Estimating timberland parcel value in the northeast United States using acreage and commercial timber value

Sean Hutchinson[1], Aaron Weiskittel[1], Don MacKay[2], Robert Lilieholm[1]

[1]University of Maine, School of Forest Resources, Orono, ME USA
[2]Forest Research, LLC, Orono, ME USA

Abstract

Evaluating market value of timberland can be difficult because of the various factors that influence it. In this analysis, 58 timberland sales were obtained from Maine, New Hampshire, New York, and Vermont for the years 1998 to 2012. The data was used to assess the relationship between the sale price, commercial timber value (CTV), acreage, and other factors like distance to the nearest town. Overall, a strong relationship between sale price, CTV, and acreage was found ($R^2 = 0.71$) with limited variation attributable to year or state. The developed equation may be useful for evaluating future land transactions and establishing baselines.

Introduction

The commercial forests of the Northeast U.S. have seen dramatic transitions in ownership over the past decade. The region has seen vertically integrated pulp and paper companies liquidating land assets to investors buying these lands for long term investments (Irland et. al., 2006; Vicary, 2005). The attractiveness to these investors is their counter cyclical nature of return (Mei and Clutter, 2010) and their low risk returns. Timberland is attractive within an institutional portfolio because of “its high upside potential and low downside risk” (IWC, 2009). The increased ownership by TIMOs (Timber Investment Management Organizations), high net wealth individuals and REITs (Real Estate Investment Trusts) has changed the way forest managers and appraisers are forced to think about the Northeast forest (Irland et al., 2006). Pre-timber sale due diligence has increased as investors want as much information about what they are investing in as possible. With the high within and between stand variation in the Northeastern forest due to previous silvicultural activity (Saunders and Wagner, 2008), appraisers face significant challenges when looking to evaluate the value of one timberland parcel compared to another.

Researchers have looked at the trends in prices for specific regions (Vicary, 2005; Kilgore and MacKay, 2007; Gorman, 2012) and have shown that timberland has seen an increase in prices over time. For example, Vicary (2005) analyzed price trends over time on a per acre basis, while Kilgore and MacKay (2007) assessed that parcel size was the major driver of price for the state of Minnesota, but did not analyze commercial timber value for these parcels. The Kilgore and MacKay (2007) analysis further emphasized the whole-sale discount, which states that as parcel size increases the price per acre decreases (Binkley, et al. 2000). Parcel size and sale price are widely available data allowing them to have been studied in depth. While parcel size does have a significant influence on value, other variables should be assessed.

Gorman (2012) utilized a hedonic model approach for the Southeast U.S. in an attempt to determine the major drivers of price. Within the analysis he utilized parcel size, sales price, volume of a variety of product classes, a broad market index (S&P 500), the consumer price index (CPI), housing variables, exchange rate, historical agricultural land prices, species composition, population density and timber price projections. A stepwise ranking of the variables showed that in the southeastern U.S. parcel size, volume of chip and saw as well as saw timber, the broad market index (S&P 500), the exchange rate, population density and finally the U.S. exchange rate were the most important determinants of timberland price (Gorman, 2012).

Given the decreased level of spatial variability and the growth dynamics of southern pine, we would expect the amount of chip and saw material as well as saw timber to play a significant role in the price of a timberland parcel. Utilizing total volume instead of an assessed monetary metric for standing timber allows for a greater comparison on a longer temporal scale. With amount of merchantable volume highly ranked by the step wise regression and timber price projections not of high importance in the analysis of Gorman (2012), it is logical to see that more emphasis is placed on current standing volume rather than future timber price projections. Given the variety of species and products harvested as well as the drastic price differences between them in the Northeast U.S., this suggests that a different approach may be needed to conduct an analysis similar to Gorman (2012).

There has been a limited availability of data with regard to commercial timber value (CTV) or the value of the standing timber for parcel transactions in the Northeast prior to 2004. However, in the past decade companies began listing commercial timberland parcels online in order to increase their reach to high net wealth individuals and other industry professionals internationally. This has provided access to data that was not previously available. With the data available new questions can be asked regarding what drives the price of commercial timberland in the northeast U.S. The primary goal of this analysis was to utilize these data to analyze current trends in timberland value across time in four New England states. Specific objectives were to: (1) compile the data and extract key metrics for each parcel; (2) relate the observed trends to various factors and determine relative importance of the factors; and (3) test the stability of these trends both spatially and over time. The working hypothesis is that parcel size and CTV will be the major drivers of timberland prices in the Northeast U.S.

