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Abstract: Data collected for the period 1970-1995 was examined to determine which factors are significant southern pine sawtimber stompage price determinants. In Georgia, pine sawtimber stompage was found to be a function of i) previous year’s housing starts, ii) previous year’s harvest volumes from National Forest lands, and iii) the trade-weighted U.S. dollar index from two years previous. Nationwide housing starts was a better predictor than southwide housing starts, suggesting that southern pine lumber competes with western and Canadian lumber on a national scale. Recent reductions in National Forest harvest levels, with subsequent reductions in both the western timber supply and the “buffering” effect of Forest Service sales, have led to increased southern pine stompage prices. The impact of lumber imports on current or future stompage prices was dependent upon the relative strength of the U.S. dollar, as measured by the trade-weighted dollar index.

Introduction

Historically, pine sawtimber stompage prices in Georgia have fluctuated within “real-price bands” for long periods of time (Figure 1). These real-price bands are characterized by upper and lower real price limits. Only rarely will real prices exceed these limits, and then only for a very short period before moving back into the real-price band.

From 1952 to 1971, this real-price band ranged from $120-$150 per MBF (1983 dollars). Only three times in 20 years did real prices move beyond this range, and then only for one year before moving back into the price band. Furthermore, except for 1953 and 1960, real price changes tended to be rather gradual.

In the early 1970s, a dramatic increase in housing starts, fueled by the maturing baby-boomer generation, pushed real prices beyond the historic real-price band. A new real-price band was established, ranging from $135-$175 per MBF (1983 dollars). This real-price band lasted from 1972 through 1992. Again, only three times in 21 years did real prices move significantly beyond this price band, and then only for a one-year period. In contrast to the 1950s and 1960s, however, real price changes within the last 20 years have tended to be more dynamic than in the past.

In the early 1990s, real pine sawtimber stompage prices began moving upward from the lower limit of the real-price band. Stumpage prices increased substantially in 1992 and continued increasing in 1993 and 1994. In 1993, real sawtimber stompage prices exceeded $180 per MBF (1983 dollars) for the first time since 1978, moving out of the real-price band. Surprisingly, rather than moving back into the real-price band in 1994, real stompage prices set an all-time annual high of $218 per MBF, clearly breaking out of the real-price band for the first time in more than two decades. Even more surprising, stumpage prices continued to counter historic trends in 1995 by increasing to an all-time annual high of $231 per MBF.

Figure 1. Real pine sawtimber stumpage price in Georgia over time.

Given this dramatic movement in the stumpage market, several important questions arose among buyers and sellers of southern pine sawtimber: i) will stumpage prices continue this dramatic increase, or ii) will prices plummet back into the real-price band that they occupied for more than 2 decades, or iii) will prices level off at some new real-price band, substantially higher than the historic band?

The purpose of this research was to examine potential southern pine sawtimber stumpage price determinants with the following objectives:

1. Determine which factors are significant price determinants for pine sawtimber stumpage in Georgia;
2. Explain possible reasons for the recent movement in the sawtimber stumpage market;
3. If possible, predict the future real sawtimber stumpage price trend.

**Methods**

Eight potential stumpage price determinants were examined to determine their effect on sawtimber stumpage prices from 1970 to 1995. The factors examined were:

1. Nationwide new housing starts;
2. Southwide new housing starts;
3. Real residential remodeling and repair expenditures;
4. Timber harvest volumes from National Forest lands;
5. Net softwood lumber imports (imports minus exports);
6. U.S.-Canadian currency exchange rate;
7. Trade-weighted U.S. dollar index (J.P. Morgan Guaranty Trust);
8. Average annual rainfall in Georgia, averaged from 12 locations throughout the Piedmont and Coastal Plain regions.

The above data was collected from a variety of public sources, mostly U.S. Bureau of the Census reports and USDA Forest Service publications. The trade-weighted U.S. dollar index is calculated by the J.P. Morgan Guaranty Trust in New York. Rainfall data was obtained from the NOAA Agricultural Weather Service in Auburn, Alabama. Pine sawtimber stumpage prices were obtained from timber sales conducted by F&W Forestry Services, Inc., throughout central and southern Georgia. Due to major market differences, sales from the Appalachian Mountain physiographic region of Georgia were excluded from this analysis. Sales were averaged to obtain the mean sawtimber stumpage price for each calendar year. Nominal stumpage prices were adjusted using the Consumer Price Index (1982-1984 = 100) to obtain real stumpage prices.

