Price Discovery in Private Cash Forward Markets – The Case of Lumber

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Practitioner's Abstract

Cash forward contracting is a common, and often preferred, means of managing price risk for agribusinesses. Despite this, little is known about the performance of cash forward markets, in particular the role they play in price discovery. The lumber market provides a unique case for examining this issue. The Bloch Lumber Company maintains an active cash forward market for many lumber products, and publishes benchmark forward prices on their website and disseminates these prices to data vendors. Focusing on 2x4 random lengths lumber and 7/16 oriented strand board, this research examines the lead-lag relationships between the three-month forward prices published by Bloch Lumber and representative spot prices. Results suggest that at least for 2x4 random lengths lumber, the forward prices published by Bloch Lumber lead the spot price. However, spot prices do not lead the forward prices for 2x4 random lengths lumber, but do for oriented strand board. While these results suggest that the Bloch Lumber forward cash prices are contributing to price discovery, the dominant market for price discovery may be an existing spot or futures market.

Introduction

Exchange traded futures markets are only one mechanism available for forward pricing. Cash forward contracting is a popular and often preferred method for use by farmers, agribusinesses, and other firms in managing output and input price risk. For some, cash forward contracts are often the only price risk management tool available for markets where exchange traded futures contracts do not exist (e.g., wheat middlings). However, cash forward contracting arrangements are almost always privately negotiated (Menkhaus et al.), and forward prices are not made public.[1] Given this, researchers have had limited opportunity to empirically examine the performance of cash forward markets. Because of the lack of data for these markets, researchers have often relied on theoretical, or more recently experimental economic methods, in analyzing cash forward market performance (Menkhaus et al.; Krogmeier et al.; Mahenc and Salaine; Mahenc and Meunier).

An existing private cash forward market for lumber, however, may provide some insight into the performance of these markets. The Bloch Lumber Company (www.blochlumber.com), a large forest products distributor based in Chicago, Illinois offers cash forward contracts through their Guaranteed Forward Price (GFP) program. Through the GFP program, Bloch provides their customers cash forward contracts for a number of lumber and board products. Customers, such as homebuilders and lumberyards, can fix their lumber or wood products prices (e.g., oriented strand board) up to one year in advance. The company also posts cash forward prices on their web page which they refer to as "Bloch Benchmarks". While these benchmark prices are more general, and do not reflect specific transaction prices, they are designed to provide the lumber trading public with forward price information that can be used for planning purposes. The Bloch

[1] One exception is the forward market for foreign currencies. See Wang and Jones.

Benchmark prices are posted daily on the company's website, and can also be accessed through Bloomberg's subscription service, providing a rare source of publicly available cash forward price data.

Therefore, the overall objective of this research is to determine the role, if any, the Bloch Benchmark program plays in discovering prices for lumber commodities. In doing this, both the Bloch Benchmark prices and the Bloch GFP program are discussed. Focus is placed on two of the most important lumber products – 2x4 random lengths lumber and oriented strand board. Following the methods of Oellermann and Farris and Koontz, Garcia, and Hudson, this research incorporates the use of Granger Causality tests to determine if the Bloch Benchmark forward prices lead lumber spot prices, or if lumber spot prices lead the forwards. Determining the lead-lag relationships between the forward and spot prices provides initial evidence into the role that cash forward markets play in the price discovery process. If the forward market prices are found to lead the spot prices, this suggests that price discovery is taking place in the forward market.

The results of this research provide initial insight into how the Bloch forward pricing program contributes to price discovery in the lumber and board markets. Indeed, the market for lumber and wood products is large, and these prices represent a major cost of production in the building industry - currently one of the major drivers of economic growth in the U.S. Furthermore, the results may provide important clues into the performance of cash forward markets in general. This is particularly important given many agribusiness products do not have active exchange traded futures markets, and forward contracting is often the only available means of price risk management. Regardless, given the paucity of cash forward price data in general, the forward price information published by Bloch Lumber provides an interesting case study. This research also broadens the academic literature examining the performance of futures and cash markets for lumber and wood products (He and Holt; Veld-Merkoulova and DeRoon; Sun and Zhang; McKenzie, Thomsen and Dixon; Rucker, Thurman, and Yoder).

