Hardwood Stumpage Price Trends and Regional Market Differences in Pennsylvania

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ABSTRACT: *Pennsylvania is a major hardwood lumber producing state. Since 1984, the Pennsylvania Timber Market Report (TMR) has provided quarterly stumpage and mill-delivered prices for important timber species groups for four subregions within the state. Stumpage price data covering the period from 1984 to 2000 are available for eight species groups. These series were analyzed with log-linear regression to determine nominal and real price growth rates. While all species show increasing prices over the period, three distinct groups are identified. Black cherry and hard maple show the highest rates of price growth (10.1% to 14.1% nominal and 6.5% to 10.7% real); northern red oak, soft maple, and yellow-poplar form an intermediate group (6.6% to 9.5% nominal and 3.1% to 6.1% real); and white oak, white ash, and miscellaneous hardwoods show the lowest rates of growth (4.3% to 6.8% nominal and 0.0% to 3.6% real). Additionally, a regression model with qualitative regional variables (i.e., "dummy" variables) was used to test whether the four market regions used by the TMR are statistically different, in terms of both the general level of prices and rates of change. The results clearly show significant differences in the price levels and trends among all regions for at least some species groups. The two regions showing the fewest significant differences are the southeast and southwest regions. The two northern regions are quite different from the southern regions. The northwest region was the most distinct of all the regions. Specific regional differences are noted for individual species groups. North. J. Appl. For. 20(3):124–130.*

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Pennsylvania is one of the leading hardwood lumber producing states in the nation. Over 60% (17 million ac) of its area is forested. More than 1 billion bd ft is harvested annually, of which over 70% is in sawlogs (Alerich 1993). The state is well known for its quality black cherry timber and other desirable hardwood species, especially northern red oak and hard maple. Seventy-five percent of the state's forestland is privately owned, and these lands provide more than 80% of the raw material harvested. This industry contributes over $5 billion annually to the state's economy (Pennsylvania Hardwood Development Council 1999).

It is axiomatic in economic theory that both buyers and sellers must have knowledge of prices in order to have a fair and competitive market. Yet such knowledge is not always easy to come by in the timber stumpage market, especially for sellers who may rarely conduct a timber harvest. Providing landowners with up-to-date market information is crucial, especially since many may make only one or two harvests in a lifetime. Other groups interested in stumpage price information include forest products industries, real estate agents, and prospective investors in timberlands. To meet the need for impartial and timely market information, the Penn State University School of Forest Resources started the Pennsylvania Timber Market Report (TMR) in mid-1984. The quarterly report provides sawlog stumpage, mill-delivered, and pulpwood prices for selected important timber species groups throughout the state.

Most states with important forest product industries have developed timber price reporting series. For example, Emanuel and Rhodes (1999) gathered reports on selected hardwood lumber prices from six eastern and southern states, including Pennsylvania. In another report, Lutz, Howard, and Sendak (1992) examined data collection, processing, and dissemination methods of stumpage price reports in 22 northern and border states. In this study the authors found that data are often collected from rather limited segments of the market with limited quality control. Prices are generally reported in terms of species, timber quality, and major products, ranging from detailed lists to gross aggregates. Their suggestions for improving stumpage price reports include more rapid dissemination, broader sampling of transactions, improved quality control and statistical analysis, and increased computerization.

Log-linear regression is a standard approach for evaluating the rate of change in stumpage prices over time. For example,

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the Southern Appalachian Timber Study (De Steiguer et al. 1989) used Timber Mart-South data to examine price trends for various combinations of hardwood and softwood species from 1977 to 1987. Other studies which used a log-linear regression approach include: Howard and Chase (1995), who studied price trends in stumpage prices in Maine using data from the Maine Forest Service from 1963 to 1990 for 27 species/products combinations; Luppold and Baumgras (1995), who examined price trends and relationships for oak and yellow-poplar stumpage, sawlogs, and lumber in Ohio from 1975 to 1993; and Sendak and McEvoy (1989), who studied quarterly stumpage prices for ten forest products in Vermont from 1981 to 1987.