Multiple least-squares regression analysis was used to model real stumpage price as a function of the eight potential price determinants. Preliminary analysis of the data suggested that changes in stumpage price lagged changes in many of the potential price determinants by as much as two years. Therefore, one- and two-year lagged parameters for each potential determinant (e.g., housing starts from the prior year) were used in the analysis, yielding 24 independent variables. An iterative process was used by which statistically significant parameters were added to or removed from the model until only those parameters that were statistically significant at \( \alpha = 0.05 \) remained in the model.

A linear model specification was found to be superior to log-linear models. Therefore, linear models were developed for the full set of data (1970-1995) to determine long-term price determinants. Since it is possible that the structure of the stumpage market may change over time, more recent data (1986-1995) was analyzed separately to determine if the same price determinants remained significant in the short-term.

Since the short-term model provided a better fit than the long-term model, ten-year data was used to test the model's predictive capability. Data from 1981-1990 was fit to the model to determine the coefficients for each price determinant. This model was then used to predict 1991 price, which was then compared to the actual 1991 price. Data from 1982-1991 was used to calculate a new set of model coefficients, used to predict 1992 price. This process was repeated for 1993-1996 predictions.

**Results and Discussion**

For the full data set (1970-1995), three significant price determinants were identified: i) nationwide housing starts from the previous year, ii) harvest volumes from National Forests for the previous year, and iii) the trade-weighted U.S. dollar index from two years previous (Figure 2 and Table 1). Substituting southside housing starts for nationwide housing starts yielded a significant, though slightly inferior, model. None of the other parameters tested were significant at \( \alpha = 0.05 \).

For the short-term data set (1986-1995), the same three price determinants were found to be significant as in the long-term model (Figure 3 and Table 2). However, the short-term model provided a better fit
Figure 2. Actual vs. predicted real sawtimber stumpage price (long-term model).


<table>
<thead>
<tr>
<th>Parameter</th>
<th>Coefficient</th>
<th>t-Statistic</th>
<th>PR &gt; t</th>
<th>Price Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>278.1800</td>
<td>11.314</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
<tr>
<td>Previous year's housing starts (000s)</td>
<td>0.0461</td>
<td>5.113</td>
<td>&lt; 0.001</td>
<td>0.44</td>
</tr>
<tr>
<td>Previous year's National Forest harvest volume (million bd. ft.)</td>
<td>-0.0104</td>
<td>-6.567</td>
<td>&lt; 0.001</td>
<td>-0.64</td>
</tr>
<tr>
<td>Trade-weighted U.S. dollar index from two years prior</td>
<td>-0.8705</td>
<td>-3.077</td>
<td>0.006</td>
<td>-0.53</td>
</tr>
</tbody>
</table>

F-statistic: 23.040
PR > F: < 0.001
Adj. R²: 0.74
Figure 3. Actual vs. predicted real sawtimber stumpage price (short-term model).

Table 2. Short-term (1986-1995) model of sawtimber stumpage price determinants.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Coefficient</th>
<th>t-Statistic</th>
<th>PR &gt; t</th>
<th>Price Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>272.51</td>
<td>11.984</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
<tr>
<td>Previous year's housing starts (000s)</td>
<td>0.0936</td>
<td>3.294</td>
<td>0.017</td>
<td>0.84</td>
</tr>
<tr>
<td>Previous year's National Forest harvest volume (million bd. ft.)</td>
<td>-0.0119</td>
<td>-7.9768</td>
<td>&lt; 0.001</td>
<td>-0.74</td>
</tr>
<tr>
<td>Trade-weighted U.S. dollar index from two years prior</td>
<td>-1.3251</td>
<td>-2.7537</td>
<td>0.033</td>
<td>-0.79</td>
</tr>
</tbody>
</table>

F-statistic: 33.521
PR>F: < 0.001
Adj. R²: 0.92
than the long-term model. Again, no other parameters examined were found to be significant at $\alpha = 0.05$.

**Housing Starts, Nationwide and Southwide**

New housing starts has long been identified as a major component of domestic lumber demand with a strong influence on lumber prices (Robinson 1974, Lewandrowski et al. 1994). Consequently, it was expected that housing starts would have a strong influence on sawtimber stumpage prices as well. In effect, housing starts acts as a suitable, and easily measured, surrogate for lumber demand.

