the most. Management review systems, program promotion, continuous improvement, and customer inquiries also prompted changes in about one-fifth to one-third of the certified organizations. The ATFS prompted changes by less than one-fifth of the owners for any individual practice, with the most important ones being continuous improvement, utilization planning and practices, minimizing wood waste, and forest research/demonstration. FSC and CERTFOR in Argentina and Chile again prompted major changes in practices for most firms. More than half the firms changed practices regarding logger/supplier training, natural heritage planning and reserves, chain of custody, internal program monitoring, continuous improvement, building a management system, forest research and demonstration, utilization practices, and minimizing wood waste.

Table 4. Number of Changes Required in Social and Legal Practices by System and Country

Change in Social or Legal Practice Required?	SFI For Mgt USA & Canada	FSC USA	ATFS USA	FSC& CERTFOR Argentina & Chile
Number of responses	***41***	***56***	***471***	***10***
	-- Number of Yes Responses --			
protection from illegal trespass	1	2	5	3
establishing tenure rights	0	1	na	1
protecting indigenous rights	7	4	na	1
consulting with communities/neighbors	6	7	5	5
social impact analyses	5	3	na	6
ensuring labor rights and practices	0	2	na	3
public / stakeholder meetings	8	6	na	7
offer program workshops	6	2	na	6
legal planning and record keeping	11	7	5	8
comply with environmental laws	3	1	0	6
compliance with social/worker laws	1	3	0	4
comply with international treaties	1	5	2	3
public release of management plan	6	22	0	5
outreach and extension	9	9	34	8
public relations / education	11	11	na	8
community grants and support	4	4	na	6
program reporting	27	16	30	4
Total of Yes Responses	106	105	79	84
Average Per Owner for Class	2.59	1.88	0.17	8.40

Table 6 summarizes the opinions of the interviewees about the merits of forest certification for their organization or lands. Most certified organizations or owners stated that they would definitely or probably maintain forest certification, with 90% of SFI, 84% of ATFS, and 69% of FSC in the U.S.A, and 90% of the firms surveyed in South America. A majority of owners in all systems and countries felt certification benefits exceeded their costs, and met the initial their objectives. Firms in South America seemed more enthusiastic regarding the merits of certification, but much fewer are certified.

Table 5. Number of Changes Required in Economic and System Implementation Practices by System and Country

Change in Economic or System Practice Required?	SFI For Mgt USA & Canada	FSC USA	ATFS USA	FSC& CERTFOR Argentina & Chile
Number of responses	***41***	***56***	***471***	***10***
	-- Number of Yes Responses --			
natural heritage planning/reserves	15	24	22	8

utilization planning and practices	3	2	60	6
minimizing wood waste	5	1	54	6
wood procurement plans/practices	14	4	na	4
chain of custody implementation	15	36	15	7
forest research / demonstration	13	5	35	6
logger / supplier training	31	9	na	9
economic analyses	5	8	25	2
internal program monitoring/auditing	28	26	na	7
implementation committee / program commitment duties	32	17	na	5
continuous improvement	22	13	85	7
time to build management system	na	na	na	6
customer inquiries / procurement	18	11	na	3
management review system	26	17	na	4
Total of Yes Responses	217	173	296	80
Average Per Owner for Class	5.29	3.09	0.63	8.00

Table 6. Summary of Responses Regarding Certification Benefits, Objectives, and Retention

Certification Assessment	**SFI For Mgt USA & Canada**	**FSC USA**	**ATFS USA**	**FSC& CERTFOR Argentina & Chile**
	-- mean score --			
Do certification costs exceed benefits?[1]	3.3	3.0	3.8	na
Has certification achieved objectives?[2]	4.1	3.6	3.8	4.3
Will organization maintain certification?[3]	4.3	3.9	4.1	4.8

[1]Benefits greatly exceed costs=5; benefits exceed costs=4; benefits=costs=3; costs exceed benefits=2; costs greatly exceed benefits=1
[2]Definitely yes=5; probably yes=4; uncertain=3; probably not=2; definitely not=1
[3]Definitely yes=5; probably yes=4; uncertain=3; probably not=2; definitely

The organizations certified by FSC felt that on average, the benefits about equaled the costs of certification. Organizations certified by SFI had a greater average ranking of certification benefits versus costs, and ATFS members rated the benefit-cost comparison greatest (note that they do not pay direct fees for certification). The average responses from representatives from all North American organizations indicated that certification had achieved the objective of their organization, with SFI being rated highest, ATFS second, and FSC third. Firms in South America rated achieving objectives higher, and were by far more likely to maintain certification. With an average ranking of about 4, most North American organizations and owners also felt that they would maintain certification. Only small differences appeared, with SFI, ATFS, and FSC ranked in that order.

Conclusions

This paper has summarized some of the first comprehensive data on the impacts of forest certification across a range of systems in the Americas. This includes FSC in the United States, Argentina and Chile, and the PEFC endorsed systems of SFI in Canada and the U.S., ATFS in the U.S., and CERTFOR in Chile. These systems differ considerably in their origins at least, and moderately in their standards as well. Modern forest certification systems were initiated first by the Forest Stewardship Council (FSC) in 1993, based on efforts by environmental groups to protect environmental and social values of forests. SFI and CERTFOR were developed initially with leadership from the forest products industry, and founded on an environmental management system (EMS) approach to forest certification. ATFS started as a Tree Farm planting and promotion program for small forest landowners, and since added forest certification as a requirement for all owners.

The three systems focused on large landowners fostered substantial efforts by the certified organizations, including many changes in forest management, environmental, social, economic, and system components. Of the various systems, FSC probably has the most indicators—up to 200 in some countries—followed by CERTFOR and SFI, with about 100 indicators. ATFS has much fewer standards, with only 24 as of 2008.

The number of changes required and performed by certified organizations, however, does not correspond directly just with the number of standards in each system. Instead, it appears that the most changes (an average of 26) prompted by receiving forest certification were adopted by the organizations in Argentina and Chile, for both FSC and CERTFOR. This could be attributed to the rigor of the standards in those countries, the difference between where the companies started and the level of those standards, the enthusiasm of the companies to implement forest certification, or all of the above. FSC and SFI seemed to prompt about the same number of changes—an average of 13 to 14—in the U.S and Canada organizations. ATFS did not require many changes, probably because of the modest number of requirements and capability of the forest landowners.

In South America, the 26 changes made by FSC and CERTFOR certificate holders were well distributed across forest management, environmental, social, legal, economic, and system components. FSC in the United States had somewhat more focus on environmental and social components; SFI had slightly more focus on economic and system components. ATFS prompted few changes, and most were focused on forest management practices. The North American systems seemed to prompt changes that corresponded well to their origins of environmental groups or forest industry, but still had some changes across all components of certification standards.

It is clear that forest certification has prompted many changes in all types of forest management practices from the forest to the forest communities. The responses to the surveys indicate that certification has promoted changes in all the major systems, with more improvements reported in Argentina and Chile than North America. In addition, data from those countries indicate that firms made more than just the minimum changes required by CARs. In fact, they made about three times more changes then the CARs under the FSC system. The public and private organizations that were certified in North America also made many changes, again indicating that forest certification does have significant impacts on the ground, across a range of components. The ATFS system required fewer changes of landowners, as appropriate for small and less intensively managed forests.

All of the systems in the U.S. have been undergoing revision in 2009, and are becoming more rigorous. Forest certification extent is apt to increase moderately in the future, and very likely to be extended to forest carbon storage programs at least, and perhaps to biomass harvesting as well. These comparisons among systems support their effectiveness, and suggest that they can indeed be used to ensure sustainable economic, environmental, and social forest practices.

Literature Cited

Auld, G., L.H. Gulbrandsen, and C.L. McDermott. 2008. Certification schemes and the impacts on forest and forestry. Annual Review of Environment and Resources 33:187-211.

Cashore, B., G. Auld, and D. Newsom. 2004. Governing through Markets: Forest Certification and the Emergence of Non-State Authority. Yale University Press. New Haven. 327 p.

Cubbage, F., S. Moore, T. Henderson, and M. Araujo. 2008. Costs and Benefits of Forest Certification in the Americas. Book Chapter for: Natural Resources: Economics, Management, and Policy. Frank Columbus, Editor-in-Chief. Nova Science Publishers.

Forest Stewardship Council. 2008. Forests certified by FSC-Accredited Certification Bodies, April 17, 2008. Accessed at: http://www.fsc.org. 31 July 2008.

Humphreys, D. 2006. Logjam – Deforestation and the Crisis of Global Governance. Earthscan: London, UK.

PEFC. 2008. Programme for Endorsement of Forest Certification - statistical figures on PEFC certification, July, 31, 2008. Accessed at: www.pefc.org. 17 August 2008.

Rickenbach, M. and C. Overdevest. 2006. More than markets: assessing Forest Stewardship Council (FSC) certification as a policy tool. Journal of Forestry 104(3):143-147

Paper for the proceedings of Southern Forest Economics Workers Meeting (SOFEW); March 9-10, 2009, Chapel Hill, North Carolina; To be posted at: http://sofew.cfr.msstate.edu/

SOFEW_2009_Certification_Americas_V7

Southern Forest Economic Workers

2009 Annual Meeting

Tuesday, March 10, 2009

1:00 PM – 2:30 PM

Session B: Recreation

Manuscripts:

Wilderness Recreation Demand: A comparison of Travel Cost and On-Site Cost Models – J.M. Bowker et al.

Is Demand for Nature-Based Outdoor Activities Declining? Evidence from Hunting in the Southeast – Suman Majumdar and Yaoqi Zhang

Landowner Willingness to Accept Fee-Based Recreation and the influence of Institutional Change in the Louisiana Delta – James E. Henderson**,** Michael A. Dunn, and Kurt M. Guidry

Wilderness Recreation Demand: A Comparison of Travel Cost and On-site Cost Models

J.M. Bowker, USDA Forest Service, Southern Research Station, Athens, GA, 30602, Voice:706-559-4271, Fax:706-559-4266, mbowker@fs.fed.us

J.P. Zhu, University of Georgia, Dept of Statistics, Athens, GA, zjp@uga.edu

Ashely Askew, University of Georgia, Dept of Statistics, Athens, GA, zjp@uga.edu

C.M. Starbuck, New Mexico State University, Dept of Business & Economics, Las Cruces, NM, starbuck@nmsu.edu

D.B.K. English, USDA Forest Service, National Visitor Use Monitoring Program, Washington, DC, denglish@fs.fed.us

Lynne Seymour, University of Georgia, Dept of Statistics, Athens, GA, seymour@uga.edu

**Wilderness Recreation Demand:
A Comparison of Travel Cost and On-site Cost Models**

Abstract

This study used travel cost and on-site day cost models, coupled with the Forest Service's National Visitor Use Monitoring data, to examine the demand for and value of recreation access to designated Wilderness.

Key Words: Wilderness, recreation, travel cost, on-site day cost, consumer surplus

Introduction

Morton (1999) has shown that land in the National Wilderness Preservation System (NWPS) has many use and nonuse dimensions contributing to its economic value. Bowker et al. (2006) found that while per capita demand for wildland recreation access may be shrinking, overall demand continues to increase because of the greater increase in population. With a shrinking land base compared to population growth, the relative values of competing uses of wildlands become more important to land allocation decisions. While, Bowker et al. (2005) provided empirical estimates of the multiple values for Wilderness based on four decades of economic research, these studies were typically fragmented, based on suspect samples, and often unclear about the basic units of measure.

Among the most important use values for Wilderness is recreation access. In most cases, while access is free, visitors would lose considerable utility if the access was unavailable. Consequently, visitors have a positive willingness-to-pay or consumer surplus (CS) for continued access to the NWPS. Traditionally, CS for Wilderness recreation access has been measured using either the Travel Cost Method (TCM) (Smith 1975; Englin and Shonkwiler 1995) or Contingent Valuation (CVM) (Pope and Jones, 1990; Keith, J.E., C. Fawson, and V. Johnson 1996). Here, we apply and contrast TCM to the On-site Cost Model (OCM) (Bell and Leeworthy 1990), to examine recreation demand and economic value for National Forest Wilderness (NFW) access.