The remainder of the paper is presented as follows. First, both the Bloch Benchmark and Bloch GFP programs are described. Second, the specific data used to analyze the lead-lag relationships between the forward and spot prices is presented and discussed. Next, the Granger Causality tests used are delineated, followed by presentation and discussion of results. The final section summarizes the research conducted, and suggests directions for further research.

Bloch Benchmark Prices and Guaranteed Forward Price Program

The Bloch Lumber Company (www.blochlumber.com) is a major wholesaler and distributor of lumber products in the U.S. Bloch Lumber is headquartered in Chicago, Illinois, and maintains six regional sales offices and nine warehouses throughout the country. Bloch Lumber has been providing cash forward contracts to their customers for a number of years through their Guaranteed Forward Price (GFP) program. Through the GFP program, Bloch Lumber provides their customers with the opportunity to lock in prices for various lumber products for up to three, six, or twelve months in the future. Bloch Lumber's customers include major purchasers of lumber and board products including other wholesale and retail lumber yards, large home builders, and developers. As with any company that provides forward contracts to their

customers, Bloch Lumber takes on the risk that prices for these products will be higher between the time the contract is entered and when they must source and deliver the product to their customers. To mitigate this risk, Bloch Lumber may hedge their exposure in the lumber futures markets, engage in cross-hedging activities, or implement various spot market strategies (personal communication). While exact volume and dollar numbers were not known or revealed by Bloch Lumber, they did suggest that the GFP program is very active with approximately $80 to $100 million worth of forward contracts written per year (personal communication)

In 2002, Bloch Lumber launched the publication and dissemination of "Bloch Benchmark" prices on their website and also through Bloomberg's subscription service. The Bloch Benchmark prices are essentially forward prices (three-, six-, and twelve-month forward prices) published by the company for a number of important lumber and wood products including 2x4 spruce-pine-fur (SPF) random lengths lumber, 2x4 Western SPF studs, 2x4 random length SPF 1650 sf MSR, and 7/16 oriented strand board (OSB). Forward prices for these products are reported for three general delivery locations including Midwest Markets (Chicago, IL and Detroit, MI), Southeast Markets (Atlanta, GA and Birmingham, AL), and Southwest Markets (Dallas, TX and Houston, TX). Therefore, forward prices for a total of four lumber products, for three general delivery markets are reported. Forward price quotes represent equal carload quantities (quoted in thousand board feet) shipped monthly during the time period.[2]

According to the Bloch Lumber website, as well as interviews conducted with Bloch Lumber personal, Bloch Benchmark prices are developed using a proprietary trading model. While specifics of the model specification were not revealed by Bloch Lumber, the model is essentially a fundamental value model incorporating information from a number of sources. As stated on the Bloch Lumber website, the model uses "…information Bloch obtains from our agents, financial market data, quotes, news, analysts opinions, and research reports…" (www.blochlumber.com)[3]. According to Bloch Lumber, the motivation for publishing the Bloch Benchmark prices is to provide greater price transparency in the lumber market. A quote from their website states "…the Bloch Benchmark prices are neither an offer to nor recommendation to buy or sell, but rather information designed to facilitate trading in an orderly market..." (www.blochlumber.com). Not only does the publication of Bloch Benchmark prices provide more transparency in the lumber markets, they help to differentiate Bloch Lumber themselves as a company (personal communication). As the disclaimer page for the Bloch Benchmark prices states "Bloch Lumber Company ("Bloch") makes a market in the products listed above, and we may or may not have a position in such products" (http://www.blochlumber.com/). While the Bloch Benchmark prices are not exactly the forward prices offered through the GFP program, they are quite similar. That is, the GFP prices are "more refined" prices than that of the Bloch Benchmarks (personal communication). The GFP prices are quoted for a larger and more specific number of products and delivery markets, and ultimately actual transaction prices may reflect discounts for large orders, quality premiums, etc.[4]

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[2] See the Bloch Lumber website at www.blochlumber.com for more details.