One goal of this study was to determine the average rates of price change in both real and nominal terms for sawtimber species that have been tracked over the entire TMR series (second quarter of 1984 through the fourth quarter of 2000). Although past rates of change in stumpage prices are not perfect predictors of future trends, they provide key information for planning future forest management and investment activities. The results of this part of the study will be useful for forest industries, public and private landowners, government agencies, and investors in timberlands. The second goal was to assess whether the market regions used in the report truly reflect different markets for each of the species and identify the type and magnitude of these differences, to the extent that they exist.

Data

The TMR price series are compiled from a survey sent to over 130 loggers, sawmill operators, forestry consultants, the Pennsylvania Bureau of Forestry (BOF), the Pennsylvania Game Commission, and the USDA Forest Service. In addition, surveys are available on the Penn State School of Forest Resources web site (http://www.sfr.cas.psu.edu/TMR/TMR.htm) and downloadable. Until 1992, the TMR was distributed by mail, and only paper records existed for the period from 1984 to 1991. Since 1992, the TMR has been available on the website. Because the pre-1992 reports were not available in a digital form, they were entered into a spreadsheet and combined with the post-1992 digital data.

For the purposes of the TMR, the state is divided into four market regions—northeast, southeast, southwest, and northwest—that correspond to recognized market zones within the state (Figure 1). Sawtimber prices are reported in \$/MBF International Scale. Average stumpage prices and high and low values that represent one standard deviation above and below the mean are reported. Mill prices are given for delivered logs of grades F1, F2, and F3. Pulpwood stumpage prices are given for both hardwoods and softwoods in \$/ton.

Participation in the survey is voluntary, so the number of responses per quarter varies considerably. Recently, an average of about 120 to 150 responses are received each quarter. Slightly more responses are generally received when prices are rising. Over the long run, each series gives a good indication of the trend of prices for that species group. However, when looking at any one species or reporting period it is important to consider how many responses were obtained in that period

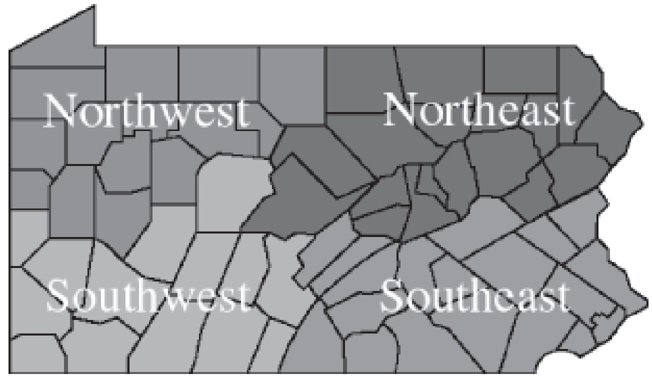

Figure 1. Timber market report regions.

for that species. Table 1 provides descriptive statistics for the number of survey responses for each species group by quarter. Not only is there wide variation in the number of responses among regions, which is to be expected given differences in the industry among regions, but great variation also exists between quarters in the same region.

The stumpage price series analyzed in this study are for black cherry, hard maple, northern red oak, soft maple, yellow-poplar, white oak, white ash, and miscellaneous hardwoods. Other species groups in the TMR—hemlock, mixed oak, pine-hemlock, and white pine—were not used because data were not available for the entire period.

Methods

In order to estimate rates of price change, the natural logarithm of the price was used to transform the trend relationships in the price data into linear form. Simple linear regression was then used to analyze price trends for each species group and region. The model used was:

$$Y_t = b_0 + b_1 X_t \tag{1}$$

where Y_t is the natural logarithm of the average stumpage price for the particular species group and region in quarter t; b_0 is the regression line intercept, signifying the natural logarithm of the value of the price trend curve at the start of the series; b_1 represents the slope of the regression; and X_t represents the quarter. The quarters are numbered sequentially for the series: 0.25, 0.5, 0.75, etc., so the coefficient b_1 represents the average annual rate of price change for the series.