Methods and Data

TCM has been the dominant behavior-based nonmarket valuation technique applied to recreation resources and Wilderness. The basic premise of the TCM is that the time and travel cost expenses that people incur to visit a site represent the "price" of access to the site. Thus, the willingness-to-pay to visit the site can be estimated based on the number of trips that are made at different travel costs. This is analogous to estimating the willingness-to-pay for a marketed good based on the quantity demanded at different prices. TCM allows for the construction of a demand curve where the number of trips to a site is assumed to relate to cost, time and other demographics (Parsons 2003). If a demand curve can be estimated, the value of site access can be measured. In the case of NFW access, the empirical demand model can be generally specified as:

$$NFV = f(TC, SUBST, SOC, SITE) + u \qquad (1)$$

where, NFV is annual visits to the Wilderness site, TC is the travel cost per visit, SUBST, SOC and SITE are vectors of socioeconomic and site characteristics respectively, and u is random error.

Bell and Leeworthy (1990) found that the TCM broke down when dealing with beach day valuation for Florida tourists because of limited variation in the annual trips variable, yet considerable variation in days on site inspired them to develop an alternative model. This problem, attributed to spatial limits, was first described by Smith and Kopp (1980) and revisited by Kerkvliet and Nowell (1999) for anglers at Yellowstone. The latter found that while the

OCM mitigated some of the problems attributable to TCM, it was not a complete success in dealing with visitor heterogeneity. To our knowledge no further applications of the OCM have been published.

In an OCM, the visitors face two distinct types of cost, on-site cost and travel cost. It is assumed that the visitors need to pay a certain charge before the consumption of recreation service on site. It can be considered a payment for privilege of purchasing the on-site service. Hof and King (1992) demonstrated theoretical validity of the OCM to obtain consumer surplus. The empirical OCM takes the form:

$$WD = f\,(DIST, OSCST, SUBST, SOC, SITE) + u \tag{2}$$

where, WD is annual days at the Wilderness site, DIST is one-way travel, OSCST is on-site cost per day, SOC and SITE are vectors of socioeconomic and site characteristics respectively, and u is random error.

Data were collected as part of Round 1 of the National Visitor Use Monitoring Program (NVUM) from 2000-2004 across all National Forests. Details of the stratified random exit sampling protocol are provided in English et al. (2002). This application uses only Wilderness stratum data containing expenditure and basic survey modules (approximately 25% of Wilderness stratum). Data collected on-site are zero-truncated, non-negative integers, overdispersed, and endogenously stratified (Ovaskainen et al. 2001) rendering the OLS estimation approaches used by Bell and Leeworthy (1990) and Kerkvliet and Nowell (1999) inappropriate. To address the on-site data collection problem, we use a truncated negative binomial estimator and weight the data to account for the sampling stratum and the probability of selection. Travel cost is computed as the average AAA variable cost per mile for medium vehicles from 2000-2003 (when the data were collected) of $0.1269 in the base TCM.

Results

Weighted and unweighted sample means for the dependent and explanatory variables are presented in Table 1. Examining the two dependent variables, WD and NFV, reveals the large discrepancy created by endogenous stratification or avidity bias. However, the respondent’s probability of being in the sample does not appear to greatly affect distance traveled, age, gender, people per vehicle, or perception of crowding.

Table 1. Means for dependent and explanatory variables, n=1620.

Variable	Unweighted	Weighted
WD (wilderness days/yr)	26.36235	5.022633
NFV (wilderness visits/yr)	21.91667	3.094234
AVGEXPV (on-site cost/day)	95.73176	131.3282
FULLTC (full travel cost)	367.0083	418.2845
TC (travel cost w/o time)	133.9227	146.7812
PRACTDIS (distance)	544.4013	596.6717
INC (income proxy thousands)	42.10245	43.55994
SUBST (=1 if had subst; 0 o.w.)	0.511728	0.62903
GEND (=1 if male; 0 o.w.)	0.676012	0.650675
OTHSITE (other sites visited)	0.322222	0.493302
AGEGROUP	3.493506	3.438731
PEOPVEH (group size)	2.474566	2.616714
CROWDING (crowding likert)	4.080713	3.970372
DHIUSE (=1 if NFV>18; 0 o.w.)	0.25679	0.019872
TIMESITE (visit time on site)	1.62716	1.994671

Regression results and fit statistics for the TCM are reported in Table 2. Visits are inversely proportional to travel cost (TC). The binary variable (DHIUSE) for high-frequency users is highly significant. Trips were inversely related to income (INC). This result is theoretically questionable, but consistent with much of the recreation demand literature. It should be noted however, that because of federal questionnaire restrictions pertaining to income, the income variable is proxy based on the average IRS tax return for the respondent's zip code. The substitute binary (SUBST) had a negative coefficient indicating that respondents with substitute sites or activities demanded fewer visits. Being a male (GEND=1) positively affected trip demand. Respondents who visited other sites (OTHSITE) during the trip, or stayed longer at the site (TIMSITE) demanded fewer trips. The age of the respondent (AGEGROUP) was insignificant, while more people in the traveling party (PEOPVEH) led to fewer trips demanded. Finally, the Alpha coefficient being positive and significant indicated that the data are over-dispersed and thus the truncated negative binomial is preferred to the truncated poisson specification.

Table 2. TCM negative binomial parameter estimates, n=1593, dependent variable NFV

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]	Mean of X
Constant	1.44460939	.25173208	5.739	.0000	
TC	-.00291533	.00028023	-10.403	.0000	134.409922
DHIUSE	3.77512046	.31788160	11.876	.0000	.25800377
INC	-.01710612	.00249755	-6.849	.0000	42.0690654
SUBST	-.27168992	.08899320	-3.053	.0023	.51098556
GEND	.58235099	.08670340	6.717	.0000	.67545512
OTHSITE	-.71976727	.08402700	-8.566	.0000	.32140615
TIMESITE	-.24207486	.02737227	-8.844	.0000	1.62586315
AGEGROUP	-.00412415	.03503506	-.118	.9063	3.48964218
PEOPVEH	-.15563758	.03764613	-4.134	.0000	2.46892655
	Dispersion parameter for count data model				
Alpha	4.15988341	1.23900014	3.357	.0008	MFRSQ=0.34

An alternative TCM incorporating an opportunity cost for time (the product of federal minimum wage for group members over 16 and travel time) was also estimated, but is not reported here. With the exception of the price coefficient (-0.0011), all coefficients were within 5 percent of those reported in Table 2.

Results for the OCM model are reported in Table 3. Annual days in Wilderness are negatively related to on-site cost per day (AVGEXPV) and travel distance (PRACDIS) which is theoretically consistent. As with the TCM, income (INC), presence of substitutes (SUBST), visiting other sites on the trip (OTHSITE), and number of people in the traveling party (PEOPVEH) all negatively affect demand for Wilderness days. Age of the respondent (AGEGROUP) is likewise insignificant, but being male (GENDER) positively affects demand. Unlike the TCM model, a time on site variable is not included, because the unit of consumption is Wilderness days. Similar to the TCM, the Alpha parameter is significant supporting the use of the truncated negative binomial.

Table 3. OCM negative binomial parameter estimates, n=1593, dependent variable WD

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]	Mean of X
Constant	1.74891483	.22619616	7.732	.0000	
AVGEXPV	-.00228622	.478720D-04	-47.757	.0000	95.3444935
PRACTDIS	-.00062317	.353842D-04	-17.611	.0000	546.381795
INC	-.02242522	.00151744	-14.778	.0000	42.0690654
SUBST	-.11369428	.05640536	-2.016	.0438	.51098556
GEND	.62181389	.04574014	13.594	.0000	.67545512
OTHSITE	-.80854053	.04662477	-17.341	.0000	.32140615
AGEGROUP	.13731531	.01691257	8.119	.0000	3.48964218
PEOPVEH	-.13605395	.02258053	-6.025	.0000	2.46892655
	Dispersion parameter for count data model				
Alpha	6.32826739	1.32530468	4.775	.0000	MFRSQ=0.58

Discussion

The regression results alone do not provide compelling evidence that either the TCM or the OCM is superior for estimating Wilderness demand. For both models the signs of estimated coefficients conform to theory, except in the case of the income proxy. Examining the McFadden R-square fit measure (MFRSQ), the OCM (0.58) appears to describe the data somewhat better than the TCM (0.34), although both of these estimates are relatively high among similar published studies. The alternative TCM model adding an opportunity cost of time to the travel cost provided a similar MFRSQ (0.33) as the TCM model reported above.

An alternative economic measure by which the two models can be compared is price elasticity. Following Bowker and Leeworthy (1998), the own price elasticity for the TCM in truncated negative binomial form is E_{TC}= -1.1, whereas for the OCM the price elasticity is $E_{AVGEXPV}$=-0.84. In both cases, the values are within the range reported in the recreation demand literature. The TCM model using time cost yielded a much lower price elasticity, E_{TCOP}= -0.18, which is at the extreme low end of those reported in the literature. This could be further evidence in the argument against the arbitrary inclusion of time costs into many recreation demand models.

Average consumer surplus for each of the two models can be computed similarly. For the TCM model, estimated as annual NFV per group, average per group per trip CS_{NFV}= (-1/B_{TC}) = $343. Alternatively, for the OCM, estimated as annual WD per group, average per group per day CS_{WD}=(-1/$B_{AVGEXPV}$) = $437. To compare the two results requires bringing both measures to a common unit, consumer surplus per person per day, CSPPD. For the TCM, $CSPPD_{NFV}$= [(CS_{NFV}/(TIMESITE*PEOPVEH)] = $148 (+/-$15). The TCM with time cost included led to a CSPPD of $366 (+/-$92). For the OCM, estimated in days rather than trips or visits, $CSPPD_{WD}$=[CS_{WD}/PEOPVEH] = $229 (+/- $11), an increase of about 50 percent over the base TCM and nearly 60 percent lower than the time cost TCM. While each model yields values that fall within the range of consumer surpluses reported in the literature for access to high quality wildland recreation, it is interesting to note that the OCM virtually splits the difference between the conservative mileage cost only TCM and the TCM which incorporates the product of minimum wage and travel time as a proxy for the adults' value of time in travel.

Conclusions

We explored the use of the TCM and OCM approaches to value recreation access to designated Wilderness. Our findings of CS per person per day indicate a range of values from $366 (TCM with time) to $228 (OCM) to $148 (TCM base) and are within the range of values reported in the literature for studies conducted at specific Wilderness areas. In this application, the TCM without time cost is probably a good lower bound for valuing per day access to the National Wilderness Preservation System, although arguments can be made in support of each of the other two models. A case can also be made for convergence validity as the on-site cost model splits the difference between travel cost models with different assumptions about travel time.

Employing the lower TCM CS value of $148 per person per day, and aggregating across 12.4 million days for National Forest Wilderness and 16.28 million days for NWPS visitation in 2002 (Bowker et al. 2006) the consumer surplus for recreation access to Wilderness are, respectively, about $1.8 and $2.4 billion per year. Employing the OCM results, and the TCM with time, the annual net economic benefits for Wilderness recreation access are higher (Table 4).

Table 4. Annual net economic values of Wilderness recreation access (lower 48 states).

Model	$CSPPD	NFW Days	NWPS Days	$NFW/yr	$NWPS/yr
TCM base	$ 148	12.4 mil	16.3 mil	$ 1.84 bil	$ 2.41 bil
OCM	$ 229	12.4 mil	16.3 mil	$ 2.84 bil	$ 3.73 bil
TCM time	$ 366	12.4 mil	16.3 mil	$ 4.54 bil	$ 5.96 bil

Assuming a discount rate of 3 percent, and a 50-year time horizon, the present value per acre of National Forest Wilderness in the lower-48 states ranges from $1500 to nearly $3800, while for the complete NWPS in the lower-48 states the per acre value ranges from $1200 to nearly $3000 per acre depending on the valuation model selected.

Economists have claimed conceptually and reported empirically that use value or recreation access value for Wilderness is likely to be less than values derived from various non-use and existence values. Nevertheless, it is clear from this study that the value of recreation access to Wilderness is nontrivial as measured by either of the two behavior-based methods employed.

Literature Cited

Bell, F.W. and V.R. Leeworthy. 1990. Recreational demand by tourists for saltwater beach days. Journal of Environmental Economics and Management 18:189-205.