[3] See further discussion on the Bloch Benchmark prices at http://www.blochlumber.com/Disclaimer.asp?page=public .

[4] Guaranteed Forward Prices (GFP) are also published on the Bloch Lumber website. As with the Bloch Benchmarks, these prices are developed using a proprietary trading model. However, the GFP prices are not reported or disseminated through Bloomberg's subscription service.

Data and Methods

Following the methods of Oellermann and Farris, as well as Koontz, Garcia, and Hudson, Granger Causality tests are used to determine if Bloch Lumber's private forward cash market contributes to price discovery in the lumber and wood product markets. To conduct the causality tests, time series of both the Bloch Lumber forward prices and competing market prices, such as spot market prices, are needed. Since the early inception of the Bloch Benchmark price program, Bloomberg has reported the three-month, six-month, and twelve-month forward prices on a daily basis for all products and market regions published by Bloch Lumber. Bloomberg also publishes spot price series for 2x4 SPF random lengths lumber and 7/16 OSB. These spot prices represent mill prices, and not delivered prices like the Bloch Benchmarks. For 2x4 SPF random length lumber, prices reflect mill prices per thousand board feet out of the Western U.S. and Canada, while the 7/16 OSB prices reflect mill prices in thousand board feet for shipments out of Wisconsin and Minnesota mills. These spot prices are provided to Bloomberg by Random Lengths, a market news service servicing the lumber industry. Random Lengths conducts weekly surveys of prices among mills, and publishes these prices each Friday in their Random Length's publication. This newsletter is widely read by lumber industry participants, and is considered a leading source of market information for the industry.

Since the Random Lengths spot prices are reported on Friday, weekly (Friday) price series are used. To keep the analysis tractable, and to minimize potential empirical issues arising from the use of overlapping data series, only the lead-lag relationships between the Bloch Benchmark three-month forward prices for Chicago/Detroit delivery and spot prices are examined. The sample data span from September 20, 2002 through March 11, 2005, for a total of 130 weekly observations. Figure 1 plots the 2x4 SPF random lengths spot price and corresponding three-month forward price, while Figure 2 shows the 7/16 OSB spot and three-month forward prices over the sample period. In both Figures 1 and 2, it is clear that the patterns in both the spot and forward series track each other closely, with the three-month forward exhibiting a premium relative to the spot price. While this premium may be reflective of many things (e.g., storage costs; risk premium) the premium likely reflects differences in transportation costs between mill (spot) and the delivery price for the Chicago/Detroit markets (three-month forwards). According to Bloch Lumber, historically the transportation premium for 2x4 SPF random lengths lumber is approximately $58 above the mill price, and is approximately $20 above the mill price for 7/16 OSB for delivery into Chicago/Detroit markets (personal communication).

Summary statistics of the price series plotted in Figures 1 and 2 are reported in Table 1. The mean for the spot 2x4 SPF random lengths lumber is 321.8, and is 382.1 for the three month forward, for a difference of $60.3. For OSB, the mean spot price over the sample period is 317.3 and the mean for the three-month forward is 342.0, for a difference of 24.7. While the differences between spot and forward prices are generally in line with the transportation differentials discussed above, transportation costs likely have varied over the sample period. Furthermore, premiums contained in the three-month forwards may reflect more than transportation differentials. Namely, a risk premium may be reflected to compensate Bloch Lumber for incurring risks in providing its customers the ability to lock in forward prices. Interestingly, the standard deviation for both OSB price series is nearly double to that of the 2x4 SPF random lengths lumber series. Correlation coefficients estimated between the spot and the

three-month forward series confirm a strong positive relationship. The correlation between the 2x4 SPF random lengths lumber spot and forwards is 0.98, and is 0.95 for the spot and forward OSB prices. Results of Augmented Dickey-Fuller tests run on all four price series fail to reject the null hypothesis of the existence of a unit root. Given this, the ensuing causality tests are conducted in first differences to ensure stationarity of the data.

