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Modeling Prices for Sawtimber Stumpage in the South-Central United States

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Abstract: The South-Central United States, which includes the states of Louisiana, Mississippi, Texas, and Arkansas, represents an important segment of the softwood sawtimber market. By using the Seemingly Unrelated Regression (SUR) method to account for the linkage among the four contiguous timber markets, this study examines the dynamics of softwood sawtimber stumpage markets within the region. Based on quarterly data from 1981 to 2014, the findings reveal that both pulpwood and chip-and-saw (CNS) prices have a positive influence on the Texas and Arkansas sawtimber markets. Moreover, Granger-causality tests suggest that unidirectional causality runs from pulpwood and CNS markets to the respective sawtimber market. Compared to the pre-financial crisis period, sawtimber prices in these four states are 9%–17% lower in the recent years.

1. Introduction

The beginning of the 21st century has marked both a high and low water mark for the North American forest products industry. U.S. housing starts peaked in 2005, along with record highs in lumber and structural panel production. As demand for single-family housing has failed to rebound as it had following previous recessions, U.S. sawmills have reduced capacity, been idled, or closed. Consequently, the demand for solid wood building products (e.g., lumber and structural panels) has been muted in the last several years [1]. As a result of the reduced demand for lumber and other solid wood building products and associated reduction in manufacturing, stumpage prices for sawtimber in the U.S. South declined around 37% over the last ten-year period [2]. As timber harvests curtailed substantially due to a closure of several industrial roundwood mills, total pine inventory in the U.S. South increased at an annual rate of 1.2% from 86.3 billion cubic feet (1 cubic feet of sawtimber = 0.004112 thousand board feet (MBF, Doyle) in 2000 to 102.0 billion cubic feet in 2014 [3].

The South-Central U.S. including the states of Louisiana, Mississippi, Texas, and Arkansas represents an important segment of the softwood market in the U.S. South. Arkansas, Louisiana, Mississippi, and Texas are major timber-producing States, comprising 53% of the total timber growing stock volume in this region [4]. This subregion has predominantly pine plantation with the most potential for loblolly pine plantation expansion [5,6]. Most of the forests in the region are owned by non-industrial private forest landowners, followed by Timberland Investment Management

Organizations (TIMOs) and Real Estate Investment Trusts (REITs). Sawtimber, pulpwood and chip-and-saw (CNS) are the principal industrial roundwood products obtained from actively managed forestlands. Pulpwood is from small-sized trees of less than 9″ at diameter at breast height (DBH), CNS is from intermediate-sized trees of 10″ to 13″ at DBH, and sawtimber is obtained from large trees of more than 15″ at DBH. In 2011, there were 23 active sawmills in Louisiana [7], 52 sawmills in Texas [8], 48 sawmills in Mississippi [9], and 79 sawmills in Arkansas [10], which procure sawtimber from nearby timberlands, but inter-state timber hauling is also quite common in these states. Sawmills usually retain major portion of their sawtimber production for within-state manufacture. Only a few sawmills in the U.S. export their lumber production [11].

The literature on forest sector modeling is robust. Several studies estimated location-specific market models of forest products using various theoretical frameworks and econometric techniques. Those studies in forest sector modeling are varied by their geographical coverage, data sample period, and econometric estimation techniques [12]. While early studies estimated aggregate demand and supply models of forest products at the national scale in the U.S. [13–15], succeeding studies by scaled down their focus of the work to the regional market [16–18]. The geographical coverage of the studies was further narrowed to a single state market by in Wisconsin, North Carolina, Texas and Louisiana [12,19–22]. Some past studies supported the rationale of estimating single state market models [23,24], which reported that using a south-wide single regional markets for both hardwood and softwood stumpage might lead to biased elasticity based forecasts and poor policy prescriptions if applied to individual state-level markets in southern states.

By testing a law of one price, a few contiguous segments among 13 Southern States were found to form a unique market for southern pines [24]. It is also reported that sawmills procure almost all (90%) of their round wood supply within a range of a 75-mile radius [25]. Since this radius can include overlapping inter-state trade of forest products between neighbor states [6,8,9], forest product markets in this sub-region are interconnected and usually driven by similar market forces and climatic factors. Consequently, the respective state's stumpage markets are likely to be subject to spillovers from the conditions in the surrounding states. Given that no past study examined timber markets at the sub-regional level, this study attempts to explore the interconnection of proximity timber markets among four neighboring states in the South-Central U.S.