Bowker, J.M., Harvard, J.E. III, J.C. Bergstrom, H.K. Cordell, D.B.K. English, and J.B. Loomis. 2005. The net economic value of Wilderness. P.161-180 in The multiple values of Wilderness, Cordell, H.K., et al. (eds.). State College, PA: Venture Publishing.

Bowker, J.M. and V.R. Leeworthy. 1998. Accounting for ethnicity in recreation demand: A flexible count data approach. Journal of Leisure Research 30: 64-78.

Bowker, J.M., D. Murphy, H.K. Cordell, D.B.K. English, J.C. Bergstrom, C.M. Starbuck, C.J. Betz, G.T. Green. 2006. Wilderness and primitive area recreation participation and consumption: An examination of demographic and spatial factors. Journal of Agricultural and Applied Economics 38:317-326.

Englin, J. and J.S. Shonkwiler. 1995. Estimating social welfare using count data models: An application to long run recreation demand under conditions of endogenous stratification and truncation. Reviewof Economics and Statistics 77:104-112.

IRS. 2005. http://www.irs.gov/newsroom/article/0,,id=147423,00.html Accessed 05/15/09.

Keith, J.E., C.Fawson, and V. Johnson. 1996. Preservation or use: A contingent valuation study of wilderness designation in Utah. Ecological Economics 18:207-214.

Kerkvliet, J. and C. Nowell. 1999. Heterogeneous visitors and the spatial limits of the travel cost model. Journal of Leisure Research 31:404-419.

Morton, P. 1999. The economic benefits of Wilderness: Theory and practice. Denver University Law Review 76:465-518.

Ovaskainen, V., J. Mikkola, and E. Pouta. 2001. Estimating recreation demand with on-site data: An application of truncated and endogenously stratified count data models. Journal of Forest Economics 7:125-144.

Parsons, G. 2003. The travel cost model. P.269-330 in Champ, P.A. et al. (eds.) A premier on non-market valuation. Dordrecht, Netherland: Kluwer Academic Publisher.
Pope, C.A. III, Jones, J.W. 1990. Value of Wilderness designation in Utah**.** Journal of Environmental Management 30: 157-174.
Smith, V.K., and R.J. Kopp. 1980. The spatial limits of the travel cost recreational demand model. Land Economics 56:64-72.
Smith, V.K. 1975. Travel cost demand models for wilderness recreation: a problem of non-nested hypotheses. Land Economics 51:103-111.

Is Demand for Nature-Based Outdoor Activities Declining? Evidence from Hunting in the Southeast

Suman Majumdar[1], Yaoqi Zhang[2]

Acknowledgements

The authors thank Dr. Diane Hite, Dr. Henry W. Kinnucan and Dr. John D. Jackson, professors at the Auburn University, for their help with ideas of econometric modeling.

[1] Graduate Research Assistant, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL 36849. majumsu@auburn.edu. Phone: (334) 844-8043; Fax: (334) 844-1084.
[2] Associate Professor, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL 36849.

Is Demand for Nature-Based Outdoor Activities Declining? Evidence from Hunting in the Southeast

Abstract

In the context of the recent controversy over the trend in nature-based recreation demand, this study examines changes in the behavior of demand for recreational trips and economic value of nature-based recreation over the last decade using hunting in the southeast as an example. Economic value of recreational hunting in the southeast is estimated in terms of consumer surplus using truncated count data models. The hypothesis that per capita demand for recreational trips is identical in the two sample years, 1996 and 2006, is rejected. Regression results suggest each hunting trip generated $106 in 1996 and $160 in 2006 in consumer surplus per person measured in 1996 dollars. Results also suggest that aggregate economic value of recreational hunting in the southeast, in 1996 dollars, is also found higher in 2006, even though the total number of hunters declined from 1996 to 2006.

Keywords: Nature-based recreation; Social welfare; Travel cost method; Count data models; Likelihood-ratio Chow test

Introduction

A controversy over the demand for nature-based outdoor recreation activities in the U.S. has emerged in recent years. Several authors (Louv 2005; Pergams and Zaradic 2006, 2008; Kareiva 2008) have claimed a declining trend in nature-based recreation. Pergams and Zaradic (2006) argue that per capita demand for nature-based recreation has been declining since the mid 1980's. Using parks and recreation area visitation data and based on simple correlation and regression analysis they attribute this decline to the increasing popularity of computers, internet, home theaters, video games and other electronic media. Pergams and Zaradic (2008) find longitudinal declines in long-term time series representing different forms of nature-based recreation on various types of public lands in the U.S. and conclude an ongoing and fundamental shift away from outdoor recreation. A conclusion of a decline in nature-based recreation demand is critical as this can have important consequences such as reduced federal, state, and other funding for natural resource conservation and for recreation management (Cordell 2008). A declining trend in outdoor recreation also indicates that humans are less likely to value nature (Kareiva 2008).

Several authors have argued against the claim of a declining trend in the demand for nature-based recreation. Jacobs and Manfredo (2008) criticize Pergams and Zaradic (2008) for not considering all forms of outdoor recreation in their study and argue that decline in nature-based recreation is not evident. Using data from the National Survey on Recreation and the Environment (NSRE), Cordell (2008) finds a 4.4 percent growth in the number of people participating in one or more outdoor activities between 2000 and 2007. He also reports a 3.1% increase in number of participants and a more than 22 percent increase in per capita days of participation in fifty nature-based activities. Cordell claims a strong and growing demand for nature-based recreation in the U.S.

Although previous studies have analyzed the trend in the demand for nature-based recreation based on visitation rate, changes in the economic value of nature-based outdoor activities over time have not been examined. This paper examines changes in the behavior of demand for nature-based recreation and the economic value of recreation over the last decade using hunting in the U.S. southeast as an example. To do this we determine the economic value of recreational hunting in twelve southeast states in terms of consumer surplus and test whether the value between 1996 and 2006 changed. Demand for recreational hunting in the southeast states is estimated by applying the travel cost method (TCM) and using data from the 1996 and 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (NSFHWAR). Count data regression models are used for econometric analysis because of the integer nature of hunting trip data.

Methods

Data Source

The data on hunters for this study is obtained from the NSFHWAR's survey data for 1996 and 2006. NSFHWAR is one of the most important national wildlife recreation databases. The U.S. Fish and Wildlife Service (USFWS) sponsors these surveys in the form of interviews conducted primarily by phone. People unreachable by phone are interviewed in person. For each year NSFHWAR collects data in two phases. The first phase is a screening interview in order to collect socioeconomic information on households and identify wildlife-related recreation participants. The second phase collects data on participation and expenditures on hunting, fishing, and nonconsumptive wildlife recreation from selected participants based on the screening survey.

Survey questions and methodology used in 1996 and 2006 are similar (USDOI and USDOC 2007). Therefore, data collected in the two surveys are comparable. The following information are available from the survey reports: number of anglers and hunters; number of trips and days spent on different types of activities; expenditures, by type of fishing and hunting; number of persons and days of participation by animal sought; demographic characteristics of participants (including age, income, sex, race, and education). For each year 1996 and 2006, this study extracts and uses a sample of individual hunters who participated in recreational hunting in twelve southeastern states; Alabama, Arkansas, Georgia, Florida, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia and West Virginia.

Count Data Models

Empirical analysis of recreational demand suffers from three intrinsic data problems (Shaw 1988). First, the dependent variable, the number of trips taken by an individual during a given period of time, is a non-negative integer. Second, non-users are usually not sampled, and thus all information about them is truncated from the sample. Third, the probability of being surveyed increases with frequency of visits. This is called the problem of endogenous stratification. Due to these problems with trip data, the standard ordinary least squares (OLS) estimator is not the right choice in modeling recreation demand. These issues lead researchers to use the count data models. The Poisson and negative binomial models have been widely used in this context (see, for example, Creel and Loomis 1990; Chakraborty and Keith 2000; Zawacki et al. 2000; Shrestha et al. 2002; Martinez-Espineira and Amoako-Tuffour 2008).

One important characteristic of data on number of recreational trips is that it is usually truncated at zero. Biased and inconsistent estimates are obtained if the presence of this truncation is not accounted for (Shaw1988; Creel and Loomis 1990; Grogger and Carson 1991; Yen and Adamowicz 1993). Also, since a few recreational participants usually make a large number of trips compared to the others, the variance is often higher than the mean for trip data (Martinez-Espineira and Amoako-Tuffour 2008). This phenomenon is called overdispersion. In the presence of overdispersion the zero truncated Poisson (ZTP) distribution gives biased and inconsistent estimates (Grogger and Carson 1991). The zero truncated negative binomial (ZTNB) model is appropriate to use with overdispersed data. The zero-truncated negative binomial (ZTNB) probability model can be written as

$$(1) \qquad P[Y_i = y_i | Y_i > 0] = \frac{\Gamma(y_i + \alpha^{-1})}{\Gamma(y_i + 1)\,\Gamma(\alpha^{-1})}(\alpha\lambda_i)^{y_i}[1 + \alpha\lambda_i]^{-(y_i + \alpha^{-1})}[1 - F_{NB}(0)]^{-1}$$

where Y_i is the i^{th} observation on the count variable of interest, y_i= 0, 1,2,3, ... are the possible positive integer values of Y_i, $\lambda_i > 0$ is a parameter, $\Gamma(.)$ is the gamma function, $\alpha > 0$ is a nuisance parameter that determines the degree of overdispersion, and $F_{NB}(0)$ is the negative binomial distribution function evaluated at 0. This model can be used in a regression framework by allowing for different λ_i which vary according to

(2) $\lambda_i = e^{X_i \beta}$

where X_i is a 1 by h vector of explanatory variables and β is an h by 1 vector of parameters to be estimated.

Empirical Specifications

This study uses TCM for estimating the demand for recreational hunting in the southeast. TCM is a revealed preference approach, that is, the actual expenditures by recreational participants are used in this method in order to derive demand from which to estimate economic benefits in terms of Marshallian consumer surplus (Fix and Loomis 1998). The variables used in econometric analysis are defined in Table 1. A two equation econometric model is specified. In the first step we estimate expenditure and in the second step we estimate trip demand.

(3) $Expenditure = f(Income, Other\,Variables)$

(4) $Trips = g(Expenditure, Income, Other\,Variables)$

This framework enables us to understand the nature of expenditure in addition to the estimation of demand.

Several observations are discarded because of missing values on some of the major variables. Some observations are deleted as severe recording errors are suspected. For example, it is not feasible that an individual traveling from Nebraska to Alabama has zero travel expenditure. Some observations in the original datasets display unusually high values of trip costs. One of the assumptions required for travel costs to proxy for price in TCM is that

Table 1. Definition of the variables used in econometric analysis.

Variable name	Description
$Trips_i$	Total annual number of hunting trips made to the southeast
Age_i	Age in years
Sex_i	=1 if sex=male, =0 otherwise
$Marital_i$	=1 if married, =0 otherwise
$Outdoor_i$	=1 if participated in other nature-based outdoor activities (fishing/wildlife watching), =0 otherwise
$Distance_i$	Distance between centroids of residence and hunting states
$Income_i$	Annual household income ($)
$Expenditure_i$	Average travel expenditure ($) per hunting trip
$Year_i$	=1 if year=2006, =0 if year=1996

Note: The subscript *i* denotes the i^{th} individual.

the trips made by individual recreational participants are single purpose (Freeman 1993). The top 5% observations based on trip expenditure (*Expenditure*) values are omitted from each of the four datasets assuming that the excessive costs are a result of multipurpose trips (Zawacki et al. 2000). A statistical summary of the variables used in econometric analysis is presented in Table 2.

The dependent variable in this study is the number of recreational hunting trips made by an individual to the southeast during a particular year. The number of visits is modeled as a function of price, income and demographics. The datasets used for econometric analysis do not include information on individuals who did not make hunting trips to the southeast. Thus the dependent variable is truncated and the truncated count data models are appropriate for econometric analysis. In the presence of overdispersion ZTNB is the best model to use. We test for overdispersion using a χ^2 test with null hypothesis that $\alpha = 0$, that is, there is no overdispersion.