Nominal prices are the actual prices for each quarter. They include inflationary effects that can mask the underlying price trends. The nominal prices were converted to real prices using the Producer Price Index (PPI) with 2000 as the base year. The industry-specific "lumber and wood products, except furniture" PPI series was used since it was the closest match available for this sector. (PPI data were obtained from the US Bureau of Labor Statistics web site, http//www.bls.gov.) Equation 1 was fitted to the natural logarithm of both the nominal and real price series for each species group and each region. The results for the real price series give a superior picture of the actual changes in the market over the time period because inflationary effects have been removed. Real price trends show the change in the price of a given product relative to the general level of prices for other goods and services.

Table 1. Summary statistics of number of responses each quarter from second quarter 1987 to fourth quarter 2000.

		Region				
Species		Northeast	Northwest	Southeast	Southwest	Average
Black cherry	Mean	16.85	46.51	5.04	15.71	21.03
	Standard deviation	5.26	11.09	6.15	4.64	
	High value	26	73	37	32	42
	Low value	0	5	0	3	2
Hard maple	Mean	17.02	36.64	5.35	12.60	17.90
	Standard deviation	5.33	8.89	3.73	4.07	
	High value	28	64	25	23	35
	Low value	1	4	1	1	1.75
Northern red oak	Mean	25.35	38.05	27.11	24.69	28.80
	Standard deviation	8.36	8.96	9.49	7.05	
	High value	51	69	54	44	54.5
	Low value	4	5	6	5	5
Soft maple	Mean	24.51	46.91	13.13	18.73	25.82
	Standard deviation	7.63	11.22	7.50	5.63	
	High value	51	73	49	41	53.5
	Low value	3	5	2	4	3.5
Yellow-poplar	Mean	11.62	26.22	22.42	16.69	19.24
	Standard deviation	3.12	6.51	7.97	4.86	
	High value	18	43	43	29	33.25
	Low value	2	2	4	2	2.5
White oak	Mean	20.25	30.24	25.53	20.89	24.23
	Standard deviation	7.16	8.01	8.87	5.75	
	High value	41	57	45	34	44.25
	Low value	3	5	6	4	4.5
White ash	Mean	19.73	37.58	16.69	13.91	21.98
	Standard deviation	5.65	8.43	6.71	4.52	
	High value	37	61	36	25	39.75
	Low value	2	4	4	1	2.75
Misc. hardwoods	Mean	22.62	37.24	22.42	20.40	25.67
	Standard deviation	8.46	10.60	8.83	6.72	
	High value	47	69	40	39	48.75
	Low value	4	3	1	4	3

To test the appropriateness of dividing the state into four market regions, data for all four regions for a given species group were combined and the regression model was expanded to include qualitative, or "dummy," variables representing each of the market regions. With four market regions, three dummy variables were needed to measure the difference between the initial price levels (intercepts) in each of the other regions relative to the default region. Three interaction variables—the products of the regional dummy variables and the time series variable—measure the difference in price trends (slopes) between the default region and each of the other regions. The model is:

$$Y_t = b_0 + b_1X_t + b_2D_1 + b_3D_2 + b_4D_3 + b_5D_1X_t + b_6D_2X_t + b_7D_3X_t \qquad (2)$$

Here again, Y_t is the natural logarithm of the stumpage price; b_0, the regression intercept, represents the natural logarithm of the value of the price trend curve at the start of the series for the species of interest in the default region; b_1 is the average annual rate of price change for that species in the default region; b_2, b_3, and b_4 are regression parameters for the other market regions, representing the difference, or offset, between the initial level of the price trend curve in the default region and the initial price levels in the other regions; D_1, D_2, and D_3 are the dummy variables for the three nondefault regions (taking a value of 1 if the price/time observation comes from the region represented by the variable, and 0 if it is not from that region); X_t is the quarter of the price series, numbered as above; D_1X_t, D_2X_t, and D_3X_t are interaction variables used to measure differences in the price trends between the regions; and b_5, b_6, and b_7 are the regression parameters for the interaction variables. The qualitative, or dummy, variable technique used here is described further in Albright et al. (2002) and Chatterjee et al. (2000).