The main purpose of this study is to examine the dynamics of softwood sawtimber stumpage markets, and to investigate the relationship among the markets of three major softwood forest product types—sawtimber, CNS and pulpwood—in the U.S. South-Central region. By using the seemingly unrelated regression (SUR) method, this study evaluates stumpage market dynamics in the South-Central U.S. by considering the interconnectedness within stumpage markets of this region. Furthermore, we include the CNS market into the analysis, which is an important segment of the forest products markets that to our knowledge has not been included in previous studies on stumpage markets. CNS can act as a substitute for small sawtimber grade roundwood and we seek to assert or reject that anecdote empirically. Our results show that both pulpwood and CNS prices are major covariates of the sawtimber price. In addition, the Granger-causality test suggests that no bi-directional causality exists between any pair of forest product prices. The next section presents empirical model and estimation methods, followed by data and empirical results. The paper concludes with discussion of the results and their implications for sawtimber stumpage markets.

2. Empirical Model and Estimation Methods

We consider a reduced-form timber market model in which the price of sawtimber stumpage is derived from an interaction of demand and supply factors for the timber markets. It is, in fact, the first stage model of the two-stage reduced form regression, which deals with the simultaneous equation

bias while estimating a system of demand and supply equations [17,26]. The sawtimber price model is specified as:

$$pst_{it} \ = \ f(ppw_{it}, \ pcns_{it}, \ plum_{it}, \ pst_{it-1}, \ sowl, \ recs08, \ post\_recs) \ldots (+) \ldots (+) \ldots (+) \ldots (?) \ldots (+) \ldots (-);$$
$$i \ = \ LA, \ TX, \ MS, \ AR; \ t \ = \ 1981q1, \ 1981q2, \ \ldots \ , \ 2014q4 \tag{1}$$

where, pst_{it}, ppw_{it} and $pcns_{it}$ represent prices of sawtimber, pulpwood, and chip-n-saw, respectively; and $plum_{it}$ denotes the price of softwood lumber in Louisiana, Texas, Mississippi, and Arkansas in the time period t, respectively. Pulpwood and chip-n-saw prices basically influence the supply side of sawtimber markets, and lumwber price is the main determinant of demand for sawtimber stumpage [12,17]. A dummy variable, *sowl* is included to capture the effects of timber harvest reductions in the Pacific Northwest region to protect the habitat of spotted owl enacted in 1990. Dummy variables *recs08* and *post_recs* represent the great financial crisis of 2008 and the period after the great financial crisis of 2008. The *post_recs* variable examines the recovery of the sawtimber stumpage market after the great financial crisis of 2008. In terms of expected effects of the variables, the predicted sign of pulpwood price on sawtimber price is uncertain, as it could be both positive and negative. Pulpwood is usually considered as complement with respect to sawtimber, as the more sawtimber harvested, the more pulpwood residuals available in a particular market. The sign associated with lumber price should be positive, as lumber is a major output of the sawmill industry. A priori expectations are that the relationship between CNS and sawtimber prices should be positive. As the price for sawtimber rises, this should incentivize wood buyers to seek out alternatives for inputs, in the case of CNS, this should cause upward price pressure for the substitute product class.

Even if sawtimber markets in all four neighboring states are not cointegrated, and might operate independently, it is assumed that nation-wide policy and market shocks might affect all state markets contemporaneously. In this circumstance, the error terms associated with the price of sawtimber stumpage across states may be highly correlated, and estimating the price equations separately using the Ordinary Least Square (OLS) method is considered to be less efficient. The Seemingly Unrelated Regression (SUR) approach is used to estimate a set of equations that have error terms correlated contemporaneously [27]. We do not explain the mathematical details of SUR approach here. Please refer to [28] for a detailed derivation of the method.

