PAPERS

First Place:
6 Lumber Futures, Price Expectations, and Short-run Production Adjustments in the Softwood Lumber Industry
   Derald J. Holtcamp, Iowa State University

Second Place:
18 Lead/Lag Relationships Between Retail, Wholesale and Farm Beef Price Changes
   Barbara A. Golden and Renee M. Lloyd, Oklahoma State University

Third Place:
30 Use Value Assessment as a Soil Erosion Control Strategy: A Case Study of Lunenburg County, Virginia
   Patricia L. Malone, Virginia Polytechnic Institute and State University

Abstracts:
42 The 1985 Farm Bill: Some Preferences of Indiana Farmers
   Amy Allred, Purdue University

42 An Economic Analysis of the Proposed Agricultural Forestation Program
   Douglas M. Collins, University of Georgia

43 An Empirical Investigation of the Relationship Between Combine Size and Wheat Harvesting Efficiency in Oklahoma
   M. John Kane, Oklahoma State University

43 Induced Institutional Change on the Pine Ridge Indian Reservation
   Patricia L. Malone, Virginia Polytechnic Institute and State University

43 Farming the Tax Code to Start a Young Person in Farming
   Scott A. Mickey, Virginia Polytechnic Institute and State University

44 An Economic Analysis of Pari-Mutual Wagering on Georgia's Economy
   Judith L. Roberts, University of Georgia

44 An Economic Analysis of Non-Brand and Brand Advertising
   Ralph Savage, Utah State University

   Glen Schmeltz, University of Illinois

45 The Economic Impact of a Marketing Order on the Price of Florida Celery
   Catherine M. Schlupf, University of Florida

45 An Economic Analysis of the Potential Effects of a Marketing Order for Pecans
   Rebecca J. Sharp, University of Florida
Lumber Futures, Price Expectations, and Short-run Production Adjustments in The Softwood Lumber Industry

by

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ABSTRACT

It was hypothesized that softwood lumber producers adjust short-run production in response to price expectations formed with respect to nearby futures market prices. A supply function which included production as a function of input costs, stocks, cash price and a basis variable was estimated using regression techniques. A small but strong statistical relationship was discovered between changed in production and nearby futures prices.

Keywords: softwood lumber, futures, lumber futures, marketing and production strategies, price expectation.

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Lumber Futures, Price Expectations, and Short-run
Production Adjustments in The Softwood Lumber Industry

Introduction

In 1980, from the last week in March to the last week in April cash lumber prices received by producers rose $35/thousand board feet from $165 to $190. Within 12 months following the oil embargo cash prices fell nearly 40 percent and production was cut in half. These examples illustrate the volatile and risky circumstances, with respect to short-term price, that have become characteristic of the softwood lumber industry in the 70s and 80s. As a result of increased price volatility increasing pressure has been put on lumber producers to make better marketing decisions in the short-run.

A prerequisite to improved marketing decisions is the ability to correctly anticipate future price changes. Producers form expectations about future prices in a variety of ways. From these expectations they can adjust their production, if the production process allows, in order to capitalize on expected developments. For example, if a producer expects the price to decline in the months ahead he may hasten production and marketing now to avoid the lower price. Conversely, if he expects higher prices to come in the future he may postpone marketing until a later period. Considering the tremendous potential for short-term gains or losses it seems reasonable to presume that producers would adjust short-run production and marketing to the extent possible, to enhance profitability.

The mid-to-late 60s saw the advent of futures for non-storable com-
modities including lumber. Producers of non-storable commodities gained the means to transfer risk to speculators and a mechanism through which they could anticipate short-run changes in price. Some research indicates that the futures price for non-storable commodities can be interpreted to be the consensus of what traders believe will be the cash price at some future date (Leuthold 1974).

Lumber is produced from cut logs called stumpage which is obtained from standing timber. Since this analysis deals strictly with the conversion of stumpage to lumber, which must be accomplished within a few months to avoid deterioration of the logs, stumpage may for practical purposes be considered a non-storable commodity. If producers use the futures market to develop price expectations, and they find that these expectations are often accurate, they may adjust production in response to changes in futures prices.

The lumber futures have been traded on the Chicago Merchantile since the late 1960s. By 1971 the open interest on nearby futures was always in excess of 500 contracts. The delivery unit consists of 130,000 board feet of random length 2x4s from 8 to 20 feet. The unit must also meet required grade standards and be manufactured and produced in specific areas of the U.S. and Canada (CME 1983).

Objective

The objective of this paper is to evaluate whether or not producers have adjusted production of softwood lumber in the short-run in response to changes in price expectation reflected by changes in the futures prices. A supply function will be evaluated to determine the relationship between production in the current period and futures prices several months prior, as
well as other variables that may influence production. A similar study was conducted in 1979 for cattle and hogs (Hoffman 1979).