Previous year's housing starts, either nationwide or southwide, were determined to be significant stumpage price determinants. The sign of the coefficient (+) is as expected, with increases in housing starts corresponding to increases in stumpage prices. The reason for the one-year lag in effect was not unexpected. In response to increased lumber demand, first retail and wholesale lumber inventories will be reduced. Then mill inventories of both lumber and logs will be reduced. Finally, inventories of purchased, but uncut, timber will be depleted. Only then will the effects of increased lumber demand be expressed directly on the stumpage market.

In this study, regional housing starts was no better in predicting stumpage price than nationwide housing starts. This is in agreement with previous assumptions that southern pine lumber competes on a national scale with lumber from the Pacific Northwest and Canada (Robinson 1974, Lewandrowski et al. 1994).

**National Forest Harvest Volumes**

The sale and harvest of timber from National Forest land is an important component of the stumpage market. In addition to directly affecting the available supply of timber, National Forest timber sales have traditionally acted as a buffer against changes in stumpage prices (Adams et al. 1991). Until recently, timber was usually sold from National Forest land under long-term contracts (3-5 years), with payment due as timber was cut. This is in contrast to sales from private land, where contract lengths are much shorter (1-2 years) and payment is often due at the beginning of the contract period. As a result, purchases of National Forest timber were made more in response to expected future stumpage prices than current prices. When buyers expected future stumpage prices to increase, they would purchase and hold National Forest timber, delaying harvest until their expectations were met.

This buffering effect has been virtually eliminated as timber sales from National Forest lands are being seriously curtailed. During the early 1990s, the buffering effect was still in effect, as older long-term contracts ran their course. For example, in 1992 the USDA Forest Service sold only 4.45 billion board feet of timber. However, loggers harvested nearly 7.3 billion board feet that same year. By 1993, however, the effects of reduced sale volumes became apparent, as the volume of timber harvested from National Forest lands fell to half the average level of the 1980s. Further reductions occurred in 1994 and are anticipated for the future.

The reduction in the supply of a substitute for southern pine timber and the elimination of the buffering capacity of National Forest sales has had a major impact on southern pine stumpage prices. National Forest harvest volume from the previous year was found to be a significant stumpage price determinant. The sign of the coefficient (-) is as expected, with decreases in harvest levels leading to increases in stumpage prices. The strength of the relationship was somewhat surprising, considering the majority of National Forest timber sales occur in the western U.S. and most of the recent reduction in sale volume has come from the western National Forests. The fact that harvest levels in the western U.S. impact stumpage prices in Georgia indicates that southern pine lumber competes in a nation-wide
market. These results also support the commonly-held belief that the future timber supply is shifting from the western U.S. to the southeast.

**U.S.-Canadian Exchange Rate and Trade-Weighted U.S. Dollar Index**

Adams *et al.* (1986) found that the U.S.-Canadian exchange rate was an important factor determining the level of Canadian lumber imports into the U.S. Elasticities of demand with respect to the exchange rate were 0.5 for softwood lumber import volume and -0.3 for the price of U.S. softwood lumber.

In this study, the U.S.-Canadian exchange rate was not a significant price determinant. However, the trade-weighted U.S. dollar index was significantly correlated with stumpage price two years later. The sign of the coefficient (-) indicates that during or immediately after periods when the dollar is weak, stumpage prices can be expected to increase. Presumably, this is in response to reduced lumber imports, due to unfavorable exchange rates for imports. Since import-export markets take some time to adjust to changes in exchange rates, the stumpage market response to changes in the import-export climate shows considerable lag.

**Residential Remodeling and Repair Expenditures**

Expenditures on residential remodeling and repairs have been used to help estimate lumber demand in the past (Lewandrowski *et al.* 1994). Recent estimates place the consumption of softwood lumber for remodeling and repair nearly equal to that for new residential construction (Random Lengths 1993).

In this study, real expenditures for remodeling and repair was not found to be a significant stumpage price determinant. Examination of the data shows that real expenditures for remodeling remained fairly constant from 1970 through the early 1980s. Real expenditures increased dramatically for a very short period, then remained constant again from the late 1980s to 1994. Thus, it appears that while remodeling and repair expenditures may be an important “baseline” component of lumber demand, expenditures remain fairly constant over time and therefore are not correlated with changes in stumpage price.