Estimating a system of equations empirically by using the SUR approach is not new in the forest economics literature. The SUR econometric method was employed to estimate a system of land use equations to study changes in forest acreage in the US Southeast [29]. Likewise, it was also used to estimate cost functions of softwood lumber products in the U.S. [30], to examine the impact of local parish harvest ordinance on harvest of pulpwood and sawtimber [31], and to study the forest policy reform in British Columbia [32]. Similarly, regional softwood lumber models in the U.S. were estimated by using the SUR approach [33]. Assuming that the disturbances in all four sawtimber price equations are correlated, we also apply the SUR method to estimate reduced-form price equations in Louisiana, Texas, Mississippi, and Arkansas. The SUR model used in this study can be specified in a system.

$$Q_i \ = \ X_i\beta_i \ + \ u_i, \tag{2}$$

where i = LA, TX, MS, AR, Q_i is a T × 1 vector, X_i is a T × K_i matrix of explanatory, β_i is a K_i × 1 vector, u_i is a T × 1 vector, and T is the total number of observations (time periods) for each state. SUR assumes no autocorrelation within individual equations, but cross-equation correlation exists among the equations. In short, the error terms in the regression equations are correlated which introduce a bias into the coefficient estimation procedure.

The SUR model used in this study can be specified empirically as follows using the previously defined variables:

$$pst_{it} \ = \ \beta_0 \ + \ \beta_1 pcns_{it} \ + \ \beta_2 ppw_{it} \ + \ \beta_3 plum_{it} \ + \ \beta_4 sowl \ + \ \beta_5 recs08 \ + \ \beta_6 post\_recs \ + \ \varepsilon_{it} \tag{3}$$

In addition to the SUR estimation, we employ a bivariate Granger Causality test to investigate the casual relationships between the forest products price series. One time series, *X*, is said to Granger-cause another time series *Y*, if *Y* can be better predicted using the past information of both *X* and *Y* than it can by using the history of *Y* alone [34,35]. Hence, testing the Granger-causality between *X* and *Y* means testing whether lagged values of *X* have any statistically significant contribution in explaining Y_t in addition to lagged $Y_{t\text{-}j}$.

$$Y_t = a + \sum_{j=1}^{K} b_j Y_{t-j} + \sum_{j=1}^{K} c_j X_{t-j} + u_t \tag{4}$$

where u_t is assumed to be a well-behaved white noise error term. If we reject the hypothesis of $c_j = 0$ in Equation (4), we can conclude that *X* Granger-causes *Y*.

3. Data

This study employs quarterly time-series data from the first quarter of 1981 to the fourth quarter of 2014 to estimate sawtimber price equations for each state. The variables and their description are presented in Table 1. The data on sawtimber, pulpwood, and chip-n-saw prices in LA, TX, MS, and AR are obtained from the Louisiana Department of Agriculture and Forestry [36], Texas A&M Forest Service [37], Mississippi State University Extension Service [38], and Arkansas Agricultural Experiment Station [39,40], respectively. Similar to [41], kiln dried #2, 2 × 4 southern yellow pine (westside) is employed as a representative lumber type, and the price data are obtained from various annual issues of Random Lengths Yearbook [42]. All nominal timber and lumber prices are deflated by the producer price index (PPI) for all commodities (WPU00000000, 1982 = 100) to create the real price series. The PPI series for all commodities is obtained from the Bureau of Labor Statistics [43].

Table 1. Variables and their descriptions.

Variable [a]	Description	Unit
pst_{it}	Price of softwood sawtimber stumpage	\$/MBF (Doyle)
ppw_{it}	Price of softwood pulpwood stumpage	\$/cord
$pcns_{it}$	Price of chip-n-saw	\$/cord
$plum_{it}$	#2, 2 × 4 KD southern yellow pine (westside)	\$/MBF
sowl	PNW federal timber harvest reductions	1 if date $\geqslant$ 1993q1, 0 otherwise
recs08	Great financial crisis 2008	1 if 2008q1 $\leqslant$ date $\leqslant$ 2009q2, 0 otherwise
post_recs	Post-financial crisis period	1 if date > 2009q2, 0 otherwise

[a] Subscripts denote region *i* and year *t*, respectively.

