Institutional Timberland Investments: Asset Pricing and the Discount Rate

by

Jacob Gorman

A dissertation submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

Auburn, Alabama
August 4, 2012

Approved by

Larry Teeter, Co-Chair, Professor of Forest Economics
Yaoqi Zhang, Co-Chair, Associate Professor of Forest Economics
Robert Taylor, Alfa Eminent Scholar and Professor of Agricultural Economics
Richard Hall, Senior VP, US Trust Bank of America Private Wealth Mgmt

Abstract

Timberland has become an increasingly popular component of the portfolios of large investors, both institutional and also those of wealthy individuals and trusts. This land is generally managed by timberland investment management organizations (TIMOs). Since the early 1980s, the amount of timberland held by investors and managed by TIMOs has increased from practically nothing in the early 1980s, to over $25 billion by 2005. In spite of the attention paid to timberland investments in recent years, questions still remain in regards to the price determinants of timberland, as well as the asset's risk and return characteristics. This study uses a database of over 600 actual timberland transactions which occurred between the years 1988 – 2010, to address questions relating to timberland investments. A hedonic model of timberland price is developed to analyze the determinants of timberland price. In addition, using tract level data in combination with industry practices and market prices, an NPV model is used to forecast cash flows and solve for the discount rate, given the sale price associated with each transaction. Lastly, least squares regression is used to analyze the discount rates in an effort to qualify and quantify both market and diversifiable risk inherent in a timberland investment. Findings support the hypothesis that both the standing timber, as well as a tract's timber producing capability, has a large impact on timberland price. In addition, characteristics regarding location, HBU potential, price expectations, and macro variables such as exchange rates also play a significant role in determining the timberland price. Historical discount rates are found to average 6.59 percent for low intensity management regimes, 8.98 percent for medium intensity management regimes, and 12.5 percent for high intensity regimes over the period 1997 – 2010. There was also a significant downward trend in discount rates from 2001 – 2008. Model results to describe the discount rate are questionable. It is found that both systematic and non-systematic risk is priced into timberland. However, some variables are found to have the opposite effect than is expected.

Acknowledgments

For my mother. She did not get to see me complete this work but without her I would have never been in the position to begin. I hope to live each day in a manner which would make her proud.

I would also like to acknowledge the support of my committee, as well as the substantial contribution of data and resources from Sizemore and Sizemore, Inc.

Table of Contents

List of Tables

List of Illustrations

Institutional Timberland Investments:
Asset Pricing and the Discount Rate

by

Jacob Gorman

A dissertation submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

Auburn, Alabama
August 4, 2012

Approved by

Larry Teeter, Co-Chair, Professor
Yaoqi Zhang, Co-Chair, Associate Professor
Robert Taylor, Alfa Eminent Scholar and Professor
Richard Hall, Senior VP, US Trust Bank of America Private Wealth Mgmt

Abstract

Timberland has become an increasingly popular component of the portfolios of large investors, both institutional and also those of wealthy individuals and trusts. This land is generally managed by timberland investment management organizations (TIMOs). Since the early 1980s, the amount of timberland held by investors and managed by TIMOs has increased from practically nothing in the early 1980s, to over $25 billion by 2005. In spite of the attention paid to timberland investments in recent years, questions still remain in regards to the price determinants of timberland, as well as the asset's risk and return characteristics. This study uses a database of over 600 actual timberland transactions which occurred between the years 1988 – 2010, to address questions relating to timberland investments. A hedonic model of timberland price is developed to analyze the determinants of timberland price. In addition, using tract level data in combination with industry practices and market prices, an NPV model is used to forecast cash flows and solve for the discount rate, given the sale price associated with each transaction. Lastly, least squares regression is used to analyze the discount rates in an effort to qualify and quantify both market and diversifiable risk inherent in a timberland investment. Findings support the hypothesis that both the standing timber, as well as a tract's timber producing capability, has a large impact on timberland price. In addition, characteristics regarding location, HBU potential, price expectations, and macro variables such as exchange rates also play a significant role in determining the timberland price. Historical discount rates are found to average 6.59 percent for low intensity management regimes, 8.98 percent for medium intensity management regimes, and 12.5 percent for high intensity regimes over the period 1997 – 2010. There was also a significant downward trend in discount rates from 2001 – 2008. Model results to describe the discount rate are questionable. It is found that both systematic and non-systematic risk is priced into timberland. However, some variables are found to have the opposite effect than is expected.

Acknowledgments

For my mother. She did not get to see me complete this work but without her I would have never been in the position to begin. I hope to live each day in a manner which would make her proud.

I would also like to acknowledge the support of my committee, as well as the substantial contribution of data and resources from Sizemore and Sizemore, Inc.

Table of Contents

List of Tables

List of Illustrations

CHAPTER 1

An Introduction to Timberland Investments

Introduction

In recent decades, United States timberland has become an asset which is held by many investors including trusts, endowments, wealthy individuals, and institutional investors. Its unique characteristics can add diversification to an investor's portfolio, decreasing risk and increasing returns. While timberland has long been a source of wealth for many businesses and individuals, only more recently has it come under the analysis of finance professionals and viewed through the perspective of modern portfolio theory. Many questions remain unanswered in regard to both the determinants of timberland value, as well as the risk and return characteristics of a timberland investment. This study attempts to shed some light on both issues.

The first issue, determinants of timberland value, is addressed by using a hedonic model to evaluate over 400 timberland transactions. While hedonic studies have often been used in the past to evaluate the price of timberland characteristics, most studies evaluate small tracts ranging from 10 acres to a few hundred acres. The present study evaluates sales with a minimum size of 5,000 acres and includes the introduction of macro variables as well, which may influence the price of investment timberland.

Second, this study seeks to qualify and quantify the determinants of the timberland discount rate, i.e., the required rate of return. This information should be useful both to appraisers seeking to correctly value a particular tract of timberland, as well as investors who, in order to properly value an asset, must have as much information as possible pertaining to the asset's risks.

Lastly the determinants of the discount rate are analyzed. Though significant research has been directed toward quantifying and qualifying timberland investment risk, questions remain about the capitalization rate that should be used to value timberland.

Transitioning Ownership

Studies between 2001 and 2006 report that United States timberland covers an area of over 500 million acres (22% of total area) and has an estimated value of $460 billion. It supplies a forest products industry that generates $240 billion per year, as well as overseas markets, and employs over 1.8 million people (Newell and Eves, 2009).

The nature of timberland ownership in the US has changed drastically over previous decades, as large tracts of timberland have changed hands from vertically integrated forest products companies (VIFPCs), to those of institutional investors such as pension funds, insurance companies, foundations, and endowments. Timber Investment Management Organizations (TIMOs) helped to facilitate this transfer of ownership by purchasing, selling, and managing these lands on behalf of institutional investors (Hickman, 2007). From 1981 to 1997, institutional ownership of timberland grew from $4.2 million to just under $5.6 billion (Caulfield, 1998). By 2005, total investment in timberland by TIMOs and REITS (Real Estate Investment Trusts) had grown to over $25 billion (Hickman, 2007).

Institutional investors entered the timberland market after passage of the 1974 Employee Retirement Income Security Act. This act required further diversification of pension plans, many of which held only stocks and bonds, and became underfunded during periods of high inflation (Binkley, 2007). At approximately the same time, publicly traded forest products companies began to rethink their timberland holdings, with the belief that the stock market did not recognize their full value (Binkley et al, 1996). Favorable tax treatment and changes in regulation further advanced timberland as an attractive investment (Binkley, 2007; Corriero, 2005; Kimbell et al, 2010).

Aside from their favorable income tax position, institutional investors have other advantages in realizing larger profits from timberland ownership. Typically, institutional investors allocate a small portion of their overall portfolio to timberland ownership, as opposed to VIFPCs and individuals. This allows the institutional investor to time timber sales based strictly on when it is financially optimal, rather than basing the decision to cut on the necessity of supplying a mill or, in the case of a private individual, when cash is needed to make a large purchase or meet some other obligation (Zinkhan et al, 1992). Elaborating, VIFPCs, as owners of both land and facilities have supply objectives that influence harvesting and land procurement decisions. Independent investors in timberland face no such constraints, so the timber is cut when prices are favorable, and when they are not, timber is left standing to appreciate in value (Hickman, 2007).

Also, institutional investors are in a position that allows them to buy timberland advantageously. Forest products companies often acquire timberland when profits are high (often meaning that timberland prices are also high). Institutional investors should be able to buy when the market is down, and so take advantage of better prices (Zinkhan et al, 1992).

What Drives Timberland Returns?

Historically, drivers of returns realized from a timberland investment are "biological growth, timber prices, and land appreciation" (Newell and Eves, p 96, 2009). Timberland is different from other investments in that (1) trees grow, and (2) the value of the underlying asset (trees) increases with age as it moves through progressively higher value classes (pulpwood, chip-n-saw, sawtimber). This growth and value appreciation occurs regardless of market performance. The end result is more product to sell (higher volume of timber) and at a higher price (since the trees have grown into a higher value product) (Healey, Corriero, and Rozenov, 2005). An additional quality of timberland as an investment is the significant amount of manager discretion when deciding when to harvest and sell timber. The nature of a timberland investment is such that there is significant flexibility in the harvest decision, which may be sped up or put off in order to take advantage of market conditions (Strong, 2000).

Timber prices are the second contributor to returns from a timberland investment. Healey, Correiro, and Rosenov (2005) report that over time, timber price appreciation has remained above inflation. Over the period 1910-2000, the compound annual real price growth is reported as 2.6 percent. The increase in real price and biological growth make timberland an attractive hedge against inflation. The authors report that timberland returns increase as inflation increases, as shown over the period 1956-1965 when CPI was 1.7 percent and timber returns were 4.4 percent, over the period 1982-1996 when CPI was 3.5 percent and timber returns were 8.4 percent, and over the period 1973-1981 when CPI was 9.2 and timber returns were 17.1.

Land appreciation is the final driver of timberland returns. When timberland is sold it is often sold to other investors in timberland. However, it may also be sold as HBU, or ‘highest and best use’. This is often for development, but may include purchasers who wish to own a smaller parcel for recreational use. These HBU properties may sell for much more than the land is worth for timber production. Breaking a tract of timberland into smaller parcels for sale is an excellent way to increase the value of such tracts. “Any opportunities to parcel out land and develop it are pursued quite vigorously” (Wilent, 2004).

Performance Characteristics

There is a significant amount of literature that investigates timberland as an investment. Relevant studies look into and explain why timberland ownership transferred away from VIFPCs, how management might differ from one form of ownership to the next, the conservation implications of institutional ownership, and how timberland performs as an investment. From a financial perspective, such studies ask “what are the expected returns from a timberland investment”, “what type of risks are prevalent”, and “what are the correlations between timberland and other investments such as a stock index or publicly traded VIFPCs as well as inflation” (Zinkhan et al, 1992; Binkley et al, 1996; Cascio and Clutter, 2008).

Like other real estate investments, timberland is not traded publicly on an exchange. Therefore, returns are not reported to the public and information regarding returns and their associated volatility is difficult to obtain. To maneuver around this problem, multiple attempts have been made to create both synthetic and real indexes that track timberland returns. Since the first indexes were created over twenty years ago, the National Council of Real Estate Investment Fiduciaries (NCREIF) Timberland Index has assumed the role as the leading index used by industry and researchers. The index is based on reports provided by timberland investment managers that include information on "appraised value, net income, capitalized expenses and any partial sales or purchases for every property in the United States they manage…that is held in a fiduciary environment and 'marked-to-market' at least once per year" (Hancock Timber Resource Group, 2003). Therefore, the NCREIF index is viewed as a good indicator of the performance of timberland held by TIMOs and their investors.

Healey, Corriero, and Rozenov (2005) report annual average returns of 14.9 percent since 1987, based upon the NCREIF index. Using the John Hancock Timber Index, they report a 12.6 percent return over the period of 1960 – 2002, with a standard deviation of 13.2 percent. This is compared to a return and standard deviation of 9.3 and 5.4 percent respectfully for commercial real estate, 10.1 percent and 16.6 percent for the S&P 500, and 7.7 and 10.6 percent for corporate bonds over the same period. They also report a "low to negative correlation with other traditional investment classes such as stocks and bonds. Whereas traditional major asset classes, including large-cap and small-cap stocks and corporate bonds, have tended to be positively correlated, timber returns, as measured by NCREIF, have exhibited little or no correlation with the returns of other asset classes" (pg 69). Timberland returns have also been shown to be most consistently correlated with inflation. Between the period of 1960-2003, Timberland returns are negatively correlated with intermediate-term government bonds, long-term government bonds, corporate bonds, small cap stocks, and the S&P 500. Returns are positively correlated with CPI and United States Treasury Bills (Healy, Corriero, and Rosenov, 2005).

This dissertation addresses the determinants of timberland price and places significant emphasis on the timberland discount rate. This information should be of interest to researchers, appraisers seeking more information on accurately valuing timberland, and investors seeking to further understand their investment. This is accomplished through two distinct studies.

1. Chapter 2 addresses the determinants of timberland value through a hedonic model of timberland price. By analyzing approximately 400 timberland transactions over a 14 year period from 1997 – 2010, statistically and economically significant variables which impact the timberland price are identified and discussed.

2. Chapter 3 takes a closer look at one important determinant of timberland price, and that is the discount rate used to capitalize future cash flows. By using the same data as analyzed in the hedonic study of timberland value, cash flow projections are made based upon the traits of each timberland tract. The discount rate which equates these cash flows to the sale price can then be solved for. An econometric model is then used to study the determinants of this discount rate.

CHAPTER 2

Price Determinants of Investment Timberland Tracts: A Hedonic Approach

Introduction

In recent decades, United States timberland has become an asset which is held by many investors including wealthy individuals, trusts, endowments, and other institutional investors. Its unique characteristics can add diversification to an investor's portfolio, decreasing risk and increasing returns. While timberland has long been a source of wealth for many businesses and individuals, only more recently has it come under the analysis of finance professionals and viewed through the perspective of modern portfolio theory. As ownership changes hands from forest products companies to investors, different valuation metrics have arisen as have different ownership objectives (USDA, 2007). Timberland is no longer viewed as a resource used to supply a company's mill, but rather a strategic asset which can diversify portfolios from market risk and hedge against inflation. It is managed with an eye toward maximizing its long term value, an objective which may be met through the sale of recreational property, development, and primarily timber production. For professionals seeking to make informed buying and selling decisions, as well as appraisers who wish to accurately estimate land values, many questions remain unanswered in regards to the determinants of timberland price.

In this study, the determinants of timberland price are addressed by using a hedonic model to evaluate over 400 investment timberland tracts. While hedonic studies have often been used in the past to evaluate the price of timberland characteristics, most studies evaluate small tracts ranging from 10 acres to a few hundred acres. The present study evaluates transactions with a minimum size of 5,000 acres and includes the introduction of macro variables as well, which may influence the price of investment timberland. Further differentiating this paper from previous research, the present study spans a time period of fourteen years and a cross section of nine states, making it broader in scope than many studies prior.

The price of timberland has many determinants. Beyond the cash flows received from timber harvests, individuals and other entities may wish to own timberland for conservation purposes, hunting, recreation, second homes, as well as a multitude of other reasons. A buyer of timberland may value amenities such as paved road frontage, water access, or wildlife habitat. These characteristics may all influence the price of timberland. Someone purchasing a tract of timberland for investment purposes may be more interested in the volume of merchantable timber, expectations about future timber demand, and the risks of such an investment.