The *Expenditure* variable accounts for both variable monetary cost of accessing recreational hunting in the southeast and opportunity cost of time. There are disagreements in the literature of TCM about which monetary trip costs should be included in the travel cost variable (English and Bowker 1996; Zawacki et al. 2000). In this study average variable monetary cost per trip for an individual is calculated by summing up transportation costs and land access fees during a year and then dividing by the total number of trips taken during that year. Several cost categories, such as expenditures on durable goods and food, drinks, and refreshments, are not included in the definition of cost because they are not variable costs of trip (Fix and Loomis 1998).

The valuation of travel time is a much debated issue in the economic literature on recreational demand (Zawacki et al. 2000). This study uses (average trip time)*0.30*(wage rate) (Martinez-Espineira and Amoako-Tuffour 2008) to proxy for opportunity cost of travel time. The

Table 2. Statistical summary of variables used in econometric analysis.

Year	Variable	N	Mean	Sum	Maximum	Minimum	Std. Deviation
1996	*Trips*	1053	16.69	17,574.00	443.00	1.00	27.18
	Age	1053	39.74	41,850.00	80.00	16.00	14.41
	Sex	1053	0.94	994.00	1.00	0.00	0.23
	Marital	1053	0.70	739.00	1.00	0.00	0.46
	Outdoor	1053	0.85	891.00	1.00	0.00	0.36
	Distance	1053	22.89	24,102.05	695.68	0.00	77.10
	Income[a]	1053	33,421.18	35,192,500.00	100,000.00	5,000.00	23,319.85
	Expenditure[a]	1053	253.31	266,738.11	13,136.54	0.87	527.95
2006	*Trips*	1128	17.94	20,237.00	325.00	1.00	26.61
	Age	1128	43.80	49,406.00	87.00	16.00	14.93
	Sex	1128	0.91	1,032.00	1.00	0.00	0.28
	Marital	1128	0.75	842.00	1.00	0.00	0.44
	Outdoor	1128	0.88	987.00	1.00	0.00	0.33
	Distance	1128	37.27	42,035.54	627.08	0.00	96.62
	Income[a]	1128	45,747.73	51,603,444.94	77,827.38	3,891.37	22,881.87
	Expenditure[a]	1128	284.27	320656.43	5,544.06	6.74	404.23

[a] Values are given in 1996 U.S. dollars.

wage rate is approximated by the annual income divided by 2080 hours of work per annum (Bin et al. 2005). Trip time is calculated from the average number of days spent per trip during the year. Data limitations prevent this study from using a more theoretically sound approach towards modeling the opportunity cost of time. In particular, the NSFHWAR data does not provide information on how much time individual hunters spend on traveling and how much time they spend on-site. Opportunity cost of time is added to variable monetary cost to estimate *Expenditure*.

The original datasets include ten categorical variables on income groups. The average income of a group, calculated as the mean of the highest and lowest income of the group, is assigned to each individual in the group in this study. The value of the lower boundary is used as the level of income for the open ended group. *Distance* is calculated by the following formula (Meridian World Data 2009)

$$(5) \qquad Distance = \sqrt{[(69.1*(\mathrm{LAT}_2 - \mathrm{LAT}_1)]^2 + [69.1*(\mathrm{LON}_2 - \mathrm{LON}_1)*\cos(\mathrm{LAT}_1/57.3)]^2}$$

where LAT_1 and LON_1 are latitude and longitude of residence state centroid and LAT_2 and LON_2 are latitude and longitude of destination state centroid.

A logarithmic expenditure function of the following form is estimated.

$$(6) \qquad Log(Expenditure_i) = \beta_0 + \beta_1 Age_i + \beta_2 Marital_i + \beta_3 Distance_i + \beta_4 \ln(Income_i) + \nu$$

where the $\beta's$ denote unknown parameters to be estimated and ν denotes independent and identically distributed random error. The dependent variable, trip expenditure, is used in log forms because models with log of the dependent variable often fulfill the classical linear model assumptions to a closer extent than models with level dependent variables (Wooldridge 2003). *Income* is used in log form because income varies greatly among individuals in the data. Taking logs reduces the range of a variable making outlier observations less effective on parameter estimates.

A Chow test (Chow 1960) is used to test if the behavior of expenditure between 1996 and 2006 changed. We first pool the data from the two years together. The unrestricted full model is estimated using the pooled data with all explanatory variables and a dummy variable for year (*Year*) and its interactions with other explanatory variables. The restricted model is estimated using the pooled data without the dummy variable and interaction terms. The test statistic, which follows an *F* distribution, is calculated using the following formula.

$$(7) \qquad F \text{ statistic} = \frac{(RSS_{\mathrm{Re}stricted} - RSS_{Unrestricted})/(k+1)}{RSS_{Unrestricted}/(N_1 + N_2 - 2k - 2)} \sim F_{(k+1),(N_1+N_2-2k-2)}$$

where *RSS* is the sum of squared residuals, *k* is the number of explanatory variables, N_1 is the number of observations in the 1996 sample and N_2 is the number of observations in the 2006 sample. The null hypothesis for the test is that that the behavior of expenditure for hunting trips in response to the explanatory variables is identical for 1996 and 2006.

Consumer surplus is widely accepted as a measure of net social benefit (Pearse and Holmes 1993). It is the difference between consumer's willingness to pay for a good or service and the actual expenditure. In this study consumer surplus measures how much better off individuals in the aggregate are by being able to participate in recreational hunting in the southeast. It can be considered as the economic value of recreational hunting in the southeast. Per trip consumer surplus is most often calculated in count data analysis of recreation demand (Zawacki et al. 2000). It can be estimated as the negative reciprocal of the coefficient of expenditure in the ZTP or ZTNB model (Yen and Adamowicz 1993). The aggregate consumer surplus is obtained by summing individual consumer surplus values over the entire population.

A log likelihood-ratio test similar to the Chow test in linear regression is used to test whether regression coefficients are jointly different between 1996 and 2006. The only difference in this case is that here the test statistic is calculated as two times the difference between the unrestricted and restricted log-likelihoods and it follows a χ^2 distribution with degrees of freedom equal to the difference in number of parameters between the two models. The null hypothesis of the likelihood-ratio Chow test is that regression coefficients are same for 1996 and 2006. A failure to reject the null hypothesis would suggest that the behavior of demand for hunting trips is not different between the two years. More importantly, if the coefficient of the interaction between *EXP* and *YRD* is not statistically significant in the estimated unrestricted model, it would directly imply that the relationship between expenditure and trip demand is not significantly different between the two years. This in turn would imply that welfare from hunting is not significantly different between the two years. Only if the null hypothesis of the likelihood-ratio test is rejected, we would conclude that the economic value of recreational hunting is different between the two years.

Results

In expenditure estimation, the sums of squared residuals for the restricted and unrestricted models are found 896.24 and 875.19, respectively. The *F* statistic is calculated to be 10.44, which is much higher than the critical $F_{5,2171}$ value at 5% level of significance, 2.21. The null hypothesis of the Chow test is rejected and we conclude that the behavior of hunting expenditure in response to the explanatory variables is different between 1996 and 2006. Separate expenditure equations are thus estimated for the two sample years. Estimation results of the logarithmic expenditure functions for 1996 and 2000 are shown in Table 3. Age, distance to destination and income have positive influence on expenditure. On an average, married people spend less on recreational hunting in both the years.

Predicting Z when log(*Z*) is the dependent variable by exponentiating the predicted value for log(*Z*) systematically underestimates the expected value of *Z* (Wooldridge 2003). According to Wooldridge Z can be predicted in this case with a simple adjustment as:

Table 3. Estimation of ln(*Expenditure*)

	1996		2006	
Variable	Coefficient	Std. Error	Coefficient	Std. Error
Age	0.0031	0.0016*	0.0029	0.0013**
Marital	-0.1452	0.0535***	-0.0890	0.0439**
Distance	0.0010	0.0003***	0.0020	0.0002***
ln*(Income)*	0.9305	0.0273***	0.9426	0.0269***
Constant	-4.5079	0.2632***	-4.8734	0.2839***
N	1053		1128	
R^2	0.57		0.58	

Note: Single, double and triple asterisks (*) indicate statistical significance at 10%, 5% and 1% levels, respectively.

$$(8) \qquad \hat{Z} = \exp(\hat{\sigma}^2 / 2) * \exp(\hat{\log}(Z)),$$

where $\hat{\sigma}^2$ is the unbiased estimator of the variance of error term. Although this prediction is not unbiased, it is consistent. Predicted per capita expenditure values are estimated using this procedure and are used in the estimation of hunting trip demand.

In trip demand estimation using negative binomial count data models, the log-likelihoods for the restricted and unrestricted models are found -8044.72 and -8025.47, respectively. The Likelihood ratio statistic is calculated to be 38.5, which is much higher than the critical $\chi^2(7)$ value at 5% level of significance, 14.07. The null hypothesis of the likelihood-ratio Chow test is rejected and we conclude that the behavior of demand for hunting trips in response to the explanatory variables is different between 1996 and 2006. Separate trip demand functions are thus estimated for the two sample years.

Estimation results of the truncated count data models are shown in Table 4. In this table α is the nuisance parameter that determines the degree of overdispersion. The test for overdispersion is a χ^2 test with null hypothesis that $\alpha = 0$. The test is highly significant for both the sample years. We conclude that the data is overdispersed and thus ZTNB models are indeed appropriate.

The absolute values of the estimated coefficients in the ZTNB models are not directly interpretable. Marginal effects of the explanatory variables on the predicted number of trips per person are shown in Table 5. The coefficients of *Age* and *Marital* are not significant in the 1996 model. All other coefficients are significant and have expected signs. In 1996, if the other variables remained constant, on an average, an increase of $9 in price caused the expected number of trips by a hunter to decrease by 1. In 2006, if the other variables remained constant, on an average, an increase of $13 in price caused the expected number of trips by a hunter to decrease by 1. Thus, demand for hunting trips was more sensitive to price changes in 1996.

Estimation of consumer surplus is shown in Table 6. Consumer surplus per trip per person is calculated as the negative reciprocal of the estimated coefficient of *Expenditure*. Estimated per trip consumer surplus for access to recreational hunting in the southeast is $106 in

Table 4. Estimation of *Trips* using negative binomial count data model

	1996		2006	
Variable	Coefficient	Std. Error	Coefficient	Std. Error
Age	-0.00475	0.00391	0.00571	0.00311*
Sex	0.93042	0.19746***	0.46873	0.15586***
Marital	0.08412	0.11783	-0.25673	0.10462**
Outdoor	0.27671	0.12651**	0.43769	0.13414***
Income	0.00006	0.00001***	0.00003	0.00000***
Expenditure	-0.00944	0.00168***	-0.00626	0.00052***
Constant	1.78897	0.26474***	2.08742	0.25755***
α	2.3751	0.22961***	2.27721	0.20491***
N	1053		1128	
Log-Likelihood	-3861.96		-4163.46	

Notes: Single, double and triple asterisks (*) indicate statistical significance at 10%, 5% and 1% levels, respectively. α is the overdispersion parameter.

Table 5. Marginal effects of regressors on predicted *Trips* in the ZTNB model

	1996		2006	
Variable	dy/dx	SE	dy/dx	SE
Age	-0.05726	0.04728	0.07082	0.03867*
Sex	7.69741	1.15382***	4.83263	1.34591***
Marital	0.99808	1.37629	-3.40331	1.49074**
Outdoor	3.04298	1.27765**	4.64618	1.23537***
Income	0.00068	0.00014***	0.00033	0.00005***
Expenditure	-0.11393	0.02110***	-0.07775	0.00749***

Notes: Single, double and triple asterisks (*) indicate statistical significance at 10%, 5% and 1% levels, respectively.

1996 and $159 in 2006 (in 1996 U.S. dollars). Predicted number of annual trips per person can be calculated by aggregating the predicted values of *Trips* over all visitors in the sample and calculating the mean. Using this procedure the restricted ZTNB model predicts 12.8 trips per hunter in 1996 and 13.97 trips per hunter in 2006. The consumer surplus for an average person is estimated to be $1,355 in 1996 and $2,233 in 2006.

A total of 4314 thousand hunters in 1996 and 3876 thousand in 2006 participated in recreational hunting in the southeast (USDOI and USDOC 1997, 2007). Total annual number of hunting trips is estimated by multiplying the predicted number of trips by total number of hunters. Total annual consumer surplus value for recreational hunting opportunities in the southeast is estimated as a product of per trip per person consumer surplus and estimated total annual trips. This value increased from 5.9 billion dollars in 1996 to 8.7 billion dollars (in 1996 U.S. dollars) in 2006.