Since the spotted owl was listed as an endangered species in the second quarter of 1990, the federal harvest reductions in the U.S. Pacific Northwest actually came into effect in 1993 [12]. Hence, the dummy variable, *sowl*, is specified as zero until 1992q4 and one thereafter. Further, *recs08* and *post_recs* are two indicator dummy variables, which represent the 2008 great financial crisis and the period after the financial crisis, respectively. Table 2 presents the summary of the data employed to estimate the sawtimber price models in all four States. The average real sawtimber price ranges from \$192.59/MBF (Doyle) in Texas to \$205.71/MBF (Doyle) in Mississippi. Louisiana has the highest average real pulpwood price and CNS price among four States. Figures 1–3 depict the overall historical trends of the sawtimber price, pulpwood price and CNS price in all four states, respectively. Compared to CNS and pulpwood prices, sawtimber prices in four states follow more close trends over the years.
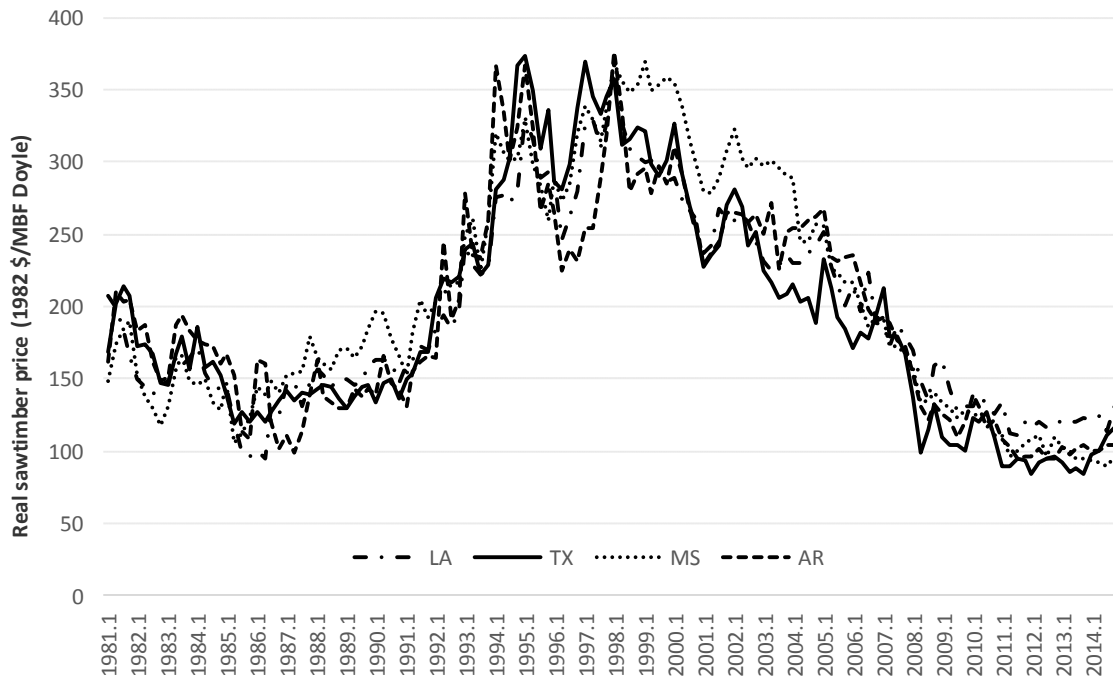
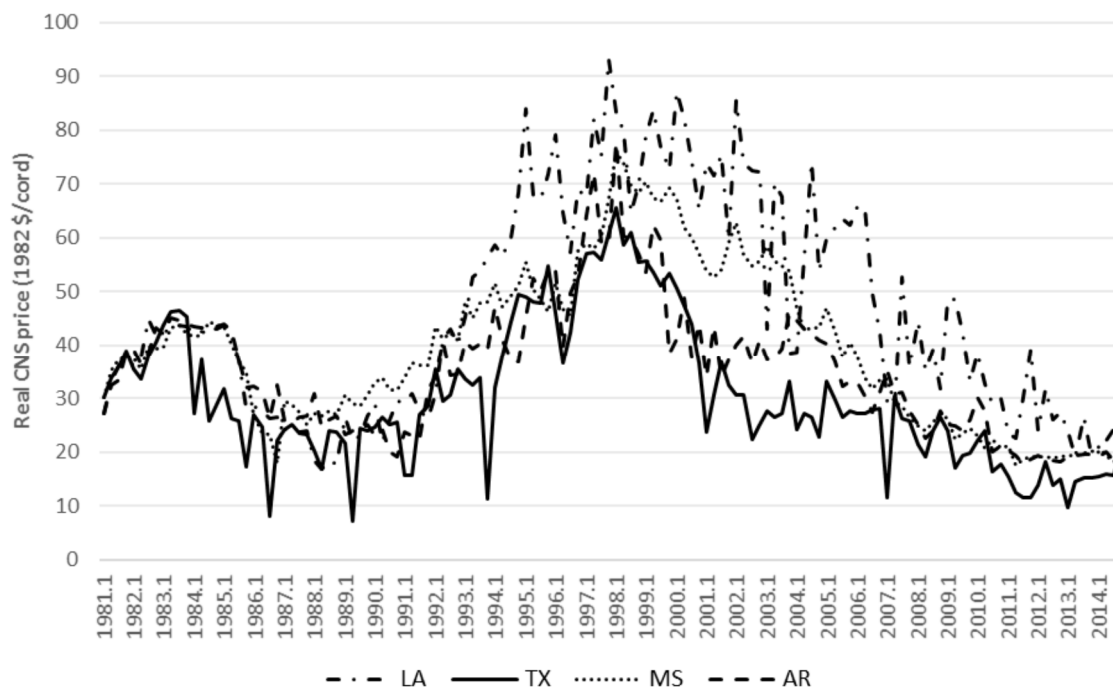**Figure 1.** Sawtimber price series in the South-Central U.S. 1981q1–2014q4.