Granger Causality tests have been used in the agricultural economics and futures market literature to examine how different markets contribute to the price discovery process. Oellermann and Farris test the lead-lag relationships between live cattle spot prices and live cattle futures prices in order to determine if the spot or futures market is the center of price discovery. Similarly, Koontz, Garcia, and Hudson examined the spatial nature of price discovery for live cattle by examining lead-lag relationships between various spot markets for live cattle, and between the live cattle futures market and these spot markets. Here, we examine if the Bloch Benchmark prices are contributing to price discovery in the 2x4 SPF random lengths lumber market and the 7/16 OSB market. While the Bloch Benchmark prices are not forward market transaction prices per se, they do provide forward price information to the lumber market participants who may ultimately forward contract using the Bloch Lumber GFP program.

Do Three-Month Forward Prices Lead Spot Prices?

The first causality test examines whether the three-month forward price changes, ΔX_t, lead the spot price changes, ΔY_t. The test is defined as:

(1) $$\Delta Y_t = \alpha + \sum_{i=1}^{m} \lambda_i \Delta Y_{t-i} + \sum_{j=1}^{n} \theta_j \Delta X_{t-j} + w_t$$

where *m* and *n* represent the lag lengths, and w_t is a random disturbance term. The null hypothesis that ΔX_t does not lead ΔY_t, or less formally that forward price changes do not Granger cause spot price changes, can be tested by examining that $\theta_j = 0$ for all *j* using a Wald chi-square statistic (Sanders, Boris, and Manfredo). Equation 1 is estimated using OLS for both the 2x4 SPF random lengths lumber and 7/16 OSB series. In estimating the relationship in equation (1), the optimal lag structure is determined by estimating all models for values of $i = 1$ to 10 and $j = 1$ to 10. The model that minimizes Akaike's information criteria (AIC) is then used (Beveridge and Oickle). Serial correlation in the relationship is tested using a Lagrange multiplier test, and heteroskedasticity is tested using the Breusch-Pagan test. For both the 2x4 SPF random lengths lumber and 7/16 OSB models, heteroskedasticity was found, and therefore White's homoskedastic consistent covariance estimator was used to correct for this.

Results from equation 1 are presented in Table 2 for both 2x4 SPF random lengths lumber and 7/16 OSB. For 2x4 SPF random lengths lumber, the lag structure used is m=1, n=2. For the 2x4 SPF random length lumber, the p-value from the Wald chi-square statistic (p-value = 0.0039) rejects the null hypothesis that the three-month forward does not cause the spot price at the 5% level. Therefore, the three-month forward does indeed lead the spot price, suggesting that price discovery is occurring in the three-month forward price for lumber. However, for OSB, the null

hypothesis that the forward price leads spot price cannot be rejected at the 5% level, but can be rejected at the 10% level. Therefore, based on these test results alone, it is difficult to determine if the three-month Bloch Benchmark forward is providing much information with regard to price discovery, or that it is the dominant market for price discovery for OSB.

Do Spot Prices Lead Three-Month Forward Prices?

It is also of interest to know if spot prices lead the three-month forward prices for 2x4 SPF random lengths lumber and 7/16 OSB. It may very well be the case that the spot market is the dominant market with regards to price discovery relative to the Bloch Lumber forward market. To test this, equation 1 is re-written where ΔX_t is designated as the dependent variable:

$$\Delta X_t = \alpha + \sum_{i=1}^{m} \lambda_i \Delta Y_{t-i} + \sum_{j=1}^{n} \theta_j \Delta X_{t-j} + w_t \,. \tag{2}$$

In this case, the null hypothesis that changes in weekly spot prices do not Granger cause weekly changes in the three-month forwards, $\lambda_i = 0$ for all *i*, is tested using a Wald chi-squared test statistic. As with equation 1, OLS is used to estimate the equation, and the optimal lag length is determined by minimizing AIC. Table 3 presents the results.

