CROSS PRODUCT HEDGING FOR STUMPAGE USING FOREST PRODUCT FUTURES: A Pacific Northwest Exploratory Study

by

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ABSTRACT

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The feasibility of using lumber and plywood futures as a means of cross product hedging for stumpage is explored from the standpoint of the producer of forest products. A survey conducted in April, 1979 indicates that this process has not been attempted in western Oregon. Historical price relationships between contract grade end products and several measures of Pacific Northwest public stumpage are defined. Based on these relationships along with an example using historical data, the process appears to be feasible as a forward pricing mechanism for stumpage. Actual application must be evaluated in terms of the firm's objectives and the risk tradeoffs associated with the process.

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INTRODUCTION

The forest products industry is extremely cyclical, and rivals any other industry for volatility of product price. The lumber industry is often cited as an example of perfect competition containing many producers, none of which can significantly influence prices, and where few barriers to entry and exit exist (Zaremba, 1963). In this setting, firms without the efficiency, cash, or diversification (the marginal producers) needed to survive the cyclical periods of slack demand are forced to close down, often permanently.

Until 1969, when plywood and lumber were included among the commodities traded on the commodity futures exchanges, there was no choice for forest products producers but to accept these price risks, and weather out the downturns. With access to the futures markets, however, producers are able to shift part of this risk through hedging.

Broadly defined, hedging is the temporary substitution of a futures contract for a merchandising transaction to be made at a later date.[1/] Hedging is a means of risk transfer, of reducing vulnerability to adverse price changes by simultaneously holding opposite positions in the cash and futures markets. The process works because the futures and cash prices tend to move up and down together over the life of the contract, and also tend to converge at the delivery date.

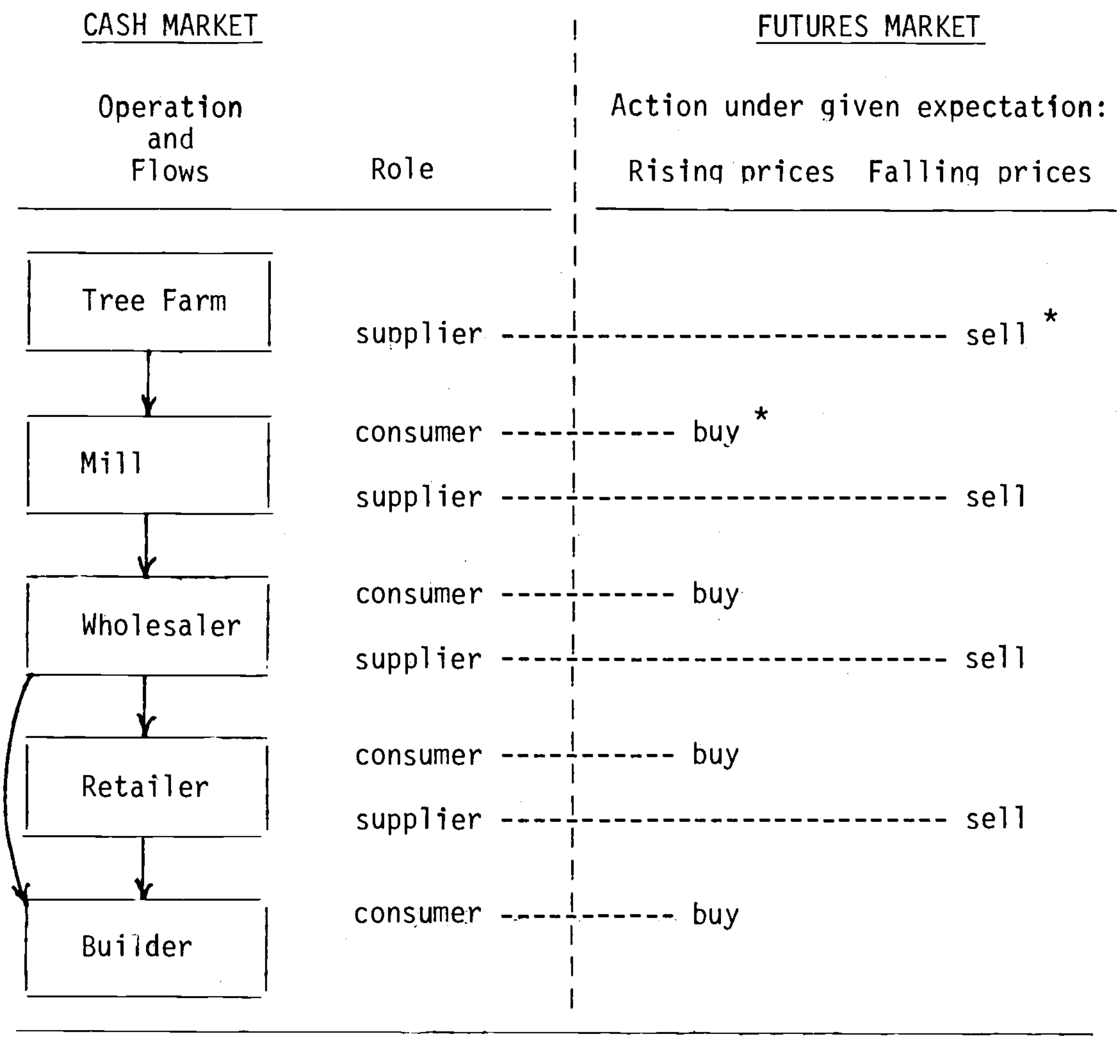
[1/] A glossary of hedging terms appears in the appendix. The reader desiring more background on the commodity hedging process and the operation of futures markets is referred to Broderick (1978) or Irland et al. (1974).