A hedonic study of large timberland tracts can be of much use to appraisers, investors, and researchers. Analyzing timberland prices through the use of a hedonic model identifies important variables in determining timberland price, as well as how those variables affect price, in both sign and magnitude. Hedonic modeling of real estate has long been an important tool in real estate appraisal, and such an extension to timberland is well justified. In addition, this study will help investors better understand the behavior of timberland prices with respect to both macroeconomic and tract specific variables. Lastly, researchers have been investigating the behavior of timberland prices and returns since before Faustmann. This study serves to compile and review literature pertaining to both timberland investments and the use of hedonic models in analyzing real estate. In addition, in expanding the methodology of previous studies of timberland price to large tracts of timberland, this study serves as a valuable addition to the literature on timberland prices.

Literature Review

For most goods, an item's price is determined in a market composed of many buyers and sellers whose interactions determine a price at which the market clears. At this point, there is no surplus or shortage, and there is only one price for the good. However, this model is inadequate for some markets. Take the case of a differentiated good such as a home. There is no one price for housing, as each home is differentiated from the next by aspects such as landscaping, number of bedrooms, flooring, etc. Similarly, timberland can be viewed as a differentiated good. Different tracts of timberland may be characterized by different species and maturities of trees, differing amounts of water access and road frontage, and differing geographies among other things.

Rosen (1974) describes the use of a hedonic model to evaluate the price of characteristics which make up a product. Rosen explains that hedonic prices are "the implicit prices of attributes and are revealed to economic agents from observed prices of differentiated products and the specific amounts of characteristics associated with them" (pg 34). These prices are determined by supply and demand and estimated by regressing the value on the characteristics of the product (in our case, timberland). This hedonic function can also yield the implicit price function which "describes how the quantity and quality of a property's characteristics determine its price in that particular market" (Day, 2001 pg 2). To further distinguish the two, the hedonic price function describes the price of a good as a function of the amount of certain characteristics that make up the good. This function can then reveal the implicit function, which is the marginal price of a particular characteristic.

Early attempts to empirically identify and quantify the characteristics that determine forestland price date back to the late-1970's. Vrooman (1978) investigated the determinants of private forestland value within the Adirondack Park in New York State. These properties were absent of any structures and included no waterfront property. This narrows the uses of the property to primarily "open-space recreation and forestry" (p 169). The dependent variable was the per acre sale price and was regressed upon many independent variables describing the traits of the property, as well as time period sold and buyer characteristics. The results indicate a rising price trend, a small but inverse relationship between sale price per acre and size, a significant increase in the price of a parcel adjacent to state land, positive price effects from ease of access, and also the fact that sale prices reflect about 70% of the value of timber on the property.

In response to decades of changing ownership characteristics associated with Vermont forestland, Turner et al (1991) used a hedonic approach to determine how different forest characteristics contributed to the sale price of forest properties. In this study, the authors evaluated slightly larger parcels, ranging between 100 and 500 acres. Results of the study indicated that there was no relationship between the size and sale price of a parcel (possibly due to the size range of the sample), that there was a positive relationship between the amount of open land and the sale price, and that county population growth influenced the sale price. Road frontage and taxes also had effects on the sale price of Vermont forestland, as did the distance to a highway and to ski facilities.

In 2002, researchers in Louisiana integrated geographic information system (GIS) technology with econometric techniques to evaluate the timberland market of Northern Louisiana using a hedonic model (Kennedy et al, 2002). Their data consisted of 133 tracts of timberland located outside of city limits, with a minimum of 50% timber production by area, and a minimum size of 10 acres, ranging up to 842 acres. These sales occurred between the years of 1993 and 1998. Results indicated that the size of the parcel was negatively correlated with the per acre selling price. Road access, proximity to a metropolitan area, and the value of improvements all provided positive and significant contributions to the sale price.

Synder et al (2008) evaluated different characteristics' effects on the price of Minnesota timberland, as well as the intentions and perceptions of the buyers. In their study, the researchers combined survey data with actual property data on parcels ranging between 10 and 313 acres which transferred ownership in 2001 and 2002. Synder et al (2008) used the natural log of sale price as the dependent variable. Results of the study indicated that a buyer's intentions to build a home on the property significantly increased the sale price of the property (41% premium, or $988/ha). Buyers whose primary reason for owning timberland was wildlife enjoyment paid a premium of $631/ha. Parcels with over 50% of the forest growth in trees exceeding 10 years of age commanded a 17% premium or $421/ha, over parcels with younger trees. The buyer's method of financing and whether or not a real estate agent was involved also had an effect on price. The size of the tract negatively influenced price, and perhaps most surprisingly, timber growing stock volume had no impact on the sale price. Lakefront, road access, and a growing population all had significant impacts on the price of Minnesota timberland.

Washburn (1990) used transaction data on over 2,500 timberland properties to separately value the determinants of both forest land value, as well as timber growing stock. In addition to property-specific variables such as timber stock and county population, Washburn also included variables such as stumpage prices, covariance of prices with stock returns, and consumer price index to evaluate the timberland price while incorporating the theory of capital (viewing timberland price as the net present value of future revenues and expenses).

Population growth rates at the county level are used in multiple studies to determine the effects of HBU potential on timberland sale price. Washburn found that the per-acre value of timberland in a county with a stable population was $336. If the growth rate of the county was 2%, the per-acre value was $396. If the growth rate increased to 5%, the land value increased to $508 per acre. The effect of sale acreage on price was found to be less substantial. The relationship was found to be negative, with the magnitude being approximately 0.035, depending on the model used.

Washburn's research showed particularly interesting results in regards to timber price behavior. His results suggest that stumpage prices affect the bare land value of timberland, differently than they do the current growing stock. More precisely, when valuing the bare land value, market participants assume that stumpage prices are stationary, fluctuating around a long-term stable price. However, when valuing current growing stock, market participants assume a non-stationary process for stumpage prices, which are dependent upon current, and possibly previous period prices as well. Another significant insight was also provided by Washburn's work. From analysis of the covariance between stumpage prices and the stock market, as well as the volatility of stumpage prices themselves, suggests that systematic *and* nonsystematic risk are priced into timberland.

A great deal of the literature on timberland investments suggests that the discretion of timberland managers to harvest when timberland prices are high is an attractive characteristic of timberland investments. While price volatility is generally seen as an added risk to investment, this explanation implies that such volatility can be an asset. However, Washburn (1990) found that the variance in stumpage price was negatively related to forest value. This implies that the cost of the added risk outweighs any advantages from adaptive management to take advantage of higher price swings. This makes sense as in hindsight it is easy to pick troughs and peaks in timberland prices, but this is much harder to do looking forward. Therefore, unknown price fluctuations are a risk that investors in timberland must face.

Data

The original data set was provided by a timberland appraisal firm and consisted of 678 timberland transactions which occurred over the years 1988 – 2010. After removing transactions including hardwood forests and those with substantial missing data, a total of 659 sales were evaluated. However, some sales were missing significant amounts of data such as the amount of premerchantable and merchantable timber, and/or had large amounts of non-forest land and hardwood timber production. In an effort to analyze investment-grade pine plantations in the Southeastern United States, the final data set was limited to transactions in excess of 5,000 acres, composed primarily of slash and loblolly pine, or some mix. The data set consists of properties in nine states from Virginia to Texas. Lastly, sales in excess of $500,000,000 were eliminated to remove large outliers. After filtering the data to meet the above specifications, the final data set consisted of 388 transactions, all occurring between the years 1997 and 2010.

Of the 388 sales analyzed in this study, the size of the tracts range between 5,050 acres and 4.7 million acres, with the average size being 98,834 acres. The median size is 16,836 acres. The total sale price ranged between 3.2 million dollars and 5.7 billion dollars, with the average transaction price being 129.9 million dollars. The median sale price is 486 million dollars. For a better indication of asset prices, the per acre sale prices ranged from 565 dollars per acre, to 2,783 dollars per acre, with the average price being 1,280 dollars per acre. The median per acre sale price is 1,203 dollars per acre. Once adjusted to 2010 dollars using the CPI for all urban consumers, the real per acre price of timberland ranged from a minimum of 685 dollars per acre, to a maximum of 3,137 dollars per acre, with the average real price of timberland being 1,437 dollars. The median real per acre price is 1,358 dollars per acre.

Table 1		Timberland Descriptive Stats				
Variable		Observations	Mean	Std Dev	Minimum	Maximum
Transaction Size (acres)		388	42,680	71,029	5,050	462,959
Sale Price		388	51,659,502	82,367,042	3,232,785	486,107,000
Price Per Acre		388	1,280	443	565	2,783
Real Price Per Acre (2010)		388	1,437	449	685	3,137

Table 2		State-Based Data Description				
State		Years	Observations	Avg Size (acres)	Avg Price/Acre	Avg Real Price/Acre
AL		1997-2010	57	51,119	1,340	1,484
AR		2000-2010	36	39,486	1,296	1,415
FL		1997-2010	48	43,175	1,176	1,393
GA		1998-2009	82	28,028	1,469	1,645
LA		2000-2010	35	57,797	1,275	1,435
MS		1997-2009	30	51,484	1,111	1,274
NC		2000-2009	20	34,663	1,373	1,465
TX		2001-2009	51	58,823	1,101	1,220
VA		1999-2010	30	21,473	1,213	1,387

Timberland is a heterogeneous asset. Each tract of timberland is different from another. In addition to other characteristics, properties may vary in size, age class of timber, and location. Therefore, when trying to gain a perspective on how timberland prices have moved over time, it is incorrect to directly compare the sale of one property at a point in time, to the sale of a different property, at another point in time. To gain a perspective on how the price of timberland has changed over the previous ten years, a moving average of the transactions was created from the data. Rather than constructing the average based on a specified time period, the average price of the previous ten transactions was taken to arrive at an average real per acre price. This ensured that the affects of different characteristics such as size and location were averaged out.

Figure 1 Real Per Acre Price of Timberland (1988 – 2010)

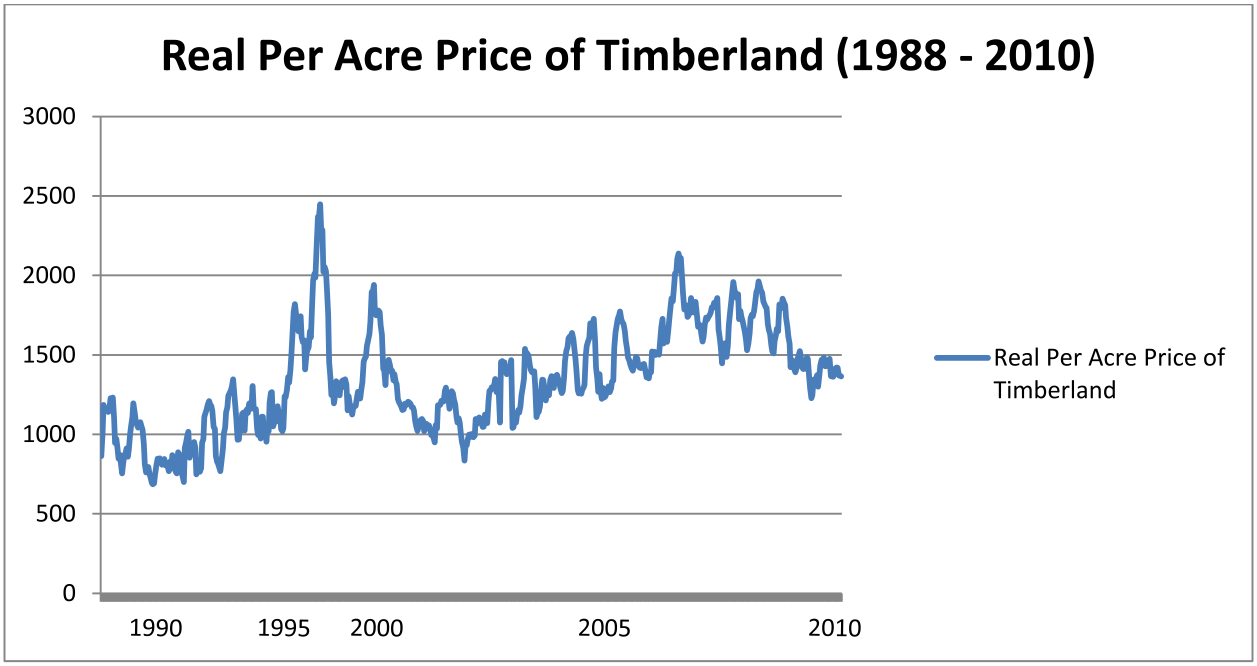
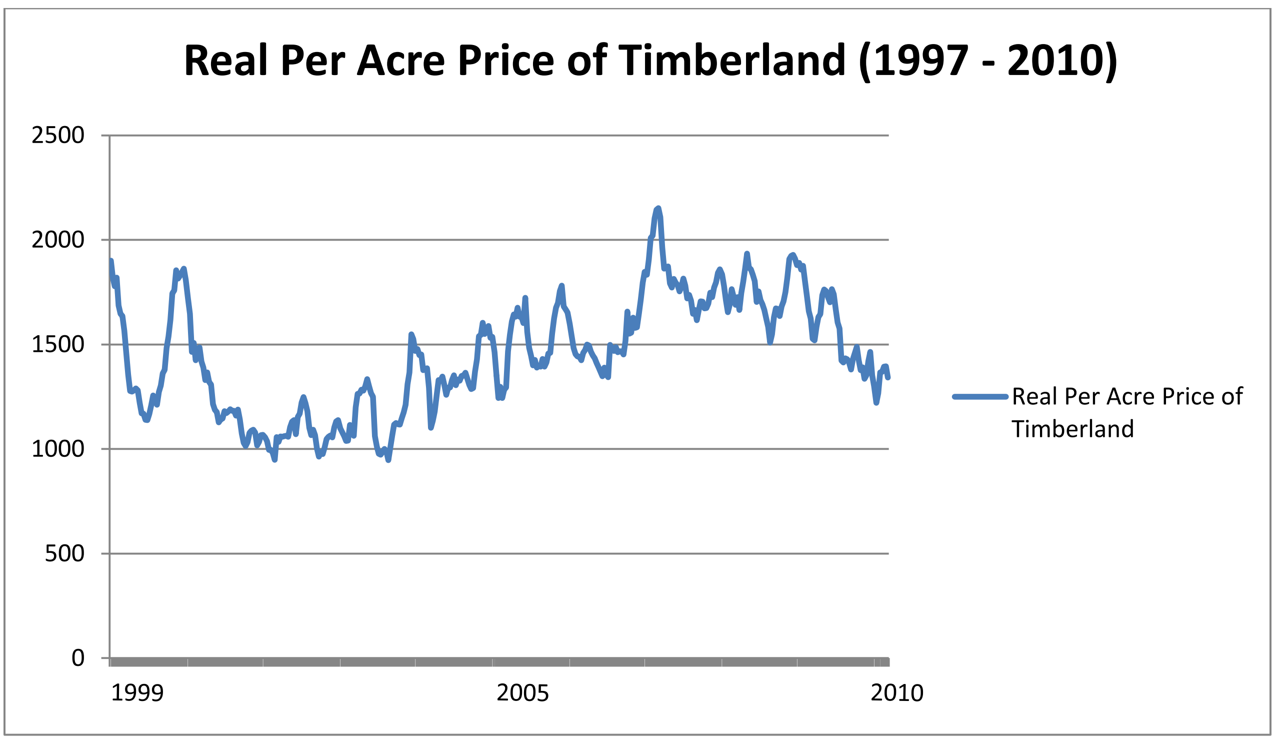


Figure 2 Real Per Acre Price of Timberland (1997 – 2010)



Generally, the real price of timberland troughed from 1999 to January 2002, where it reached a low of 948 dollars per acre. In early 2002, the price of timberland began a five year uptrend, finally reaching a high of over 2,100 dollars per acre in December of 2006. From this high, the real price of timberland has decreased over 31% as of September 27, 2010, the last point in the data series. The following table describes the data hypothesized to impact the timberland price:

Table 3		**Variable Summary**					
Variable Name		**Units**	**Mean**	**Min**	**Max**	**Std Dev**	**Expected Sign**
Sale Acres		acres/10,000	4.2	0.5	46.2	7.1	(-)
Premerchratio		premerch acres/ total	0.362	0.026	0.697	0.13	(-)
Ppulp_acre		tons	10.43	0	35.45	5.75	(+)
Pcns_acre		tons	5.74	0	23.57	3.79	(+)
Psaw_acre		tons	5.07	0	31.4	4.45	(+)
10yearfixed		percent	4.6	2.34	6.94	0.83	(-)
S&P500		S&P500/10	118.74	75.07	155.31	19.54	(+)
Population Density		persons per sq mile/10	4.86	0.823	33.04	4.73	(+)
CPI		index level	192.2	159.6	218.9	16.25	(+)
Five year saw		percent	-11.2	-50	94.4	20.2	(+)
Five year pulp		percent	-13.2	-75.6	101	35.8	(+)
Growth Avg		percent	7.06	3.39	11.17	1.43	(+)
Real Farm Real Estate		2010 dollars	2694.22	1006.68	7208.32	1438.05	(+)
Real Income		2010 dollars	25015	16934	38417	3800	(+)
Housing Index		Index Value	107	37	148	30	(+)
States		dummy (0,1)	N/A	N/A	N/A	N/A	(-/+)
Slash		dummy (0,1)	N/A	N/A	N/A	N/A	(-)
Mix		dummy (0,1)	N/A	N/A	N/A	N/A	(-)
Pied		dummy (0,1)	N/A	N/A	N/A	N/A	(-)
UCP		dummy (0,1)	N/A	N/A	N/A	N/A	(-/+)
Exchange Rate		index level	89.8	70.4	112.1	12.1	(-)

Hedonic Modeling of Timberland Price

Investors hold timberland because of its ability to produce returns from both timber growth and harvest, as well as appreciation in the underlying land value. The correlation of these returns, or lack of, with other investments or macro-economic variables makes timberland particularly attractive to some investors.