Methods

This analysis used available data to statistically model timberland sales price. Several variables including CTV, acreage, state, and, based on the analysis presented in Gorman (2012), a broad market index and other hard asset prices (oil and gold) were tested. The standard model originally tested was CTV and acreage as the independent variables with sale price per acre as the dependent variable. This has often been the conventional thought amongst appraisers, but there has been little documented research in the Northeast to support these assumptions. Appraisers typically assess the ratio of the sales price to the CTV in order to compare sales. The expectation for this analysis is that acreage and commercial timber value will both have a significant influence on the sale price of timberland parcels, with acreage having a negative effect and CTV having a positive effect on price per acre. The broad market index and hard asset variables are not hypothesized to influence timberland prices in the Northeast U.S.

Price data was converted to 2005 constant dollars using a GDP adjustment. Preliminary analysis indicated that the data exhibited non-normality as well as heteroskedasticity. After a log-log transformation of the data, it still appeared heteroskedastic. To account for this heteroskedasticity and hierarchical nature of the data, a non-linear mixed effects model was fitted in order to assess the potential temporal and spatial variation from year to year, and state to state, and as well as apply a weight to the acreage variable. The mixed effects model tests whether unexplained variation can be attributed to the different hierarchical factors within the data. Initially, the temporal variation was attempted to be explained by utilizing year-adjusted state population in a fixed effects model, but the covariate was insignificant in the model. Given that the data had a nested structure (i.e., lack of independence), a mixed effects model allowed for factors that influenced parameter estimates to be separated within the model. The mixed models help ensure proper estimation of the parameter standard errors and the parameter's implied p-values.

For comparison, an ordinary least squares (OLS) regression model was also fitted for the data. Sales price per acre was modeled based on parcel size and commercial timber value, as well as an indicator variable for each state with Maine being held as the reference. In order to test the interaction between state and commercial timber value an OLS model utilizing an interaction coefficient was tested. The interaction variable proved insignificant within the model.

Data

Data were collected from a variety of public sources and was compiled for the Northeast US. The final database dates from 1998 to 2012 and contains 58 records from four states: Maine (31), New Hampshire (4), Vermont (15), and New York (8). Only data from pure timberland properties; parcels whose main function is the production of forest products, was evaluated. This excluded parcels with exceptional higher and better use (HBU) potential, properties sold under duress (i.e., foreclosure, tax sale, etc.), properties with long-term conservation easements, and conservation properties sold outright to local, state, federal governments or non-governmental organizations (NGOs). Determination of a property's HBU potential was based primarily on specific knowledge of the property. Properties with no encumbrances and large amounts of easily developable lake frontage were the only parcels removed from the data set because they were considered to have high HBU potential influencing price. Removing properties under conservation easement significantly reduced New York's sample size due to the large number of conservation easements in the Adirondacks. Parcels were also assumed to be arm's length transactions, i.e. that both buyer and seller were negotiating in their own best interest.

Results

Parcel acreage ranged from 264 to 236,294 acres, real dollars (2005 adjusted dollars) per acre ranged from $225 to $1,554.90, and CTV ranged from $178.90 to $1051.80 an acre. Figure 1 shows that Maine had the lowest average sale price of commercial timber properties, while New York had the highest. The most expensive parcel per acre was sold in New Hampshire, while the cheapest parcel per acre was sold in Maine. For the ratio of CTV/Sale Price, Maine and New York had the highest ratio and New Hampshire had the lowest ratio. When compared to the variation of CTV by state in Figure 1, New Hampshire has similar CTV values as Maine, while Vermont and New York have significantly higher CTV per acre values. Annual market trends for timberland parcels are shown in Figure 2, which indicates the substantial variation within the mean price per acre across time. The year to year variation within these data suggests that the lack of data may have caused price swings caused by parcel specific factors instead of general market trends.