Producers are vulnerable to changes in the prices of their products (output) as well as their supplies (inputs). In the forest products industry, this price risk extends from standing timber to the finished forest product. On the output side, producers of forest products can reduce or shift the unwanted portion of the risk of declining product prices through forward pricing (establishing a selling price today in the futures market for later production). If a producer can earn an acceptable return, given his costs, at the futures price, he can stabilize earnings and guarantee his profit margin through forward pricing.

On the input side, producers in general can often use forward pricing to assure a certain price and source of supply material. This practice is common for the lumber or plywood wholesaler (although not truly a producer), who may need to quote firm prices to customers for future transactions. He assures himself of lumber or plywood supply at a certain time and price through buying futures contracts. Figure 1 diagrams the components of the forest products industry, and how each might hedge in a given role under expectations of rising or falling prices.

Stepping now from the wholesaler to the producer of lumber and plywood, the following question is raised: Can the material (timber) requirements of the producer be forward priced? The answer to this question is the focus of this paper. If the forward pricing of stumpage through cross product hedging in the lumber and plywood futures markets is feasible, this process would assure producers of future stumpage at a predetermined price during a rising market with tight supplies. Referring back to

Figure 1. Diagram of potential hedging activity in the forest products industry under expectations of rising or falling prices.



* Cross product hedging of stumpage. No evidence of activity in these roles at present.

In this scheme consumers are depicted as anticipatory hedgers, and suppliers as selective hedgers. Note that the mill as a supplier fills a dual role depending on the form of his inventory: he uses anticipatory hedging for his log and timber inventory, and selective hedging for his finished product inventory.

figure 1, the diagram shows how cross hedging applies to the mill in the role of a consumer of stumpage.

As there is no futures market for stumpage, cross product hedging (cross hedging) is the only way this commodity could be hedged. Cross hedging is the hedging of an off contract grade or commodity which tends to move in price similarly to the futures contract grade. Examples include wheat and flour, or hemfir lumber and Douglas-fir lumber. The quality of the contract grade to off contract grade price relationship is usually defined by the simple correlation coefficient (r). An r-value of .90 or greater is considered the minimum acceptable for purposes of cross hedging (Olmedo, 1975; Merrill Lynch, Inc., undated).

In hedging, there are costs and risks. The costs are commission fees (roughly $50 per round turn per contract) and the interest cost of putting up and maintaining the required margin. When hedging the contract grade, risks are minimal because the hedger has the option of making (or taking) delivery of the actual production at the futures price. In hedging the off contract grade, however, whether it is Douglas-fir lumber, Douglas-fir logs, or Douglas-fir stumpage, there is a basis risk. This is the risk that the contract and off contract cash prices will not move up and down in tandem. Since delivery against a futures contract cannot be made for the off contract grade, convergence of the contract and off contract prices is not of concern here.