Interpreting the results of the expanded model, Equation (2), is somewhat more difficult than for the first model. Assume that the northwest is the default region and that the qualitative variables $D1$, $D2$, and $D3$ represent the northeast, the southeast, and the southwest, respectively. For the northwest region, the regression model reduces to Equation (1):

$$Y_t = b_0 + b_1X_t \qquad (3)$$

For the northeast region, the model reduces to:

$$Y_t = (b_0 + b_2) + (b_1 + b_5)X_t \quad (4)$$

The regression parameter b_2 is the offset of the initial price level in the northeast from the initial price level in the northwest. The parameter b_5 tests whether the slope of the curve, or the rate of price change over time, is statistically different in the two regions. The models for the other regions reduce as follows:

Southeast:

$$Y_t = (b_0 + b_3) + (b_1 + b_6)X_t \quad (5)$$

Southwest:

$$Y_t = (b_0 + b_4) + (b_1 + b_7)X_t \quad (6)$$

If the intercept parameters are statistically significant (b_2, b_3, or b_4), then their corresponding regions have statistically different initial price levels than the default region. If the interaction parameters (b_5, b_6, or b_7) are statistically significant, then the rates of price change for the corresponding regions are statistically different from the default region. In order to test all of the species/region combinations, the model was run separately with successive regions as the default.

A basic assumption of linear regression is that the errors, or residuals, of each observation are independent. Time series data, such as the stumpage price series, often violate this assumption since residuals of adjacent data points have a tendency to be similar, a condition known as autocorrelation. Positive autocorrelation is the most common (Berenson et al. 1983). In first-order autocorrelation, the residuals of any one point are correlated with the previous period's residual. The Durbin-Watson (DW) statistic is typically used to test for first order autocorrelation. A DW statistic of 2 means no autocorrelation. With a relatively large data set and five or more regression variables, a DW of 1.5 or less indicates the presence of autocorrelation (Albright et al. 2002). The initial regressions for both the individual species by region and species across region models showed moderate to severe autocorrelation, with DW statistics ranging from 0.5 to 1.5. The autocorrelation was corrected using generalized least squares procedures (SAS Institute 2001).

Results

Tables 2 and 3 show the average annual percentage rate of change (b_1) for the various species by region [Equation (1)]. Because the error term on the untransformed equation is multiplicative, the regression root mean square error (RMSE) is converted to a percent root mean square error with this equation: $(e^{RMSE} - 1) * 100$. This percent error gives some indication of the variability of the results and is reported in Tables 2 and 3. Table 2 gives the nominal rates of change, and Table 3 shows the real rates of change. Nominal rates of change typically differ from real rates of change by roughly 3.4%, the average rate of inflation over the study period in the PPI series used. Because real rates of change are more meaningful than nominal rates of change, our discussion focuses on the results from the real price data (Table 3).

The differences in the rates of price change among species groups tend to be related to the initial price level in that the prices for the more valuable species tend to increase faster than the prices for the less valuable species. For example, black cherry, hard maple, and northern red oak have long been among the highest valued species in the state, and miscellaneous hardwoods have tended to be a low-value species group. However, there are some exceptions to this trend. In particular, soft maple has traditionally been a relatively low-value species,

Table 2. Average annual nominal rates of sawtimber stumpage price change and percent RMSE in Pennsylvania by market region.

	Northeast	Northwest	Southeast	Southwest
Black cherry	14.09	13.15	10.15	11.45
	12.21	17.65	35.54	18.35
Hard maple	11.26	12.61	10.08	10.31
	15.33	18.42	25.17	25.51
Northern red oak	7.82	7.03	8.20	9.05
	9.78	14.05	12.65	15.97
Soft maple	7.63	9.46	6.95	7.50
	12.37	15.27	19.82	18.40
Yellow-poplar	6.59	7.91	6.74	8.32
	17.41	19.07	15.08	17.89
White oak	6.17	4.85	6.81	6.59
	12.44	12.38	14.00	14.94
White ash	5.47	3.68	6.44	6.65
	12.75	13.04	19.70	26.12
Misc. hardwoods	4.30	4.11	6.23	6.54
	17.38	42.48	17.71	24.04

NOTE: Percent RMSE for the regression calculated by $(e^{RMSE}-1)*100$.

Table 3. Average annual real rates of sawtimber stumpage price change and Percent RMSE in Pennsylvania by market region. (Boldface values not significant at the 0.05 level. Critical value = 1.96.)

