Vermont Stumpage Price Trends Revisited: With Comparisons to New Hampshire

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Abstract

Our objective was to describe the trends of Vermont stumpage prices for major sawtimber species and products over the approximately last quarter century and propose a likely explanation of changes that we observed. Annual percentage rates of change (APR) were estimated for 10 forest products in Vermont from the third quarter of 1981 (1981Q3) to the first quarter of 2007 (2007Q1) when the price series was discontinued. In addition, we tested for changes in the percentage rate within the period. We found differences in the trend of APR between hardwood sawtimber and softwood sawtimber. With one exception, price trends differed significantly between 1981Q3 to 1992Q2 and 1992Q3 to 2007Q1 for inflation-adjusted (real) hardwood sawtimber prices. There were no differences in price trends for any of the softwood sawtimber species between the two periods. Real price trends for pulpwood and firewood were similar to those for hardwood sawtimber. We also examined stumpage price trends for selected species in adjacent New Hampshire from 1985Q1 to 2011Q1. Stumpage price trends for like species and proximate time periods in Vermont and New Hampshire were similar, but no statistical tests were done. The direction of trend (positive or negative) was the same for sugar maple, red oak, yellow birch, and white pine, and the magnitude of APR was similar for sugar maple, yellow birch, and white pine.

Stumpage price reporting in Vermont began in 1981 (Sendak and McEvoy 1989). Due to budget cuts, the University of Vermont Extension Service ceased compiling and reporting timber stumpage prices for Vermont in 2007. The program had created one of the longest-running quarterly databases of stumpage prices in the northeastern United States, spanning almost 27 years (McEvoy 1981–2007). Our objective was to describe the trends of Vermont stumpage prices for major sawtimber species and product groups from 1981 to 2007 and offer an explanation of observed changes. In addition, we examined stumpage price trends for selected species in adjacent New Hampshire from the first quarter of 1985 (1985Q1) through the first quarter of 2011 (2011Q1; New Hampshire Timberland Owners Association [NHTOA] 1985–2011) to compare with trends in Vermont; examine red maple timber price trends, which were not reported in Vermont; and estimate price trends from 2007Q2 to 2011Q1, a period that included the 2007 to 2009 recession. We present the data sources, methods, and results of the statistical analysis and discuss our conclusions. This research adds to the growing body of stumpage price analyses and is one of the first to include the period spanning the Great Recession of 2007 to 2009.

We anticipate a difference in response between hardwood and softwood sawtimber prices as a result of the different uses of hardwood and softwood lumber. Species that are desirable for their appearance in interior applications, such as furniture, cabinets, trim, paneling, and flooring, are subject to changes in consumer preferences. Softwoods are used mainly in structural and exterior applications where appearance is secondary to physical properties. White pine, the most versatile of the softwoods, is used in millwork, furniture, and cabinets as well as structural applications, such as dimension lumber and timber-house framing. Spruce-fir is used to produce dimension lumber and other products used in construction. Hemlock lumber has various uses in rough construction, shipping pallets, wooden-bridge planking, and timber-house framing but is perceived as inferior in many applications to other softwoods. Pulpwood prices depend on the global demand for paper products and the general state of the US and global economies. Demand for firewood, a substitute for heating with fossil fuels, depends on the price of fossil fuels, particularly No. 2 fuel

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oil in New England. The price of firewood rises as fuel oil prices increase relative to firewood.

Stumpage prices are of prime importance to the forest landowner because they can create an incentive to manage the forest and indicate how profitable the operation can be. Analysts use stumpage prices to understand timber markets and follow trends.

Macroeconomic Setting

The period in US economic history over which Vermont and New Hampshire stumpage prices were analyzed here is notable for a number of reasons, including the longest sustained period of growth in the US economy in modern history. Reporting started in Vermont in 1981Q3 when the economy was in recession, ended in 2007Q1 on the eve of the worst recession since the Great Depression, and suffered two recessions in between (National Bureau of Economic Research [NBER] 2010). The period began with a recession in the US economy that lasted from 1981Q3 to 1982Q4 that was generally attributed to the Iranian oil embargo and an increase in interest rates by the Federal Reserve; unemployment peaked at 10.6 percent. The next recession, attributed largely to the savings-and-loan crisis, occurred from 1990Q3 to 1991Q1. The period from 1993 to 2000 saw the strongest economic growth performance in the preceding three decades (Frankel and Orzag 2001). By 2000, the expansion of the US economy became the longest recorded, and unemployment fell to a long-unmet goal of 4 percent with inflation remaining low. Productivity continued to increase well into the end of the expansion coinciding with the new millennium.

The first decade of the 21st century was notable for two speculative bubbles. The first of these bubbles was the result of increased value of stocks of Internet companies, or so-called dot-com stocks. When prices achieved unsustainable levels, the bubble burst, resulting in the recession of 2001Q1 to 2001Q4 that was exacerbated by the 9/11 terrorist attacks in the United States (NBER 2010). The NASDAQ Composite, an index of technology and growth stocks, closed at a daily high in excess of 5,000 in March 2000 and fell to just above 1,000 in October 2002. The subprime-mortgage crisis and the bursting of the housing bubble in 2008 resulted in the worst financial crisis and the worst recession in the US economy since the Great Depression. Aptly named the Great Recession, it lasted from 2007Q4 to 2009Q2 (Verick and Islam 2010). The subprime-mortgage crisis in the United States led to a global banking credit crisis, the effects of which continue to reverberate in the US and world economies.