The price paid for a tract of timberland has a significant influence on the returns the asset will generate. Thus, buyers and sellers who have more and better information on what drives timberland prices will have a distinct advantage in the market place. In addition, appraisers can do a better job when making sale comparisons if they have more information on the value assigned to particular characteristics of a property. As discussed previously, a hedonic model of timberland price can provide significant insight into the drivers of timberland price.

For this study, two models were analyzed. The first incorporates thirty independent variables to explain the price of timberland. With the number of observations (approximately 400), this number of variables should not pose a problem. However, to concisely discuss the most important factors, forward step wise regression is used to reduce the model to the ten most critical determinants of timberland price. There is no universally agreed upon functional form for hedonic price models. However, most analysis settles on a semi-log model. This is because relationships can be expected to be non-linear in many cases. For example, the price of a house is expected to increase more from the addition of a 3rd bedroom, than from the addition of a 6th bedroom. Relating to timberland, the unit price of timberland is less likely to fall with the addition of the 5,000th acre, than the 20th acre. Additionally, asset prices are often skewed to the right, as prices cannot be negative, but can theoretically approach infinity. A logarithmic distribution is common. To further investigate the model specification, a Box-Cox transformation of the dependent variable was used. The transformation takes the form:

$$=Y^{\lambda}$$

Where Y is the dependent variable (real price per acre in our model), and λ is a the parameter to be estimated. A value of λ=1 indicates that a standard, linear model be used, while a value of λ=0 indicates that the natural log of the dependent variable should be taken and a semi-log form be utilized. Results from the Box Cox transformation result in a lambda value of -0.25 at the 95% level of confidence. For context, a value of λ = -1 equals Y^{-1} indicates a value of 1/Y; a value of λ= -0.5 equals $Y^{-0.5}$ indicates a value of $1/\sqrt{Y}$; while a value of λ=0 would indicate that a semi log model be used, or log(Y). A λ value of -0.25 is close to zero, and previous research, as well as intuition suggests that a semi-log model be used. The models are described as follows:

Model I:

lnrealprice = f(acres, premerchratio, ppulp_acre, pcns_acre, psaw_acre, 10 year fixed, S&P500, population density, cpi, fiveyearsaw, fiveyearpulp, growthavg, real farm real estate, real income, housing index, states, slash, mix, pied, ucp, basis pts, exchange rate)

Variables:

(1) lnrealprice = natural logarithm of real price per acre;

(2) sale acres = total acreage of the tract / 10,000; Previous studies of timberland price show an inverse relationship between the per acre sale price and the number of acres. This largely reflects the number of potential buyers and the decreased liquidity of

a larger land tract. It is expected that as the number of acres included in a sale increases, the per acre sale price will decrease.

(3) premerchratio = acres of premerchantable timber/total acres; A greater number of premerchantable acres relative to the total is expected to decrease the per acre price of timberland. While planted permerch acres indicate significant capital investment, returns are still years from being realized. In contrast, fewer premerch acres should indicate greater amounts of standing, merchantable timber which may be harvested and sold immediately.

(4) Ppulp_acre = tons of pine pulpwood per acre; As pulpwood is a marketable product with positive value which may be realized immediately, or left to grow to a higher value product, a greater amount of pine pulpwood is expected to have a positive effect on the per acre sale price.

(5) Pcns_acre = tons of pine chipnsaw per acre; As chip n saw is a marketable product with positive value which may be realized immediately, or left to grow to a higher value product, a greater amount of pine chip n saw is expected to have a positive effect on the per are sale price.

(6) Psaw_acre = tons of pine sawtimber per acre; As sawtimber is a marketable product with positive value which may be realized immediately, or left to grow and wait for better market conditions, a greater amount of pine sawtimber is expected to have a positive effect on the per acre sale price.

(7) 10yearfixed = yield on 10 year US Treasuries; US government issued debt is commonly used as a proxy for the risk free rate. As this rate rises, assuming other aspects of risk remain unchanged, the rate of capitalization (discount rate) will increase.

Discounting future cash flows by a larger rate of capitalization decreases the present value of an investment. It is expected that as the yield on 10 year Treasuries increases, the per acre price of timberland will decrease, resulting in a negative relationship.

(8) S&P500 = S&P 500 / 10; To be interpreted as 'a ten point change in the S&P 500 effects the price of timberland by x percent'. A long history of research shows that increases in wealth due to positive stock market returns have a positive effect on consumer spending. As recreational opportunities, second homes, etc., are consumption goods, changes in the S&P 500 may influence demand for retail timberland tracts, hence effecting HBU potential and timberland price. At the same time, positive returns to the S&P 500 (hence higher levels) may affect investment options at the margin. As investors become wealthier they may have the ability and desire to seek out investments such as timberland for diversification purposes. It is expected that the relationship between timberland price and the S&P 500 is positive.

(9) Population Density = persons per square mile (county level) / 10; To be interpreted as 'a 10 person change in the county population density effects the timberland price by x percent'. As the population density of a county increases, it is reasonable to expect that the demand for land will increase as well. This demand for land is not specifically for the purpose of producing timber. As the population density increases, more individuals will seek housing, roads will be needed, etc. As timberland can be converted to other uses, an increase in demand for bare land implies an increase in demand for timberland, putting upward pressure on price. The relationship is expected to be positive.

(10) CPI = consumer price index; Investors are concerned not with total nominal returns, but rather real returns. A significant amount of literature establishes timberland as a

hedge against inflation. It is expected that real price of timberland is positively related to the consumer price index.

(11) Five year saw = Five year change in saw timber prices; Past changes in market conditions may influence investor perceptions of the future. It is expected that a positive change in prices over the previous five years will have a positive effect on timberland price.

(12) Five year pulp = Five year change in pulp price; Past changes in market conditions may influence investor perceptions of the future. It is expected that a positive change in prices over the previous five years will have a positive effect on timberland price.

(13) Growth Average = average growth rate of pine pulpwood, chip n saw, and saw timber in the primary county the property is located, and those surrounding the county. This data comes from FIA sample plots. Because different locations within a county may be very heterogeneous, and due to the small sample size used to arrive at the growth rates, the average of the growth rates in the surrounding counties is used. It is expected that higher average growth rates indicate higher productivity of land and will have a positive relationship to timberland price.

(14) Real Farm Real Estate = Farm real estate values as reported by the National Agricultural Statistics Service and reported in real terms (2010). Timberland may be converted to agriculture and vice versa. Both agricultural and timberland may be converted for development purposes. While the productivity of the land types may differ somewhat, it is reasonable to assume that the two real estate types are similar in many ways. In a traditional Faustmann approach, it is assumed that all land value is derived from timberland production and that input costs, product prices, and the cost of capital

are constant into perpetuity. These assumptions are unrealistic in many cases and the bare land value of timberland may be affected by many other factors. These factors may be reflected in farm real estate values as well. It is expected that the relationship between farm real estate and timberland is positive.

(15) Real Income = average per capita real income by county (2010). Higher incomes are expected to have a positive impact on land prices. A positive relationship between real income and timberland price is expected.

(16) Housing Index = based on 1997 housing starts where 1997 equals 100, calculated as housing starts in year x / 1997 housing starts. Increased housing starts not only require additional lumber (end product of timber), but also require additional land upon which to build. Increased housing starts are expected to have a positive relationship with timberland price.

(17-25) States = dummy variables for each state. There is no prediction for each state. However, different policies, business environments, and tax treatment, among other factors, may affect the price of timberland. Listed as follows: AR, FL, GA, LA, MS, NC, TX, VA; The variable 'Alabama' is left out of the regression, therefore, state parameters should be interpreted as 'compared with Alabama'. By including the variable 'Alabama', the coefficients on each state can be interpreted as average per acre prices (ceteris paribus) for each state, but this approach introduces other modeling issues. The average per acre prices of each state are reported in the data section.

(26) Slash = dummy variable for species (1 = slash pine, 0 otherwise); Loblolly generally has greater productivity on the majority of sites. Therefore it is expected that

slash pine will have a negative effect on the price of timberland which is primarily loblolly.

(27) Mix = dummy variable for species (1 = slash and loblolly, 0 otherwise); Some counties are located in an area where both slash and loblolly have a significant presence. It is expected that the variable 'mix' will also have a negative relationship on the price of timberland which is primarily loblolly. However, the magnitude should be less than that for the variable 'slash'.

(28) Pied = dummy variable for location (1 = piedmont, 0 otherwise); A review of productivity observed in other studies suggests that site indexes in the lower coastal plain may be higher than in the upper coastal and piedmont. It is expected that the variable 'Pied' will have a negative relationship with the real price of timberland in the lower coastal plain.

(29) UCP = dummy variable for location (1 = upper coastal plain, 0 otherwise); The previously discussed review of observed productivity is less conclusive that there is a distinct difference between upper coastal plain productivity and lower coastal plain. However, it is worth investigating whether possible differences in productivity between the two are priced into timberland.

(30) Exchange Rate = US trade weighted dollar; As discussed previously, foreign ownership of US timberland has increased in recent years. As the value of the US dollar falls, the relative wealth of foreign investors is increased as is their ability to invest in US assets (Ruiz, 2005). It is expected that the exchange rate and the price of timberland have a negative relationship. As the value of the dollar falls relative to other currencies, the timberland price should increase in dollar denominated terms.

Model II:

An effort is made to spotlight the most important variables in explaining the price of timberland. For this task, a forward stepwise model is constructed and the top ten variables are discussed. The model chooses from the 30 variables previously discussed in Model I.

Results

Table 4 Model I Results:

Variable	Coefficient	Standard Error	P > |t|
Intercept***	6.84225	0.62971	<.0001
Sale Acres***	-0.00648	0.00162	<.0001
Premerch Ratio***	0.33173	0.09801	0.0008
Ppulp_acre*	0.00379	0.00225	0.0933
Pcns_acre***	0.01596	0.00345	<.0001
Psaw_acre***	0.02638	0.00344	<.0001
10 Year Fixed	-0.00820	0.03129	0.7934
S&P 500***	0.00292	0.00095	0.0023
Population Density**	0.00663	0.00312	0.0347
CPI	-0.00088	0.00244	0.7152
Fiveyearsaw	0.00132	0.00082	0.1132
FiveyearPulp***	0.00189	0.00056	0.0010
GrowthAvg**	0.02743	0.01069	0.0107
Real Farm Real Estate**	0.00005	0.00002	0.0455
Real Income	0.00000	0.00000	0.3060
Housing Index	0.00095	0.00060	0.1162
Arkansas***	-0.21628	0.05609	0.0001
Florida	-0.01434	0.10626	0.8927
Georgia	0.06007	0.05241	0.2525
Louisiana***	-0.21029	0.07205	0.0038
Mississippi	-0.03570	0.05905	0.5458
Ncarolina***	-0.29923	0.07215	<.0001
Texas***	-0.26343	0.05451	<.0001
Virginia***	-0.38639	0.08068	<.0001
Slash***	-0.14252	0.04600	0.0021
Mix**	-0.10188	0.04966	0.0410
UCP	0.03406	0.04011	0.3962
Pied	-0.04009	0.04707	0.3950
Exchange Rate***	-0.00577	0.00214	0.0074

* Denotes significance at 10%

** at 5%

*** at 1%

n = 367

R^2 = .5606

Table 5 Model II Results:

Variable	Coefficient	Standard Error	P > |t|
Intercept***	7.37210	0.14363	<.0001
Sale Acres**	-0.00383	0.00164	0.0202
Pcns_acre***	0.01464	0.00316	<.0001
Psaw_acre***	0.02195	0.00325	<.0001
S&P 500***	0.00327	0.00063	<.0001
Population Density**	0.00623	0.00250	0.0131
Florida***	0.10873	0.03807	0.0045
Georgia***	0.18851	0.03158	<.0001
Louisiana**	-0.14904	0.05763	0.0101
Texas***	-0.17358	0.03683	<.0001
Exchange Rate***	-0.00860	0.00108	<.0001

*** significant at 1%
**significant at 5%
n = 367
R^2 = .4669

The White test could not reject the null of homoscedasticity (Pr > ChiSquare = .5591). Plotting residuals further supports this evidence, and the residuals are normally distributed. In hedonic models, variables are often correlated. For this model, the variance inflation factor shows no evidence of collinearity, as almost all variables have a VIF between one and four. Only two variables have a VIF in excess of six. These are CPI and Real Farm Real Estate with a VIF of 13.

Results from Model I indicate that the total number of acres which make up a sale, have a negative relationship to price. This is consistent with previous studies of land prices. However, while statistically significant at 1% and having the expected sign, the economic significance of this relationship is small. Because the variables are regressed against the natural log of the real price per acre, a coefficient of -0.00648 is to be interpreted so that an increase of 10,000 acres in the size of the sale decreases the per acre sale price by 0.64%, or by $6.40 per acre on a tract which sells for 1,000 dollars per acre.

The variable ‘Premerch Ratio’ is significant at 1%. The sign was expected to be negative under the logic that a greater percentage of premerchantable timber means a smaller volume of merchantable timber and a greater time before realizing cash flows, as well as increased risk. Therefore, the positive coefficient in the results was unexpected and is counterintuitive. However, after further reflection and testing, the positive coefficient can be explained sufficiently. In Model I, merchantable timber was controlled for by including variables for the volume of pulpwood, chip n saw, and sawtimber. So the coefficient of 0.33173 should be interpreted so that *given* a fixed volume of merchantable timber, a premerchantable ratio of 0.4 increases the per acre price of timberland by 13.2%. Having controlled for the volume of standing timber, the premerchantable ratio is an indicator of the amount of productive land. This explanation is supported by removing the variables for standing merchantable timber and running the regression again. With these variables removed, the coefficient for premerchantable timber becomes negative.

The amount of merchantable pulpwood, saw timber, and chip n saw are all significant at 1%, and as expected, have a positive coefficient. A greater amount of standing timber on each acre would logically increase the per acre sale price of timberland.