	Northeast	Northwest	Southeast	Southwest
Black cherry	10.68	9.60	6.70	7.89
	12.95	17.31	37.01	17.97
Hard maple	7.87	9.29	6.50	6.74
	14.86	17.70	24.48	26.28
Northern red oak	4.33	3.62	4.89	5.68
	9.85	13.42	12.59	15.26
Soft maple	4.04	6.14	3.29	3.97
	12.34	14.84	19.30	18.04
Yellow-poplar	3.09	4.43	3.56	4.68
	16.18	18.43	14.32	18.15
White oak	2.62	1.53	3.64	3.18
	11.42	12.06	13.62	15.04
White ash	2.08	**0.27**	3.20	3.25
	12.30	**12.22**	19.07	26.46
Misc. hardwoods	**0.70**	**0.50**	0.03	3.08
	17.16	**42.36**	17.01	23.27

NOTE: Percent RMSE for the regression calculated by $(e^{RMSE}-1)*100$.

but soft maple prices have been rising relatively fast, especially compared to other low-value species. Conversely, white ash was once one of the faster growing species, but it is now one of the lower growing species.

There are several reasons why prices for a timber species can be statistically different between two market regions, including quantity of timber, quality of timber, number and type of local sawmills, and local demand. Growing conditions (soil types, rainfall, etc.), past silvicultural practices, and land ownership patterns all affect the quality and availability of timber. For a particular species, if the intercepts of the estimated price trend curves are significantly different between two regions then the prices started at different levels at the beginning of the price series. In many cases this difference, or offset, is consistent throughout the series. However, if the rate of change or slope of the equation is different, then the curves may coincide or spread further apart over time. To fully understand whether the price trends in different regions represent different markets, both kinds of information are needed. Therefore, if neither the intercept nor the slope is significantly different, then the price relationships between the two regions are indistinguishable. If only the intercepts are significantly different, then the two regions share a common price relationship with a consistent offset. If only the slope is different, the two regions started at the same price level, but diverged over time. When both intercept and slope are different, then the two regions have very different price relationships. With four market regions, there are six different unique region-pair combinations.

Tables 4, 5, and 6 show the results from the multiple regression models where interaction variables are included [Equation (2)]. Table 4 lists the *t*-test results for the qualitative variables testing for differences in the intercept of the regression between regions; a value greater than the critical value (1.96) indicates that the price trend curves for the two regions have statistically different intercepts ($P = 0.05$). Table 5 lists the *t*-test results of the qualitative variables testing for differences in the slopes between regions; again, the critical value indicating a statistically different rate of price change is 1.96. Table 6 summarizes the significant ($P = 0.05$) differences in slope and intercept for each of the region pairs for each species.

Discussion

The results suggest that the eight species analyzed here divide into three fairly distinct groups. Black cherry and hard maple show the highest rates of growth over the length of the

Table 4. Values of *t*-test results for qualitative variables indicating differences in the intercept in multiple regressions showing interactions among regions. (Boldface values not significant at the 0.05 level. Critical value = 1.96.)

Species	NE-SE	NE-SW	NE-NW	SE-SW	SE-NW	SW-NW
Black cherry	3.11	2.81	2.35	**1.05**	5.95	6.49
Hard maple	**1.26**	**0.41**	**1.64**	**1.04**	2.85	2.25
N. red oak	**0.05**	**1.74**	3.10	**1.72**	3.04	6.90
Soft maple	2.93	2.07	2.55	**1.23**	5.34	4.23
Yellow poplar	3.86	**0.13**	2.93	3.53	5.72	2.55
White oak	2.57	2.01	3.97	**1.13**	**0.07**	**1.18**
White ash	**0.12**	3.25	**0.70**	**1.85**	**0.62**	4.33
Misc. hardwoods	3.63	2.45	**1.76**	**1.50**	3.97	3.19

Table 5. Values of *t*-test results for qualitative variables indicating differences in the slope in multiple regressions showing interactions among regions. (Boldface values not significant at the 0.05 level. Critical value = 1.96.)