There are several features of the softwood lumber industry that make it amenable to this kind of analysis. The cycle involved in converting standing timber to lumber can be thought of as being similar to the production of fed beef. First, the production process and marketing decision can be adjusted in response to changes in short-run price expectations. For instance, cattle producers can generally delay marketing from two weeks to a month by adjusting feed intake if future price increases seem likely. In the same fashion lumber manufacturers can delay processing stumpage for several weeks if short-run prices are expected to increase. Second, as in cattle production, increasing or decreasing production cannot be accomplished instantaneously. The time involved in converting standing timber to lumber averages around one year. Therefore, a producer must plan production up to a year ahead of time. As the product is converted, the costs of storage increase at each phase. Standing timber is relatively inexpensive to store whereas stumpage becomes more susceptible to insect and weather damage.

Because lumber is produced under competitive conditions, a supply function can be derived from the firm's short-run production function. Aggregate supply is then a summation of each individuals supply function. While other factors enter the supply function besides expected price, it is assumed that the over-riding influence on short-run production is expected price. In addition, it is assumed that the firms are independent and not involved in contract marketing which limits the producers ability to make
production decisions. In reality contract marketing is becoming more and more common in the lumber industry.

Theoretical Model

The hypothesized short-term supply function for softwood lumber is thought to be the following:

Production = f (expected output price, stocks, input costs).

Expected Output Price = The short-run price producers expect to receive for random length 2x4s.

Stocks = The quantity of cut lumber in the producers inventory.

Input Costs = Costs involved in converting stumpage to random length 2x4s.

The hypothesized relationship between expected output price and production is a positive one. If producers anticipate a rise in output price, production should also increase. Alternatively, an expected decline in price should result in a decline in production. Level of stocks, on the other hand, have a negative relationship with production. If stocks are large, production would be expected to be lower since current demand could be supplied from inventory. Finally, input costs have an inverse association with production. As input costs rise, the individual's marginal cost curve shifts upward and to the left which suggests that profit maximizing producers will, ceteris paribus, reduce production. The theoretical model above will now be used to derive the empirical model.

Empirical Model

The empirical model contains four independent variables, some of which involve a time lag. The proposed model is:
\[ \text{Prod}_t = \beta_0 + \beta_1 \text{cash}_{t-1} + \beta_2 \text{basis}_{t-2} \\
+ \beta_3 \text{stocks/use}_{t-1} + \beta_4 \text{labor}_t + t \]

\( \text{Prod}_t \) = monthly production of softwood lumber in millions of board feet;

\( \text{Cash}_t \) = monthly cash price of Hem-fir lumber in dollars per thousand board feet;

\( \text{Stocks/use}_t \) = ratio of softwood lumber stocks to disappearance periods;

\( \text{Labor}_t \) = monthly average hourly wage rate paid to lumber mill workers;

\( \text{Basis}_t \) = nearby futures \( t \) - cash price \( t \).

In the theoretical model, production was assumed to be a function of expected output price. In the empirical model this effect is captured by both the cash price lagged two months and the basis lagged two months. The lag enables us to consider how producers use the past cash price to adjust future production. It is hypothesized that if prices are relatively high 2 months prior, production will be high in the current month.\(^2\) As mentioned above, the Hem-Fir price refers to a specific type of lumber (i.e. that from Hemlock and Fir trees). This price series was chosen because Hem-Fir generally come closest to the quality grade specified as deliverable on a lumber futures contract (Oliveria 1977). Because of the unavailability of data however, the series for production and stocks are for all softwood lumber production. Use of the Hem-Fir price series can nonetheless be justified for two reasons. First, a large portion of softwood lumber production is Hem-Fir. Second, changes in the short-run price for most types of softwood lumber are relatively similar. In other words, a $15 increase in the price of Hem-Fir from one month to the next is generally accompanied by approximately a $15 increase in most other types of softwood lumber.
The proposed variable that we are most interested in is the basis. The basis is defined as the nearby futures price minus the cash price. The nearby futures contract is defined as the contract closest to the current month but at least two months in the future. To avoid the situation where the nearby futures price was too close to allow for an adjustment in production, the nearby futures alternates between 2 and 3 months ahead of the current month. For example, the nearby for January is the March contract whereas the nearby for February and March is the May contract. If the nearby futures price is high relative to current cash prices, the basis as defined will be large. If producers form future price expectations by this variable we would expect some fraction of production and/or marketing to be delayed in expectation of higher prices. As such, we hypothesize a positive relationship between the lagged basis and current production.