The period covering the collection of price data in Vermont was largely favorable for landowners. Inflation as measured by the average annual change in Producer Price Index (All Commodities) was 2 percent (1981 to 2007). The same period in New Hampshire was also largely favorable to landowners, but stumpage prices fell in response to the Great Recession. Inflation as measured by the average annual change in Producer Price Index (All Commodities) was 2.4 percent during the reporting period analyzed for New Hampshire (1985 to 2011).

Methods

Data

We analyzed Vermont stumpage prices for the seven sawtimber species and three products previously studied by Sendak and McEvoy (1989). Data included stumpage prices for sugar maple (*Acer saccharum* Marsh.), yellow birch (*Betula alleghaniensis* Britt.), white ash (*Fraxinus americana* L.), red oak (mostly northern red oak [*Quercus rubra* L.]), eastern white pine (*Pinus strobus* L.), spruce-fir (mostly red spruce [*Picea rubens* Sarg.] with some balsam fir [*Abies balsamea* (L.) Mill.] and small amounts of black spruce [*P. mariana* (Mill.) B.S.P.] and white spruce [*P. glauca* (Moench) Voss]), and eastern hemlock (*Tsuga canadensis* (L.)), the seven species that account for most sawtimber volume harvested. In addition, hardwood pulpwood, softwood pulpwood, and firewood (roundwood, not biomass chips) were analyzed. The seven species represented 80 percent of the 180 million board feet of sawlogs and veneer logs harvested in 2010, and the pulpwood categories represented all of the 149,000 cords harvested (Vermont Department of Forests, Parks, and Recreation 2010).

Vermont and New Hampshire are each divided into three stumpage-price reporting regions—northern, central, and southern—as shown in Figure 1. Areas where greater volumes of high-quality sugar maple, red oak, and yellow birch are found are highlighted in Figure 1 (Cerulli 2007), but both states are heavily forested. In Vermont, within each region there are three reporting groups or sources of price information, including primary wood processors (buyers), who are mostly independent loggers and mill crews; private consulting foresters (representing sellers); and public or service foresters, called county foresters in Vermont (offering limited advice to private sellers). All known

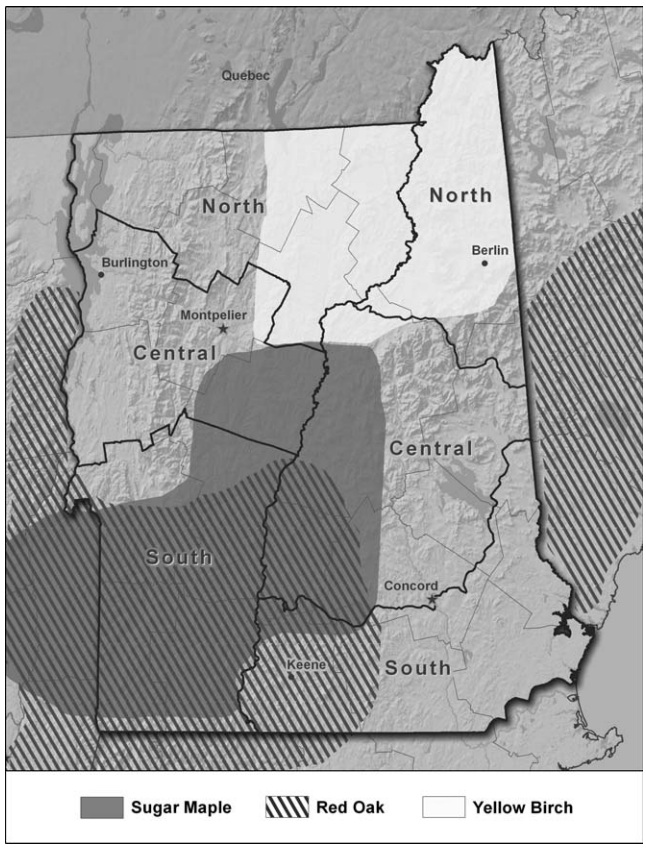

Figure 1.—Vermont (left) and New Hampshire (right) stumpage price reporting regions with proximate areas of selected high-quality hardwood timber delineated. (Source for hardwood quality data: Cerulli 2007.)

sources (approximately 760) are canvassed by mail at the beginning of each quarter. Each source is asked to report known stumpage transactions that were settled or consummated during the previous quarter. In 1988, a policy change within the Vermont Department of Forestry, Parks, and Recreation related to the Current-Use Tax Program ended county forester involvement in management of privately owned forestland to avoid any appearance of conflicts of interest. County foresters still can give forest management advice on municipal or town forests (William Moulton, personal communication). Prior to mid-1988, about five prices on average were reported by county foresters for each species and quarter, but from mid-1988 forward, about two prices on average were reported by this group.

Respondents are specifically asked to report only stumpage value, not mill-delivered prices, fob prices, or log sales from landings, to eliminate costs associated with logging and hauling. The median, low, and high prices are reported by species and by region when at least five prices are received from respondents. When fewer than five prices are received, the low and high prices are reported, and if only one price is received, that single price is reported. The original individual stumpage price data from 1981Q1 to 2005Q3 totaled more than 39,000 stumpage prices. The original prices from 2005Q4 through 2007Q1 were lost, and only the summary data are available (McEvoy 1981–2007).