Discussion

This study estimates the economic value of recreational hunting in the southeast using truncated negative binomial count data regression models. Aged unmarried males are found likely to demand more hunting trips. A complementary relationship between hunting and other nature-based activities is found, which can be explained by the possibility that hunters combine trips for hunting and other activities in order to reduce per trip cost. It can also be argued that the individuals who participate in fishing and wildlife watching reveal general preference for nature-based outdoor activities, and thus are likely to experience more recreational hunting. Income has a positive influence on demand of hunting. Trip expenditure has significant negative effect on trip demand.

The primary objective of this study was to test if the demand for hunting trips and the economic value of recreational hunting in the southeast has changed between 1996 and 2006. Estimated annual per capita number of trips and consumer surplus per trip per person are found higher in 2006 than in 1996. Although the total number of hunters declined by 10% from 1996 to 2006, aggregate economic value of recreational hunting in the southeast increased by 48%.

Table 6. Estimated consumer surplus (CS) values (in 1996 U.S. dollars)

Year	Total hunters (thousand) (A)	Predicted annual trips per person (B)	Estimated total trips (thousand) (A)*(B)	CS/Trip/Person (dollars) (C)	Mean annual CS (dollars) (B)*(C)	Total annual CS for the southeast (thousand dollars) (A)*(B)*(C)
1996	4314	12.80	55,219	105.89	1,355.39	5,847,161.09
2006	3876	13.97	54,148	159.81	2,232.55	8,653,347.13

An increasing disconnection between human beings and the natural world has been claimed recently. It has been inferred that likeliness of valuing nature decreases as a result of this disjunction. This paper investigates the economic value of recreational hunting in the US southeast. It is shown that *per capita* consumer surplus value for hunting in the southeast has actually increased between 1996 and 2006. The aggregate social welfare value has also increased even though the total number of hunters has declined from 1996 to 2006. Demand for hunting trips is found to be less sensitive to price changes in 2006. Thus, using the example of hunting in the southeast, the results of this study do not support the claim that demand for nature-based recreation is declining and that natural resources are being undervalued by human beings. They rather support Cordell's (2008) claim of a growing demand for nature-based outdoor recreation in the United States.

References

Bilgic, A. and W.J. Florkowski. 2007. Application of a hurdle negative binomial count data model to demand for bass fishing in the southeastern United States. *Journal of Environmental Management* 83(4):478–490.

Bin, O., C.E. Landry, C. Ellis, and H. Vogelsong. 2005. "Some consumer surplus estimates for North Carolina beaches." *Marine Resource Economics* 20(2):145–61.

Chakraborty, K. and J.E. Keith. 2000. Estimating the recreation demand and economic value of mountain biking in Moab, Utah: An application of count data models. *Journal of Environmental Planning and Management* 43:461–469.

Chow, G. 1960. Test of equality between sets of coefficients in two linear regressions. *Econometrica* 28(3):591–605.

Cordell, H.K. 2008. The latest on trends in nature-based outdoor recreation. *Forest History Today* Spring:4–10.

Creel, M.D. and J.B. Loomis. 1990. Theoretical and empirical advantages of truncated count estimators for analysis of deer hunting in California. *American Journal of Agricultural Economics* 72:434–441.

English, D.B.K. and J.M. Bowker. 1996. Sensitivity of whitewater rafting consumers surplus to pecuniary travel cost specifications. *Journal of Environmental Management* 47:79–91.

Fix, P. and J. Loomis. 1998. Comparing the economic value of mountain biking estimated using revealed and stated preference. *Journal of Environmental Planning and Management* 41(2):227–236.

Freeman, A.M., III. 1993. *The measurement of environmental and resource values: Theory and methods*. Washington, DC: Resources for the Future.

Grogger, J.T. and R.T. Carson. 1991. Models for truncated counts. *Journal of Applied Econometrics* 6(3):225–238.

Jacobs, M.H. and M.J. Manfredo. 2008. Decline in nature-based recreation is not evident. *Proceedings of the National Academy of Sciences* 105(27):E40.

Kareiva, P. 2008. Ominous trends in nature recreation. Proceedings of the National Academy of Sciences 105(8):2757–2758.

Louv, R. 2005. *Last child in the woods: Saving our children from nature-deficit disorder*. Chapel Hill, NC: Algonquin Books.

Martinez-Espineira, R. and J. Amoako-Tuffour. 2008. Recreation demand analysis under truncation, overdispersion, and endogenous stratification: An application to Gros Morne National Park. *Journal of Environmental Management* 88(4):1320-1332.

Meridian World Data. 2009. http://www.meridianworlddata.com/Distance-Calculation.asp. Accessed 5/20/2009.

Pearse, P.H., and T.P. Holmes. 1993. Accounting for nonmarket benefits in southern forest management. *Southern Journal of Applied Forestry* 17:84–89.

Pergams, O.R.W. and P.A. Zaradic. 2006. Is love of nature in the U.S. becoming love of electronic media? 16-year downtrend in national park visits explained by watching movies, playing video games, internet use, and oil prices. *Journal of Environmental Management* 80:387–393.

Pergams, O.R.W. and P.A. Zaradic. 2008. Evidence for a fundamental and pervasive shift away from nature-based recreation. *Proceedings of the National Academy of Sciences* 105(7):2295–2300.

Shaw, D. 1988. On-site samples' regression problems of non-negative integers, truncation, and endogenous stratification. *Journal of Econometrics* 37:211–223.

Shrestha, R.K., A.F. Seidl, and A.S. Moraes. 2002. Value of recreational fishing in the Brazilian Pantanal: A travel cost analysis using count data models. *Ecological Economics* 42:289–299.

U. S. Department of the Interior, Fish and Wildlife Service, and U. S. Department of Commerce, Bureau of the Census (USDOI and USDOC). 1997. *1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation*. Washington DC: U.S. Government Printing Office.

U. S. Department of the Interior, Fish and Wildlife Service, and U. S. Department of Commerce, Bureau of the Census (USDOI and USDOC). 2007. *2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation*. Washington DC: U.S. Government Printing Office.

Yen, S.T. and W.L. Adamowicz. 1993. Statistical properties of welfare measures from count-data models of recreation demand. *Review of Agricultural Economics* 15:203–215.

Zawacki, W.T., A. Marsinko, and J.M. Bowker. 2000. A travel cost analysis of nonconsumptive wildlife-associated recreation in the United States. *Forest Science* 46(4):496–506.

Landowner Willingness to Accept Fee-Based Recreation and the Influence of Institutional Change in the Louisiana Delta[1]

James E. Henderson
Assistant Extension Professor in the Department of Forestry at Mississippi State University[2],

Michael A. Dunn
Associate Professor in the Department of Agricultural Economics at Louisiana State University,

Kurt M. Guidry
Professor in the Department of Agricultural Economics at Louisiana State University

[1] Approved as Publication No. FO390 of the Forest and Wildlife Research Center, Mississippi State University.
[2] James E. Henderson, Assistant Extension Professor, Department of Forestry, Box 9681, Mississippi State, MS, 39762. Phone: (662) 325-0754. Email: jhenderson@CFR.MsState.Edu

Landowner Willingness to Accept Fee-Based Recreation and the Influence of Institutional Change in the Louisiana Delta

Abstract

Fee-based recreational access to private land for public use may be a possible revenue generating alterative for landowners in the Lower Mississippi Valley or Delta region of Louisiana. Previous studies have identified that landowners often chose not to engage in recreational leasing due to liability concerns. Thus, an institutional change that reduces liability risk to landowners may increase the amount of private land available for public recreation and reduce transaction costs associated with liability mitigation. Using primary data obtained from a mail questionnaire, the influence on landowner willingness to accept (WTA) a fee to allow fee-based recreation both pre- and post-institutional change was examined using Tobit models.

Survey results indicate that 14% of landowners indicated a willingness to allow fee-based recreation under the current institutional environment. Modifying the Louisiana recreational use statute giving greater liability protection to landowners increases the number of landowners willing to allow fee-based recreation to nearly 24%. Transaction costs associated with liability are evident and amending the recreational use statute appears to produce a reduction in WTA reflecting a transaction cost savings to landowners.

Key Words: Recreational Use Statute, Tobit, Risk Preference, Transaction Costs

Introduction

An alternative income source for Louisiana Delta[13] landowners is fee-based public recreational use of private land. Activities such as recreational hunting, fishing, and wildlife watching can provide additional income to landowners and may be an acceptable land use alternative, particularly for marginal agricultural lands. However, generating additional income by allowing recreational access introduces the possibility of legal action if bodily injury results to a recreational user of the property (Copeland, 1998). All 50 states have adopted recreational use statutes (RUS) designed to encourage landowners to allow recreational use of their land by offering landowners immunity from lawsuits related to accidental injury (Copeland, 1998). Most state RUS insulate landowners from liability provided that recreational access is granted without charge.

Wright et al. (2002) observed that researchers have clearly identified that landowners are concerned about liability but have only documented it is perceived as a problem and a better understanding is needed of how liability and various other disincentives collectively influence landowners' access decisions. Mozumder et al. (2004) suggested that the necessary institutions for hunters and landowners may not be in place to promote recreational leasing, and institutional changes that facilitate more exchanges would shift the supply curve for recreational land outward. The effects of institutional change on landowner leasing behavior can be explored by asking if landowners would allow recreational access if liability was limited by state law. During the time of the study, Louisiana's recreational use statute (La. R.S. § 9:2791) did not extend liability protection to landowners charging a fee for recreational access. It would be interesting to see how landowner access policies may change by expanding the liability protection of recreational use statutes to allow charging fees to generate a return to the landowner.

The potential for a law-suit, whether real or perceived, creates a disincentive for fee-based recreation to the landowner. To mitigate the liability disincentive the landowner may incur costs associated with seeking legal information, consulting lawyers, having contracts drafted to protect property rights and reduce liability, and/or securing commercial liability insurance. All of these actions create a transaction cost for fee-based recreation. This transaction cost could be reduced through institutional change. For example, if the Louisiana RUS was amended to allow charging an access fee and also allow retention of the liability protection accorded to free access granting landowners, then the transaction cost could be reduced. There are an increasing number of states that have amended their RUS to allow landowners to charge a fee and retain liability protection (Wright, 1989; Wright et al., 2002). Amending the Louisiana RUS would be an example of institutional change that could facilitate transactions between private landowners and recreationists and reduce transaction costs borne by landowners.

The primary objectives of this study are to investigate how landowner willingness to accept (WTA) fee-based recreational access may be influenced by risk and liability perceptions and by institutional change. An additional objective is to determine if transaction costs are reduced following an institutional change. Survey data is analyzed to examine relationships between explanatory variables and the willingness to allow fee-based recreation in both the

[13] Louisiana Delta parishes: Catahoula, Concordia, East Carroll, Franklin, Madison, Morehouse, Richland, Tensas, and West Carroll.

current legal environment and in a hypothetical scenario that reduces landowner liability risk. The study will identify land and landowner characteristics that may have a positive or negative effect on a landowner's WTA compensation to allow fee-based recreational access both pre- and post-institutional change.

Methodology

This study utilizes primary data obtained from a mail questionnaire developed according to the tailored design method (Dillman, 2000) and sent to agricultural landowners in the Delta region of Louisiana. Questions focused on current land uses, landowner access policies, and landowner attitudes and perceptions regarding the potential for allowing fee-based recreational access. Additional questions addressed land tenure and landowner demographics. Landowners were also asked to indicate their knowledge of the Louisiana RUS and how a possible change in the use statute would impact their access decision and compensation for allowing access.

Contingent valuation questions were used to estimate landowner WTA to allow recreational access. Ultimately, the choice of elicitation technique in a contingent valuation study depends on the nature of the good being valued, survey cost, statistical technique used, and the nature of the survey respondents (Venkatachalam, 2004). Kealy and Turner (1993) found that there was no statistical difference between results derived from open-ended and dichotomous choice questions for a private good but there was a significant difference in the case of a public good. Mitchell and Carson (1989) found that open-ended questions work well in situations where respondents are familiar with paying for the good. Open-ended contingent valuation questions can be appropriate if the respondent is familiar with the good being valued and has a reasonable understanding of its value. An open-ended style question asked landowners to indicate the dollar value per acre they require to allow public recreational use of their land. The open-ended WTA question was presented twice in the survey instrument to assess WTA for allowing recreational access under the current legal environment and under a hypothetical legal environment with reduced landowner liability risk.