**Net Softwood Lumber Imports**

Since Canadian lumber is generally assumed to be a good substitute for southern pine lumber (Adams *et al.* 1986, Lewandrowski *et al.* 1994), increased imports of lumber would be expected to depress domestic stumpage prices. Evidence exists that when exchange rates are favorable for imports, domestic lumber and stumpage prices decrease (Adams *et al.* 1986 and this study).

In actuality, both stumpage price and import volume respond similarly to domestic lumber demand. Using data from 1965-1978, Buongiorno *et al.* (1979) found that softwood lumber imports followed changes in the price of U.S. lumber (elasticity of demand = 1.16). They concluded that import levels were a function of construction activity and domestic lumber price.

When lumber demand and price increase, more lumber will be imported. This is particularly true when the import-export climate is favorable for imports. However, imports appear to buffer stumpage price increases rather than actually drive prices down. This may explain why the trade-weighted U.S. dollar index is a better indicator of future stumpage prices than lumber import volumes. When demand increases while exchange rates are unfavorable for imports, the increase in lumber imports will be less and some of the buffering effect afforded by increased imports is lost. Therefore, we see
Table 3. Predicted vs. actual stumpage price and annual price change.

<table>
<thead>
<tr>
<th>Year</th>
<th>$ / MBF (1983 $)</th>
<th>% Change from Previous Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Predicted</td>
<td>Actual</td>
</tr>
<tr>
<td>1991</td>
<td>$144</td>
<td>$137</td>
</tr>
<tr>
<td>1992</td>
<td>$151</td>
<td>$153</td>
</tr>
<tr>
<td>1993</td>
<td>$168</td>
<td>$186</td>
</tr>
<tr>
<td>1994</td>
<td>$196</td>
<td>$218</td>
</tr>
<tr>
<td>1995</td>
<td>$235</td>
<td>$231</td>
</tr>
<tr>
<td>1996</td>
<td>$222</td>
<td>$211*</td>
</tr>
</tbody>
</table>

* Actual 1996 price and % change are through March 31, 1996.

A greater increase in stumpage prices than would be expected if exchange rates were favorable for imports.

Annual Rainfall

Using the short-term data (1986-1995) in this study, previous year's rainfall was found to be significantly correlated with current stumpage prices when used alone (adj. R² = 0.38, F-statistic = 6.611). However, rainfall was not a significant variable when added to models containing the most significant parameters already discussed. In addition, no correlation could be found between rainfall and stumpage prices over the long-term (1970-1995).

In the South, where late fall and winter generally bring substantial rainfall and rising water tables, the seasonal nature of stumpage prices is well-known. However, it is possible that seasonal rainfall does not have any long-term effect that would cause yearly average prices to fluctuate beyond that expected from changes in the previously mentioned price determinants. To truly gauge the effects of rainfall on stumpage prices, it is probably necessary to examine data on a quarterly or monthly basis.

Yearly Model Predictions

Using data from the previous ten years, successive short-term models correctly predicted the directional movement in the stumpage market six consecutive years, assuming the 1996 prediction holds true for the entire year, which seems very likely (Table 3). In addition, the model predicted the relative magnitude of the price change (within 5 percentage points) in three of the last five years, not including 1996.

In terms of actual price, short-term models' predictions of real stumpage price were within 10 percent of the actual yearly average price in all five years (1991-1995) and were within 5 percent in three of the five years.

Conclusions

Data from this study suggests that the dramatic rise in southern pine stumpage prices over the last few years has been caused by a drastic reduction in the supply of a competing substitute (western timber from National Forests) during a period of increasing demand (housing starts) and an unfavorable...
climate for lumber imports (weak U.S. dollar index). Although lumber demand and the strength of the dollar will continue to fluctuate in the future, it is unlikely that National Forest harvest volumes will return to previous levels. Thus, the most likely scenario for the future is the establishment of a new “real-price band” above the historic band that had been in effect for over 20 years.

Although the short-term (10-year) stumpage price model showed surprisingly good predictive capabilities, changes in the market structure may cause stumpage price changes not reflected in this model. For example, changes in historically stable “baseline” components, such as remodeling and repair expenditures, may cause price fluctuations beyond those predicted by this model. Also, new trade agreements may alter the market structure. Reductions in Canadian lumber imports not brought about by market forces (e.g., tariffs or quotas) are likely to cause further increases in domestic stumpage prices.

**Literature Cited**