Thus, in cross hedging, the quality of the relationship must be evaluated, and the judgement made whether the basis risk is greater or less than the undesirable price risk. The analytical portion of this paper deals with evaluating the relationship of stumpage to contract grade lumber and plywood in the Pacific Northwest. Whether or not the risk tradeoffs are favorable for cross hedging stumpage must be determined by the circumstances and objectives of the individual producer.

The Study

This study is exploratory in nature, and the scope is restricted to the Pacific Northwest. The analytical portion of the paper attempts to find and define acceptable relationships between public stumpage prices in Oregon and Washington, and prices of contract grade lumber and plywood for purposes of cross hedging of stumpage.

There are several reasons why this study is directed toward public stumpage rather than logs as the supply commodity to be cross hedged.

1) A well defined log market no longer exists in the Pacific Northwest, except for foreign export.
2) Public stumpage makes up about half of the Oregon and Washington annual timber harvest, and is the major source of domestically consumed logs in the region (public agency timber is excluded from export in log firm).
3) There is more price risk associated with acquiring public stumpage than acquiring logs, due to the added time needed for logging.
4) Public stumpage prices are well documented, and are available on a quarterly basis.

Through discussions with people familiar with forest products futures and the forest products industry, there was no indication that cross hedging of stumpage was operational. In order to verify this, as well as to get an idea of the general hedging activity of producers in the region, a telephone survey of 48 western Oregon independent lumber and plywood producers was conducted in April, 1979. These producers had little or no timber base, and it was felt that they would stand to gain the most from hedging. Results showed that this application of hedging had not been systematically attempted, and that only 14 percent of the firms surveyed had hedged at all in the preceding five years.[2/]

Story (1975) conducted a mail survey of plywood producers in the U.S. in the summer of 1973. He found that 16 of 50 firms responding had ever traded plywood futures, and that larger firms were more apt to trade than smaller firms. Since this survey did not distinguish between hedging and "trading" (which presumably includes speculation), there is not too much basis for comparing results. Story did not address the question of cross hedging of stumpage.

The following section develops the structure of the stumpage market in the Pacific Northwest. This background is necessary for an understanding of the stumpage to end product price relationship.

[2/] A complete discussion of survey structure, methods, and findings appears in Appendix B.

The Stumpage Market

The stumpage market in Oregon and Washington could be divided into two sectors: public and private. In 1976, 47 percent of the total timber harvest in the two state area was provided by the public sector, as detailed in Table 1.

Table 1. 1976 Oregon and Washington timber harvest by owner type (Million board feet Scribner)

Owner (agency)	Oregon	Washington	Total
Public			
USFS	3173.9	1214.4	4388.3
BLM	1081.9	3.1	1085.0
State	203.4	766.5	969.9
BIA	107.6	516.0	623.6
Other Federal	5.3	20.6	25.9
Other Public	19.9	34.7	54.6
Private			
Industry	3147.2	3702.1	6849.3
Other Private	414.3	712.3	1126.6
Total	8153.5	6969.7	15,123.2

Source: Lloyd, 1978

This analysis is concerned with the public stumpage market, which differs from the private market in several respects.

Public timber is usually sold in large amounts at auction with a specified minimum bid, and the contract life is relatively long. The U.S. Forest Service and Bureau of Land Management, which sold almost 80 percent of the public timber in Oregon and Washington in 1978, usually allow three years for sale completion. The sale award price is fixed for the period of the contract in most cases.

Private timber is most often sold by negotiation, the volume sold is typically less, and contract life is generally shorter. As an example, Starker Forests, a Corvallis tree farm, has a policy of requiring sale completion and payment within six months of contract negotiation.[3/]

In the public stumpage markets, prices are often paid which are above the current converted value of the timber.[4/] The following hypothetical example using current Douglas-fir stumpage and product prices illustrates the situation.

[3/] Personal communication: Gary Blanchard.

[4/] A note on stumpage prices:

As stumpage and end product markets are closely linked, product demand and stumpage supply are the key determinants of stumpage price. The common method of stumpage valuation, however, is through the residual approach. This is the calculated difference between the expected product selling value (some time in the future), less all operating costs and associated profit from timber removal and manufacture. This value will vary from stand to stand as a function of timber quality, logging and hauling costs, and milling efficiency.