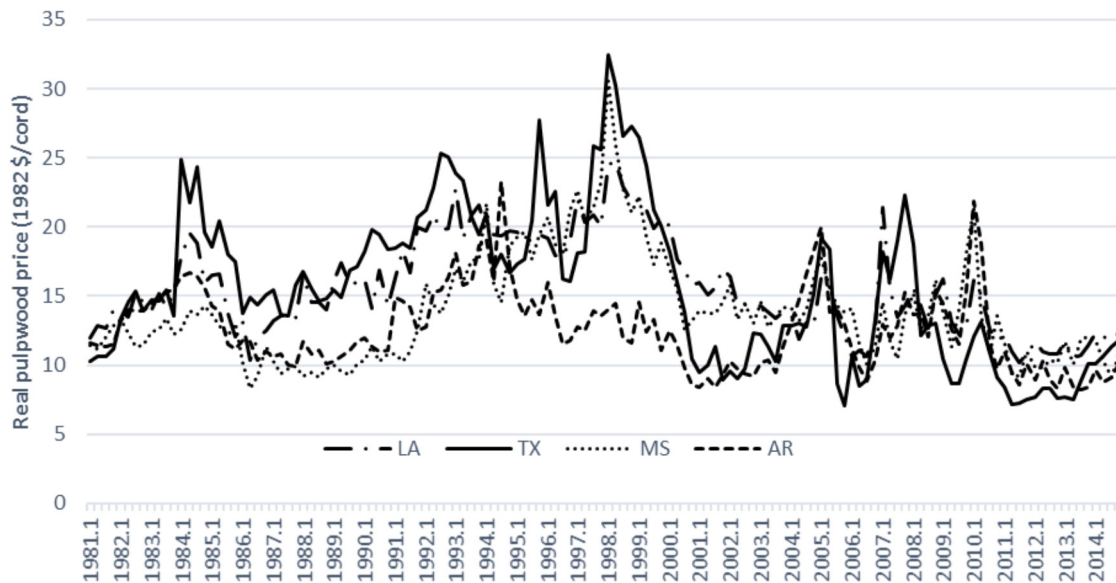**Figure 2.** Chip-N-Saw price series in the South-Central U.S. 1981q1–2014q4.

Figure 3. Pulpwood price series in the South-Central U.S. 1981q1–2014q4.

Table 2. Data Summary: *N* = 136 (1981q1–2014q4).