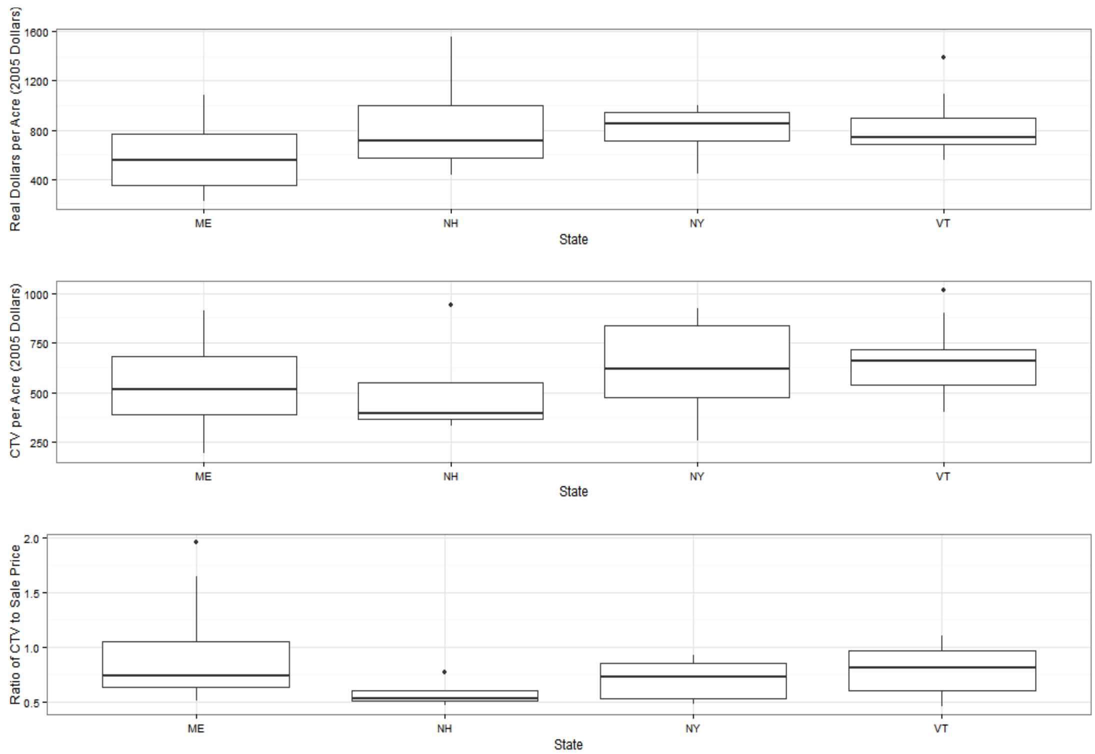

Figure 1: Analysis by state timberland transaction data. All dollar values are in 2005 US$.