Here, the optimal lag length for 2x4 SPF random lengths lumber is *m*=1, *n*=3 and for OSB is *m*=5, *n*=4. For 2x4 SPF random length lumber, the p-value of 0.395 suggests a failure to reject the null hypothesis that the spot price changes do not lead the forwards. Clearly, the spot market is not contributing to price discovery relative to the Bloch Benchmarks. It is important to note though that the 2x4 SPF random lengths lumber market does have an active futures contract traded at the Chicago Mercantile Exchange. While these results suggest that the Bloch Benchmark three-month forwards are contributing to price discovery, the extent of this may actually rely on how much the forward prices rely on the futures market in their development. Indeed, it may be the case that Bloch Lumber relies heavily on the information provided in the 2x4 SPF random length futures market in developing their three-month forward prices.

For lumber, the evidence suggests that the Bloch Benchmark forward market prices are contributing to price discovery. However, this is not the case for OSB, where the OSB spot price is found to lead the three-month forward price, a result which is significant at the 5% level (p-value = 0.0102). This result, combined with the result that three-month OSB does not lead the OSB spot market (Table 2), suggests that the spot market is indeed providing more in terms of price discovery than the Bloch Lumber three-month forward market prices. This is an interesting result, especially since there is currently not an active futures market for OSB.

Summary, Conclusions, and Future Research

While cash forward contracts are routinely used by agribusinesses to manage commodity price risk, little is known about the performance of cash forward markets and their role in the price discovery process. Indeed, the paucity of price data for cash forward market transactions makes

empirical research into these markets limited. The Bloch Lumber Company, through their Bloch Benchmark forward market price program, provides a publicly available source of forward market price data that may provide some insight into the performance of cash forward markets.

After describing the Bloch Benchmark and Guaranteed Forward Price (GFP) programs and data, we ask the question of whether the Bloch Lumber forward market is playing a role in discovering prices for two important lumber products – 2x4 SPF random lengths lumber and oriented strand board (OSB). Using Granger causality tests, we find that the Bloch Benchmark three-month forwards do lead spot prices for 2x4 SPF random length lumber, but not (OSB). When reversing the direction of causality, we find that the spot market prices for 2x4 SPF random length lumber do not lead the three-month forwards, but do for OSB.

These results suggest that at least for 2x4 SPF random length lumber, the Bloch Benchmark program is aiding in price discovery for this important lumber market. However, this cannot be said about the OSB market, at least not at the 5% level of statistical significance. The question of whether the Bloch Benchmarks are indeed the center of price discovery, however, remains to be examined as there is an active and successful futures market for 2x4 SPF random length lumber. To truly determine which market is the dominant market for price discovery, the lead-lag relationships between the 2x4 SPF random length futures market and other markets must also be considered. This is particularly relevant if Bloch Lumber relies on futures market prices for developing their forecasts for 2x4 SPF random lengths lumber and OSB. Therefore, a natural extension for future research is to consider futures prices and their role in price discovery vis-à-vis the spot market and the Bloch Lumber Benchmark forward market prices. Another extension of this work is to consider the possibility that the spot and three-month forward series are cointegrated (Fortenbery and Zapata). This result can certainly be hypothesized given that the Augmented Dickey-Fuller tests suggest that the three-month forward and spot series for both 2x4 SPF lumber and OSB contain a unit root. Also, since there is some initial evidence that the Bloch Benchmark prices contribute to price discovery, a next step would be to examine how the Bloch Benchmark forward prices perform as forecasts of eventual, realized, lumber prices (Sanders and Manfredo; Wang and Jones). Indeed, the forward prices provided by Bloch Lumber provide a unique opportunity to examine the performance of a private cash forward market for an important commodity group.