There were 8,640 potential reporting cells in Vermont (96 quarters by 3 regions by 3 sources by 10 species) from 1981Q3 to 2005Q3. No data were collected for 2004Q3. For region-by-species combinations, there were 2,880 quarterly reporting values (medians calculated over reporting sources). Twenty of these cells contained no data. Fifty cells (1.7%), including 20 for red oak in the northern region and 7 in the central region, contained only one price. There were 35 cells (all species) with one price in the northern region (70%). The remaining 15 cells reporting one price occurred randomly in the other two regions and over several species. None of the single-price cells appeared to be outliers by visual inspection and likely were the result of species distribution and markets. There were 302 cells that contained from two to four observations (10.6%). Almost a third of these cells were for red oak, and the remaining cells were distributed over several other species. Quarterly mean number of prices reported by species and region excluding the empty cells and cells with one price are shown in Table 1.

Median quarterly prices were calculated from the individual sales data by species/product and region across sources. Because the sample size tended to be small, the median was estimated rather than the mean, giving a better intuitive sense of the middle of the distribution and avoiding pulling the mean in one direction or the other by an extremely low or high price. The regional medians were then averaged to produce the final database of statewide quarterly prices by species and product. Since individual sales data from 2005Q4 through 2007Q1 were not available, published regional medians were averaged and added to the database to complete the series.

To offer a comparison to stumpage price trends in Vermont, we analyzed New Hampshire stumpage prices for sugar maple, red maple (*Acer rubrum* L.), yellow birch, red oak, and white pine sawtimber for similar time periods. Beginning with 1985Q1, quarterly stumpage prices were collected and reported by the NHTOA, an organization of landowners, foresters, loggers, and the forest industry. The prices reported by the NHTOA are gathered via a quarterly mail questionnaire sent to approximately 90 of a total population of approximately 900 private consulting, Cooperative Extension, and industrial foresters, loggers, timber buyers, and mill owners in the state. Data are compiled for three geographic regions (northern, central, and southern; Fig. 1), and median prices and price ranges are reported by species and product. Since 2005, the average price and range have been reported instead. We expect that the median and average prices are not the same, but there was no way to adjust for the change because individual sales data are not available in New Hampshire. The New Hampshire data offered insight into red maple timber prices, which were not reported in Vermont, and price trends from 2007Q2 to 2011Q1, a period that included the Great Recession (2007Q4 through 2009Q2).

Table 1.—Mean number of stumpage prices reported quarterly by region in Vermont (excluding empty cells and cells with only one price reported).

Species	Mean no. of prices reported by region		
	Northern	Central	Southern
Sugar maple	5	6	9
Yellow birch	5	5	7
White ash	4	5	8
Red oak	3	3	7
White pine	5	6	9
Spruce-fir	6	6	6
Hemlock	5	5	7
Hardwood pulpwood	6	5	6
Softwood pulpwood	5	6	6
Firewood	5	6	7

Data gathered by the methods used in the Vermont and New Hampshire stumpage price surveys can be characterized as samples from volunteer reporters and are not true probability samples. Another shortcoming in most stumpage price reporting is the lack of volume associated with reported price. Thus, a small sale with a high unit price is accorded the same weight as a large sale at a low price. This is somewhat ameliorated by reporting the median rather than the average price. Other potential deficiencies in stumpage price reporting have been stated elsewhere (see, e.g., Duerr 1960; Rosen 1984, 1988; Michie and Kmetz 1987; Michie 1988). Nevertheless, we feel that stumpage price reporting done in a systematic and consistent way provides important information about the market and how it changes over time.

Statistical analysis

Average quarterly rate of change in stumpage prices was calculated by estimating the natural logarithm of price as a function of time (quarter) and an error term. Measurements over time, such as time-series data, result in higher correlations (autocorrelation) among years and quarters closer in time, underestimating standard errors of regression parameters and resulting in higher t values. If detected, the regression model was estimated using maximum likelihood (ML) in the autoregression procedure in SAS, adding two autoregressive (AR) parameters to test for first- and second-order serial correlation, with backward elimination of insignificant AR parameters ($\alpha = 0.05$; SAS Institute Inc.

2002–2003). Because of serial correlation, all but one model had AR components added to the model. Ordinary least squares regression was used for that model. Methods to analyze stumpage price trends are detailed in Sendak (1991) and Wagner and Sendak (2005). (A summary of the statistical analysis including abridged autoregression output tables and data are available online at http://dx.doi.org/10.6084/m9.figshare.845672.)

By visually inspecting plots of nominal and real Vermont stumpage prices over time, it was evident, particularly for hardwood sawtimber, that prices for sugar maple and yellow birch began a sharp increase around 1992Q2, and prices for red oak began to decrease. On that basis, the data were divided into two periods: 1981Q3 to 1992Q2 and 1992Q3 to 2007Q1. In brief, quarterly changes in nominal and real stumpage prices were calculated by estimating the natural logarithm of price as a function of time (quarter) and an error term, allowing both intercept and slope (rate of change) to shift between two time periods. The following equation was used:

$$\ln P_t = \beta_1 + \beta_2 d + r_1 t + r_2 dt + \ln \varepsilon_t \quad (1)$$

where

P_t = stumpage price at time t,
β_1 = initial stumpage price (intercept),
β_2 = the intercept shifter,
t = the time period for compounding,
r_1 = the continuous rate of change for period 1,
r_2 = the change in the continuous rate for period 2,
d = an indicator variable ($d = 0$ if $t \leq$ 1992Q2; otherwise, $d = 1$), and
$\ln \varepsilon_t$ = an error term; normally distributed, with mean 0 and standard deviation σ.