One factor that may influence the behavior of landowners regarding fee-based recreation is that of risk preference, given that there is an inherent element of risk associated with recreation and liability. A common method used to elicit risk preference is that of direct risk preference elicitation. A study by Fausti and Gillespie (2006) compared mail survey results for five commonly used methods to elicit risk preference and examined the consistency of the elicitation procedures. Fausti and Gillespie (2006) noted that a simpler elicitation method (such as the self-rank risk preference question) performs relatively well and may be a better choice for elicitation of risk when mail survey respondents are not offered rewards or incentives for spending time to correctly answer questions. The questionnaire used in this study attempted to assess landowner risk preference by using a self-rank risk preference elicitation method that asked respondents to indicate if they tend to avoid, take on, or neither seek nor avoid risk in their investment decisions. Information on landowner risk preference may be a useful variable in understanding recreational access decisions.

Responses to the open-ended WTA question produced a continuous variable; however, the responses were also censored since some respondents did not indicate a willingness to allow fee-based recreational access. Thus, the survey data had a number of zero values for the WTA question since landowners not willing to allow fee-based recreation were recorded as a zero value indicating an unwillingness to allow recreational access and accept compensation.

Including censored observations as zero values in a standard OLS regression model results in biased parameter estimates and simply deleting the censored observations can result in a loss of efficiency in estimation (Franses and Paap, 2001). Thus, to avoid such problems this study employed a censored regression model.

The relationship between a censored dependent variable and explanatory variables can be investigated using a Tobit model. In the Tobit model the censored variable Y_i is 0 if the unobserved latent variable y_i^* is positive. The censored regression model or Tobit model and its general formulation is represented by the following general form (Franses and Paap, 2001):

$$Y_i = X_i\beta + \varepsilon_i \; if \; y_i^* = X_i\beta + \varepsilon_i > 0$$

$$Y_i = 0 \qquad if \; y_i^* = X_i\beta + \varepsilon_i \leq 0,$$

$$with \; \varepsilon_i \sim N(0, \sigma^2)$$

where y_i^* represents the WTA value of the i^{th} landowner to allow recreational access. Values of zero for landowners not willing to allow recreational access are not observed. Thus the y_i is observed WTA value for landowners willing to allow recreational access which is censored at zero. Survey response to the open-ended WTA question will be modeled as a function of independent variables (X_i) representing landowner attributes and land uses. Using Tobit censored regression allows for information on landowners not willing to accept compensation for recreational access to be included in the model that would otherwise not be included.

The log-likelihood for the Tobit model is given by

$$\ln L = \sum_{y_i > 0} -\frac{1}{2}[\log(2\pi) + \log\sigma^2 + \frac{(y_i - x_i\beta)^2}{\sigma^2}] + \sum_{y_i = 0} \ln[1 - \Phi(\frac{x_i'\beta}{\sigma})]$$

The two terms on the right hand side of the equation correspond to the classical regression for nonlimit observations and the relevant probabilities for the limit observations, respectively (Greene, 2003). Possible independent variables hypothesized to influence a landowner's choice include current and personal land use, liability concern, distance of land from home, risk preference, past leasing, and demographic variables.

A second Tobit model was used to examine the access decision following a hypothetical institutional change. This was examined using responses to a second WTA question that included a hypothetical scenario where the Louisiana RUS would allow landowners to charge a fee for recreational access while also retaining liability protection.

Results

Survey Results

The survey response rate was 26.9%. More than half of respondents have allowed individuals outside of their immediate households to use their land for recreational purposes; however, such access was not commonly allowed for individuals that respondents do not know personally. Just over 10% of respondents have allowed recreational access to individuals they do not know personally, and only 11.2% have accepted money to allow recreational use of their land.

More than 80% of respondents indicated they are very concerned about liability issues associated with allowing people on their land. This concern may explain in part why so few respondents have allowed recreational access to individuals they do not know personally. However, when asked if their liability concerns were eased would they be more inclined to allow recreational access, 36% of respondents indicated they either somewhat or strongly agreed. This indicates that, for these respondents, an institutional change may increase recreational access to private lands. However, over 40% of respondents either somewhat or strongly disagreed with allowing recreational access if their liability concerns were eased. This suggests that, for these respondents, liability concern may not be a major factor in their decision for not allowing recreational access.

The results indicated that there exists a clear need for more landowner education on land access and liability. When it came to having knowledge of liability and legal issues, the vast majority of respondents either do not know or are unsure about matters regarding written agreements between landowners and land entrants, posting of "no trespassing" signs, state recreational use statute, and the availability of liability insurance for fee-based recreation.

Another possible factor that may influence the decision to allow fee-based recreation is that of risk preference. Allowing recreational use of land introduces the risk associated with liability, and over 70% of respondents indicate they are risk averse and they tend to avoid risk in their financial decisions. The implications are that many landowners may choose not to allow fee-based recreation because of the liability risk, but it may also indicate that an institutional change reducing landowner liability may increase landowner willingness to allow fee-based recreation.

Fee-based recreation may be more attractive to respondents owning marginal agricultural land. Respondents considered 33.3% of their lands to be marginal for agricultural purposes. There seems to be potential for developing such opportunities as results indicate a high volume of marginal land. About 80% of respondents described their marginal land as forest or wooded areas, which would be ideal for certain types of wildlife associated fee-based recreation.

When asked if they would be willing to allow fee-based recreation on their land, 14.1% of respondents said yes. When presented with a hypothetical scenario describing a change to the recreational use statute that would allow charging a fee for recreational access while also retaining liability protection, 24% of respondents indicated a willingness to allow access, a 70% increase. Clearly, an institutional change that reduces the liability risk to landowners could increase the potential amount of private land that could be used for fee-based recreation. The average amount of land that respondents would be willing to use for fee-based recreation was 256.6 acres. The potential exists to make a sizable amount of land available for public fee-based recreational use by modifying the Louisiana RUS.

The level of participation in government conservation programs was high, as indicated by 60% of respondents. This suggests that Louisiana Delta landowners may be willing to adopt non-agricultural uses of their land, such as fee-based recreation. While most are single owners, 37% of respondents indicated they owned land jointly. Such joint owners of land responding to the survey may not be comfortable with allowing fee-based recreation since they may lack autonomy in the decision process. In addition, there may be costs involved such as the costs of negotiating with co-owners. Over 55% of respondents purchased their land. Alternative land uses may not be as attractive to individuals that purchased land with the assumption that land was purchased for some specific purpose or use. However, 46% of respondents indicated that they acquired land through inheritance and may be more inclined to consider alternative uses. Also, agricultural production of row crops was indicated by 57.4% of respondents. This may suggest that those landowners might be willing to consider alternative land uses, since over 40% are not using their land for agriculture.

It was hypothesized that an institutional change that reduced the liability to landowners willing to allow fee-based recreation would reduce the transaction cost associated with liability borne by the landowner. The mean WTA values were compared by response category to examine if a hypothetical institutional change could reduce the transaction cost associated with fee-based recreation (Table 1).

Table 1. Willingness to accept (WTA) mean values by response category indicating change in WTA for respondents allowing access under both current and amended RUS and only under an amended RUS.

Variables	Observations	Mean	Std. Dev.
Current RUS WTA	64	$107.98	$187.89
Amended RUS WTA	122	$91.58	$154.35
Amended only RUS WTA	58	$61.74	$69.58
Change for Amended		-$16.40	-$33.54
Change for Amended only		-$46.24	-$118.31

That the change in mean WTA is negative may be attributable to reduced transaction costs associated with liability mitigation that is achieved by institutional change. The change was negative; however, a more telling indicator of possible reduced transaction costs is obtained by examining the change in WTA for respondents willing to allowing fee-based recreation under both the current and modified recreational use statutes (Table 2). The change in mean WTA again is negative indicating a possible reduction in transactions costs.

Table 2. Willingness to accept (WTA) mean values by response category for respondents answering both WTA questions associated with the current and amended recreational use statute indicating change in WTA.

Variables	observations	mean	Std. Dev.	t-value	p-value
Current RUS WTA	63	$109.30	$189.10	0.426	0.6709
Amended RUS WTA	63	$104.63	$166.51	0.2227	0.8241
Change in WTA		-$4.67	-$22.59		

Description of Variables

The dependent and independent variables used in the Tobit model analyses are described and their mean and standard deviation values presented in Table 3.

Tobit Model for Willingness to Accept Compensation to Allow Access

Tobit models were used to analyze the potential relationship between respondents' WTA compensation to allow fee-based recreational access and various explanatory variables under both the current and modified recreational use statute. Parameter estimates for the WTA associated with the decision to allow fee-based recreational access under the current RUS are presented in Table 4. The parameter estimates for WRITTENAGREE2 and WRITTENAGREE3 are both positive in sign and significant at the 0.01 and 0.05 levels of significance, respectively.

Table 3. Description of variables.

Variable	Description	Mean	Std. Dev.
Dependent Variable			
WTACURRENT	Willingness to accept allow under current RUS	13.918	104.066
WTAAMENDED	Willingness to accept allow under amended RUS	19.229	94.555
Independent Variable			
PERSONALUSE	Land is used for personal recreational use (1=yes)	0.588	0.493
FRIENDSFAMILY	Land is used for recreation by family or friends (1=yes)	0.563	0.496
LEASEDREC	Land has been leased for recreational use (1=yes)	0.112	0.316
LIABILITYCONCERN2	Liability concern over recreational use, disagree (1=yes)	0.106	0.308
LIABILITYCONCERN1	Liability concern over recreational use, not sure (1=yes)	0.090	0.287
LIABILITYCONCERN3	Liability concern over recreational use, agree (1=yes)	0.799	0.401
WRITTENAGREE2	Written agreement protects from liability, disagree (1=yes)	0.250	0.433
WRITTENAGREE1	Written agreement protects from liability, not sure (1=yes)	0.400	0.490
WRITTENAGREE3	Written agreement protects from liability, agree (1=yes)	0.343	0.475
CONCERNEASED2	Liability concern eased, allow recreation, disagree (1=yes)	0.405	0.491
CONCERNEASED1	Liability concern eased, allow recreation, not sure (1=yes)	0.220	0.415
CONCERNEASED3	Liability concern eased, allow recreation, agree (1=yes)	0.369	0.483
NOTRESSPASS	Protection from liability requires me to post, unsure (1=yes)	0.464	0.499
RUSPROTECTS	Protected from recreational liability if free, unsure (1=yes)	0.661	0.474
INSURACEKNOW	Insurance exists for allowing recreation, unsure (1=yes)	0.618	0.486
RISKPREFERENCE1	substantial levels of risk in my financial decisions (1=yes)	0.073	0.260
RISKPREFERENCE2	I tend to avoid risk in my financial decisions (1=yes)	0.754	0.431
RISKPREFERENCE3	I neither seek nor avoid risk in financial decisions (1=yes)	0.158	0.365
MARGINALLAND	Any land "marginal" for agricultural purposes? (1=yes)	0.446	0.497
MARGINALACRES	Number of acres marginal for agricultural purposes	46.283	127.649
LANDOWNERCOOOPER	Ever worked with your adjacent or local landowners (1=yes)	0.258	0.438
COOPERATIVE	Ever been involved with a cooperative (1=yes)	0.141	0.349
CONSERVATION	Enrolled land in a government conservation program (1=yes)	0.447	0.498
TRACTS	Number of separate tracts of non-residential land	2.066	2.077
ADJACENT	Non-residential land adjacent to primary residence (1=yes)	0.432	0.496
DISTANCE	Number of miles to nearest tract of land	70.319	238.110
TOTALACRE	Total acreage of all tracts of land	324.809	634.085
YEARSOWNERSHIP	Number of years you have been a land owner	28.010	22.637
OWNERSHIP1	Ownership of land organized as corporation (y=1)	0.011	0.105
OWNERSHIP2	Ownership of land organized as LLC (y=1)	0.034	0.181
OWNERSHIP3	Ownership of land organized as joint ownership (y=1)	0.369	0.483
OWNERSHIP4	Ownership of land organized as single ownership (y=1)	0.642	0.480
ACQUIRE 1	Acquire non-residential land by inheritance (y=1)	0.467	0.499
ACQUIRE 2	Acquire non-residential land by marriage (y=1)	0.027	0.163
ACQUIRE 3	Acquire non-residential land by purchasing (y=1)	0.552	0.498
ACQUIRE 4	Acquire majority of non-residential land by other (y=1)	0.008	0.089
ROWCROPS	land for agricultural production of row crops (y=1)	0.574	0.495
COTTON	land for cotton production (y=1)	0.457	0.499
LEASEDFORAG	leased any of your land for agricultural uses	0.674	0.469

HAYLAND	Own land for hay production (y=1)	0.222	0.416
LIVESTOCKLAND	Own land for raising livestock (y=1)	0.204	0.403
GENDER	Gender (female=1)	0.349	0.477
AGE	Age in years	61.872	13.666
ETHNIC	Ethnic background: Caucasian (1=yes)	0.945	0.229
OCUPATION1	Primary occupation: farming (1=yes)	0.140	0.347
OCUPATION2	Primary occupation: business (1=yes)	0.102	0.303
OCUPATION3	Primary occupation: self-employed (1=yes)	0.109	0.312
EDUCATION1	Education: high school graduate or less (1=yes)	0.343	0.475
EDUCATION2	Education: some college to college graduate (1=yes)	0.435	0.496
EDUCATION3	Education: graduate or professional degree (1=yes)	0.171	0.377
INCOME1	Less than $25K (1=yes)	0.117	0.322
INCOME2	Income $25K to $75K (1=yes)	0.370	0.483
INCOME3	Income $75K or more (1=yes)	0.313	0.464

Table 4. Tobit estimates for the decision to allow fee-based recreational access under the current Recreational Use Statute for Louisiana landowners.