Hypothetical cost and revenue example: a western Oregon lumber mill. (December, 1978 prices)

Assume:

1 Mbf log scale (LS) Douglas-fir stumpage at recent prices:		\$300/Mbf
Add: production costs (conservative)		
stump-to-truck	40	
hauling	10	
manufacturing	180	
		230
total costs:		\$530/Mbf

Overrun factor (generous): 1.5 yields:

1.5 Mbf lumber tally (LT) lumber at \$530, equivalent to

1.0 Mbf lumber tally lumber at $\frac{\$530}{1.5} =$ \$353/Mbf adjusted cost per Mbf.

Comparing these costs with the average 1978 Douglas-fir wholesale lumber price of \$362/Mbf yields a 3 percent margin on gross sales. This example ignores sawmill profit, risk, and taxes.

In this example, costs are presented conservatively and overrun is liberal, yet the before-tax profit margin is only 3 percent of sales. This situation is due to expectations of higher prices for the product in the future, as well as concern over supply. Since stumpage and product prices are both rising currently (and the prevailing attitude seems to be that this will continue), the producers' strategy is to buy stumpage at high prices today, and sell products in several years at much higher prices.

The result on public timber sales is that operators delay cutting their timber as long as possible, hoping that rising product prices will improve their profit margins. In a sample of 189 Forest Service timber sales in western Oregon from 1974 to 1977, an average of 80 percent of the timber had yet to be cut after two-thirds of the contract period had elapsed.[5/] It could be surmised that the 20 percent that had been cut could be attributed to road building activity on these sales.

This activity could be considered speculation in the cash price of forest products. The producer has no protection from a subsequent drop in product prices unless he forward prices his production. If unhedged, the cost of stumpage previously bought under contract would probably exceed the revenue that could be recovered for products sold in a declining market. Under these conditions, one might expect such timber sales to expire without completion, with the purchaser forfeiting his performance bond. This expectation is borne out in the last five years on the Siuslaw National Forest, where an estimated four or five sales expired without completion during the 1973-74 downturn, while only one or two have expired since during the recent rising market.[6/]

Sale speculation is not as pronounced on the Oregon and Washington east side, where the sale process is slightly different. Here Forest Service stumpage sale prices may be adjusted after the sale award according to a product price index. This price index is calculated periodically for various products, then translated back to stumpage prices by species for each sale. If the price index has risen from the last quarter, 50 percent of the equivalent stumpage price increase is applied to the sale volume not yet removed. If the index declines, the equivalent stumpage price

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5/ Personal communication: C. Ellis, Oregon State University.

6/ Personal communication: Vern Fredrick, USFS.

reduction is 100 percent of the decline, down to a base price set by law. This process removes much of the incentive for speculation.

Forest Products Cash and Futures Markets

There are three forest products traded on the commodity futures exchanges:

1) Lumber: 2x4 random length hemfir (inland)

2) Plywood: 1/2" CDX 4/5 ply western sheathing

3) Studs: 2x4, 8 foot SPF

This paper deals only with the first two: lumber and plywood; which have now traded for ten years, and shown sufficient volume since 1973 to allow confidence in the market. Studs are relatively new, and trade on low volume. Figure 2 shows quarterly cash prices for the two contract grades since 1963. The plywood grade goes back only to 1966, when good price documentation begins. Hereafter, the two contract grades will be referred to as hemfir and plywood.