For example, in Vermont when $d = 0$, r_1 denotes the continuous rate of change from 1981Q3 to 1992Q2. When $d = 1$, $r_1 + r_2$ denotes the continuous rate of change from 1992Q3 to 2007Q1. We tested for first- and second-order autocorrelation ($\alpha = 0.05$), and if present, we used ML on the lagged data to correct this problem. The same methods were applied in the analysis of New Hampshire stumpage prices.

Reporting in New Hampshire began almost 4 years later than in Vermont (well into the recovery from the recession from 1981 to 1982), and visual inspection of the data indicated that the change in trends occurred at slightly different times. Differences in timing of the change in trends were most obvious for red oak and white pine. In addition, 1992Q4 to 2007Q1 and 2007Q2 to 2011Q1 were compared to test for effects of the recession from 2007 to 2009.

The metric of interest was the annual percentage rate of change, so the following conversion was made to the estimated continuous quarterly rate:

$$\text{APR} = e^{4h} - 1 \quad (2)$$

where $h = r_1$ or $r_1 + r_2$ and e is the base of natural logarithms.

Results

In Vermont, the stepwise autoregression procedure indicated positive first-order autocorrelation for real prices for all species and products. There were two species with second-order autocorrelations: white pine and eastern hemlock sawtimber. ML procedures were used to estimate an AR(1) term (lagged one period) and an AR(2) term (lagged two periods), where appropriate. Average quarterly rates of change were estimated for both nominal (market) and real (adjusted for inflation) stumpage prices. To simplify the presentation, only real rates are discussed in the text, with nominal rates differing approximately by the rate of inflation.

The real rates of price change for the two time periods tested in Vermont were significantly different for red oak, sugar maple, white ash, and yellow birch sawtimber (Figs. 2 and 3; Table 2) and hardwood pulpwood, softwood pulpwood, and firewood (Fig. 4; Table 2). Rates of change for white pine, spruce-fir, and eastern hemlock sawtimber were not significantly different between time periods (Fig. 5; Table 2). All quarterly rates of change were significantly different from 0 ($\alpha = 0.05$) except for yellow birch, hardwood pulpwood, and firewood, all in period 1992Q3 to 2007Q1 (Table 2). When quarterly rate estimates between the two time periods were not different, results from the overall model were used.

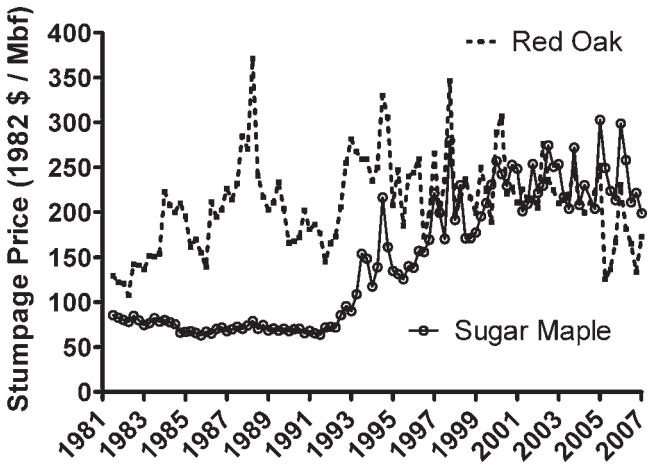

Figure 2.—Vermont red oak and sugar maple sawtimber stumpage prices in real (1982) US dollars, 1981Q3 to 2007Q1.

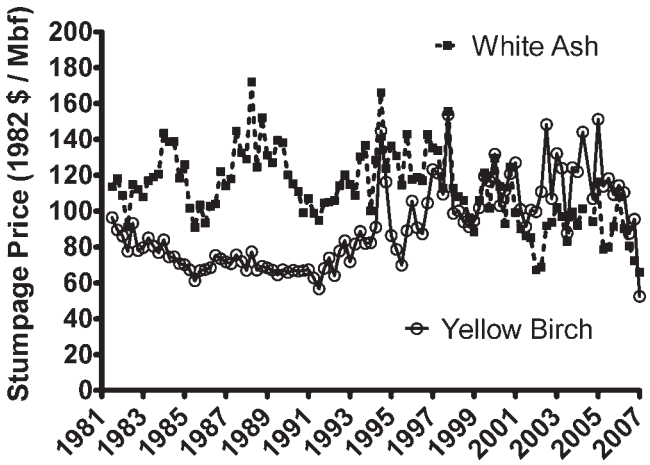

Figure 3.—Vermont white ash and yellow birch sawtimber stumpage prices in real (1982) US dollars, 1981Q3 to 2007Q1.