Variable	Mean [a]	Std. Dev.	Min	Max
pst in LA	194.71	66.51	95.16	367.57
ppw in LA	15.66	3.47	10.20	24.74
pcns in LA	46.27	20.25	16.78	93.11
pst in TX	192.59	78.44	84.08	374.10
ppw in TX	15.58	5.59	7.06	32.47
pcns in TX	30.28	13.11	7.17	65.56
pst in MS	205.71	82.60	88.83	368.95
ppw in MS	13.97	3.97	8.35	30.59
pcns in MS	39.45	14.96	17.54	75.85
pst in AR	194.60	72.73	94.11	375.90
ppw in AR	12.62	2.92	8.23	23.25
pcns in AR	35.32	12.39	17.78	77.88
plum	235.18	62.31	128.70	407.63
sowl	0.65	0.48	0	1
recs08	0.04	0.21	0	1
post_recs	0.18	0.38	0	1

[a] Mean values of all price series are real prices deflated in $1982 dollars.

4. Empirical Results

The SUR parameter estimates for four sawtimber price equations are reported in Table 3. All data series, with the exception of the binary dummy variables, are log-transformed. The high R-squared values for each equation suggest a good model fit. Most of the variables are found statistically significant at the 5% level. Moreover, the hypothesis of no autocorrelation in each equation cannot be rejected by the Portnanteau (Q) test for white noise of residuals. More importantly, the Breusch-Pagan test of independence reveals that the error terms associated with the price of sawtimber stumpage in the four states are highly correlated, indicating that SUR estimates in the system are more efficient than the coefficients estimated using the single-equation OLS method.

Findings indicate that both pulpwood and CNS prices have a significant effect in the sawtimber markets in Texas and Arkansas, and all three forest product prices move in a same direction (Table 3). The estimated values of 0.059 in the Texas model suggests that the sawtimber price increases 5.9% when pulpwood price increases by 100%. The CNS price is quite effective in explaining the price of

sawtimber in these two states in the expected positive direction. The magnitude of CNS price estimate in Arkansas is relatively higher, indicating that a 1% increase in CNS price results in a 0.11% increase in sawtimber price. However, pulpwood and CNS prices in Louisiana are found to be statistically insignificant, and the pulpwood price in Mississippi has even a negative, but insignificant, coefficient estimate. Previous studies also reported an insignificant effect of the pulpwood price in the sawtimber supply in Louisiana [12,22]. Moreover, as expected, the lumber price is found to be an important factor explaining the sawtimber price in South-Central states. The positive magnitude of the lumber price ranges from 0.13 in Mississippi to 0.16 in Louisiana. Similarly, the sawtimber price in the last quarter is a major determinant of the price in the current quarter with a positive and statistically significant influence in every equation. The lagged value in the equation not only acts as an expectations operator of the future price [17] but also corrects for the serial autocorrelation in the system.

Table 3. Seemingly Unrelated Regression estimates of the softwood sawtimber prices in the South-Central region: 1981q1–2014q4.

Variable	SUR Coefficient Estimates			
	Louisiana	Texas	Mississippi	Arkansas
ppw_{it}	0.052 (0.04)	0.059 [a] (0.02)	−0.010 (0.04)	0.094 [a] (0.04)
$pcns_{it}$	0.01 (0.02)	0.046 [b] (0.02)	0.068 [b] (0.04)	0.111 [a] (0.04)
$plum_{it}$	0.157 [a] (0.03)	0.149 [a] (0.04)	0.133 [a] (0.04)	0.132 [a] (0.05)
pst_{it-1}	0.745 [a] (0.04)	0.715 [a] (0.05)	0.777 [a] (0.04)	0.630 [a] (0.05)
$sowl$	0.088 [a] (0.03)	0.095 [a] (0.03)	0.064 [a] (0.02)	0.128 [a] (0.03)
$recs08$	−0.054 (0.04)	−0.152 [a] (0.05)	−0.061 (0.04)	−0.164 [a] (0.06)
$post\_recs$	−0.088 [a] (0.03)	−0.125 [a] (0.04)	−0.104 [a] (0.04)	−0.173 [a] (0.05)
$quarter\ 2$	−0.060 [a] (0.02)	−0.025 (0.02)	−0.045 [a] (0.02)	−0.024 (0.02)
$quarter\ 3$	−0.041 [a] (0.02)	−0.013 (0.02)	−0.026 (0.02)	−0.061 [a] (0.02)
$quarter\ 4$	−0.022 (0.02)	−0.001 (0.02)	−0.001 (0.02)	−0.015 (0.02)
$constant$	0.284 (0.22)	0.320 (0.26)	0.218 (0.25)	0.563 (0.31)
Q-test for white noise at 4 lags	3.78 [0.44]	2.59 [0.36]	4.25 [0.37]	6.47 [0.17]
R^2	0.961	0.958	0.968	0.939
Breusch-Pagan test of independence—$\chi 2(6)$: 108.63, p-value = 0.0000				