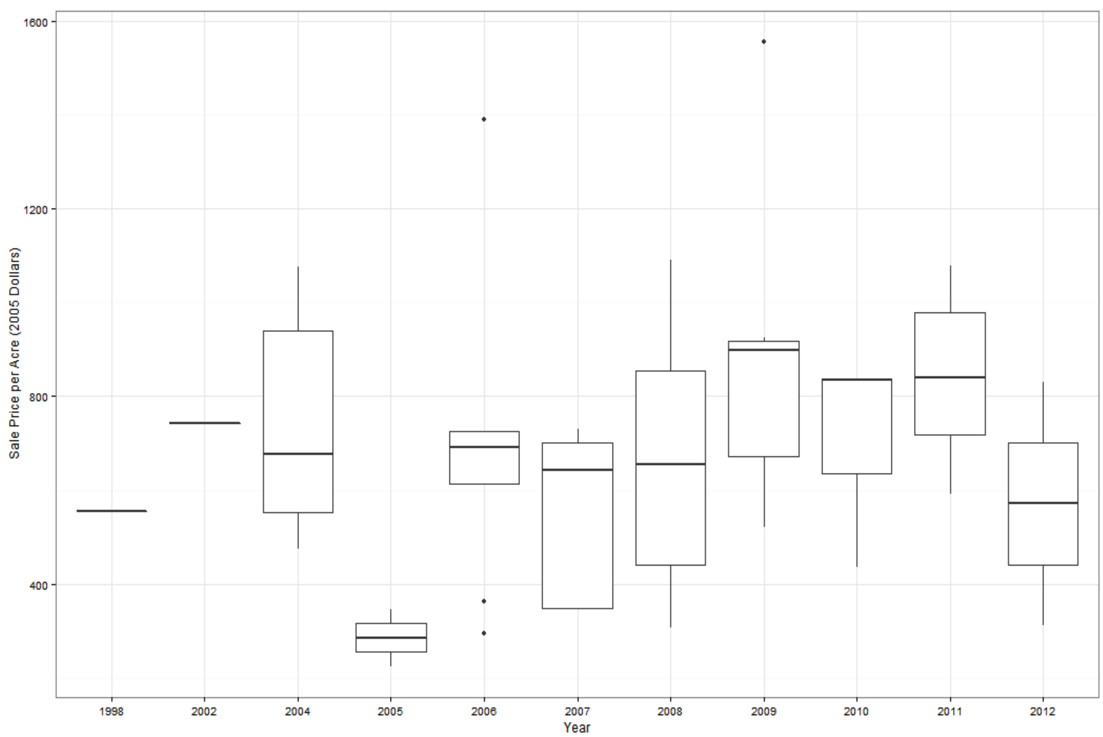

Figure 2: Annual market trends for Northeast US timberland sale prices.

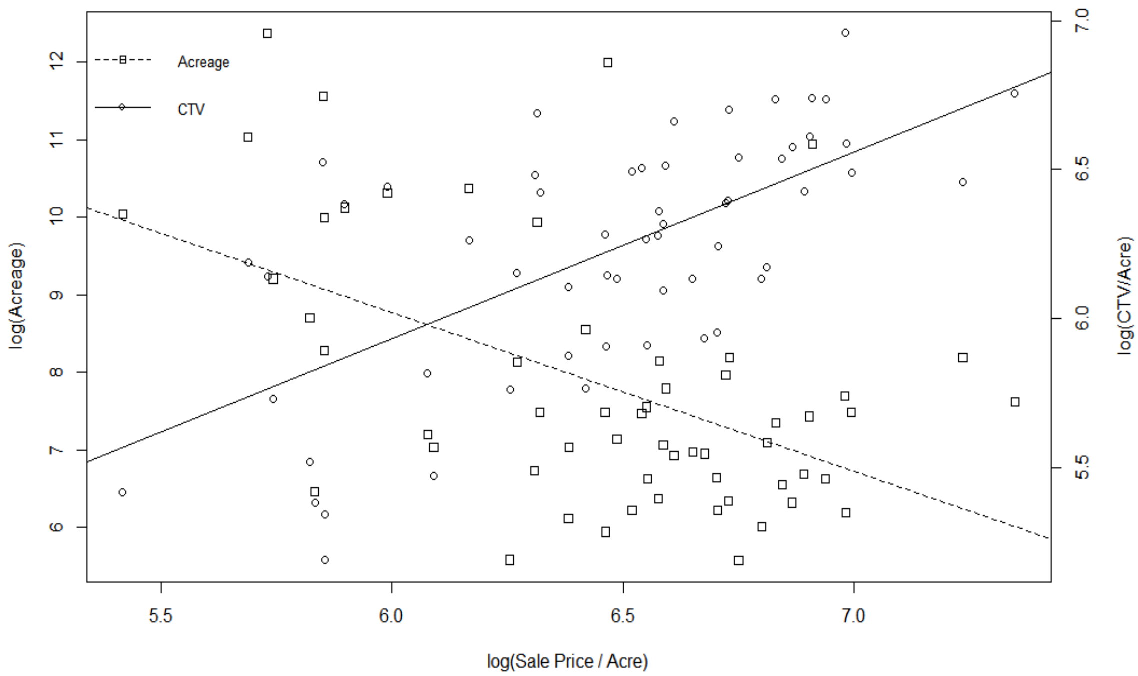

Figure 3: Relationship of log(Acreage) and log(CTV/Acre) and log(Sale Price / Acre).

An analysis of the raw data shows that the log (Sale Price / Acre) has a negative (slope = -2.06) relationship with the log (Acreage) variable, shown in Figure 3. There is significant variation within the data (R^2 = 0.24), however the general trend is quite clear. The relationship between log(Sale Price / Acre) and log(Acreage) is positively related with a slope of 0.62. The variation of CTV explains 39.5% of the variation in sale price individually (R^2=0.39).