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Figure 1. 2x4 SPF Spot Price and Bloch Benchmark Three-Month Forward ($/thousand board feet): September 2002 – March 2005

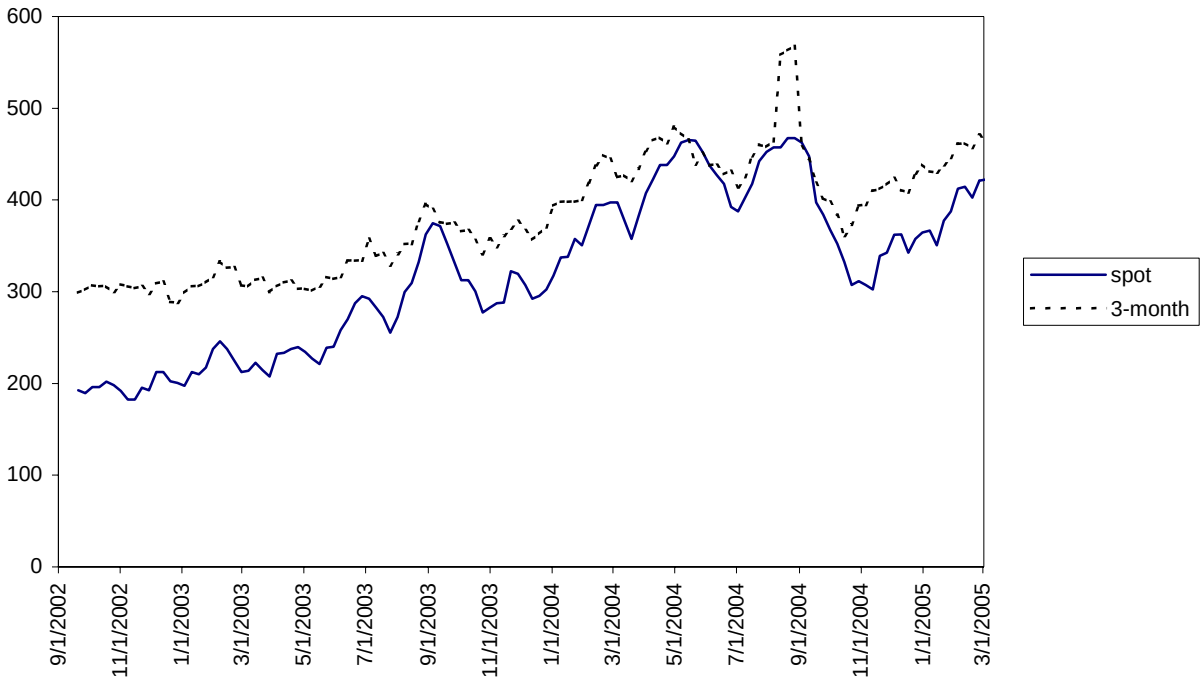

Figure 2. 7/16 OSB Spot Price and Bloch Benchmark Three-Month Forward ($/thousand board feet): September 2002 – March 2005