The S&P 500 is also significantly correlated with the price of timberland at 1%. Since the variable measures the level of the S&P 500 divided by 10, it is interpreted that a

10 point increase in the S&P 500 increases the per acre sale price of timberland by 0.29% (or $2.90 on a $1,000 per acre tract of timberland).

The variable ‘population density’ is positive and significant at 5%. As the variable measures the population density of a county by every 10 people, a 10 person increase in the population density of the primary county where the property is located, increases the per acre price of timberland by 0.6%.

The change in pulpwood price over the five years prior and leading up to the sale date had a significant and positive impact on the price of timberland. It is interesting to note that price changes in saw timber did not have a significant effect. This could be attributable to the limited time frame that buyers have to sell pulpwood. While it is possible to ride out a period of low prices while pulpwood prices are depressed and allow the timber to increase in volume and value, it is also likely that management constraints (such as thinning) will require the timber to be cut before prices recover. It seems much more likely that a landowner has greater flexibility in harvesting sawtimber than pulpwood. This may explain why previous changes in pulpwood price have a more significant impact on land prices than changes in sawtimber price.

The variable ‘growthavg’ is both positive, and significant at 5%. This is as expected. While productivity would be expected to affect the land value of most sizes of land sales, large tracts whose value is derived primarily from timber production are particularly reliant on the underlying productivity. The average growth rate of pine timber classes in the surrounding area is both statistically, and economically significant as a unit increase in growth rates increases the per acre timberland price by 2.7%.

Results from Model I indicate that timberland prices in Alabama are higher than five southeastern states (Arkansas, Louisiana, North Carolina, Texas, Virginia). While other states have positive coefficients, they are not statistically significant. Interesting and significant research could be conducted to further explain the differences in land prices between these states.

The variable ‘slash’ and ‘mix’ are both significant at the 1% and 5% levels respectively. Both have a negative sign, as expected, indicating that properties dominated by loblolly sell at a premium compared to those composed of slash pine or a mix of slash and loblolly.

Lastly, the exchange rate is significant at 1% and has a negative relationship to the price of timberland. As discussed earlier, this is expected. As the dollar falls, the price of timberland is expected to increase as foreign capital flows into the asset class. From the results of this model, a one unit increase in the index (increase in the value of the US dollar) causes the timberland price to fall by 0.6% (or $6 for a tract of timberland selling at $1,000 per acre). In 2008 the index increased from 69 to 80 within a year, so the effect is not insignificant.

Model II was estimated in an attempt to gain the greatest explanatory power with a limited number of variables. Results indicate that the amount of merchantable timber has a substantial impact on the sale price, as both pulpwood and saw timber variables are positive and significant at 1%.

As in Model I, the variable ‘Sale Acres’ is significant in Model II. Also, there is a negative coefficient of -0.00383, implying that a decrease in tract size of 10,000 acres increases the per acre sale price of timberland by 0.38%.

Also as in Model I, variables accounting for merchantable timber volumes (Pcns_acre and Psaw_acre) are also significant and enter the model early. As expected, the coefficients are positive and economically significant.

The variable S&P 500 is significant and positive, as is the variable measuring the county population density. Both of these results confirm the results of the first model and support the hypotheses presented earlier.

Four states, Florida, Georgia, Louisiana, and Texas also enter into the regression. As in Model I, Louisiana and Texas timberland sell at a discount to Alabama, but Georgia and Florida lands sell at a premium. This is indicative that some unknown variable(s) is impacting these prices. Again, this further supports the results from the first model, and the hypothesis that the state location of a property can play a significant role in determining timberland price. Additional research should be done in this area.

Lastly, the exchange rate is once again significant at 1% and has a negative coefficient. The results from Model II indicate that a one unit decrease in the dollar index indicates that timberland prices would rise by 0.8%.

Conclusion

In recent decades, significant changes have occurred in regards to ownership of large timberland properties. Once viewed as a source to feed a mill, timberland has become an asset held by sophisticated investors, seeking to maximize its value as part of a diversified portfolio of investments. While significant research has investigated the determinants of small timberland holdings, limited research has been done to investigate the properties of large timberland holdings.

This study attempts to evaluate 389 actual timberland sales which occurred between 1997 and 2010 through the use of a hedonic model, to determine what drives the timberland price. The most significant determinant seems to be the amount of standing, merchantable timber on the property. This is expected as the primary purpose of owning these properties is to generate cash flows from timber harvest. Standing timber is in many ways equivalent to 'money in the bank' and only needs to be harvested in order to make a withdrawal.

In addition, variables describing local market conditions for land such as population density and states (which may proxy tax effects, lifestyle, climate) had a significant effect in both Model I and II. Additional evidence from Model I suggests that timber productivity variables such as the pine growth rate and premerchantable ratio also have significant effects on the timberland price. This is expected, as the primary objective of owning a timberland investment is to generate cash flows from timber harvest. Greater productivity increases cash flows and is expected to increase the price of timberland.

Also, Model I suggests that financial variables such as prices, market indexes, and exchange rates impact the price of timberland as well. As owners of timberland seek to maximize returns and minimize the risk of their portfolios, it seems logical that macro economic considerations would play into their decisions on whether and how to participate in the market for timberland.

The significant variability in timberland prices between the nine different states suggests room for further research into why and what causes these differences. In addition, little work has been done to evaluate the effect of exchange rates on US timberland. It is possible that the effect is different in different markets. For example, as the northwest exports more timber to Asia, it is possible that a weaker dollar has different effects on land prices than it does on Southeastern timberland where a significant amount of the product is destined for domestic fiber markets.

CHAPTER 3

Derivation of the Timberland Discount Rate

Introduction

United States timberland covers an area of over 500 million acres (22% of total area) and has an estimated value of $460 billion. It supplies a domestic forest products industry that generates $240 billion per year, as well as overseas markets, and employs over 1.8 million people (Newell and Eves, 2009).

The nature of timberland ownership in the US has changed drastically over previous decades, as large tracts of timberland have changed hands from vertically integrated forest products companies (VIFPCs), to those of institutional investors such as pension funds, insurance companies, foundations, and endowments. Timber Investment Management Organizations (TIMOs) helped to facilitate this transfer of ownership by purchasing, selling, and managing these lands on behalf of institutional investors (Hickman, 2007). From 1981 to 1997, institutional ownership of timberland grew from $4.2 million to just under $5.6 billion (Caulfield, 1998). By 2005, total investment in timberland by TIMOs and REITS (Real Estate Investment Trusts) had grown to over $25 billion (Hickman, 2007).

The nature of timberland as an investment has been well established in the financial and forestry literature (Zinkhan et al, 1992, Binkley et al, 1996, Caulfield, 1998, Cascio and Clutter, 2008, Newell and Eves, 2009). Studies have found that timberland returns have a low correlation with other investments such as stocks and other real estate classes, serving to add diversification to a portfolio. In addition, timberland investors are taxed at the lower capital gains rate, adding to its attractiveness as an investment.

While significant research has focused on timberland investments, a question that continually arises among both appraisers and investors is what discount rate to use when valuing timberland cash flows.

From an appraiser's perspective, this is also an important topic to address. Appraisals are conducted frequently on timberland properties. While foresters at appraisal and consulting firms have a solid grasp on estimating the future growth and volume of timber inventories, and price forecasting methods are available, settling on a discount rate to value future cash flows is a reoccurring topic.

The basic idea behind discounting future revenues is that $1 received today is worth more than $1 received tomorrow. Cash flows received in the future must be discounted appropriately to be comparable to an investment made today. To demonstrate the effect that differing discount rates can have on the price of an asset, consider the following formula for an annuity, as presented by Gunter and Haney (1978):

$$Vo = a[\frac{(1+i)^n - 1}{i(1+i)^n}]$$

where, *Vo* is the value in year zero (present value)

a is a periodical payment

n is the number of years

and *i* is the interest rate (discount rate)

Suppose that the investment we are considering provides $400,000 of net cash flow each year for 100 years. Consider two cases, one where the discount rate is 4% and one where the discount rate is 5%. In the first example, the present value of the cash flows is just over 9.8 million dollars. When the discount rate increases to 5%, the present value of the cash flows decreases to just over 7.9 million dollars; a difference of approximately 2 million dollars. Making the mistake of using an incorrect discount rate, even when off by only 1% can be very costly.

The concept that a dollar today is worth more than a dollar received tomorrow has laid the foundation for discounting future revenues. But a second key concept is also crucial in determining the appropriate discount rate. This is the concept that "a safe dollar is worth more than a risky dollar" (Strong, p 11, 2000). The discount rate is composed of both the safe rate, or *risk free* rate (compensation for delaying consumption), as well as a risk premium. In evaluating cash flows over time, selection of the correct discount rate will depend upon correctly identifying and quantifying the risk associated with the investment (Strong, 2000).

The total risk of an investment is measured by the variance or standard deviation of the investment's returns, and is composed of two types of risk: systematic and unsystematic. Unsystematic risk can be diversified away as explained by Evans and Archer (1968). Systematic risk is the risk remaining after there are no further benefits from diversification. This is known as 'market risk', and is easily described as the degree of correlation between the returns of a particular investment, and the returns of a 'global portfolio' of investments (often proxied by returns to the S&P 500 in empirical work). Elaborating, this risk exists due to investors' desire for smooth consumption over time. If a particular investment performs well when the market does not, it is more attractive as it allows consumption patterns to continue during a time that would otherwise see a decrease in wealth. The opposite holds true for an investment that is highly correlated with the market and is less attractive as it offers no benefit when the market performs badly and consumption is impacted accordingly (Cochrane, 2005).

Investors are not rewarded for bearing unsystematic risk. They are only rewarded for the systematic risk that they bear. This risk is measured by an asset's beta (ß) (Strong, 2000). Mathematically, beta can be shown from the Capital Asset Pricing Model (CAPM), as presented by Binkley et al (1996):

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f)]$$

where, $E(R_i)$ is the expected return on asset i

R_f is the risk free rate of return

$ß_i$ is the beta of asset i

and $E(R_m)$ is the expected return on overall market portfolio.

Therefore, $E(R_m) – R_f$ is the expected risk premium on the market portfolio. As beta goes up, so goes the asset's systematic risk. An asset with a beta of one is expected to earn the market rate of return. An asset whose beta is greater than one is expected to earn higher returns than the market, and an asset whose beta is lower than one should earn a lower return than the market. An asset with a beta of zero should earn the risk-free rate of return, and an asset with a negative beta should earn even less (Binkley et al, 1996). One should not interpret a small or negative beta, earning a low rate of return, as an undesirable characteristic, but rather as an indicator that inclusion of the asset will lower the risk of the portfolio (Zinkhan, 1992).

CAPM is forward looking and predicts what beta ought to be in the next period. "We can only perform statistical tests on events that have already occurred; we cannot test future events. It is possible, however, to attempt to predict future events using past data…" (Strong, p 147, 2000). In practice, researchers and analysts often use the terminology *CAPM*, when what they are really referring to is the *market model*. The market model analyzes past returns of an asset by regressing them on a market index's returns and so describes previous behavior of prices. This analysis of past behavior of an asset's price behavior and that of the overall market can provide insight to expected future relationships. Similar to CAPM, the equation for the market model, as presented by Strong (2000) is:

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

where, R_{it} is the return on asset i in period t

α_i is the intercept (alpha)

$ß_i$ is the beta for asset i

R_{mt} is the market return for period t

e_{it} is the error term on asset i for period t.

There are several assumptions underlying the CAPM. Two of these that are important to point out are that "there are no taxes or commission costs", and that "investors look only one period ahead". "We know that people are concerned about taxes…[and] that many people do look ahead more than one period" (Strong, p 156-147, 2000). This is particularly true with an investment in timberland. As previously discussed, tax advantages are a key component of timberland's attractiveness to investors. Also, when investors commit to a timberland investment (in the form of a

TIMO), there is a mandatory investment period of approximately ten to fifteen years. Thus, the one period model may be insufficient for valuing timberland. Additionally, Binkley et al (1996) state that, "CAPM is a single-factor model, postulating that the risk of an asset derives solely from exposure to fluctuations in returns for the overall market portfolio" (p 26). The low R^2 value reported from their CAPM estimates of timberland suggests that only a small percentage of the variability in timberland returns is explained by returns of the overall market. The authors state that, "other factors may be 'priced' by asset markets, and thus increase or decrease the 'riskiness' and required return for the asset. For timberland, these additional factors include comparatively high information and transactions costs and illiquidity. Thus, there may logically be a disparity between the level of return that timberland has produced (and is expected to produce in the future) and the level the CAPM suggests" (Binkley et al, p26).

A second complication arises in using CAPM to evaluate a timberland investment. That complication arises from the data which is used. NCREIF (National Council of Real Estate Investment Fiduciaries) is the index of choice for those wishing to model timberland returns relative to the market, or macro economic variables such as inflation. Healey, et al (2005) describe some of the problems posed with NCREIF data.

The NCREIF Timberland Index has been criticized as suffering from a number of limitations. First, the income component of NCREIF timberland returns is overstated, as it is based on EBITDA, before fees, and not on net income. Second, the NCREIF Index is a property-level index and not a fund-level benchmark. Third, not all managers report their returns to NCREIF using GAAP-based accounting standards, and at least one reporting manager employs cash, rather than the accrual basis accounting system required under GAAP. Fourth, many of the returns reported to the index are based on appraisals, not on actual transactions. Fifth, the index debuted in 1987, which was a trough year in timber prices, and the total index may not include a complete business cycle. Sixth, the index may be skewed upward by a small number of properties in specific *geographic regions since total returns are calculated as a weighted average; exceptionally high returns for a single property can skew the returns for any particular region. Finally, although the index tracks the performance of a large and diverse number of timberland properties (valued at over $3.7 billion), it does not track all institutional timberland investments (pg 73).*

While questions exist with the data and appropriateness of the methodology in calculating the required rate of return for timberland, researchers and practitioners still need the best available information with which to make decisions. While NCREIF data and the use of CAPM may not be optimal, much can be learned by utilizing both.

Literature Review

Zinkhan (1988) used the Southern Timberland Index Fund in a Capital Asset Pricing Model (CAPM) analysis to evaluate timberland returns. CAPM evaluates how an asset's returns move with respect to those of the broader market in order to analyze its market risk. An asset with beta greater than one is deemed more risky, while an asset with a beta less than one can decrease the risk of a portfolio. A negative beta asset is negatively correlated with the market and its required return is less than the risk free rate (proxied by the appropriate Treasury security). With his analysis, Zinkhan determined that timberland was a negative beta asset, implying a 4.3% discount rate, or a rate lower than the risk free rate. Such an investment has attractive diversification benefits, reducing the overall volatility of portfolio returns.

In a later study, Zinkhan (1992) reports the beta of different timberland investments presented in numerous peer-reviewed articles published between 1981 and 1989. These include pine and hardwood timberland investments from both the Southeastern United States, as well as the Pacific Northwest, over varying periods of time. These betas ranged from -0.93 to 1.19. With a risk free rate of 8%, and returns to the market portfolio of 8.4%, the required rate of return, based upon CAPM, for the differing timber investments ranged between 0.2% and 18% (Zinkhan, 1992). Again, these are different assets with betas calculated at different points in time, so a wide range of betas is not a surprise. In the case of a negative beta asset, when the market (proxied by the S&P 500) has negative returns, the negative beta asset will have positive returns, reducing the overall losses of the investment portfolio. An asset with a positive beta less than one moves in the same direction as the overall market, but with less magnitude, helping to smooth returns, and hence the final objective, consumption.