[a] significant at 5%; [b] significant at 10%; Values in parentheses represent standard errors, and values in brackets refer to p-values.

The 1990 federal policy of harvest reductions in the Pacific Northwest region in order to protect the habitat of endangered spotted owl is found to have a significant positive effect in all four timber markets (Table 3). It is revealed that the harvest reductions policy causes to increase the sawtimber price ranging from 6.4% in Mississippi to 13% in Arkansas. On the other hand, the influence of the great financial crisis of 2008 is found to have a significant negative effect in Texas and Arkansas with a magnitude of approximately −15%. However, the financial crisis of 2008 is found to have no statistically significant impact in Louisiana and Mississippi. In the period after the 2008 financial crisis, the sawtimber prices in all four states are found to be significantly lower than the period before the financial crisis. Right after the second quarter of 2009, the sawtimber price decreases 9% in Louisiana and 17% in Arkansas. This indicates that there are lingering effects of the financial crisis still being felt in softwood sawtimber markets in the South-Central region. No quarterly seasonal effect is detected in Texas, but second and third quarter seasonal effects have a negative impact in the Louisiana sawtimber price.

Table 4 presents the results of the Granger-causality test between the price pairs of four forest products in all states. The null hypothesis of no Granger-causality between the pulpwood and sawtimber prices in Louisiana and Mississippi is rejected, suggesting that the lagged value of pulpwood price is found to help predict the sawtimber price in these two States. Similarly, the CNS price in every state is found to Granger-cause the price of sawtimber. In other words, sawtimber prices can be better predicted using histories of both of CNS and sawtimber prices than by using the sawtimber price only. Moreover, the lagged value of the sawtimber price in all states Granger-causes the lumber price. This

result is expected, as sawtimber is a main input material for lumber production. We find that there is no bi-directional causal relationship between any price pair. The Granger-causality test between prices of pulpwood and CNS cannot be rejected in any of the four states, indicating that one series does not help predict another price series.

Table 4. Pair-wise Granger Causality relationship among the price series of sawtimber, pulpwood, Chip-n-Saw and softwood lumber: 1981q1–2014q4. The null hypothesis is of non-causality between each pair. Values in Brackets represent *p*-values.

Variable	Granger Causality Wald Test—χ^2 value, *p*-values in brackets			
	Louisiana (Lags = 1)	Texas (Lags = 1)	Mississippi (Lags = 3)	Arkansas (Lags = 3)
pst to *ppw*	0.61 [0.43]	1.05 [0.31]	1.69 [0.19]	0.08 [0.77]
ppw to *pst*	4.79 [0.03]	0.01 [0.99]	8.28 [0.00]	0.01 [0.95]
pst to *pcns*	0.19 [0.66]	0.01 [0.92]	1.18 [0.28]	0.02 [0.87]
pcns to *pst*	13.05 [0.00]	21.12 [0.00]	9.26 [0.00]	2.83 [0.09]
pst to *plum*	15.15 [0.00]	19.35 [0.00]	11.09 [0.00]	11.20 [0.00]
plum to *pst*	0.72 [0.39]	0.74 [0.39]	0.09 [0.76]	1.95 [0.16]
ppw to *pcns*	1.80 [0.18]	1.00 [0.32]	0.79 [0.37]	2.38 [0.12]
pcns to *ppw*	0.46 [0.49]	2.58 [0.10]	2.08 [0.15]	0.13 [0.72]
ppw to *plum*	0.42 [0.52]	0.06 [0.81]	0.44 [0.51]	1.80 [0.18]
plum to *ppw*	3.22 [0.07]	1.42 [0.23]	0.01 [0.98]	0.01 [0.92]
pcns to *plum*	0.01 [0.91]	0.88 [0.35]	10.98 [0.00]	2.16 [0.14]
plum to *pcns*	0.88 [0.35]	0.01 [0.92]	1.69 [0.19]	4.19 [0.04]