A likelihood ratio between the non-linear mixed effects and the OLS model indicated that the two were significantly different ($p<0.05$). Based on the observed Akaike information criterion (AIC), the OLS regression model was the most appropriate model. The model had an adjusted R^2 of 0.71 and showed no obvious trends in the residuals. The final model was:

[1] log(Timberland Sale Price / Acre) = Intercept + log(Acreage) + log(CTV / Acre) + NH + NY + VT + e

where NH, NY, VT are indicator variables (1 if the state, 0 otherwise) for New Hampshire, New York and Vermont, respectively, and e is the residual error that is assumed to be normally distributed.

The predicted versus actual sales prices distribution is shown in Figure 4. The data points are evenly distributed on both sides of the slope=1 or perfect regression line. We observe less variability in the lower price points, and greater variation at the higher price points.

Table 1: Results from fixed effects model of log(Acreage), log(CTV/acre) and log(Timberland Sale Price/acre).

Term	Slope Coefficients	Std. Error	t-value
Intercept	3.46	0.50	6.82
log(Acreage)	-0.12	0.02	-6.46
log(CTV/acre)	0.62	0.08	7.79
New Hampshire	0.31	0.12	2.59
New York	0.30	0.09	3.29
Vermont	0.09	0.08	1.11

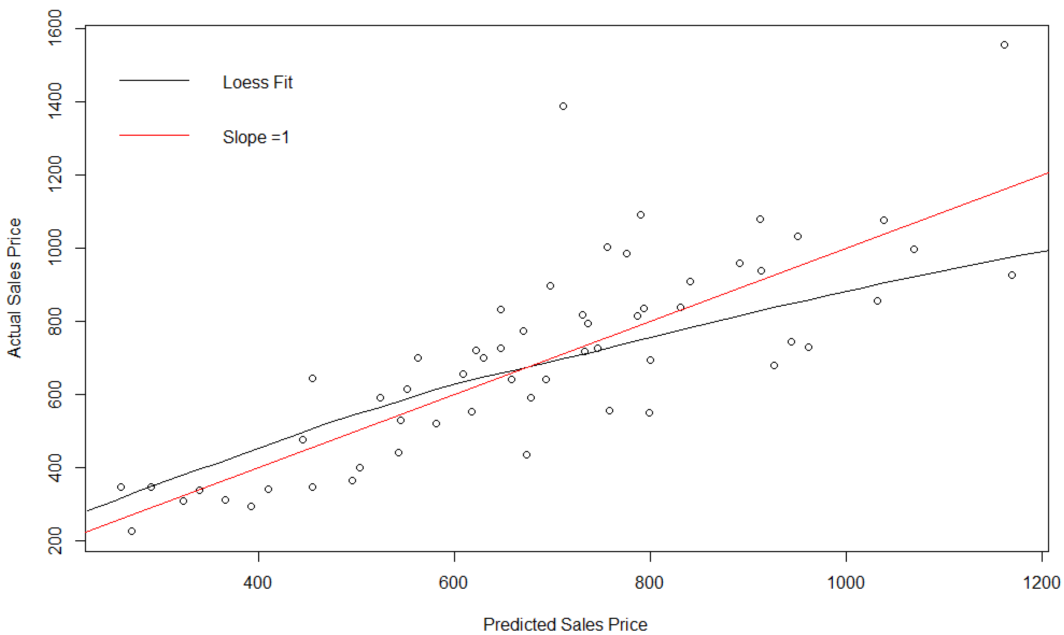

Figure 4: Predicted and actual sales price ($) with a one-one line (red) and lowess regression line (black).

Discussion

The results of the final model indicated that both acreage and CTV have a significant effect on estimating timberland sale price with an acceptable level of risk (error) within the model. This analysis further confirmed the idea of a whole-sale discount (Binkley, et al. 2000; Kilgore and MacKay 2007), showing that as parcel size increases, timberland sales price decreases. The current value of the standing timber has the opposite effect on timberland sale price as it increases with CTV. This is a basic assumption of the timberland appraisal process. It is common to assess the ratio of CTV to timberland sales price in order to assess the risk associated with alternative investments. Increased CTV decreases risk by providing a liquidation value for the parcel in theory, should the investor need an influx of capital, the timber could be liquidated for the value of the standing timber at a given discount.