Klemperer et al (1994) use certainty equivalents to make the theoretical case for discount rates lower than typically found using risk adjusted discount rates. In 1996, Binkley, Raper, and Washburn used the John Hancock Timberland Index to calculate timberland returns. With these returns, the authors found timberland to be a negative beta asset with positive alpha (returns in excess of those justified by its risk). More recently, Cascio and Clutter (2008) used NCREIF data to find that Southern timberland had a beta of .147 (positive but significantly less than one), which ranged from -0.137 to 0.279 within the South. Assets with a small but positive, or negative beta, serve to reduce risk through portfolio diversification, while assets with a positive alpha generate excess returns. A large volume of previous research, as discussed above, provides evidence that timberland is an asset which exhibits both characteristics, serving to reduce portfolio risk, and generate returns in excess of those required to compensate investors for risk.

Problems exist in using CAPM to evaluate the riskiness of timberland investments. Stumpage prices, used to calculate returns, are based on quarterly averages

(Washburn and Binkley, (1989) which may understate volatility. Also, when beta is calculated based upon NCREIF returns, capital gains are based upon appraisals. There are also several assumptions of CAPM which do not hold for timberland investments. One is that there are no taxes and that investors are only looking one period forward (Strong, 2000). As the favorable tax advantages of timberland for institutional investors are well documented, this assumption is obviously violated. In addition, timberland ownership is a long term investment, and investors are looking forward much further than one period. Also, as pointed out by Binkley (1996), "CAPM is a single factor model, postulating that the risk of an asset derives solely from exposure to fluctuations in returns for the overall market portfolio" (p 26). The low R2 value reported from their CAPM estimates of timberland suggests that only a small percentage of the variability in timberland returns is explained by returns of the overall market. The authors state that, "other factors may be priced by asset markets and thus increase or decrease the 'riskiness' and required return for the asset. For timberland, these additional factors include comparatively high information and transaction costs and illiquidity. Thus, there may logically be a disparity between the level of return that timberland has produced (and is expected to produce in the future) and the level that CAPM suggests" (p 29). In light of these issues, other researchers have addressed the issue from different perspectives.

Sun and Zhang (2001) analyzed different forest-related investments from the perspective of both CAPM as well as arbitrage pricing theory (APT). In their analysis the authors use the Timberland Performance Index (TPI) and the NCREIF Timberland Index to evaluate the performance of institutionally held timberland. The estimated betas of the CAPM are .07 and -.05 for the TPI and NCREIF respectfully, however, these estimates are not statistically significant at the 10% level. For the APT analysis, 8 forest-related assets (including TRI and NCREIF) and 10 non-forest related assets were used to extract 5 factors. Betas were calculated but are not reported here for the sake of time and space. However, it is important to note that from the CAPM and APT analysis, the respective required rates of return are 6.12 and 12.06 for the Timberland Performance Index, and 4.73 and 7.93 for the NCREIF Timberland Index. The differences in required rates of return are both statistically and economically significant.

Scholtens and Spierdijk (2010) use a mean-variance framework to analyze the possible diversification benefits of including timberland in an investment portfolio. At first, their results seem to confirm the previously described attributes of a timberland investment. However, the authors then address the issue of appraisal smoothing bias.

In all the previously described studies, the authors evaluated the risk and return characteristics of timberland based upon an index such as the John Hancock Timber Index or the NCREIF Timberland Index. Such an index is subject to an appraisal smoothing bias, which understates the volatility of the asset. The problem associated with such an index is described by Scholtens and Spierdijk (2010):

Timberland properties are not traded frequently enough to construct a transaction-based index. For this reason the NCREIF Timberland Index is based on appraisal values. Timberland properties are appraised on the basis of recent transactions of comparable properties, and these appraisal values are used to construct the index. As a consequence, the NCREIF Timberland Index may suffer from an appraisal smoothing bias and may contain certain inertia. A major concern is that the volatility of the observed index returns is too low compared to the true (unobserved) index. This would seriously distort a mean-variance analysis, resulting in a too optimistic picture of the diversification potential of timberland. To avoid analyzing NCREIF Timberland Index returns with too low a volatility compared to the true returns, we consider an unsmoothed version of the index… The unsmoothed index returns have the same mean as the raw index returns, but a substantially higher volatility (p 518).

The results of the research show that after adjusting for the appraisal smoothing bias, the inclusion of timberland does not seem to improve the risk adjusted returns of the portfolio of investments (Scholtens and Spierdijk, 2010).

Underestimating the volatility of timberland returns would lead to the use of discount rates which are below that which should be used in discounting a riskier asset. Steve Burak (2001) approaches the topic using actual timberland transaction data, instead of that provided by NCREIF. Thirty-eight timberland tracts located in Georgia and Florida, and ranging from 5,000 to 104,750 acres were used in his analysis. The sales occurred between the years 1988 and 1998 and sales prices ranged from approximately 2.5 million dollars to 123 million dollars. Using information provided in the appraisal summaries, Burak forecasted the future timber harvest each year, and combined with forecasted timber prices, projected the future cash flows over the ensuing 100 years. The discount rate was solved for as the rate that equated the future cash flows to the given sale price. There was wide variability in the discount rates, ranging from 2.82 percent at the low end, to 9.90 percent at the high end (Burak, 2001).

After deriving the discount rate, Burak attempted to determine what factors affect this rate and to what extent. His model is based on the premise that the discount rate is a function of the safe rate (or risk free rate), as well as a risk premium which can be further defined as a function of market risk and project risk.

Just as the beta in the CAPM describes how the return from asset *i* moves with respect to the market, so the betas in Burak's model describe how the discount rate of a timberland tract move with respect to each variable. Variables describing the risk free rate, corporate bond returns, location of the timberland tract, species, and price expectations all have a significant effect on the timberland discount rate (Burak, 2001).

Taking Burak's lead, this study analyzes discount rates using actual sale data to derive discount rates. Using actual sale prices from timberland transactions, and associated property characteristics, cash flows were modeled, and we were then able to solve for the discount rate which equated the sale price to the forecasted cash flows.

Data

Data was provided by Sizemore & Sizemore, Inc., an appraisal and management consulting firm located in Tallassee, AL. The initial data set consisted of 659 timberland transactions which occurred over the years 1988 – 2010 and covered 9 states. However, some sales were missing significant amounts of data such as the amount of premerchantable and merchantable timber, and/or had large amounts of non-forest land and hardwood timber production. In an effort to analyze investment-grade pine plantations in the Southeastern United States, the final data set was limited to tracts in excess of 5,000 acres, composed primarily of slash and loblolly pine, or some mix. The data set consists of properties in nine states from Virginia to Texas. After filtering the data to meet the above specifications, the final data set consisted of 416 transactions, all occurring between the years 1997 and 2010.

Of the 416 sales analyzed in this study, the size of the tracts range between 5,050 acres and 4.7 million acres, with the average size being 98,834 acres. The median size is 18,496 acres. The total sale price ranged between 3.2 million dollars and 5.7 billion dollars, with the average transaction price being 129.9 million dollars. The median sale price is 23.2 million dollars. For a better indication of asset prices, the per acre sale price ranged from 565 dollars per acre, to 5,369 dollars per acre, with the average price being 1,313 dollars per acre. The median per acre sale price is 1,214 dollars per acre. Once adjusted to 2010 dollars using the CPI for all urban consumers, the real per acre price of timberland ranged from a minimum of 685 dollars per acre, to a maximum of 5,602 dollars per acre, with the average real price of timberland being 1,468 dollars. The median real price per acre is 1,383 dollars.

Table 6		Timberland Descriptive Stats				
Variable		Observations	Mean	Std Dev	Minimum	Maximum
Transaction Size (acres)		416	98,834	363,393	5,050	4,759,063
Sale Price		416	129,932,593	465,011,194	3,232,785	5,710,875,600
Price Per Acre		416	1,313	511	565	5,369
Real Price Per Acre (2010)		416	1,468	526	684	5,602

Table 7		State-Based Data Description				
State		Years	Observations	Avg Size (acres)	Avg Price/Acre	Avg Real Price/Acre
AL		1997-2010	58	103,262	1,337	1,480
AR		2000-2010	40	66,402	1,333	1,443
FL		1997-2010	51	59,659	1,253	1,485
GA		1998-2009	84	29,898	1,521	1,695
LA		2000-2010	40	311,794	1,275	1,426
MS		1997-2009	31	58,333	1,128	1,286
NC		2000-2009	21	34,663	1,373	1,474
TX		2001-2009	61	189,098	1,197	1,306
VA		1999-2010	30	21,473	1,213	1,387

Timberland is a heterogeneous asset. Each tract of timberland is different from another. In addition to other characterstics, properties may vary in size, age class of timber, and location. Therefore, when trying to gain a perspective on how timberland prices have moved over time, it is incorrect to directly compare the sale of one property at a point in time, to the sale of a different property at another point in time. To gain a perspective on how the price of timberland has changed over the previous ten years, a moving average of the transactions was created from the data. Rather than constructing the average based on a specified time period, the average price of the previous ten transactions was taken to arrive at an average real price per acre. This ensured that the effects of different characteristics such as size and location were averaged out. Four extreme outliers were removed from the data, and the moving average starts in year 1999, due to the dispersion of observations in previous years. A discussion of historical price behavior of southern timberland is provided in Chapter Two.

Methodology

A discounted cash flow model was used to derive the discount rate associated with each transaction. Given the timber growing characteristics of each tract, cash flows from timber harvest could be forecast, and the discount rate equating future net cash flows with the sale price can be determined. The standard equation to discount cash flows is:

$$PV = \frac{Future\ Value}{(1+i)^n}$$

Where i = the discount rate

n = number of periods (years in this analysis)

For multiple cash flows, the present value is simply the sum of all future net cash flows, discounted to the present:

$$PV = \frac{FV_1}{(1+i)^1} + \frac{FV_2}{(1+i)^2} + \ \ldots + \frac{FV_n}{(1+i)^n}$$

Once the value of each future cash flow has been forecast (revenue from timber harvest in each year), the discount rate that equates these cash flows with the sale price (PV), can be determined.

Forecasting Cash Flows

There are three components to forecasting cash flows. The first is determining the volume of wood in each product class that is available for harvest each year in the future. The second is determining the price at which each product will be sold. These two components make up the revenue portion of net cash flows. The third component is determining management and input costs to be subtracted from revenues in order to calculate the net cash flow in each year.

This analysis assumes that timberland properties are purchased based primarily on their capacity to produce income from timber production. As mentioned previously, the minimum timberland tract size included in this analysis was 5,000 acres. While the minimum size chosen was somewhat arbitrary, it was the intent to not include any properties from which significant value derives from recreational opportunities, second homes, and characteristics of smaller timberland properties. While the ability to sell smaller parcels of higher and better use (HBU) property is often mentioned as one of the attractive characteristics of a timberland investment, it is difficult to anticipate such opportunities and many investment managers do not anticipate any HBU revenue when evaluating a timberland acquisition (FIA, spring 2011). It is the intent of this study to evaluate timberland investments, so the assumption is that all revenues during the timberland holding period (20 years) derive from timber harvest and the eventual sale of the property. At the end of the twenty year period, the tract is assumed to be sold, and any capital gains due to bare land value appreciation will be reflected by the real increase in the regional farmland value as reported by the national agricultural statistics service (NASS). As timberland can be converted to farmland and vice versa, there is a correlation between farmland and timberland values. This correlation has grown weaker in recent years as commodity prices have increased substantially. However, for most of the time period covered by this data set, the assumption seems appropriate.

Current Inventory

The data set used for this study breaks merchantable timber into five classes: hardwood pulpwood, hardwood saw timber, pine pulpwood, pine chip n saw, and pine pulpwood. The volume of each product in tonnage for each sale is listed within the data set. This is the current timber inventory which is available for harvest as merchantable timber. While managers of timberland investments can plan harvests in order to maximize returns, we did not have the same information that an investor would have access to as the purchaser of the property. Primarily, in determining the optimal rotation age and liquidation period, the manager would take into account the required rate of return for the investment, which is what we are trying to determine. Additional factors that may influence harvest decisions are future price and interest rate expectations. For this study, the assumption was made that merchantable timber was liquidated over a ten year period.

The growth of existing stands was determined from Forest Inventory and Analysis (FIA) county level data. This data lists the average growth rate for pine pulpwood, pine sawtimber/chip n saw, hardwood pulpwood, and hardwood saw timber by county. An average was taken of the primary county in which the tract is located, as well as the surrounding counties, to determine the growth rate of each product. This is because the tracts were often located in multiple counties, and there may be very few sample plots in a county at the same time growth rates may fluctuate significantly from one location to another.

Growth and Yield

To forecast the future cash flows from a timberland investment, some assumptions must be made. One of the most important is the management regime utilized by the investor to produce timber. A variety of management decisions must be made, ranging from the lowest intensity of silvicultural practices, such as simply planting trees and waiting for them to grow, to the highest intensity, including site preparation, planting of genetically improved seedlings, fertilization, herbicide, and thinning. Siry (2002) reports that intensive pine management practices have the ability to nearly double the growth and yield of pine plantations. Allen et al (2005) report that growth rates exceeding 10 tons/year/acre can be achieved in the Southeastern United States. Such differences in growth rates will have a significant influence on the volume of wood produced, as well as the costs associated with production, hence affecting the discount rate that equates cash flows with the sale price. Speculating as to what methods of production were used to grow timber on each site and in each period of time is difficult, so multiple management regimes were evaluated for each property, with a different discount rate calculated for each regime.

For sales/transactions from the years 1988-1999, 'low' and 'medium' intensity management regimes were evaluated, with the addition of a 'high' intensity regime for 2000 and later sales to reflect new production methods and genetics. The evaluation of three different regimes follows in the spirit of Allen et al (2005) who also evaluated three levels of silvicultural treatment for southeastern forests, incorporating 'low', 'medium', and 'high' intensity management regimes. To arrive at the three silvicultural regimes the study evaluated, as well as their associated costs, an extensive review of published research was conducted (Albaugh et al, 2007; Fox et al, 2007; Allen et al, 2005; Jokela et al, 2010; Yin and Sedjo, 2001) as well as a review of industry publications such as Forest Farmer and Forest Landowner. Extensive talks with forest researchers, investors, and appraisers also took place to gain further insight into the different management regimes employed over time. With a wide diversity of forest professionals, all with different backgrounds and experiences, it is impossible know with certainty what management practices may have been envisioned for the purpose of pre-purchase evaluation on each site. This study sought to gain insight and recommendations from a wide variety of sources to arrive at management assumptions that are representative of the management practices that were likely to have been considered in a variety of places and at different times. From any particular point in time, cash flow projections assumed cost and prices would remain constant in real terms. The tables below describe the management regimes utilized in this study:

Table 8 Management Regimes (1988-1999)

	J-1-L	**J-1-M-C**	**J-1-M-P**
Site Prep:	Single Chop-Burn	Shear-Chop-Bed	Shear-Chop
Seedlings: Method: TPA: 1 yr survival:	1^{st} Generation Hand Plant 580 90%	1^{st} Generation Hand Plant 580 90%	1^{st} Generation Hand Plant 580 90
Herbaceous Weed Control	None	Band Early-year1	Band Early- Year1
Fertilization:	None	Age 0-Elemental P-50lbs/ac	Age 0-Elemental P-50lbs/ac
Thinning:	None	Age 19-5^{th} Row + Selection-to 60 BA	Age 19-5^{th} Row + Selection- to 60 BA

Where each regime is as follows:

J-1-L : 1988 – 1999 Low Intensity Management (Coastal & Piedmont)

J-1-M-C: 1988 – 1999 Medium Intensity Management (Lower Coastal Plain)

J-1-M-P: 1988 – 1999 Medium Intensity Management (Upper Coastal & Piedmont)

Table 9 Management Regimes (2000-2010)