Table 2.—Nominal and real annual percentage rate change (APR) in Vermont stumpage prices by sawtimber species and products from 1981Q3 to 2007Q1 or subperiods 1981Q3 to 1992Q2 and 1992Q3 to 2007Q1.[a]

Species	Period	APR (%) Nominal	APR (%) Real
Hardwood sawtimber			
Sugar maple	81Q3–92Q2	−0.32	−2.22
	92Q3–07Q1	7.64	5.30
Yellow birch	81Q3–92Q2	−1.41	−3.20
	92Q3–07Q1	3.52	1.27[b]
White ash	81Q3–92Q2	NA	−0.39
	81Q3–07Q1	0.49[b]	NA
	92Q3–07Q1	NA	−3.44
Red oak	81Q3–92Q2	5.06	3.22
	92Q3–07Q1	−0.10[b]	−2.16
Softwood sawtimber			
White pine	81Q3–07Q1	3.10	1.17
Spruce-fir	81Q3–07Q1	4.83	2.79
Hemlock	81Q3–07Q1	0.48[b]	−1.39
Pulpwood			
Hardwood	81Q3–92Q2	−2.06	−4.00
	92Q3–07Q1	2.96	0.52[b]
Softwood	81Q3–92Q2	NA	−1.23
	81Q3–07Q1	−0.05[b]	NA
	92Q3–07Q1	NA	−4.65
Firewood	81Q3–92Q2	−1.82	−3.44
	92Q3–07Q1	2.31	0.16[b]

[a] Two or more entries for a species indicate a statistically significant difference between periods; a single entry indicates no significant difference. NA = not applicable.

[b] Not statistically significant from zero ($P \leq 0.05$). Statistical tests were performed on the log of quarterly price data (see Eq. 1).

The APR for hardwood sawtimber stumpage ranged from −3.44 percent for white ash from 1992Q3 to 2007Q1 to 5.30 percent for sugar maple for the same period. The trends for sugar maple and yellow birch were down for 1981Q3 to 1992Q2, and up for 1992Q3 to 2007Q1. Red oak prices increased from 1981Q3 to 1992Q2 and decreased from 1992Q3 to 2007Q1. White ash prices trended down for both periods (Table 2).

There were no differences in price trends for any of the softwood sawtimber species between the two periods. Spruce-fir had the greatest increase in mean price over the period with a 2.79 percent increase, and white pine followed with a 1.17 percent increase. Hemlock decreased by −1.39 percent annually (Table 2).

In New Hampshire, there were significant first-order positive autocorrelations for most species tested except for yellow birch. There were no second-order autocorrelations. Difference between slopes and intercepts for the periods 1985Q1 to 1992Q3 and 1992Q4 to 2007Q1 were similar to but not the same as Vermont. Differences in timing of changes in trends were most obvious for red oak and white pine.

The annual rates of price change for the two time periods tested in New Hampshire were significantly different for red oak, sugar maple, red maple, and white pine (Figs. 6 and 7; Tables 3 and 4). There were no differences in price trends for yellow birch, red oak, and white pine for 1992Q4 to 2007Q1 when compared with 2007Q2 to 2011Q1 (Figs. 6 and 7; Table 4). Quarterly rates of change were significantly different from 0 ($\alpha = 0.05$) except for sugar maple for 2007Q2 to 2011Q1 (Table 4).

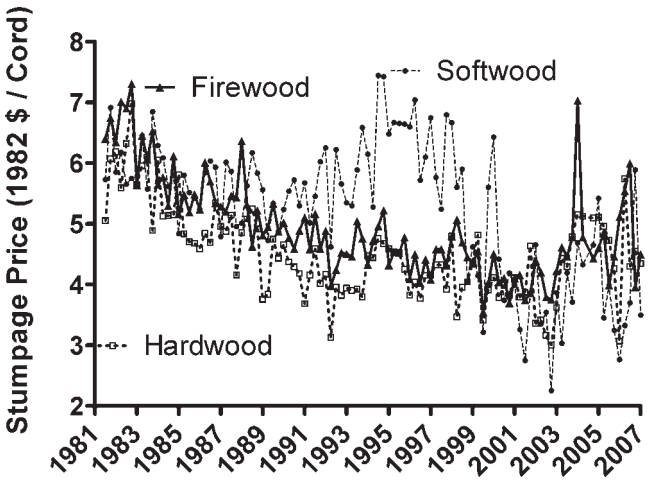

Figure 4.—Vermont hardwood pulpwood, softwood pulpwood, and firewood stumpage prices in real (1982) US dollars, 1981Q3 to 2007Q1.

After 2007Q1, New Hampshire red maple stumpage price trends were similar to trends in yellow birch prices. Where sugar maple prices decreased, red maple and yellow birch continued to appreciate. Yellow birch prices increased at the annual rate of 1.9 percent from 1985Q1 to 2011Q1. Red maple prices increased at the annual rate of 2.4 percent from 1992Q4 to 2011Q1. We do not have price trends for red maple in Vermont, but it is reasonable to assume that they were similar to trends in New Hampshire. Volumes of sugar maple and red maple harvested in Vermont from 1977 to 2010 indicate an increase in red maple harvest starting about 1994 and an increase relative to sugar maple about 1996 (Table 5), supporting an assumption of increasing red maple stumpage prices in Vermont (Vermont Department of Forests, Parks, and Recreation 2010).