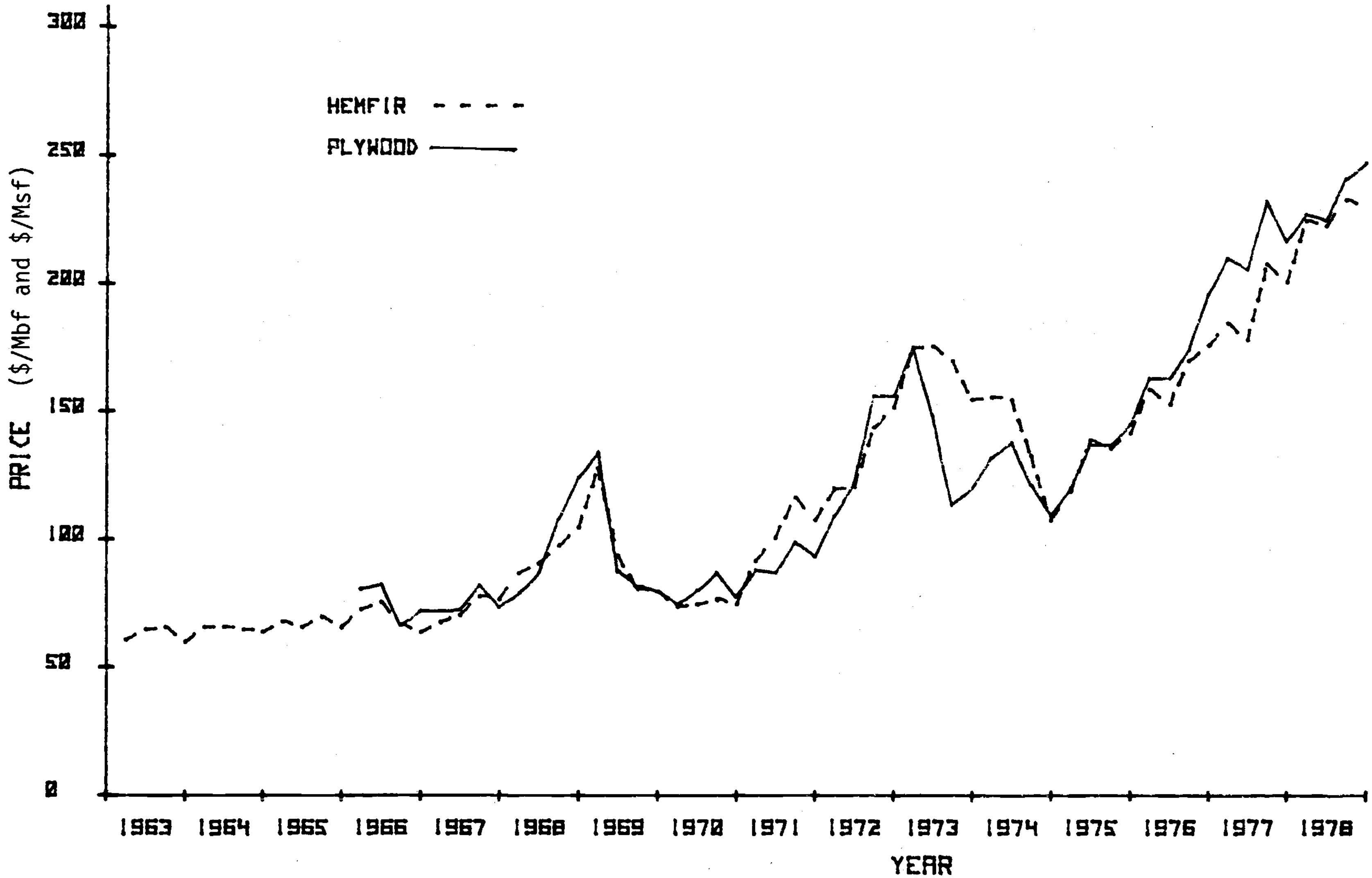

Figure 2. Quarterly hemfir lumber and ½" CDX plywood cash prices (1963 to 1978)

LITERATURE REVIEW

Literature on hedging forest products is relatively abundant, considering trading in forest products futures began only ten years ago. Publications include brokerage house guides (Broderick, 1978), and works on application and strategy (Kingslien and McMahon, 1975; Irland and Olmedo, 1973). A search for product-stumpage price relationships was partly successful. These relationships might be broken into three categories: long term aggregate, short term specific, and short term aggregate.

In the long term aggregate category, prices have been studied as a basis for timber supply outlooks and derived demand studies (Adams, 1977; Haynes, 1977). In these, the long term secular trends were of interest rather than short term cyclical variations needed for business and hedging decisions.

In the short term specific category, the feature of interest is the stumpage price of a specific timber sale. Three studies in southern pine use a combination of market price data and stand conditions to predict specific stumpage sale prices. Guttenberg and Fasick (1965) used seven independent variables to describe stumpage price based on 1716 sealed bid timber sales. Holley (1970) used the same variables and a later data set to do the same thing. Anderson (1976) also developed models for southern pulpwood stumpage, for each of three regions.

The third category is the one I feel this analysis belongs: the short term aggregate. The relationship defined must be short term in nature, to catch seasonal and cyclical variation in prices, yet an aggregate measure of price is needed, so inferences can be drawn about a range of specific stumpage conditions. No literature on this category of product to stumpage price relationship was found.