	J-2-L	J-2-M-C	J-2-M-P	J-2-H-C	J-2-H-P
Site Prep:	Single Chop-Burn	Single Bed-Burn Chemical: No woody/No Grass left	Burn Chemical: No Woody/No Grass Left	3 in 1 Plow Chemical: No Woody/ No Grass Left	Rip – Disk Chemical: No Woody/ No Grass Left
Seedlings: Method: TPA: 1 yr survival:	2nd Generation Hand Plant 580 90	2nd Generation Hand Plant 580 90	2nd Generation Hand Plant 580 90	2nd Generation Hand Plant 580 90	2nd Generation Hand Plant 580 90
Herbaceous Weed Control	None	None	None	Band Early-Year 1	Band Early – Year 1
Fertilization	None	Age 16-DAP 125, Urea 380	Age 16-DAP 125, Urea 380	Age 2-DAP 200 lb/ac Age 5 – DAP 125, Urea 380 Age 9 – DAP 125, Urea 380 Age 13-DAP 125, Urea 380 Age 19-DAP 125, Urea 380	Age 2 – DAP 200 lbs/acre Age 5 – DAP 125,Urea 380 Age 9 – DAP 125, Urea 380 Age 13-DAP 125, Urea 380 Age 19-DAP 125, Urea 380
Thinning:	None	Age 16-5th Row + Selection-to 60 BA	Age 16-5th Row + Selection-to 60 BA	Age 13 – 5th Row + Selection – to 80 BA Age 19 – From Below – to 50 BA	Age 13-5th Row + Selection – to 80 BA Age 19-From Below –to 50 BA

Where each regime is as follows:

J-2-L: 2000-2010 Low Intensity Management (Coastal & Piedmont)

J-2-M-C: 2000 – 2010 Medium Intensity Management (Lower Coastal Plain)

J-2-M-P: 2000 – 2010 Medium Intensity Management (Upper Coastal & Piedmont)

J-2-H-C: 2000 – 2010 High Intensity Management (Lower Coastal Plain)

J-2-H-P: 2000 – 2010 High Intensity Management (Upper Coastal & Piedmont)

The base site index (measure of soil productivity) for each species was determined by the location of each property and also the primary species grown on each property, reported at age 25. While site index may vary significantly even within a stand, such detailed information was not available and assumptions were made based on a review of previous studies which detail site index conditions for various locations and species (Pienaar et al, 1989; Borders et al, 1990). For slash pine grown in both the lower coastal and upper coastal plain, a base site index of 60 was assigned. For loblolly pine grown in the lower coastal plain, a base site index of 62 was assigned, while for loblolly grown in the upper coastal plain and piedmont, a base site index of 59 and 56 was assigned, respectively. This is a measure of dominant tree height at age 25, with minimal management. For example, using the above information, the expected height of a dominant loblolly pine grown in the upper coastal plain is 59 feet at age 25. As management regimes are intensified and incorporate practices such as herbaceous weed control, fertilization, and thinning, the height of dominant trees at age 25 will increase.

Growth rates may also be variable within a tract of timberland. Such detailed information at the tract level was not available. To forecast future timber volumes for existing inventories, growth rates were obtained from the Sizemore and Sizemore, Inc. data set described earlier and included the growth rate of different pine products by county from USDA Forest Service FIA data. Due to the small number of plots within a county which are sampled to arrive at FIA county level statistics, as well as the nature of many properties to span multiple counties, average growth rates were determined based on the primary purchase county and those surrounding it.

Additional assumptions had to be made related to timber harvest, particularly the liquidation of mature standing timber. Given a discount rate, forest practitioners can solve for the optimal harvest age and rotation. Since solving for the discount rate is a major objective of the research, this was not possible. An attempt was made to choose the liquidation period that maximized the rate of return, but often resulted in unrealistic liquidation periods. For example, immediate liquidation of a large tract's mature timber may be impractical due to environmental concerns and/or a flooding of the local markets, decreasing prices for the timber products being sold. Therefore, a liquidation period of 10 years was assumed. A 25-year rotation was used to plan harvests and determine the value of immature and regenerated stands following the liquidation of the standing timber.

Product Prices

Once wood flows were determined, price assumptions had to be made to generate a forecast of cash flows. Keeping in mind the objective to determine past discount rates used to value timberland in actual transactions, an attempt was made to determine what price expectations and assumptions investors had related to stumpage markets when making their investment decision. After an extensive review of stumpage price models, it was determined that to speculate what assumptions the market had about future price fluctuations was a guess at best. An excellent review and evaluation of stumpage price forecasts is provided by Mei et al (2010). Regional stumpage prices reported by Timber Mart South (TMS) during the quarter preceding the date of sale were used as the product price to forecast cash flows going forth (zero percent real growth). This is a reasonable assumption. While at one time, real price gains over long periods of time were seen as an attractive quality of timber, this is unsustainable as production increases, technology increases efficiency, and other materials are substituted. This is supported by Rinehart (2010) who states that real price appreciation is generally set at zero when calculating expected income.

Profit Maximization

Using the traditional Faustmann approach, one solves for the optimal timber rotation given the discount rate and a stable series of future cash flows. As described previously, this information was not available in our study, so certain assumptions had to be made in determining the cash flows from timber harvest. However, timberland returns come not only from operational cash flows, but also from capital gains as the underlying land value appreciates. While our analysis assumes potential HBU sales are not factored into periodic cash flows, land values appreciate over time due to land uses other than timber values. The timberland conversion option is explained in detail by Zinkhan (1992). While the classical model of forest valuation assumes bare land value is derived from perpetual cash flows associated with management activities and timber harvests, such assumptions ignore the possibility of conversion to cropland or other uses such as development arising in the future. Cropland also shares the same options as fields can be planted to timber or converted to some other use such as development property. In a study spanning the years 1987 - 2007, Newell and Eves (2009) found that farmland values are significantly (P<5%) and positively (.33) correlated with southern timberland values . In a sub-period analysis, the same study found a significant (P<5%) and positive correlation (.72) between timberland and farmland real estate prices for the period 1997Q3-2007Q2. This is a dramatic increase from a statistically insignificant and smaller correlation (.15) during the sub-period 1987:Q1-1997Q2. TIMOs generally hold timberland for a specified period of years in each fund and periodically, sales of timberland occur. In order to reflect the gain in land value due to other sources of bare land value appreciation, it was assumed that after twenty years of timber management and harvest, each tract in the sample was sold, and the bare land value experienced an increase in value as estimated by the annual rate of real appreciation of farmland value in the respective region, reported by NASS.

With all the cash flows estimated, and given the sale price recorded with each transaction, the timberland discount rate could then be determined. Results are summarized in the tables below:

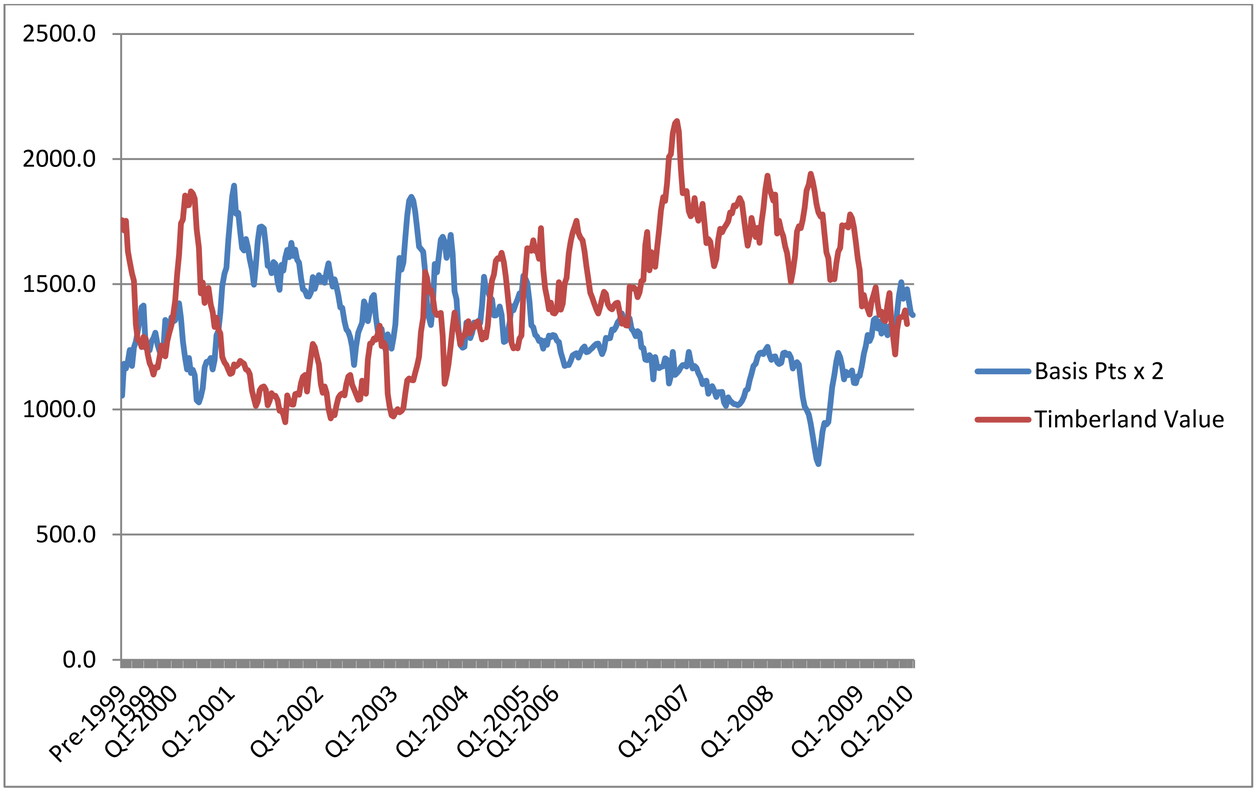
Table 10	Derived Discount Rates (For All Sales~659 Transactions)					
REGIME:		Mean	Variance	Std Dev	Min	Max
Low		6.2%	1.8%	4.26%	-10.36%	67.57%
Medium		8.1%	2.0%	4.55%	-10.36%	66.77%
High		12%	0.22%	4.77%	-10.36%	32.86%

Table 11	Derived Discount Rates (Filtered Sales~412 Transactions)					
REGIME:		Mean	Variance	Std Dev	Min	Max
Low		6.59%	0.03%	1.7%	1.04%	14.19%
Medium		8.98%	0.06%	2.6%	1.93%	25.19%
High		12.5%	0.17%	4.2%	2.46%	28.78%

Discussion

In the following chart, estimated real discount rates are presented in relation to the real price per acre (2010) of timberland associated with the transactions in the data set. To smooth the data, and due to the inconsistent number of sales in each quarter, and year, a 10 sale moving average was constructed. For visual purposes, the discount rate is presented as basis points multiplied times two, where a single basis point is 1/100 of a percent, so that 100 basis points equals a 1% cap rate.

Figure 3 Real Timberland Price and Discount Rate



The data which make up this graph are based on individual sales, some with significantly different characteristics, and with differing time periods between sales. Hence, there is an obvious degree of volatility in the graph. This should not be taken as representative of the asset class. However, despite this volatility, some significant trends and relationships are obvious.

After 2000, timberland prices fell significantly, while the timberland discount rate experienced a dramatic increase. This makes economic sense, because as the discount rate increases, future cash flows are discounted more significantly, decreasing the timberland price. An additional explanation posed for falling timberland prices is decreasing cash flows. However, the model takes into account the current product prices when determining the discount rate. Therefore, falling prices should only affect the timberland price and not the discount rate (ceteris paribus). The exception would be if expectations about future cash flows were negative. In the above model, real prices are modeled as constant, so if prices were expected to decline further, the timberland price would go down, but according to our model, this would be explained by the discount rate, rather than expectations.

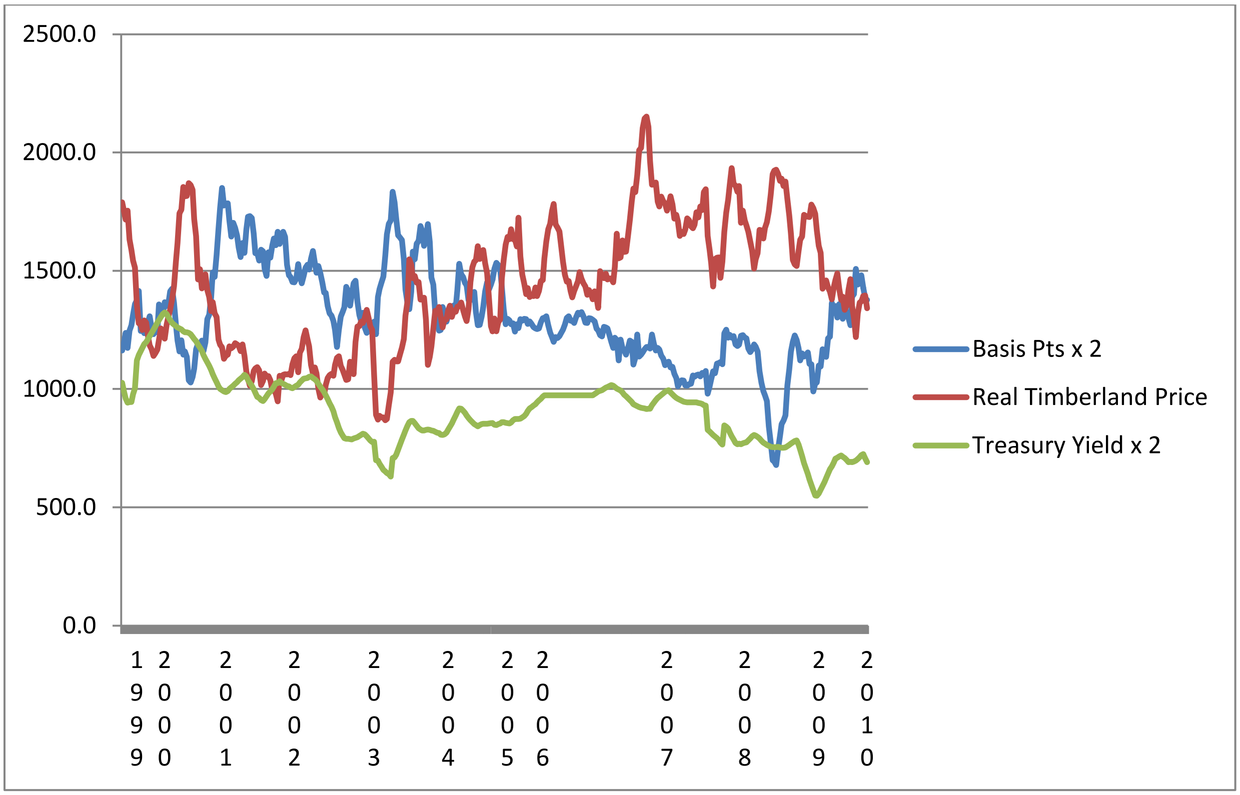
The real timberland price bottomed in 2001, and a strong uptrend is apparent starting in the first quarter of 2003 and lasting through the fourth quarter of 2006 and first quarter of 2007. This rise in prices is matched by a decrease in the timberland discount rate during this time period. Contrary to a rise in the timberland discount rate, a fall in rates discounts future cash flows by a smaller amount, hence raising asset prices. Again, this model forecasts a zero percent change in real stumpage prices, and no cash flows from HBU sales. If market assumptions are different (increasing real prices or HBU assumptions) the timberland price could increase without a decrease in the discount rate and the above chart would be incorrect. However, as timberland became a more desirable and well known asset, and as competition increased, it is very plausible that prices increased by putting downward pressure on discount rates, as shown above.

Lastly, a downward trend begins in 2007, with a significant decrease in timberland prices in the third quarter of 2008, lasting through 2009. This again is matched by an increase in the timberland discount rate, as risk is again priced into the asset class with real discount rates rising from a low of 3.5% upward to 7.5%.