WTACURRENT	Coef.	Std. Err.	t	P>|t|	dF/dx	Std. Err	z	P>|z|
PERSONALUSE	-25.585	51.826	-0.49	0.62	-3.204	6.447	-0.50	0.62
FRIENDSFAMILY	39.472	49.530	0.80	0.43	4.873	6.161	0.79	0.43
LEASEDREC	-71.815	69.522	-1.03	0.30	-8.396	8.648	-0.97	0.33
LIABILITYCONCERN2	-22.447	128.309	-0.17	0.86	-2.734	15.961	-0.17	0.86
LIABILITYCONCERN3	60.117	111.656	0.54	0.59	7.161	13.890	0.52	0.61
WRITTENAGREE2	**148.880†**	58.438	2.55	0.01	**20.413†**	7.270	2.81	0.01
WRITTENAGREE3	**103.216‡**	51.008	2.02	0.04	**13.404‡**	6.345	2.11	0.04
CONCERNEASED2	**-167.206‡**	72.418	-2.31	0.02	**-20.117‡**	9.009	-2.23	0.03
CONCERNEASED3	49.832	54.148	0.92	0.36	6.279	6.736	0.93	0.35
NOTRESSPASS	35.387	44.423	0.80	0.43	4.419	5.526	0.80	0.42
RUSPROTECTS	-4.850	47.362	-0.10	0.92	-0.604	5.892	-0.10	0.92
INSURACEKNOW	-33.895	48.115	-0.70	0.48	-4.251	5.985	-0.71	0.48
RISKPREFERENCE1	107.077	73.948	1.45	0.15	**14.936***	9.199	1.62	0.10
RISKPREFERENCE2	**-136.842‡**	56.809	-2.41	0.02	**-18.651†**	7.067	-2.64	0.01
MARGINALLAND	**96.698‡**	47.309	2.04	0.04	**12.183‡**	5.885	2.07	0.04
MARGINALACRES	-0.002	0.143	-0.01	0.99	0.000	0.018	-0.01	0.99
LANDOWNERCOOPER	**73.716***	45.539	1.62	0.11	**9.584***	5.665	1.69	0.09
COOPERATIVE	-36.033	58.758	-0.61	0.54	-4.347	7.309	-0.59	0.55
CONSERVATION	**80.082***	47.350	1.69	0.09	**10.049***	5.890	1.71	0.09
TRACTS	-10.551	11.412	-0.92	0.36	-1.313	1.420	-0.92	0.36
ADJACENT	**-79.818***	45.516	-1.75	0.08	**-9.822***	5.662	-1.73	0.08
DISTANCE	-0.155	0.120	-1.29	0.20	-0.019	0.015	-1.29	0.20
TOTALACREAGE	**0.059***	0.034	1.72	0.09	**0.007***	0.004	1.72	0.09
YEARSOWNERSHIP	-0.156	1.177	-0.13	0.89	-0.019	0.146	-0.13	0.89
OWNERSHIP1	-12.747	183.157	-0.07	0.95	-1.562	22.784	-0.07	0.95
OWNERSHIP2	28.171	80.412	0.35	0.73	3.618	10.003	0.36	0.72
OWNERSHIP3	-45.460	44.418	-1.02	0.31	-5.562	5.525	-1.01	0.31
ACQUIRE1	105.965	73.837	1.44	0.15	13.364	9.185	1.45	0.15
ACQUIRE2	68.442	118.502	0.58	0.56	9.225	14.741	0.63	0.53
ACQUIRE3	96.623	75.687	1.28	0.20	11.884	9.415	1.26	0.21
ROWCROPS	**-174.466‡**	88.129	-1.98	0.05	**-22.695‡**	10.963	-2.07	0.04
COTTON	**185.150‡**	82.737	2.24	0.03	**23.540‡**	10.292	2.29	0.02
LEASEDFORAG	3.668	49.322	0.07	0.94	0.456	6.136	0.07	0.94
HAYLAND	-5.387	59.055	-0.09	0.93	-0.668	7.346	-0.09	0.93
LIVESTOCKLAND	**-113.490***	65.055	-1.74	0.08	-13.134	8.093	-1.62	0.11
GENDER	-65.224	50.424	-1.29	0.20	-7.918	6.273	-1.26	0.21
AGE	1.609	1.923	0.84	0.40	0.200	0.239	0.84	0.40
ETHNIC	-19.435	86.729	-0.22	0.82	-2.469	10.789	-0.23	0.82

OCUPATION1	**111.769***	68.859	1.62	0.11	**15.405***	8.566	1.80	0.07
OCUPATION2	92.661	67.418	1.37	0.17	12.610	8.387	1.50	0.13
OCUPATION3	**108.615***	61.827	1.76	0.08	**15.054‡**	7.691	1.96	0.05
EDUCATION1	78.418	49.501	1.58	0.11	**10.076***	6.158	1.64	0.10
EDUCATION3	**144.384†**	57.434	2.51	0.01	**20.271†**	7.145	2.84	0.01
INCOME1	-76.477	80.481	-0.95	0.34	-8.882	10.012	-0.89	0.38
INCOME3	**-92.757***	48.810	-1.90	0.06	**-11.144***	6.072	-1.84	0.07
CONSTANT	**-579.998†**	227.362	-2.55	0.01	**-72.151†**	28.283	-2.55	0.01
SIGMA	221.144	22.448						

†, ‡, *, indicates significance at the 1, 5, and 10 percent level, respectively. N = 531; Chi-square = 120.73; Log-L= -476.95; Prob>chi2 = 0.0000; Pseudo R-squared: 0.1123

Respondents that do not believe a written agreement can protect them from liability have an expected WTA that is $20.41 greater than respondents that are not sure if a written agreement can protect them from liability. In contrast, respondents that do believe a written agreement can protect them from liability have an expected WTA that is $13.40 greater than respondents that are not sure if a written agreement can protect them from liability.

The coefficient for CONCERNEASED2 is negative in sign and significant at the 0.05 level, indicating that respondents who agree to allow fee-based recreation also indicated that they disagree with allowing recreational use of their land if their liability concerns were eased have an expected WTA that is lower by $20.12. Also, respondents that consider themselves to be risk averse have a predicted WTA that is $18.65 lower than respondents that consider themselves to be risk neutral. Owning marginal land increases expected WTA by $12.18 and is significant at the 0.05 level. The coefficient for LANDONWERCOOPER is significant at the 0.10 level and is positive in sign, indicating that respondents that have worked with adjacent or local landowners have a predicted WTA that is $9.58 greater than respondents that have not worked with adjacent or local landowners. Having land in a government conservation program has a positive effect on expected WTA and is significant at the 0.10 level indicating an increase in expected WTA of $10.05. The coefficient for ADJACENT is significant at the 0.10 level and negative in sign indicating that respondents that have their nearest tract of non-residential land adjacent to their home have an expected WTA that is $9.82 lower than respondents not having land adjacent to their homes. Each one acre increase in total acreage results in an increase in predicted WTA by $0.01, which is significant at the 0.10 level. Respondents that indicated they use their land for agricultural production of row crops reduces predicted WTA by $22.70 while having land used for cotton production increases WTA by $23.54, which are both significant at the 0.05 level of significance. The coefficient for LIVESTOCKLAND is significant at the 0.10 level and negative in sign indicating that owning land for livestock production reduces expected WTA by $13.13. Four of the demographic variables are significant. Respondents that consider their primary occupation to be either business or self-employed have an expected WTA that is $15.41 and $15.05 greater than other landowners and both are significant at the 0.10 level of significance. The coefficients for EDUCATION3 and INCOME3 are both significant at the 0.10 and 0.10 levels, respectively. This indicates that respondents that are more highly educated have a predicted WTA that is greater by $20.27 than the WTA of respondents that attended college (EDUCATION2) while respondents that have a higher annual household income have a WTA that is lower by $11.14 as compared with respondents having a annual household income in the $25 to $75 thousand range (INCOME2).

Tobit parameter estimates for WTA associated with the decision to allow fee-based recreational access under an amended RUS are presented in Table 5. The coefficient for ACCESSCUR is significant at the 0.01 level indicating that respondents allowing fee-based recreation under the current Louisiana RUS have an expected WTA that is $19.21 greater than respondents that did not allow fee-based recreation under the current RUS. The coefficient for WTACURRENT is significant at the 0.01 level of significance and positive in sign indicating that for each $1 indicated under the current RUS results in an increase of $0.17 for WTA under the modified use statute. Parameter estimates for CONCERNEASED2 is significant at the 0.05 level and negative in sign indicating that respondents that disagree with allowing recreational use of their land if their liability concerns were eased have a WTA that is $11.55 lower than respondents that are unsure about allowing recreational use of their land if their liability concerns were eased. The coefficients for RISKPREFERENCE2, DISTANCE, and OWNERSHIP3 are all negative in sign and significant at the 0.10 level of significance. Respondents considering themselves to be risk averse have an expected WTA that is $8.91 lower than risk neutral respondents. The greater the distance a respondents' nearest tract of non-residential land is from their primary residence the lower their WTA, since each one mile increase in distance results in a

Table 5. Tobit estimates for the decision to allow fee-based recreational access under the amended Recreational Use Statute for Louisiana landowners.