ANALYSIS AND DISCUSSION

Methodology

To determine whether cross hedging of stumpage is feasible, a good stumpage to product price relationship must be found and defined. As several measures of public stumpage are available to choose from, criteria for selection must be set. Following are the basic criteria. The measure of stumpage used must:

1) represent a large portion of public stumpage
2) be measured consistently over the period
3) cover sufficient time.

As mentioned previously, a simple correlation coefficient of .90 is the cutoff criterion for cross product hedging.

Initially, quarterly Forest Service price data for five species were collected for Oregon and Washington. The period covered was 1967 through 1978, which includes two complete business cycles. These five categories of stumpage and the volume sold in 1977 are shown in Table 2.

Another measure of stumpage used was an all-agency, all-species western Oregon quarterly average. This category accounts for over 48 percent of the total volume sold for all public agencies in Oregon and Washington in 1977 as shown in Table 3.

Table 2. Volume sold and percentage of total volume sold for 1977 U. S. Forest Service sales by species category, Oregon and Washington. (volumes in million bd. ft. Scribner)

Species category	USFS volume sold	% of USFS total	% of OR and WA public agency total
Douglas-fir			
west side	1791.7	38.3	24.5
east side	308.8	6.6	4.2
Ponderosa pine	701.7	15.0	9.6
Western hemlock	654.9	14.0	9.0
True firs	332.1	7.1	4.6
Other species *	888.8	19.0	12.2
totals	4678.1	100.0	64.1

* not used in analysis

Table 3. Contributions by western Oregon public agencies to total volume sold by all Oregon and Washington public agencies in 1977.

Agency	Volume sold, 1977 (MMbf)	Percent of Oregon and Washington agency (1977)
U.S. Forest Service	2212.7	30.3
U.S. Bureau of Land Management	1129.7	15.5
State of Oregon	221.0	3.0
total: Western Oregon Average	3563.4	48.8

source: Ruderman, 1978.

Correlating the various quarterly measures of stumpage prices with contract grade product prices yields the r-values in Table 4.

Table 4. Stumpage - end product price correlations (r-values) for six categories of Oregon and Washington stumpage and two categories of end product. 1967 - 1978, quarterly.

Stumpage Category	End Product Category	
	Hemfir	Plywood
Douglas-fir		
west-side	.869	.858
east-side	.770	.705
Ponderosa pine	.880	.856
Western hemlock	.811	.725
True firs	.851	.797
Western Oregon all-agency and species average	.888	.900

These figures indicate that the all agency, all species Western Oregon average stumpage price measure (denoted WORAVG) yields the best measure, followed by the west side Douglas-fir price measure (denoted DFWEST). Pine was not considered further as it comprises only 15 percent of all Forest Service stumpage, and is not a component of either hemfir lumber or 1/2" CDX plywood. These first two measures were selected for closer examination in defining a relationship.

In an attempt to determine correlation sensitivity to price reporting interval, monthly stumpage data was examined for all species on five representative west side National Forests over the four year period 1975-78, and compared with contract grade product prices.[7/] The correlation coefficients were low: between .55 and .56; and variation was high. Average prices varied greatly from month to month, largely due to large monthly variation in the number of sales offered.

The quarterly data base for the two contract grades (hemfir lumber and plywood) and the two measures of stumpage (WORAVG and DFWEST) was extended back to 1963 for further examination (the contract grade of plywood extends back only to 1966, the point where documentation for this grade begins). In all cases, the simple correlation coefficient was improved.

Product prices were regressed against stumpage prices, and the residual plots analyzed. The error terms tended to show serial correlation when scattered over time, which was confirmed by computation of the Durbin-Watson statistic.[8/] This serial correlation indicates that stumpage price changes tend to lag behind product price changes, which is evident in examining a time plot of stumpage and product prices. Figure 3 shows western Oregon all agency stumpage prices and plywood product prices over time. In this plot, the lag between product and stumpage

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[7/] The five forests were the Gifford Pinchot, Mt. Baker-Snoqualamie, Mt. Hood, Siuslaw, and the Willamette. The volume sold by these five in 1977 represents 30% of all public agency timber sold in Oregon and Washington that year. Monthly data not available before 1974.