A publication by Timberland Market Report (2011) shows a similar trend in real discount rates between the period 2000 and 2010, though it should be noted that this is an average of both Western and Southern timberland properties. TMR reports discount rates trending downward from a high of just under 7% in 2000, to a low of just over 4.5% in

2008. Since 2008, discount rates have once again increased to over 6%. For additional insight, it is helpful to include the yield on 10 US Treasuries to the above graphic.

Figure 4 Real Timberland Price, Discount Rate, and Treasury Yield



For most of the time period illustrated, there appears to be a casual relationship between the timberland discount rate, and the yield on 10 year US Treasuries. As the risk free rate is a crucial component in the cost of capital, this is expected. From pre-1999 to mid 2000 there appears to be a close relationship, before a dramatic divergence in 2001, in which real timberland prices fall while the discount rate increases substantially. After this divergence, the trend is closely correlated as the timberland discount rate, and 10 year Treasury yields decrease until 2003. It is at this time period in 2003, when the spread between 10 year Treasury yields and the timberland discount rate is the largest.

From this point, throughout the ensuing four years, the timberland discount rate falls while Treasury Yields gradually increase. This is accompanied by rising prices for timberland in the US South. It seems a plausible explanation that as investors piled into the asset class and comparative sales were analyzed with speculative HBU pricing, that the timberland price increased at the expense of the discount rate. For an empirical approach at explaining the discount rate, three models were created to evaluate the presence and impact of both systematic and nonsystematic risk in the timberland discount rate.

Determinants of the Timberland Discount Rate

Model I:

As discussed previously, only market risk should be priced into an asset. This market risk is also referred to as systematic risk and is non-diversifiable. So theoretically, the only source of risk is the covariance of the asset with the market portfolio. This is the foundation of the capital asset pricing model (CAPM). While the problems with using CAPM to evaluate the timberland discount rate have been discussed thoroughly, the first step in this analysis was to construct a model evaluating only the theoretically correct components of risk.

In practice, there are many sources of returns from a timberland investment. In addition to those from timber harvest, these can include payments for ecosystem services, hunting leases, and land appreciation from development needs, among other things. As previously described, for our analysis we made the simplifying assumption that our yearly cash flows derive only from timber harvest. To model the risk of these cash flows, the covariance of stumpage prices and the S&P 500 were calculated. Stumpage prices come from Timber Mart South (TMS) and data from the S&P 500 come from the St. Louis Federal Reserve. Since TMS prices are based on an average of surveyed prices from throughout the quarter, the average of daily S&P 500 values throughout the same quarter was used to calculate beta for a period using quarterly data for the previous five years leading up to each sale.

The second source of risk is the appreciation in underlying land value. As previously described, this was captured using the appreciation in farmland value as a proxy for gains in the underlying timberland value. The beta of these returns with the S&P 500 was also calculated. Farmland values are reported by the National Agricultural Statistics Service (NASS) on a yearly basis. Because of the lack in quarterly data and the resulting lack of observations, eight years of data was used to calculate beta.   The natural log of basis points (discount rate multiplied by 100 so that a 1% discount rate equals 100 basis points) was the dependent variable.

Variables:

(1) Basis Points = derived discount rate x 100

(2) Pulp Beta = beta of pulp stumpage price

(3) Chip Beta = beta of chip n saw stumpage price

(4) Saw Beta = beta of saw timber stumpage price

(5) Land Beta = beta of farmland price

Model II:

While the model described above is theoretically correct, a wide discrepancy in discount rates exist due to the management regimes selected. The averages range between 6.5% for the low intensity management regime, and 12.5% for the high. This difference in capitalization rate cannot be attributed to market risk, but rather the imposition of different cash flow assumptions in the original model used to determine the discount rate. To control for these differing discount rates, two dummy variables were included in Model I.

Variables:

(1) All Model I variables

(2) Mngt Medium = (1 if using medium intensity management, 0 if not)

(3) Mngt High = (1 if using high intensity management, 0 if not)

Model III:

The third and last model incorporates the inclusion of diversifiable risk in the discount rate. While the problems of applying CAPM to timberland have been discussed, even a more traditional CAPM analysis with respect to equities has limited explanatory power. While this may be related to issues of reality not matching the model's assumptions (proxy of global portfolio by S&P 500 for example), or a lack of sufficient data in the case of timberland, it is also likely that diversifiable risk is priced into timberland. To address this possibility, a third model was constructed which incorporates additional measures of risk, some of which is diversifiable and theoretically should not determine the asset price, such as the variability in stumpage prices (variance). Thus, the required rate of return is composed of the risk free rate, project specific risk (diversifiable), and market risk. Due to the number of variables included in the model, each is discussed separately.

Variables:

(1) Acres = number of acres constituting each tract/one thousand. The division is to interpretation purposes only, as the coefficient is otherwise quite small. The variable ‘acres’ is a measure of liquidity risk. As the size of a tract increases there will be fewer potential buyers as access to capital becomes a constraint. Past studies have shown that as acreage increases, the per acre sale decreases. A decrease in price can be attributed to either a decrease in expected cash flows, or an increase in the discount rate. There is no practical reason that per acre cash flows should be expected to decrease as timberland size increases, so the alternative, and more likely scenario is that the discount r ate increases to compensate for the increased liquidity risk. It is expected that the effect may be less in magnitude as transaction size increases from 10,000 acres to 50,000 acres than if a tract increases from 100 to 500 acres, but the relationship is still expected be positive.

(2) Premerchratio = acres of premerchantable timber/total acreage of the tract. The overwhelming majority of sales have premerch timber classified through age fifteen, though a few sales have premerch listed through ages 16-20. The variable ‘premerchratio’ is meant to capture the risk attributed to the timing of cash flows. Cash flows which occur sooner rather than later are exposed to less uncertainty about key variables such as future inflation and reinvestment risk. When considering fixed income

investments such as bonds, the characteristic of later cash flows being considered as more risky creates a positive sloping yield curve. The same logic should apply to timberland investments. Younger timber is associated with later cash flows and greater uncertainty about market conditions. Thus, it is expected that cash flows from a property having more acres of premerchantable timber relative to the overall size of the tract will be discounted more so than cash flows from timber which is ready to be harvested earlier.

(3) Pulp3var = variance of pulpwood prices over the three year time period prior to the date of sale. The variance of prices and returns is the deviation between actual prices or returns, and the mean. As the variance of returns increases, the risk of an individual investment increases. When considering the inclusion of diversifiable risk in the timberland discount rate, the variance of stumpage prices can be a predictive measure of the variance of cash flows, and hence the volatility of returns. It is expected that the variance of pulpwood price has a positive relationship to the timberland discount rate.

(4) Chip3var = variance of chip n saw prices over the three year time period prior to the date of sale. As with the variable 'Pulp3var', it is expected that the variance of chip n saw price has a positive relationship to the timberland discount rate.

(5) Saw3var = variance of saw timber prices over the three year time period prior to the date of sale. As with the variables 'Pulp3var' and 'Chip3var', it is expected that the variance of saw timber price has a positive relationship to the timberland discount rate.

(6) Sawbeta = $\rho_{s,m} \frac{\sigma_s}{\sigma_m}$, the beta of sawtimber price calculated over five years, just as in model I and model II. As the beta of sawtimber price increases, the market risk of holding sawtimber increases as well. The timberland discount rate is expected to have a

positive relationship with the beta of sawtimber prices, reflecting the increase in market risk.

(7) Chipbeta = $\rho_{c,m} \frac{\sigma_c}{\sigma_m}$, the beta of chip n saw price calculated over five years, just as in model I and model II. As the beta of chip n saw prices increases, the market risk of holding chip n saw increases as well. The timberland discount rate is expected to have a positive relationship with the beta of chip n saw prices, reflecting the increase in market risk.

(8) Pulpbeta = $\rho_{p,m} \frac{\sigma_p}{\sigma_m}$, the beta of pulp price calculated over five years, just as in model I and model II. As the beta of pulp price increases, the market risk of holding pulpwood increases as well. The timberland discount rate is expected to have a positive relationship with the beta of pulpwood prices, reflecting the increase in market risk.

(9) Landbeta = $\rho_{l,m} \frac{\sigma_l}{\sigma_m}$, the beta of land values calculated over eight years, just as in model I and model II. As the beta of land prices increase, the market risk of holding land increases as well. The timberland discount rate is expected to have a positive relationship with the beta of land, reflecting the increase in market risk.

(10) 10 year fixed = the yield on 10 year Treasury notes. United States government issued debt is classically viewed as the 'risk free rate'. From this rate, a premium is added to compensate for the additional risk of different investments. While short term Treasury bills (3 months) are generally seen as compensation for delaying consumption without taking on risk, a longer term investment should use a longer dated Treasury note or bond as the risk free rate. Because most timberland investments facilitated by a TIMO are locked into an investment time period of ten years, this is the maturity that was

chosen as the 'risk free rate'. It is expected that as the yield on 10 year fixed Treasuries increases, so will the timberland discount rate, hence resulting in a positive relationship between the two.

(11) Annual Time Trend = takes on the values one through fourteen and captures any change over time not factored by the previously described variables. It is expected that the trend will be negative. As timberland became more well known among investors, and more TIMOs entered the market, competition for timberland may have increased, pushing up prices and reducing the cap rate.

Results

Table 12 Discount Rates, Model I Results

Variable	Coefficient	Standard Error	P > |t|
Intercept***	6.75673	0.02011	<.0001
PulpBeta	0.03465	0.05110	0.4979
ChipBeta***	-0.50362	0.10150	<.0001
SawBeta***	1.02193	0.10956	<.0001
LandBeta***	-0.24266	0.02325	<.0001
R^2 = .1040 Adj R^2 = .1009 n = 1153 * denotes significance at 10% level. ** 5% level, *** 1% level			

While a plot of residuals did not show any obvious heteroskedasticity, a White test indicated otherwise. Therefore, White robust standard errors are reported. No collinearity was detected. Results from Model I are mixed. While three of the four explanatory variables are significant at the 1% level, the signs for ChipBeta and LandBeta8 are the opposite of that expected. A negative coefficient indicates that as the beta (and hence the degree of market risk) increases, the timberland discount rate *decreases* (indicating less risk). Model I has been included as a key component of the discussion of discount rates, and the research process. However, as a large degree of variance among this model of discount rates is due to the different management regimes tested (low, medium, high), these must be included to account for the large differences in discount rates.

Table 13 Discount Rates, Model II Results

Variable	Coefficient	Standard Error	P > |t|
Intercept***	6.46035	0.01816	<.0001
PulpBeta***	0.11163	0.03896	0.0042
ChipBeta***	-0.49301	0.07942	<.0001
SawBeta***	0.85966	0.08558	<.0001
LandBeta***	-0.21568	0.01832	<.0001
Mngt Med***	0.30659	0.01923	<.0001
Mngt High***	0.61927	0.02008	<.0001
R^2 = .5220 Adj R^2 = .5194 n = 1153			
*denotes significance at 1% level, ** 5% level, *** 1% level			

As in Model I, a plot of residuals showed little heteroskedasticity, but results from the White test indicated otherwise. Therefore, White standard errors are reported. Additonally, no collinearity was detected. Having controlled for the management regimes, the coefficients are still similar to the results in Model I. PulpBeta remains positive, as expected, but once again, ChipBeta is significant at 1%, and has a negative coefficient. This implies that as the beta of chip n saw price increases (increasing its market risk), the timberland discount rate decreases. This is counter intuitive, as an increase in market risk should increase the discount rate. It is possible that this is a spurious correlation. As chip n saw is rarely the goal product and may be held to grow into sawtimber, market participants may pay little attention to its market risk.

SawBeta is significant at 1% and has a positive coefficient. This is in line with expectations. As the beta of saw timber price increases, so does the level of market risk associated with holding saw timber. As the level of market risk increases, the discount rate should increase as well. The coefficient implies that a 1 unit increase in beta (a significant move) increases the timberland discount rate by 89.4%.

LandBeta is significant at 1% and has a negative coefficient. This implies that as the beta of land price increases (increasing its market risk), the timberland discount rate decreases. As with chip n saw price, this is unexpected, as an increase in market risk is expected to cause an increase in the discount rate. A possible explanation is that as household wealth increased and demand for second homes and recreational property increased, this demand for, and hence the price of land, became more highly correlated with the market. If land prices were driven upward due to comparative sales reflecting HBU potential, while the correlation of land and the market increased, our derived discount rates (which only include cash flows from timber harvest) would decrease at the same time the level of market risk was increasing.

Mngt Med and Mngt High were also significant at the 1% level. Much of the explanatory power of Model II is due to the inclusion of these two variables. This is expected as the discount rates were derived based on the assumptions made within these two variables. They were included largely to control for the wide spread in discount rates which can be attributed to the management regime. Insight gained from these variables should be interpreted with caution. However, if we make the assumption that these discount rates are the correct discount rates under each management regime, we can determine that timberland managed under medium intensity are valued with a discount rate that is 30% higher than those managed with a low intensity regime. For tracts managed under a high intensity regime, the investment is valued with a discount rate which is 61% higher than those managed with a low intensity regime. This is indicative of the higher returns which are capable by using a higher intensity regime, as well as the greater risk of recouping additional costs and realizing a profit justifying the added investment.

As mentioned, the explanatory power of measures of market risk and their impact on discount rates is minimal. If diversifiable risk is priced into timberland, the results above are subject to change. Model III incorporates those measures of diversifiable, as well as market risk. While the previous two models are interesting to discuss, a more appropriate model is discussed in model III.

Model III:

Lastly, to evaluate the existence and nature of diversifiable risk which may be priced into timberland through the discount rate, Model III was constructed to include the previously described measures of diversifiable risk. While the management regime was important in viewing different discount rates under different production intensities, it is also a cause for large variance among discount rates. While there is a lot of promise shown by using high intensity production techniques to increase returns, they are still costly, provide for a high degree of uncertainty, and are generally not utilized by investors on a large scale. To analyze the nature of the timberland discount rate, without distortion from management regimes, Model III analyzes the discount rate within the low intensity management regime.

Table 14 Discount Rate, Model III Results

Variable	Coefficient	Standard Error	P > |t|
Intercept***	6.68922	0.16415	<.0001
Acres*	0.00309	0.00176	0.0800
PremerchRatio	-0.00658	0.09554	0.9451
Pulp3var**	0.01346	0.00647	0.0380
Chip3var	-0.00127	0.00125	0.3084
Saw3var***	0.00020	0.00007	0.0056
Pulpbeta***	-0.60197	0.12565	<.0001
Chipbeta	0.07115	0.18259	0.6970
Sawbeta**	0.39304	0.19869	0.0486
Land Beta***	-0.14063	0.03961	0.0004
10 Year Fixed	0.00500	0.02709	0.8537
TimeAnnual***	-0.03929	0.00846	<.0001
R^2 = .2146 Adj R^2 = .1916 n = 388			
*denotes significance at 1% level, ** 5% level, *** 1% level			

Results from Model III indicated no heteroskedasticity or collinearity. Results from Model III are mixed. Several significant findings indicate that diversifiable risk is priced into timberland. The variable ‘Acres’ indicates, with a positive coefficient, that a each 10,000 acre increase in the size of a timberland transaction increases the discount rate by 0.3%. This is sensible (ignoring portfolio theory) in that as the size of a tract increases, its liquidity decreases, hence increasing its diversifiable risk. The variance of both saw timber and pulpwood prices over the previous three years leading up to a sale also have a positive and significant impact on the timberland discount rate. While price variability is diversifiable, to the extent that diversifiable risk is priced into timberland, a higher variance of price indicates less predictability and greater risk. A positive relationship indicates that as price volatility increases, so does the discount rate, effectively pricing this risk into the price of timberland as future cash flows are discounted at a higher rate.