Current production is also assumed to be affected by the level of stock or inventory. It was decided that a stocks to use ratio would be superior to simply level of stocks. By doing this we can consider the relative size of stocks in relation to disappearance or use. Use is defined as:

beginning of month stocks + current production - end of current month stocks. It is expected that a negative relationship will be shown between the stocks/use variable since if stocks are building in relation to use, then production will be reduced in future months. The final independent variable included in this model is labor. Since labor is the single most significant input cost in the lumber industry, it is used as a representative of all input costs. As with total input costs, labor is expected to have a negative relationship with production.
Results of Estimation

The data set for this analysis consisted of monthly data for each variable. The sample period is from January 1971 to December 1981 resulting in 132 observations. Data for production and stocks were obtained from the Survey of Current Business. The Chicago Mercantile Exchange Yearbook was used to obtain data for the cash and futures price series. The labor series is from United States Government publication Employment and Earnings.

The results of the estimation are as follows, t-values are in parenthesis:

\[ \text{Prod}_t = 3438.29 + 3.96 \text{ cash}_{t-2} + 5.17 \text{ basist}_{t-2} \]
\[ (16.71) (3.54) (2.65) \]
\[ - 548.38 \text{ stocks/use}_{t-1} - 144.13 \text{ labor} \]
\[ (-5.16) (-4.18) \]

\[ N = 126 \]
\[ R^2 = 0.55 \]
\[ \text{Durbin-Watson Statistic} = 1.85 \]

All of the variables have the anticipated sign and are all significant at the .05 level of significance. The Durbin-Watson statistic indicates that first order auto-correlation is not likely. The \( R^2 \) statistic indicates that approximately 55 percent of the variation in the dependent variable is accounted for by the model. Possibilities to expand the model in order to explain more of the variability exist. Seasonality is apparent in plots of the production series with peaks in the spring and fall corresponding to traditional timber harvest months. Moreover, large residuals exists for the
recession in the latter part of 1974 and the beginning of 1975. The previously mentioned phenomena suggest dummy variables could be included. In addition, the input cost and cash price series could be improved if the data were available. However, data availability for lumber is not as complete as it is for many other commodities.

Economic Analysis and Implications

In order to derive conclusions from the estimated model, one needs to determine to what magnitude the independent variables, specifically the basis, and cash price, affect production. The most direct way to interpret the model is to consider the absolute influence changes in expected price have on production. The following table illustrates the affect.

Table 1. Change in Short-run Production per $1 Change in Selected Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Production Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Price</td>
<td>3.96 Million Board Feet</td>
</tr>
<tr>
<td>Basis</td>
<td>5.17 Million Board Feet</td>
</tr>
</tbody>
</table>

Elasticities can also be calculated using the following formula:

$$E_i = \beta \frac{\bar{x}}{y} \frac{\bar{y}}{X} / \frac{\bar{y}}{X}$$

where $\beta_x$ = the estimated coefficient for $x$

$\bar{x}$ = the mean of the independent variable

$\bar{y}$ = the mean of the dependent variable (prod.)

$E_c = 0.295$

$E_b = -0.016$
\[ E_B = -0.392 \]
\[ E_I = -0.289 \]

For the basis elasticity we can say that a 1 percent change in the basis will be accompanied by a -0.016 percent change in production. Elasticities are particularly useful because their values are independent of the units in which the variables are measured. In general large elasticities imply that the dependent variable is very responsive to changes in the independent variable. Note also, that the elasticities are measured at the mean of each series so that if the model was used for forecasting a recent value (rather than the mean) would provide more current information about supply response.

Judging from the estimated coefficients, the futures price seems to have influence on short-run production. This is compatible with the hypothesis that futures price do indeed provide short-run price forecasts.

One possible modification would entail changing the lag on the basis and cash variables. An analysis of the relative elasticity of production as timber moves through the process could be done by adjusting the variable lags. It would likely be found that a model for a longer production horizon would show more responses to changes in expected price.

Conclusion

Initially it was hypothesized that lumber producers use the futures market to form short-run expectations about lumber prices and adjust production and marketing accordingly. In order to test the hypothesis, a short-run supply function was proposed. If the hypothesis was to be accepted, we expected to see a significant, positive relationship between the basis and
production in the regression analysis. The results did demonstrate that such a relationship, though relatively small, does exist. Therefore, the hypothesis can be accepted. Although not the objective of this study, it is interesting to note the relatively small role current cash prices play when producers form price expectations.

It is important that producers have the best possible information available to form price expectations in order to plan production and marketing in advance. Futures markets can provide such information for nonstorable commodities since, as mentioned earlier the weight of evidence suggests that these prices contain the consensus of what futures traders believe the cash price will be at some future date. The futures are an inexpensive means by which producers can form price expectations as the prices are readily available on a daily basis in many publications.

Throughout the rest of this century it is likely that the lumber industry will become increasingly risky with respect to price. It is also likely that the futures market will be an increasingly important tool used by producers to mitigate against the effects of this price volatility.

Footnotes

1 January, March, May, July, September, and November.

2 The cash price is the price received by producers at the end of each month. A one month lag was judged insufficient time for producers to adjust planned production.
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