WTAAMENDED	Coef.	Std. Err.	t	P>|t|	dF/dx	Std. Err	z	P>|z|
ACCESSCUR	**86.793†**	24.927	3.48	0.00	**19.2071†**	4.7892	4.01	0.00
WTACURRENT	**0.861†**	0.099	8.66	0.00	**0.1654†**	0.0191	8.66	0.00
PERSONALUSE	-33.596	23.429	-1.43	0.15	-6.5607	4.5014	-1.46	0.15
FRIENDSFAMILY	22.851	22.909	1.00	0.32	4.3548	4.4015	0.99	0.32
LEASEDREC	8.672	29.536	0.29	0.77	1.6902	5.6747	0.30	0.77
LIABILITYCONCERN2	71.113	51.198	1.39	0.17	15.5626	9.8366	1.58	0.11
LIABILITYCONCERN3	69.092	43.491	1.59	0.11	12.1423	8.3559	1.45	0.15
WRITTENAGREE2	-5.329	25.154	-0.21	0.83	-1.0180	4.8328	-0.21	0.83
WRITTENAGREE3	-0.115	21.651	-0.01	1.00	-0.0221	4.1598	-0.01	1.00
CONCERNEASED2	**-61.630‡**	27.755	-2.22	0.03	**-11.5512‡**	5.3326	-2.17	0.03
CONCERNEASED3	29.113	24.595	1.18	0.24	5.6708	4.7254	1.20	0.23
NOTRESSPASS	-3.491	19.916	-0.18	0.86	-0.6703	3.8264	-0.18	0.86
RUSPROTECTS	-22.652	21.087	-1.07	0.28	-4.4199	4.0515	-1.09	0.28
INSURACEKNOW	-8.548	21.174	-0.40	0.69	-1.6484	4.0681	-0.41	0.69
RISKPREFERENCE1	-35.239	37.610	-0.94	0.35	-6.3478	7.2260	-0.88	0.38
RISKPREFERENCE2	**-44.035***	24.881	-1.77	0.08	**-8.9112***	4.7804	-1.86	0.06
MARGINALLAND	30.694	20.483	1.50	0.14	5.9363	3.9353	1.51	0.13
MARGINALACRES	-0.012	0.076	-0.16	0.87	-0.0023	0.0145	-0.16	0.87
LANDOWNERCOOPER	-10.107	21.931	-0.46	0.65	-1.9216	4.2137	-0.46	0.65
COOPERATIVE	-33.222	27.417	-1.21	0.23	-6.0622	5.2676	-1.15	0.25
CONSERVATION	10.744	20.142	0.53	0.59	2.0678	3.8698	0.53	0.59
TRACTS	0.528	5.205	0.10	0.92	0.1014	1.0000	0.10	0.92
ADJACENT	-15.049	19.857	-0.76	0.45	-2.8792	3.8150	-0.75	0.45
DISTANCE	**-0.155***	0.091	-1.71	0.09	**-0.0299***	0.0174	-1.71	0.09
TOTALACREAGE	0.013	0.017	0.79	0.43	0.0025	0.0032	0.79	0.43
YEARSOWNERSHIP	-0.359	0.487	-0.74	0.46	-0.0690	0.0936	-0.74	0.46
OWNERSHIP1	-119.011	104.503	-1.14	0.26	-18.0273	20.0779	-0.90	0.37
OWNERSHIP2	-11.295	42.616	-0.27	0.79	-2.1208	8.1877	-0.26	0.80
OWNERSHIP3	**-34.806***	20.843	-1.67	0.10	**-6.5355***	4.0046	-1.63	0.10
ACQUIRE1	31.918	34.277	0.93	0.35	6.1734	6.5855	0.94	0.35
ACQUIRE2	-18.500	61.634	-0.30	0.76	-3.4213	11.8417	-0.29	0.77
ACQUIRE3	31.713	35.334	0.90	0.37	6.0468	6.7886	0.89	0.37
ROWCROPS	16.762	31.525	0.53	0.60	3.2014	6.0568	0.53	0.60

COTTON	-19.640	30.014	-0.65	0.51	-3.7665	5.7664	-0.65	0.51
LEASEDFORAG	-15.250	21.581	-0.71	0.48	-2.9644	4.1463	-0.71	0.48
HAYLAND	-27.769	26.715	-1.04	0.30	-5.1647	5.1327	-1.01	0.31
LIVESTOCKLAND	-11.858	27.400	-0.43	0.67	-2.2454	5.2643	-0.43	0.67
GENDER	-1.630	21.233	-0.08	0.94	-0.3128	4.0794	-0.08	0.94
AGE	**1.710‡**	0.853	2.00	0.05	**0.3286‡**	0.1640	2.00	0.05
ETHNIC	50.611	44.289	1.14	0.25	8.8253	8.5093	1.04	0.30
OCUPATION1	33.755	29.757	1.13	0.26	6.8536	5.7171	1.20	0.23
OCUPATION2	-1.691	31.007	-0.05	0.96	-0.3239	5.9573	-0.05	0.96
OCUPATION3	-14.785	30.611	-0.48	0.63	-2.7693	5.8812	-0.47	0.64
EDUCATION1	-5.057	21.083	-0.24	0.81	-0.9681	4.0506	-0.24	0.81
EDUCATION3	-25.956	26.540	-0.98	0.33	-4.8085	5.0991	-0.94	0.35
INCOME1	16.165	31.286	0.52	0.61	3.1935	6.0109	0.53	0.60
INCOME3	12.698	21.903	0.58	0.56	2.4631	4.2081	0.59	0.56
CONSTANT	**-294.720†**	100.293	-2.94	0.00	**-56.6241†**	19.2692	-2.94	0.00
SIGMA	132.498	9.461						

†, ‡, *, indicates significance at the 1, 5, and 10 percent level, respectively. N = 531; Chi-square = 209.67; Log-L= -846.63; Prob>chi2 = 0.0000; Pseudo R-squared: 0.110

$0.03 reduction in the expected WTA. If a landowner owns land jointly and allows fee-based recreation, the effect on predicted WTA is a reduction of $6.54 as compared with respondents that are single owners. AGE is significant at the 0.05 level and positive in sign indicating that each one year increase in age increases the expected WTA by $0.33.

Discussion

Discussion of Willingness to Accept and Transaction Cost

It was hypothesized that an institutional change that reduced the potential for liability would reduce the transaction cost associated with offering fee-based recreation. If this is true, then a reduction in the WTA for respondents allowing fee-based recreation pre-and post-institutional change should reflect this transaction cost savings. The theory appears to hold. For respondents allowing fee-based recreation pre- and post-institutional change the mean WTA was reduced by $4.67 per acre per year. The results of the Tobit models discussed in the next section provide additional evidence of transaction cost.

Discussion of Econometric Results

The significant and positive effect of ACCESSCUR in the post-institutional change Tobit model indicates that respondents who choose to allow fee-based recreation under both pre- and post-institutional change environments have higher WTA values than respondents only opting to allow fee-based recreation post-institutional change. Respondents allowing fee-based recreation under the current RUS have an expected WTA that is $19.21 greater than respondents that did not allow fee-based recreation under the current RUS. This result suggests that the potential negative effect of liability may have a much higher impact on respondents choosing to allow recreation only under the post-institutional change environment as compared to those who would allow it pre- and post-institutional change. Apparently the potential transaction cost for respondents not allowing fee-based recreation pre-institutional change is perceived as being greater than it is by respondents opting to allow fee-based recreation pre-institutional change. Thus, when the effect of the transaction cost associated with liability is reduced by an institutional change, the WTA of pre-institutional change non-access granting respondents is much lower than pre-institutional change access granting respondents. This implies that not only are transactions associated with liability evident but that transaction costs are perceived differently by pre-institutional change access and non-access granting respondents.

The significant and positive effect of WTACURRENT also provides indication of a reduction in transaction cost under a modified recreational use statute, since each $1 increase in WTA indicated under the current RUS results in an increase of $0.17 for expected WTA under the modified use statute. These results imply that a modification to the RUS that extended liability protection to fee-based recreational access granting landowner would reduce the transaction cost borne by landowners thus reducing the fee for recreation use of land and also potentially reducing the cost of fee-based recreation to the public.

Further possible evidence of a reduction in transaction costs can be seen in results for the variables CONCERNEASED2 and RISKPREFERENCE2 which indicates if a landowner is risk averse. The WTA of respondents that disagree with allowing recreational use of their land if their liability concerns were eased (CONCERNEASED2) have a WTA that is $20.12 lower than respondents that were unsure about allowing recreational use of their land if their liability concerns were eased. The post-institutional change WTA for CONCERNEASED2 was only $11.55 lower than unsure respondents. The reduced magnitude of the marginal effects seems to indicate that institutional change does reduce the transaction cost of fee-based recreation.

Individuals that are risk averse experience reduced utility from investments with higher returns and greater risk. Allowing fee-based recreation under the current RUS is riskier than under a modified recreational use statute that would extend liability protection to landowners charging a fee for recreational access. Therefore, it is interesting to notice that under a pre-institutional change environment that risk averse respondents have an expected WTA that is $18.65 lower than risk neutral respondents, yet after an institutional change that substantially reduces the risk of liability it is observed that risk averse respondents have an expected WTA that is $8.91 lower than respondents considering themselves to be risk neutral. This difference in magnitude of the marginal effects seems to indicate that institutional change does reduce the risk of liability and the transaction cost associated with offering fee-based recreation.

Conclusions

The primary questions to be answered by this study was whether a transaction cost exists for fee-based recreation, which is borne by delta landowners, and can transaction costs be reduced by adopting a modified RUS as has been done by many other states. When looking at the mean values reported by survey respondents it appears that the theory holds. Additionally, results for the Tobit models seem to indicate evidence of reduced transaction costs. Rather than examining simple means, the Tobit model results allow for a comparison of pre- and post-institutional expected WTA by modeling post-institutional WTA as a function of pre-institutional WTA and the decision to allow recreational access in the pre-institutional change environment. Tobit model results indicate that respondents allowing fee-based recreation both pre- and post-institutional change have an expected WTA that is $19.21 greater than respondents that did not allow fee-based recreation under the current RUS. This result implies that perceived transaction costs are so high under the pre-institutional environment that many respondents do not allow fee-based recreation. When the transaction cost associated with liability is eliminated the expected WTA for respondents allowing recreation post-institutional change only is much lower than for respondents allowing both pre- and post-institutional change. Transaction costs are also evident in the relationship between expected WTA post-instructional change and WTA pre-institutional change. Tobit model results indicate that each $1 increase in WTA under the current RUS results in an increase of $0.17 for expected WTA under the modified use statute. This implies that there is a transaction cost savings resulting from the institutional change.

Amending the Louisiana recreational use statute can increase the number of private landowners willing to use their land for fee-based recreational use. About 14% of respondents indicated they would be willing to allow fee-based recreation under the current institutional environment. If the Louisiana RUS were amended giving greater liability protection to landowners, the number of respondents willing to allow fee-based recreation would increase by 0% to nearly 24% of respondents. Clearly, an institutional change that reduces the liability risk to landowners could increase the potential amount of private land available for fee-based recreation.

A fee-based recreational enterprise under a traditional RUS environment caries with it the risk of liability; thus, as expected, risk preference was a significant predictor of the decision to allow fee-based recreation. Risk averse respondents were more unlikely to allow fee-based recreation under the current institutional environment. Following an institutional change, risk preference was no longer a significant predictor of the willingness to allow fee-based recreation indicating that the element of risk was diminished.

Literature Cited

Copeland, J.D. 1998. Recreational access to private lands: liability problems and solutions. Second edition. National Center for Agricultural Law Research and Information. Robert A. Leflar Law Center. University of Arkansas: Fayetteville. 212p.

Dillman, D.A. 2000. Mail and Internet Surveys: The Tailored Design Method. New York: Wiley. 464p.

Fausti, S. and J. Gillespie. 2006. Measuring risk attitude of agricultural producers using a mail survey: how consistent are the methods? Australian Journal of Agricultural and Resource Economics. 50: 171–188

Franses, P.H. and R. Paap. 2001. Quantitative Models in Marketing Research. Cambridge: Cambridge University Press. 206p.

Greene, W.H. 2003. Econometric Analysis. 5th ed. Prentice Hall: Upper Saddle River.

Kealy M.J. and R.W. Turner 1993. A test of the equality of closed-ended and open-ended contingent valuations. American Journal of Agricultural Economics. 75:321-331.

Mitchell R.C. and R.T. Carson. 1989. Using surveys to value public goods: the contingent valuation method. Washington, D.C.: Resources for the Future.

Mozumder P., M. Starbuck, R.P. Berrens, and S. Alexander. 2004. Lease and Fee Hunting on Private Lands in the U.S.: A Review and Synthesis of the Issues, With Annotated Bibliography. Final Report. USDA Forest Service. Corvallis, Oregon. 125p.

Wright, B.A. 1989. Toward a better understanding of recreational access to the nation's private lands: supply, determinants, limiting factors. In: Income Opportunities for the Private Landowner through Management of Natural Resources and Recreational Access. W.N. Grafton, A. Ferrise, D. Colyer, D.K. Smith, and J.E. Miller, editor. Morgantown, West Virginia. West Virginia University Extension Service.

Wright, B.A., R.A. Kaiser, and S. Nicholas. 2002. Rural landowner liability for recreational injuries: myths, perceptions, and realities. Journal of Soil and Water Conservation. 57(3):183-191.

Venkatachalam, L. 2004. The contingent valuation method: a review. Environmental Impact Assessment Review. 24:89-124.