The results of the analysis presented in Figure 4 provide an interesting insight into the price per acre distribution for the modeled and actual sales price. As was noted in the Results, there was less variation in the lower price points and greater variation in the higher price points. This would suggest that the model does a better job predicting the sales price of parcels with lower value than those with higher value. The main hypothesis for this phenomenon is the inability of the model to capture alternative attributes which may have an influence on price. Some of these attributes could be road frontage on a road that does not get “posted” (restricted to light weight vehicles) in the spring, seasonal operability of the parcel, or a strategic acquisition of the parcel. Road frontage on a non-posted road allows for trucking of timber year round with no restrictions, this would be thought to increase the value of the property. Seasonal operability would relate to when during the year the parcel could be harvested. Winter ground would be thought to be worth less than spring or fall ground because of the rarity of spring and fall ground demanding a premium in the market for it. Strategic acquisition could mean that the property was close to other ownerships managed by the same management organization reducing the management costs. It could also mean purchasing of the property by a neighbor, or by a vertically integrated company with a processing facility in close proximity. All of these attributes are difficult to model statistically, but could influence the purchase price of the property. This model does not attempt to model development potential as was discussed in the Methods; however this also could influence the purchase price of even pure timberland properties.

For the Southern U.S., Gorman (2012), hypothesized that changes in timberland price over time is a function of discount rates. His data for the Southern U.S. showed a distinct drop in timberland prices from the end of 2007 to 2010. The causal relationship he cites is the influence of increased discount rates on future cash flows. One hypothesis for the increase in the discount rate could be the perceived risk in the housing market leaving uncertainty around the southern pine dimensional sawlog market. In the Northeast, an increase in mean timberland prices from 2007 to 2010 is observed, counter to what was happening in the Southeastern U.S. Our hypothesis for this is based more on the species and product mix of the region than of the discount rate. Southern pine saw timber inflation adjusted prices from 2007-2010 saw a nearly 50% decrease in prices from $42/ton to $22/ton (Lutz, 2012). With chip and saw and saw timber tons ranking as the 2nd and 3rd variables from the stepwise regression of the price model produced by Gorman (2012), we should expect timberland prices to be negatively influenced by this drastic erosion in price. This suggests that southern timberland investors are weighting current value of the timber more than the current volume of timber. With the increased discount rates noted by Gorman (2012), growing volume on the stump can become costly as the cost of the upfront capital becomes more expensive.

When we compare the southern pine sawtimber prices to Maine timber prices across three major product categories over time, we see distinctly different trends. Maine experienced severe price erosion from 2002 to 2004 in both the sawlog and veneer product classes, as well as from 2004 to 2006 in pulp prices. Maine sawtimber prices over time exhibited slightly increased variability than pulp prices. Observing the general trends from 2000 to 2012, there is a distinct drop in prices from 2004 through 2009. For red oak this was almost a 50% decline in stumpage price from 2004 to 2009, similar to the southern pine sawtimber discussed earlier. Spruce and fir sawtimber, what would be considered the Northeast’s most competitive product with southern pine sawtimber, experienced a

31% decline in price from $145/mBF to $100/mBF from 2005 to 2012.

Due to the variation observed across species and product classifications, there are some clear benefits of timberland investing in the Northeast. With diversification within a portfolio, a top objective of investment in timberland, the variability across the resource in the Northeast only adds to its allure. Coupled with the low cost of entry for the Northeast, with an inflation adjusted (2005$) average sales price of $699/ac and standard deviation of $274 compared to an inflation adjusted (2005$) average sales price of $1295/ac and standard deviation of $405 for the Southeast U.S (Gorman, 2012), the Northeast U.S. can play a pivotal role in a timberland investment portfolio.