Stumpage price trends for like species and proximate time periods in Vermont and New Hampshire were similar, but no statistical tests were done. The direction of trend

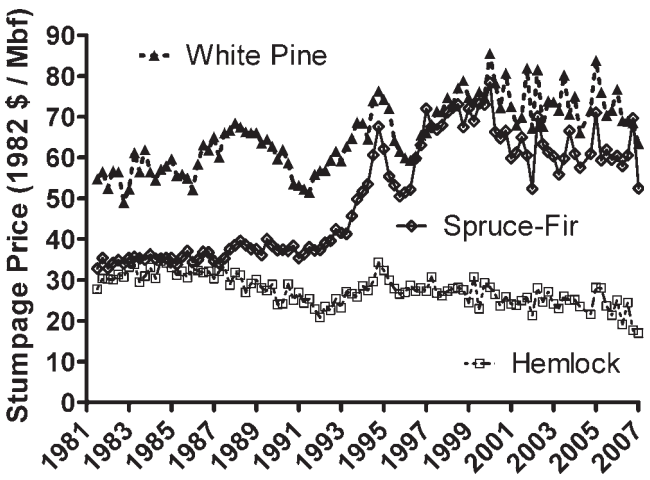

Figure 5.—Vermont white pine, spruce-fir, and hemlock sawtimber stumpage prices in real (1982) US dollars, 1981Q3 to 2007Q1.

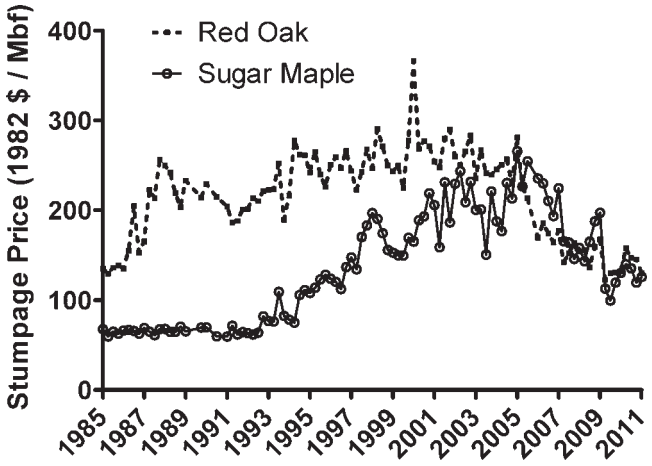

Figure 6.—New Hampshire red oak and sugar maple sawtimber stumpage prices in real (1982) US dollars, 1985Q1 to 2011Q1.

(positive or negative) was the same for sugar maple, red oak, yellow birch, and white pine, and the magnitude of APR was similar for sugar maple, yellow birch, and white pine (Table 6).

Discussion and Conclusions

Stumpage prices in Vermont and New Hampshire reacted to events in the economy in general and to factors specific to the forest products market. Red oak stumpage prices in Vermont began to decline in 1992 after a long period of growth. Simultaneously, stumpage prices for sugar maple began to increase after a long period of little growth or decline. According to Luppold and Bumgardner (2005, 2007), consumer tastes were changing along with more subtle changes in relative supply of major hardwood species. They analyzed real prices of red and white oak (*Quercus alba* L.) lumber grades and sugar (hard) and red (soft) maple lumber grades from 1965 to 2005. Fundamental changes occurred about 1986 with declining consumer preference for red oak furniture, millwork, and cabinetry but an increase in preference for red oak flooring, probably because red oak flooring is relatively inexpensive compared with other hardwoods and is a traditional flooring material.

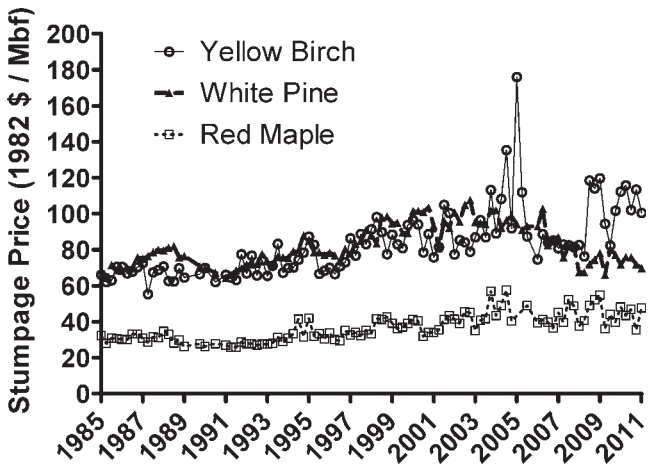

Figure 7.—New Hampshire yellow birch, white pine, and red maple sawtimber stumpage prices in real (1982) US dollars, 1985Q1 to 2011Q1.

Table 3.—Nominal and real annual percentage rate change (APR) in selected New Hampshire stumpage prices by sawtimber species from 1985Q1 to 2007Q1.[a]

Species	Period	APR (%)	
		Nominal	Real
Hardwood sawtimber			
Sugar maple	85Q1–92Q2	0.52	−2.33
	92Q3–07Q1	10.12	7.81
Red maple	85Q1–92Q2	0.04	−2.35
	92Q3–07Q1	5.21	3.10
Yellow birch	85Q1–07Q1	3.98	1.95
Softwood sawtimber			
White pine	85Q1–07Q1	3.71	1.63

[a] Two or more entries for a species indicate a statistically significant difference between periods; a single entry indicates no significant difference.

At approximately the same time, consumer preference for products manufactured from hard and soft maple lumber increased, but the dramatic increase in lumber prices for soft maple occurred in 1990 and for hard maple in 1992 (Luppold and Bumgardner 2005, 2007). These trends in lumber prices are reflected in trends in stumpage prices in Vermont for red oak and sugar maple and in New Hampshire for red oak, sugar maple, and red maple. Similar trends were evident in graphs of real stumpage prices in Maine reported in Irland (2011) for red oak, sugar maple, and red maple. Irland noted, ''The red maple trend line also reflects changing wood fashion. Red maple prices were barely worth tallying … in 1959. Red maple stumpage rose significantly after the late [19]80s.''