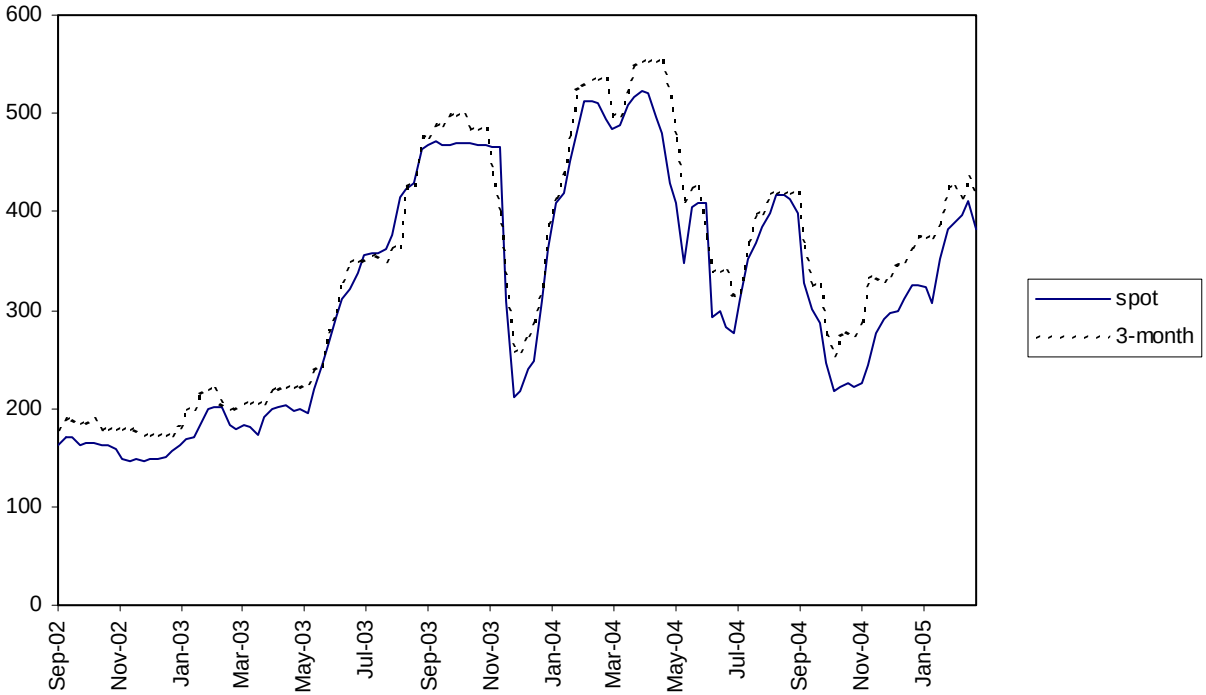

Table 1. Summary Statistics – 2x4 SPF Random Lengths Lumber and Oriented Strand Board: Spot and Three-Month Forwards: September 2002 – March 2005

NAME	MEAN	ST. DEV	MIN	MAX
2x4 SPF R/L Lumber - Spot[1]	321.8	85.5	182.5	467.5
2x4 SPF R/L Lumber - 3-Month Forward	382.1	63.9	288.0	568.0
7/16 OSB - Spot	317.3	118.1	147.0	522.0
7/16 OSB 3-Month Forward	342.0	117.1	172.0	554.0
ρ : 2x4 SPF R/L Lumber Spot / 3-Month Forward[2]	0.98			
ρ : 7/16 OSB Spot / 3-Month Forward	0.95			

[1] R/L is the abbreviation for Random Lengths.
[2] ρ is the correlation coefficient between the two price series.

Table 2. Granger Causality Test that Three-Month Forward Price Changes Lead Spot Price Changes

Commodity	Lag Structure (m,n)	P-value[1]
7/16 OSB	5,4	0.10169
2x4 SPF R/L Lumber[2]	1,2	0.00387

[1] Causality test is of the form $\Delta Y_t = \alpha + \sum_{i=1}^{m} \lambda_i \Delta Y_{t-i} + \sum_{j=1}^{n} \theta_j \Delta X_{t-j} + w_t$, where ΔY_t is the change in spot price and ΔX_t is the change in the three-month forward. The p-value is from a Wald chi-squared test of the null hypothesis that $\theta_j = 0 \; \forall \; j$.

Table 3. Granger Causality Test that Spot Price Changes Lead Three-Month Forward Price Changes

Commodity	Lag Structure (m,n)	P-value[1]
7/16 OSB	5,4	0.01023
2x4 SPF R/L Lumber[2]	1,3	0.39549

[1] Causality test is of the form $\Delta X_t = \alpha + \sum_{i=1}^{m} \lambda_i \Delta Y_{t-i} + \sum_{j=1}^{n} \theta_j \Delta X_{t-j} + w_t$, where ΔY_t is the change in spot price and ΔX_t is the change in the three-month forward. The p-value is from a Wald chi-squared test of the null hypothesis that $\lambda_i = 0 \; \forall \; i$.