This diversification inherently produces its own unique challenges when attempting to model the sales price of distinctly unique properties with high variation across product, merchantability, and size classes. This analysis found that a similar model focusing on the expected drivers of timberland price was more appropriate for the region, when compared to the more complex models used in other regions. The remaining 29% of variation could potentially be explained by including additional predictor variables within the model. However, including more predictor variables would likely reduce the power of the test and therefore increase the risk of a Type II error, essentially a false negative result (Greene, 2012). In addition, the lack of significance for the mixed effects model was likely affected by having an unbalanced dataset with a disproportionate amount of data from Maine. Further research should focus on increasing the size of the data set and improving the predicting power of the model.

Conclusion

This analysis provides a base for further inquiries into timberland valuation. With the financial aspect of timberland value being widely studied, the knowledge gap exists in the determination of CTV. As we have seen from this study, CTV exhibits significant influence on timberland sales price, and therefore is an important variable. Decreased variation around an estimate of CTV will also decrease the variation around an estimate of timberland sales price. By reducing the compound error within the models, a more precise estimate of timberland sales price could be determined. Future models should analyze the influence of a growth potential parameter for each timberland parcel sold. This parameter could be estimated using the new Acadian growth model, and could be incorporated in this model as a quantity of product per acre per year separated amongst different product classes (i.e. saw logs, pulpwood, veneer etc.). As we have seen, CTV is influential in the sales price of timberland, therefore, a better estimate of the growth potential by product classes could provide better insight into trends in timberland sales prices, assuming investors value future growth as well as current stocking. We would hypothesize that the market would value saw log growth potential higher than biomass growth, as well as growth being valued at a discount to current standing volume. This would require an increase in the sample size of sales due to the decrease in the degrees of freedom, and therefore reduced power of the test. In order to conduct this analysis, in depth and consistent timber inventories would have to be analyzed. These are typically proprietary and difficult to acquire for research purposes, to an even greater extent than commercial timber value is to acquire for the purpose of the current analysis.

The question of timberland valuation has been raised as a practice that should be standardized in order to help institutional investors compare one investment to another (Binkley, et al., 1996). With the development of an appropriate model, these estimates of timberland sale price could be used as a baseline, with deviations from this baseline justified by a professional appraiser. This standardization of the baseline would clear some of the confusion caused by the variety of methods currently used to estimate commercial timberland values. It would also shift commercial timberland investment from less of a real estate speculation to a statistically informed decision based on the parcel's current and future ability to produce raw materials for market.

Literature Cited

Binkley, C.S., Raper, C.F., & Washburn, C.L. 1996. Institutional ownership of US Timberland: History, rationale and implications for forest management. *Journal of Forestry*, *99*(9), 21–28.

Binkley, C.S., Washburn, C.L., & Aronow, M.E. 2000. *Taking advantage of the wholesale discount for large timberland transactions*. Hancock Timber Research Report. R-00-1. Boston, MA. http://www.htrg.com/pdf/r001.pdf.

Binkley, C.S. 2009. *The sensitivity of the value of timberland assets to changes in the discount rate*. International Forestry Investment Advisors, LLC. Cambridge, MA. http://www.ifiallc.com/PDFs/The-Sensitivity-of-the-Value-of-Timberland-Assets-to-Changes-in-the-Discount-Rate.pdf.

Gorman, J. 2012. *Institutional timberland investments: Asset pricing and the discount rate*. PhD dissertation. Auburn University. Auburn, AL.

Greene, W. H. (2012). *Econometric Analysis*. (D. Battista, Ed.) Pearson Education Inc. Upper Saddle River, NJ.

Irland, L. C., Hagan, J., & Lutz, J. (2006). Large timberland transactions in the northern forest 1980-2006: Analyzing an historic landownership change. Research Paper 11. Global Institute of Sustainable Forestry. Yale University. New Haven, CT.

Kilgore, M. A., & Mackay, D. G. (2007). Trends in Minnesota's forestland real estate market: Potential implications for forestland uses. *Northern Journal of Applied Forestry*, *24*(1), 37–42.

Lutz, J. (2012). Historic lows in southern pine sawtimber prices (?). *Forest Research Notes*, *9*(3), 1–4.

Mei, B., & Clutter, M. L. (2010). Evaluating the financial performance of timberland investments in the United States, *Forest Science 56* (5), 421–429.

Vicary, B. P. (2005). Northeast timberlands: Strong markets & returns. *Timberland Report* 7, 1–6.