Red oak price trends in Vermont were positive from 1981Q1 to 1992Q2 and negative from 1992Q3 to 2007Q1, but in New Hampshire, red oak price trends were positive from 1985Q1 to 2000Q3 and negative from 2000Q4 to 2011Q1. It is possible but unlikely that differences in the

Table 4.—Nominal and real annual percentage rate change (APR) in selected New Hampshire stumpage prices by sawtimber species from 1985Q1 to 2011Q1.[a]

Species	Period	APR (%)	
		Nominal	Real
Hardwood sawtimber			
Sugar maple	85Q1–92Q3	1.57	−1.82
	92Q4–07Q1	9.99	7.59
	07Q2–11Q1	−4.88	−1.00[b]
Red maple	85Q1–92Q3	0.04	−2.33
	92Q4–11Q1	5.17	2.35
Yellow birch	85Q1–11Q1	4.29	1.90
Red oak	85Q1–00Q3	5.56	3.75
	00Q4–11Q1	−3.56	−7.36
Softwood sawtimber			
White pine	85Q1–05Q3	3.77	1.90
	05Q4–11Q1	−2.19[b]	−4.95

[a] Two or more entries for a species indicate a statistically significant difference between periods; a single entry indicates no significant difference.

[b] Not statistically significant from zero ($P \leq 0.05$). Statistical tests were performed on the log of quarterly price data (see Eq. 1).

Table 5.—Vermont sugar maple and red maple saw- and veneer-log harvest: 1977 to 2010, in thousands of board feet.[a]

Year	Sugar maple	Red maple	Red maple/ sugar maple ratio
1977	38,358	7,257	0.19
1978	39,247	8,147	0.21
1979	38,721	8,994	0.23
1980	38,552	7,935	0.21
1981	39,639	6,562	0.17
1982	32,854	5,055	0.15
1983	34,111	6,161	0.18
1984	34,729	6,953	0.20
1985	31,735	7,171	0.23
1986	29,135	5,687	0.20
1987	29,348	5,559	0.19
1988	28,920	6,331	0.22
1989	32,206	5,747	0.18
1990	34,776	7,303	0.21
1991	36,827	7,817	0.21
1992	40,793	7,802	0.19
1993	41,206	7,917	0.19
1994	54,593	10,464	0.19
1995	53,016	10,952	0.21
1996	40,823	14,556	0.36
1997	53,938	13,110	0.24
1998	47,531	11,939	0.25
1999	39,143	18,381	0.47
2000	42,254	12,288	0.29
2001	40,476	19,776	0.49
2002	36,432	12,587	0.35
2003	41,165	14,257	0.35
2004	41,639	11,846	0.28
2005	41,876	13,535	0.32
2006	31,866	11,009	0.35
2007	—	—	—
2008	33,491	6,435	0.19
2009	31,563	10,905	0.35
2010	31,406	9,085	0.29

[a] Source: Vermont Department of Forests, Parks, and Recreation (2010).

timing of red oak peak prices could have resulted from different start times of the two price series. It is more likely that differences in markets and species availability are more significant. Red oak sawtimber volume in New Hampshire (2.3 billion board feet) accounted for 18 percent of hardwood sawtimber inventory, while in Vermont (1 billion board feet of red oak) it accounted for 7 percent of hardwood sawtimber inventory (Frieswyk and Widmann 2000a, 2000b). In New Hampshire, more mills utilizing red oak and a larger marketing network for red oak logs and lumber could have supported relatively higher stumpage prices for a longer period of time.

Table 6.—Real annual rate change (APR) for selected species and time periods for Vermont and New Hampshire.

	Vermont		New Hampshire	
Species	Period	APR (%)	Period	APR (%)
Sugar maple	92Q3–07Q1	5.30	92Q3–07Q1	7.81
Yellow birch	92Q3–07Q1	1.27	85Q1–11Q1	1.90
Red oak	92Q3–07Q1	−2.16	00Q4–11Q1	−7.36
White pine	81Q3–07Q1	1.17	85Q1–07Q1	1.63

Red maple stumpage prices were not reported in Vermont. In New Hampshire, red maple stumpage price trends were similar to trends in sugar maple prices, although red maple APR was less than the APR for sugar maple. New Hampshire red maple and sugar maple prices decreased at similar annual rates from 1985Q1 to 1992Q2: –2.4 and –2.3 percent, respectively. Red maple prices appreciated at the annual rate of 3.1 percent from 1992Q3 to 2007Q1 compared with 7.8 percent for sugar maple.

The US forest products market, particularly markets supplying the housing sector, were devastated by the dramatic housing bubble collapse, the failed financial system, and ensuing deep recessions in the US and European economies (Smith and Guldin 2012). In Vermont, these declines were roughly consistent with national experience (Vermont Department of Forests, Parks, and Recreation 2010). Similar data were not available for comparison in New Hampshire.