Species	NE-SE	NE-SW	NE-NW	SE-SW	SE-NW	SW-NW
Black cherry	3.42	2.92	**0.96**	**1.33**	3.03	2.28
Hard maple	**1.02**	**1.12**	**1.22**	**0.07**	2.20	2.51
N. red oak	**0.41**	**1.51**	**0.76**	**1.00**	**1.25**	3.22
Soft maple	**0.87**	**0.29**	2.32	**0.73**	3.05	2.39
Yellow poplar	**0.56**	**1.73**	**1.17**	**1.18**	**0.66**	**0.27**
White oak	2.07	**0.71**	**1.67**	**0.38**	2.07	2.20
White ash	**0.72**	**1.52**	**1.62**	**0.15**	**1.96**	3.46
Misc. hardwoods	2.07	2.63	**0.21**	**0.07**	**1.75**	2.14

series; northern red oak, soft maple, and yellow-poplar form a middle group; and the lowest performing species are white oak, white ash, and miscellaneous hardwoods.

Black cherry showed the highest rates of real price growth in the northern tier of the state, with 9.5% to 10.4% annual rates of increase, compared with 6.3% to 7.8% in the southern tier. This makes sense because the highest quality and greatest quantity of cherry is located in the north. Hard maple prices show smaller differences among the regions, with real annual rates of change ranging from 6.4% in the southeast to 9.6% in the northwest.

Northern red oak is a very popular and common lumber species; northern red oak prices grew at real annual rates ranging from 3.6% in the northwest to 5.6% in the southwest. Soft maple is becoming a much more valued species in the state; soft maple prices grew at real annual rates ranging from 3.3% in the southeast to 6.5% in the northwest. Yellow poplar prices grew at real annual rates ranging from 3.1% in the northeast to 4.6% in the southwest and northwest.

White oak, white ash, and miscellaneous hardwoods are economically less important components of Pennsylvania's forest resource today and showed lesser rates of price growth. White oak prices grew at real annual rates ranging from 1.5% in the northwest to 3.8% in the southeast. Real white ash prices grew at an annual rate of only 0.1% in the northwest, a value that was not significantly different from zero. However, in the southeast and southwest, real white ash prices increased at more healthy rates: 3.4% and 3.3%, respectively. The miscellaneous hardwoods species group consists of species that are not produced in large enough quantities to merit a group of their own; they include hickories, birches, beech, black locust, and basswood. Miscellaneous hardwood prices grew at real annual rates of only 0.7% in the northeast to 3.3% in the southeast.

The differences in species' rate of growth compared among regions are mixed. Of the 48 possible species–region combinations, 17 (35.4%) show no difference, 15 (31.2%) show both slope and intercept differences, 14 (29.2%) show only intercept differences, and 2 (4.2%) show only slope differences. Examining the *t*-test results in Tables 4 and 5 shows that although many of the relations are statistically significant, they are only marginally so.

The two southern regions are very similar. For seven species, there was no significant difference in either the intercept or the slope of the price trend curve. Yellow poplar differs only in terms of the intercept.

The northwest region seems to stand out as quite different with regard to the other regions, especially in comparison with the southern regions. The northwest differed significantly from the southwest in terms of both intercept and slope for six of the eight species groups, and the two regions differed significantly either in terms of intercept or slope for the remaining three species groups. Similarly, both the slopes and the intercepts of the price trends in the northwest differed significantly from the price trends in the southeast for three species groups, and the remaining species groups' (except white ash) price trends were significantly different in terms of either slopes or intercepts. The statistical tests for comparisons between the northwest and the southern regions also tended to produce stronger *t*-statistics.

The comparison of the northwest with the northeast is mixed, but shows more similarities than differences. The price trend for soft maple was significantly different in both intercept and slope. The price trends for miscellaneous hardwoods, white ash, and hard maple were not significantly different with regard to either slope or intercept in either region. The remaining species' price trends all differ significantly with regard to intercept.

Table 6. Summary of statistically significant differences between market regions (*t* values > 1.96).