While the previously discussed variables are consistent with expectations if nonsystematic risk is priced into timberland, the variables ‘pulpbeta’ and ‘land beta’ are opposite of what is expected. While significant, the coefficient on both variables is negative. The expected relationship is positive. Recalling the earlier discussion of CAPM, a higher beta indicates higher market risk (and hence a higher discount rate) and vice versa. A negative coefficient on beta indicates that as market risk increases, the discount rate decreases. This is counter to what theory predicts. Possible explanation are that cash flow expectations were modeled incorrectly, or that other omitted variables have a stronger affect which outweighs that of the land and pulpwood beta variables.

Lastly, both saw timber beta and an annual time trend are significant. These findings are both expected. As discussed, as the beta of saw timber increases (increasing market risk), the discount rate is expected to increase as well and vice versa. In regards to the annual time trend, as timberland consistently outperformed comparative investments and became a more well established and sought-after investment, downward pressure was put on the discount rate, increasing timberland price.

CONCLUSION

This study utilizes actual sale data from approximately 400 timberland properties located in the Southeastern United States, each in excess of 5,000 acres. By utilizing actual sale data, which included information on timberland productivity, assumptions about future cash flows could be made. This was done for low, medium, and high intensity management regimes. With the sale price given, and cash flows estimated, the discount rate which equated those future cash flows with the sale price could be extracted.

Timberland purchases associated with an anticipated low intensity management regime averaged a discount rate of 6.57%. As management intensity rises to medium and then high, the required return increases to 8.94% and 12.5% respectively. Such discount rates seem to fall in line with those reported by other researchers. For example, Aronow et al (2004) report using a discount rate of 7.2% for Southern timberland in 2003.

Discount rates also fluctuate through time. As more investors crowd into the asset class, this puts downward pressure on discount rates, as is apparent during the run-up to 2007. It is possible that speculative cash flow assumptions were made that were not reflected in this cash flow model. However, results from this study show that if the investment analysis is made from the perspective of producing timber, discount rates compressed significantly and had a substantial impact on the timberland price.

While significant research has been conducted on the use of discount rates to value timberland, this study uses actual transactions to estimate the discount rate used in sales of timberland assets, under different management regimes. Such information should be valuable to appraisers and investors working to accurately value timberland.

A further extension of the research took the derived discount rates and used them as dependent variables in a model seeking to describe what determines these discount rates. As a matter of discussion, it is obvious that higher intensity management regimes have a large effect on discount rates. More interestingly, model results indicate that diversifiable risk is priced into timberland through the discount rate. This is evidenced by the variables measuring tract size and variability in stumpage prices. Additionally, a significant negative trend in discount rates is apparent throughout the time period under investigation. Lastly, it was expected that the beta (market risk) of stumpage and land prices would have a significant and positive effect on the timberland discount rate. While significant, the coefficients of the variables ‘pulp beta’ and ‘land beta’ are negative. This suggests that as market risk increases, the timberland discount rate decreases. It is possible that investor expectations of cash flows were significantly different from those modeled in this analysis, or that a divergence in the performance of timber and farmland occurred. This could explain the negative relationship.

CHAPTER 4

Conclusion

In recent decades, over $25 billion of timberland has entered into investment portfolios. Timberland provides favorable tax treatment for investors and returns have historically had a low or even negative correlation to equities, while still providing attractive returns, often exceeding those of the S&P500 over long time periods. Additionally, timberland is seen as a hedge against inflation. These qualities have led to increased investor interest in the asset and in recent decades direct ownership of timberland assets as a component of investor portfolios has increased from essentially zero, to over $25 billion.

Reasons for investor interest in the asset include the fact that biological growth of timber can provide a return (both through increasing volume as well as moving into higher valued products) even if prices and financial markets are depressed. Additionally, cash flows from timber harvest are taxed at capital gains. This makes investor ownership more efficient as timber harvest revenues from a forest products company are taxed at a higher corporate tax rate, and any dividends paid are subject to additional taxes.

In addition to cash flows from timber production, other opportunities to garner revenue exist as well. These may include payments for recreational use such as hunting, conservation easements, and payments for ecosystem services. While such payments can improve returns at the margin, a much larger driver of returns is the potential for HBU sales and capital gains through the appreciation of the underlying land value.

This change in ownership structure has changed how the market approaches questions of timberland value. As timberland has become a larger component of investor portfolios, the asset has come under the management of sophisticated managers who treat the asset not with an eye on maximizing production, but rather the underlying land value and its contribution to the performance of a diversified portfolio. This led the application of modern portfolio theory in order to correctly price the asset.

Additionally, frequent appraisals are required. Appraisals of large timberland holdings held by institutional investors can be more difficult relative to smaller properties for which there may be many comparison sales in an area. A discounted cash flow model is generally used, but many assumptions must be made such as future prices and appreciation in underlying land values.

A significant amount of research has been published on the determinants of timberland value. These studies have, for the most part, focused on smaller properties which are often bought for reasons other than timber production and garner higher prices reflective of the larger pool of buyers, greater liquidity, and differing objectives of ownership.

One variable which has a significant effect on timberland value is the discount rate. A large amount of analysis has focused on analyzing the timberland discount rate through the use of index data and modern portfolio theory. Problems with the use of such data, as well as low explanatory power of models such as CAPM, leave much room for further analysis of the timberland discount rate.

This study seeks to provide more information on the determinants of timberland price. Additionally, it focuses on one particular determinant, the discount rate, to analyze what determines this rate and if diversifiable risk is priced into timberland.

To address the broader question of, "what determines the price of investment timberland", a hedonic model of timberland price is constructed to evaluate actual timberland transactions. These transactions occurred between the years 1997 and 2010, numbering over 400 and ranging between 5,000 and 500,000 acres.

As expected, variables having a direct impact on standing timber value have a significant impact on the per acre price of timberland. As timber volumes and prices increase, the real per acre price of timberland increases as well. The amount of merchantable saw timber has a greater effect on price than the amount of chip n saw, and the amount of chip n saw has a greater effect on price than the amount of pulpwood. Measures of timberland productivity, such as growth rates and premerchantable timber ratio (discussed previously as a measure of productivity) also have a direct impact on the timber producing aspects of each property and have a positive and significant impact on timberland price. While these findings are not surprising, they highlight the difference between smaller tracts of timberland sold at retail, for which studies have actually found negative value attached to standing timber, and those sold at wholesale to investors whose primary objective is to maximize returns from timber production.

In addition to variables measuring timber production and standing volume, those indicating growth in the value of the underlying land and potential HBU opportunities also are significant. Real farm real estate and county population densities both have a significant impact on timberland. Not only can farmland become timberland and vice versa, but both have option value in regards to their development opportunities. Additionally, prices differed with respect to locations as well. Significant differences arise between coastal plain and piedmont, as well as between states.

Lastly, as timberland has moved from a source of inputs for forest products companies to investments to be included as part of a broader portfolio, financial variables were included as well. The S&P500 and the US dollar index also had significant affects on the price of timberland. As the broader economy is doing well, demand for recreational property and second homes will increase and drive HBU sales, hence positively affecting the price of timberland.

While cash flow expectations drive the numerator of the discounted cash flow equation that derives timberland price, the discount rate determines by how much to discount those cash flows. In an effort to study discount rates of actual southern timberland transactions, a discounted cash flow model was constructed. Given the sale price and the forecasted cash flows, the discount rate could be solved for. Three management regimes were evaluated, ranging from low intensity, to medium, and to high.

The average real discount rate for low intensity management of timberland was 6.59% over the period 1997-2010. For medium intensity management this rate was 8.98%, and for high intensity, the average discount rate was 12.5% over the period. While these are the average discount rates over the period, a general downward trend was apparent in discount rates over the period under analysis.

A model was used to analyze the determinants of the discount rate. Variables incorporating both market and diversifiable risk were included. Results indicate that diversifiable risk is priced into timberland. Variables measuring the size of the transaction, as well as the variance of prices have significant effects on the timberland discount rate. These risks are diversifiable and theory suggests that in an efficient market, such risk will not be priced into an asset. In analyzing the presence of market risk, the betas of product prices, as well as the beta of land prices, are included in the model. While the beta of saw timber price was significant with a positive sign (as expected) the betas of pulpwood price and land prices have a negative impact on timberland price.

While the statistical analysis of discount rates provides interesting findings, they may be viewed with an eye of skepticism. The dependent variable (discount rates) is not an observed variable. Rather, it is derived by making multiple assumptions with respect to cash flows. If these assumptions are not correct, the relationships found in this model may not be robust. This note aside, the broader study provides significant information in regards to pricing of timberland investments. The hedonic model extends a widely accepted methodology from other real estate classes and retail timberland tracts, to larger timberland tracts purchased for investment. Additionally, while multiple assumptions were used to derive the discount rates in this model, the information provided is still very useful for appraisers and forest investment professionals. Given the assumptions about prices and HBU development, one can gain significant insight into the historical levels and trends in the discount rate. While the results of this study provide a significant amount of information in regards to pricing of investment timberland tracts, it also opens the door for further research. Additional studies could further investigate whether diversifiable risk is priced into timberland, as well as why timberland prices vary significantly between states, and the effect that the value of the US dollar and influxes of foreign capital have on the timberland price.

REFERENCES

Albaugh, T.J., Allen, L.H., Fox, T.R. 2007. Historical Patterns of Forest Fertilization in the Southeastern United States from 1969 to 2004. Southern Journal of Applied Forestry. 31(3) 2007.

Allen, H.L., Fox, T.R., Campbell, R.G. 2005. What is ahead for Intensive Pine Plantation Silviculture in the South? Southern Journal of Applied Forestry. 29(2) 2005.

Aronow, M.A., Binkley, C.S., Washburn, C.L. 2004. Explaining Timberland Values in the United States. Journal of Forestry. Volume 102, No 8.

Binkley, C., Raper, C., Washburn, C. 1996. Institutional ownership of US timberland: History, rationale, and implications for forest management. Journal of Forestry. Vol 94 no 9.

Binkley, C. 2007. The rise and fall of the timber investment management organizations: Ownership changes in US forestlands. Pinchot Institute for Conservation.

Borders, B., Harrison, W., Adams, D., Bailey, R., Pienaar, L. Yield Prediction For Site Prepared Loblolly Pine Plantations in the Carolinas, Georgia, Florida, and Alabama. Plantation Management Research Cooperative. Research Paper 1990-2. UGA. Athens, GA.

Cascio, A., Clutter M. 2008. Risk and Required Return Assessments of Equity Timberland Investments in the United States. Forest Products Journal. Vol 58(1).

Caulfield, JP. 1998. Timberland return drivers and investing styles for an asset that has come of age. Real Estate Finance. Vol 14.

Cochrane, J. 2005. Asset Pricing: Revised Edition. Princeton University Press. Princeton, New Jersey.

Day, B. 2001. The theory of hedonic markets: Obtaining welfare measures for changes in environmental quality using hedonic market data. Economics for the Environmental Consultancy.

Evans, J., Archer, S. 1968. Diversification and the Reduction of Dispersion: An Empirical Analysis. The Journal of Finance 23(5): 761-767.

Fox, T.R., Jokela, E.J., Allen, L.H. 2007. The Development of Pine Plantation Silviculture in the Southern United States. Journal of Forestry. 105(7) 2007.

Fox, T.R., Allen, L.H., Albaugh, T.J., Rubilar, R., Carlson, C.A. 2007. Tree Nutrition and Forest Fertilization of Pine Plantations in the Southeastern United States. Southern Journal of Applied Forestry. 31(1) 2007.

Gunter, J.D., Haney, H.L. 1978. A Decision Tree for Compound Interest Formulas. South. J. Appl. For 2(3): 107.

Hancock Timber Resource Group. 2003. The NCREIF Timberland Property Index. Research Notes 2003.

Healey, T., Corriero, T., Rozenov, R. 2005. Timber as an Institutional Investment. Journal of Alternative Investments. Vol 8 (3).

Hickman, 2007. Timos and REITS. Forest service.

Jokela, E.J., Martin, T.A., Vogel, J.G. 2010. Twenty-five Years of Intensive Forest Management with Southern Pines: Important Lessons Learned. Journal of Forestry. 108(7) 2010.

Kennedy, G.A., Vandeveer, L.R., Henning, S.A., Niu, H., Deckard, D.L. 2002. Estimating tract value relationships in the north Louisiana timberland market. Southwestern Economic Review.

Kimbell, A., Hickman, C., Brown, H. 2010. How do taxes affect America's private Forest landowners? Journal of Forestry. March 2010.

Mei, B., Clutter, M., Harris, T. 2010. Modeling and Forecasting Pine Sawtimber Stumpage Prices in the US South by Various Time Series Models. Canadian Journal of Forestry 40:1506-1516. 2010.

Morningstar. 2011. 2011 Ibbotson Stocks, Bonds, Bills, and Inflation Valuation Yearbook. Morningstar, Inc. Chicago, Illinois.

Newell, G., Eves, C. 2009. The role of US Timberland in Real Estate Portfolios. Journal of Real estate portfolio management. Vol 15(1).

Pienaar, L., Page, H., Rheney, J. 1989. Growth and Yield Prediction Based on the PMRC Slash Pine Thinning Study. Plantation Management Research Cooperative. Technical Report 1989-4. UGA. Athens, GA.

Rinehart, J. 2010. U.S. Timberland post-recession: Is it the same asset? R&A Investment Forestry. http://investmentforestry.com/resources/1%20-%20Post-Recession%20Timberland.PDF

Rosen, S. 1974. Hedonic prices and implicit markets: Product differentiation in pure competition. Journal of Political Economy. Vol 82 No1.

Ruiz, C.I. 2005. Does it Really Matter? Theoretical Aspects, Literature Review and Applied Proposal. Ecos de Economia No 21.

Scholtens, L., Spierdijk, L. 2010. Does money grow on trees? The diversification properties of U.S. timber investments. Land Economics v83(3). 514-529.

Siry, J. 2002. Intensive Timber Management Practices. Southern Forest Resource Assessment Draft Report. Department of Forestry. NCSU.

Strong, R. 2000. Portfolio construction, management, & protection. Southwestern College publishing.

Sun, C., Zhang, D. 2001. Forestry related investment vehicles: Capital asset pricing model vs. arbitrage pricing theory. American Journal of Agricultural Economics. 83(3) August 2001:617-628.

Synder, S.A., Kilgore, M.A., Hudson, R., Donnay, J. 2008. Influence of purchaser perceptions and intentions on price for forest land parcels: A hedonic pricing approach. Journal of Forest Economics 14(2008) 47-72.

Timberland Market Report. 2011. Markets appear to thaw; discount rates again under pressure.

Turner, R., Newton, C., Dennis, D. 1991. Economic Relationships Between Parcel Characteristics and Price in the Market for Vermont Forestland. Forest Science. Vol 37 No 4.

Vrooman, D. 1978. An Empirical Analysis of Determinants of Land Values in the Adirondack Park. American Journal of Economics and Sociology. Vol 37. No 2.

Washburn, C. 1990. The determinants of forest value in the U.S. South. Dissertation. Yale University.

Washburn, C. 2011. What's Up with Markets for US Timberland? UGA 2011 Timberland Investment conference. A presentation.

Wilent, S. 2004. Investors increase timberland holdings. The Forestry Source. December 2004.

Yin, R., Sedjo, R.A. 2001. Is This the Age of Intensive Management? A Study of Georgia's Piedmont. Journal of Forestry. 99(12) 2001.

Zinkhan, C., Sizemore, W., Mason, G., Ebner, T. 1992. Timberland investments: A portfolio perspective. Timber Press. Portland, Oregon.

Zinkhan, C.F. 1992. Option Pricing and Timberland's Land-Use Conversion Option. Land Economics. 67(3).