A number of changes in the national and regional economies likely influenced the trends in stumpage prices we observed. The growth in housing that peaked in 2006 was the most significant factor in rising stumpage prices in Vermont and New Hampshire. Consumer preference for hardwoods changed in the mid- to late 1990s from a preference for open-grained species, such as oak and white ash, to closed-grain species, such as maple and yellow birch. In 1992 to 1993, prices for softwood pulpwood in Vermont (mostly spruce-fir with lesser amounts of hemlock and pine) rose abruptly and stabilized for about 10 years before dropping in the early 2000s. Similar behavior was evident for spruce-fir sawtimber prices in Vermont for about the same period. Spruce-fir stumpage prices for pulpwood and sawtimber exhibited similar behavior throughout the region (for Maine data, see Irland 2011). A number of factors were at play, but perhaps the most important was that a significant back-haul market developed whereby Canadian truckers transporting spruce-fir construction lumber into the United States hauled spruce-fir pulpwood back to Canada. At about the same time, Canadian sawmills began using spruce-fir logs down to a top diameter of 4 inches for structural lumber production. A third factor, perhaps not as significant, was the end of the salvage of spruce-fir timber killed or weakened in the last spruce budworm infestation in the region. These factors in turn put pressure on the spruce-fir resource across northern New England and New York, resulting in increased stumpage prices. The sudden drop in prices resulted from the shutdown of a major pulp and paper mill in New York that utilized spruce-fir and the eventual bursting of the housing bubble (Sloane Crawford and Jack Santamour, personal communication). No. 2 fuel oil prices were low from about 1989 to 1999 and increased from 2000 to 2009 with firewood prices in Vermont moving in similar directions.

In Vermont, stumpage price reporting ended at the beginning of the Great Recession, and the effects of the worsening economy are not apparent in the stumpage price data. In New Hampshire, stumpage price reporting continued through the recessionary period and beyond. New Hampshire stumpage prices declined from 2007 to 2011 for sugar maple, red oak, and white pine sawtimber, but prices continued to increase for red maple and yellow birch, possibly because they are substitutes for relatively more expensive sugar maple.

Sendak and McEvoy (1989) concluded on a hopeful note: ''It may be that lower interest rates and the resulting stimulation of the housing industry that have occurred over the past 2 years will ultimately have a positive effect on sawtimber stumpage prices in Vermont.'' The housing sector did continue to improve beyond wildest expectations as interest rates continued to fall, the financial sector was deregulated, and political will to increase the percentage of households owning their own home was strong. In retrospect, the strong housing sector, seemingly single-handedly driving growth, was also hiding weaknesses in the economy. By mid-2007 and perhaps earlier, the economy started to unravel, setting the stage for the Great Recession and its dire consequences for US and global economies.

The following can be stated in summary:

- Stumpage prices in Vermont and New Hampshire for sugar maple, yellow birch, and red maple (New Hampshire) sawtimber changed from a negative to a positive trend in the early to mid-1990s. In New Hampshire, yellow birch price trends were positive for the entire period analyzed.
- Red oak sawtimber stumpage price trends changed from positive to negative from the early to late 1990s.
- Red maple sawtimber emerged from a period of having low market value to one of appreciating prices up to and including the recessionary period from 2007 to 2009. This change is likely attributable to its similarity in appearance to sugar maple and possibly yellow birch.
- Spruce-fir sawtimber in Vermont and white pine sawtimber in both states increased in price for the entire period analyzed. Hemlock sawtimber in Vermont trended downward for the entire period analyzed.
- The effects of the Great Recession from 2007 to 2009 were evident in New Hampshire with negative stumpage price trends for sugar maple, red oak, and white pine but not for red maple and yellow birch (prices were not available for this period in Vermont).
- Stumpage prices in Vermont and New Hampshire were influenced by the state of the US economy. The two most influential factors in the economy were the long expansionary period from 1993 to 2000 followed by the troubling decade of the new millennium with two recessions. During the expansion, stumpage prices tended to rise, even into the middle of the 2000 to 2009 decade. But due to the Great Recession from 2007 to 2009, prices for key species tended to fall, based on the limited evidence we analyzed for New Hampshire.

Looking forward, the regression model used in this study to estimate past rate of stumpage price change is of little value because it contains no structural variables that might indicate when the estimated linear trend will likely change. However, it seems likely that until the demand for new and existing houses begins to rise and well-paying jobs become available in sufficient numbers, the housing sector will continue to lag, as will the forest sector (Alderman and Buehlmann 2012; Albert Schuler, personal communication). Banks must work through the problem of houses in foreclosure and those in danger of foreclosure as well. Late in 2012, the housing sector began to improve and has continued to improve at a slow pace into late summer 2013, and the market for residential remodeling has remained positive (Buehlmann and Schuler 2013). Stumpage prices for wood products tied directly or indirectly to housing may continue to lag for some time. In addition to lackluster performance in housing, uncertainties in the US economy may lead to continued slow growth. Add to that economic problems in Europe, China, and other developing markets, and the prospects for a growing world economy in the near term are not good.

Irland (2011) declined to make any specific predictions about when stumpage prices will recover in Maine except to say that rapid recovery of stumpage prices in the next 5 years is unlikely. We do not see a rapid recovery of stumpage prices in Vermont or New Hampshire in the short term either. There are bright spots, however, in development of new markets, such as bioenergy; chips, pellets, and torrefied wood; and chemical feedstock. When markets do return, they might be different with increasing use of the resource for engineered wood products, such as wooden I-joists and I-beams, laminated wood products, and structural building panels, resulting in more efficient utilization. The pulp and paper industry in the northeastern United States will continue to evolve as pulp and paper companies have divested themselves of timberlands, depending instead on long-term contracts with new timberland owners, wood purchased on the open market, and greater reliance on market pulp. How all this will affect stumpage prices is not easy to determine, but it is likely that there will be a market for high-quality hardwood and an expanding market for low-quality timber.

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