Species	NE-SE	NE-SW	NE-NW	SE-SW	SE-NW	SW-NW
Black cherry	Both	Both	Intercept	Neither	Both	Both
Hard maple	Neither	Neither	Neither	Neither	Both	Both
N. red oak	Neither	Neither	Intercept	Neither	Intercept	Both
Soft maple	Intercept	Intercept	Both	Neither	Both	Both
Yellow poplar	Intercept	Neither	Intercept	Intercept	Intercept	Intercept
White oak	Both	Intercept	Intercept	Neither	Slope	Slope
White ash	Neither	Intercept	Neither	Neither	Neither	Both
Miscellaneous hardwoods	Both	Both	Neither	Neither	Intercept	Both

NOTE: Both—both slope and intercept values significantly different (t>1.96).
Slope—only the slope value shows significantly different (t>1.96).
Intercept—only the intercept value shows significantly different (t>1.96).
Neither—no statistically significant difference between the two regions.

Comparisons between the northeast and the two southern regions also suggest that the northeast region is unique. Comparing the northeast with the southeast, the price trends for three species groups differ significantly with regard to both intercept and slope; while the northeast–southwest comparison shows only two species with both intercept and slope differences. The northeast and southern regions show three species each with no significant differences.

There are a variety of explanations for the regional differences shown here. One clear factor is forest type. The northern tier for the most part is comprised of northern hardwoods (black cherry, hard maple, birch, etc.), while the south is predominately an oak-hickory forest with a higher percentage of oaks, yellow poplar and soft maple. The northwest tends to have higher quality sites and higher quality hardwoods than the northeast. To some extent, this explains the differences between the price trends in the northwest and the northeast. Other regional differences relate to forest area, extent of forest industry, and urbanization. For example, the northern tier is more forested than the southern tier and has a higher number of primary manufacturing facilities than the southern region. The southeast and the southwest also encompass the two large metropolitan regions of the state, although both regions also include substantial rural areas. The northeast is also becoming more urbanized due to the tourism and recreation-based activities associated with the Poconos.

Looking at the regional differences by individual species groups, it is clear that the black cherry market is relatively unique in each region. Most comparisons differ significantly with regard to both intercepts and slopes. Only the southeast–southwest comparison shows no significant difference. The northeast and northwest's markets for black cherry seem to be following a similar trend, but at a different overall level. Black cherry prices tend to be higher in the northwest than elsewhere because of the higher quality of the black cherry wood grown in that region.

In the hard maple markets, the northwest and southern markets are significantly different. All the other comparisons show no significant difference. In both northern red oak and soft maple the northwest is significantly different from the other regions, which are not very different from each other.

The yellow-poplar market shows the same price trends, but different levels among the regions. The white oak and white ash markets are similar, with stronger differences between the northwest and the other regions. The results for miscellaneous hardwoods suggest that there are unique northern and southern regions for this species group, but show no significant differences between the two northern regions or between the two southern regions.

These results show that the market regions used in the TMR do represent different markets. However, this is an aggregate difference. The price trends for each species have to be examined individually. Also, in counties that are on the border of a region, there will be fewer differences in stumpage prices between local prices and the neighboring region.

Conclusion

The stumpage price series in the Pennsylvania Timber Market Report indicate strong growth in both nominal and real prices over the 1984 to 2000 period. The species analyzed divided into three distinct groups: black cherry and hard maple showed the highest rates of price growth; northern red oak, soft maple, and yellow poplar formed and intermediate group; and white oak, white ash, and miscellaneous hardwoods showed the lowest rates of growth. Although still statistically significant for the most part, the relatively weaker results for the lower performing group indicate a much more variable picture. These rates of price growth should encourage landowners to increase investments in forest management, all other things being equal. However, there is no guarantee that the same rates of price growth will continue into the future. Overall economic conditions, changes in environmental and tax regulations, changes in harvesting technologies and costs, and changes in species demand caused by, among other factors, changes in the furnishing styles, will all combine to influence stumpage prices offered to landowners.

The regional comparisons clearly show significant differences in the price levels and trends among all regions for at least some species groups. The two regions showing the fewest significant differences are the southeast and southwest regions. The two northern regions are quite different from the southern regions. The northwest region showed the greatest differences with all the other regions. Black cherry showed the greatest differences in each market region. The miscellaneous hardwoods market seems to be broken into two unique regions in the northern and the southern parts of the state. Hard maple showed the fewest differences among the regions.

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