5. Discussion and Conclusions

The results suggest that timber markets in Mississippi, Louisiana, Arkansas, and Texas are inter-related. This recognition is important to avoid possible econometric misspecification that the OLS estimation of individual states might be less efficient. More specifically, the results indicate the necessity of including sawtimber prices of nearby states when estimating sawtimber prices of a particular state. These results are consistent with the timber market reality of the South-Central U.S. where across-the-state timber hauling is a common phenomenon. For example, 96.3 million cubic feet of timber volumes were imported in the state of Texas in 2014, whereas 55.3 million cubic feet were exported [44]. Similar observations were noted in other states as well [7,9].

Timber product prices impacted each other in general but responsiveness differed with product types and across states within this region. For example, pulpwood prices positively impacted pine sawtimber prices in Texas and Arkansas, but the effects of pulpwood prices in Louisiana and Mississippi are insignificant. Compared to the pulpwood market, CNS and sawtimber markets are more closely linked because of the product similarity and less price differentiation between pine CNS and sawtimber. Moreover, the Granger-causality tests also validate the SUR results. One-way causality running from pulpwood and CNS prices to the sawtimber price implies that both pulpwood and CNS prices help predict the sawtimber price but not the other way around. Both pulpwood and CNS are relatively short-term forest products compared to sawtimber, which can take 30 years to reach maturity. From pulpwood and CNS markets, which serve as short-term and medium-term price guides, landowners can obtain the general idea of the longer-term sawtimber prices they can expect.

Interestingly, timber prices in a specific quarter were positively impacted by prices from a previous quarter. However, sawtimber prices beyond the first quarter were not significant, suggesting the current timber price does not influence the price more than a quarter ahead. In other words, the long-term timber price cannot be well forecasted based on the current timber price trend. Moreover, no quarterly seasonal effect in the Texas timber market is detected, but it is found that, in second and third quarters, sawtimber prices are 4% to 6% lower in Louisiana, Mississippi and Arkansas. It is commonly accepted that that prolonged stretches of wet and dry weather in summer time generally impact timber prices in this region [2,37]. Full mill inventories during dry weather, all else constant, dampen timber product prices.

The U.S. South timber market was hard hit by the recent great financial crisis of 2008 and our study results are in line with this reality. The period after 2009 is still recovering from this crisis. We find up to a 17% decline in the sawtimber price is realized in Arkansas in the period between 2009 and 2014. There was more than 20% decline in economic output and employment opportunities in 2012 compared to 2007 in Texas [45]. In Texas, there was more than 40% price depreciation for sawtimber during this period. Similar observations were noted in other timber producing regions in U.S. South [46]. Our results suggest that the southern lumber price strongly impacted sawtimber prices in this region. Lumber demand is highly correlated with housing starts, which is slowly but steadily improving in the U.S. [2], with a caveat that multifamily dwellings comprise their largest percentage of the housing market since the late 1970s and early 1980s. Therefore, we expect some price appreciations for pine sawtimber in near future, but how much will be influenced not only by overall demand for housing, but also the composition of that demand. On the supply side, years of timber harvesting at lower volumes may also result in an outward supply shift that will suppress sawtimber price movement that would otherwise respond to increases in sawtimber demand for the next decade, ceteris paribus.

One limitation of this study could be that due to lack of data, quarterly timber volumes cannot be used to determine own-price elasticity values for each State. Moreover, readers are cautioned not to make the short-run price projections based on our study findings as many factors, including location and number of mills, product quality, climate, and weather, can determine timber product prices in a specific area.

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Conflicts of Interest: The authors declare no conflict of interest.

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