[8/] The Durbin-Watson test allows testing the hypothesis that the error terms are serially correlated. Roughly, a value around 1.5 indicates no significant serial correlation. A smaller value indicates positive serial correlation, while a larger value indicates negative serial correlation.

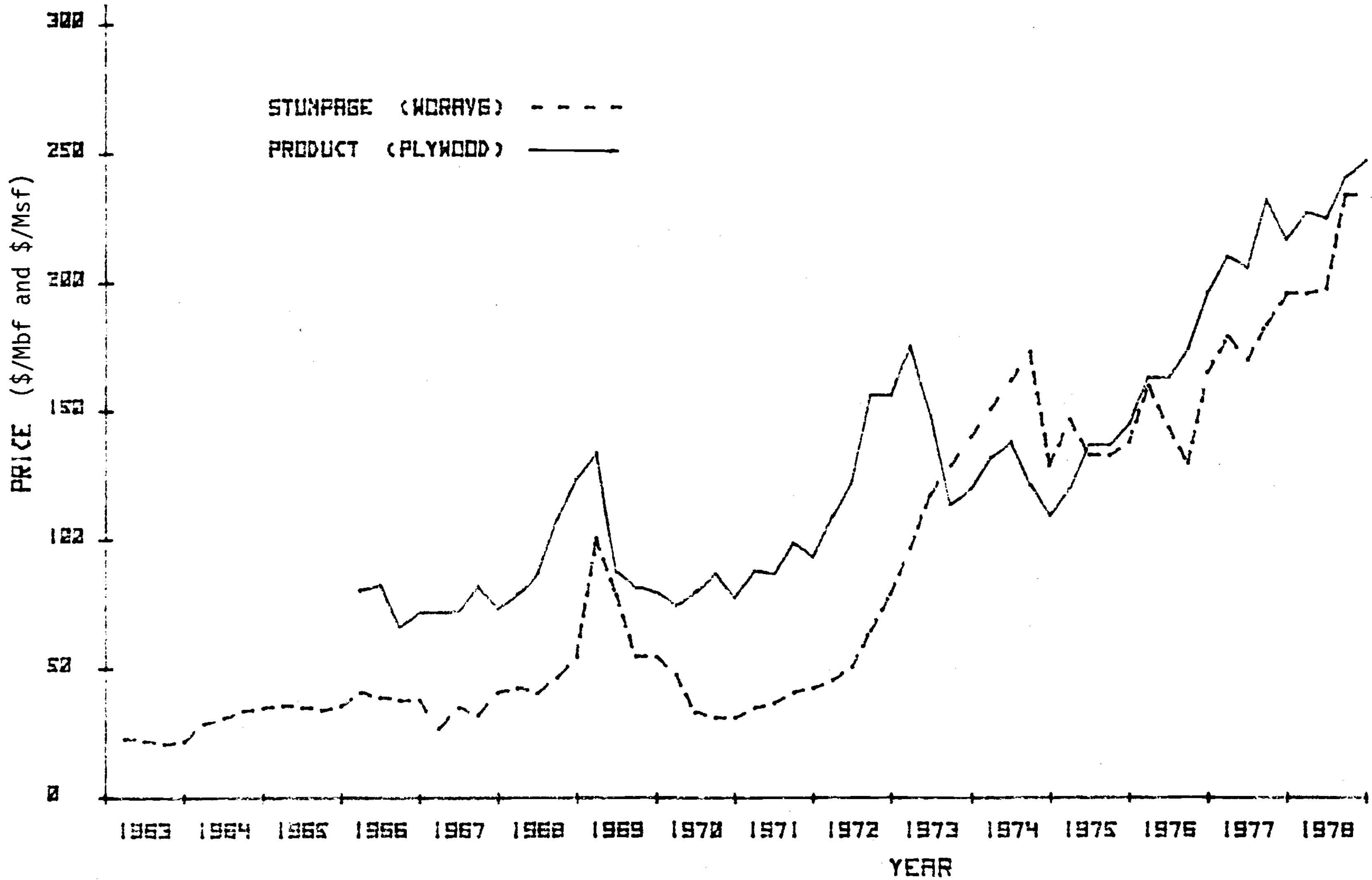

Figure 3. Quarterly western Oregon all agency average stumpage and ½" CDX plywood cash prices (1963 to 1978)

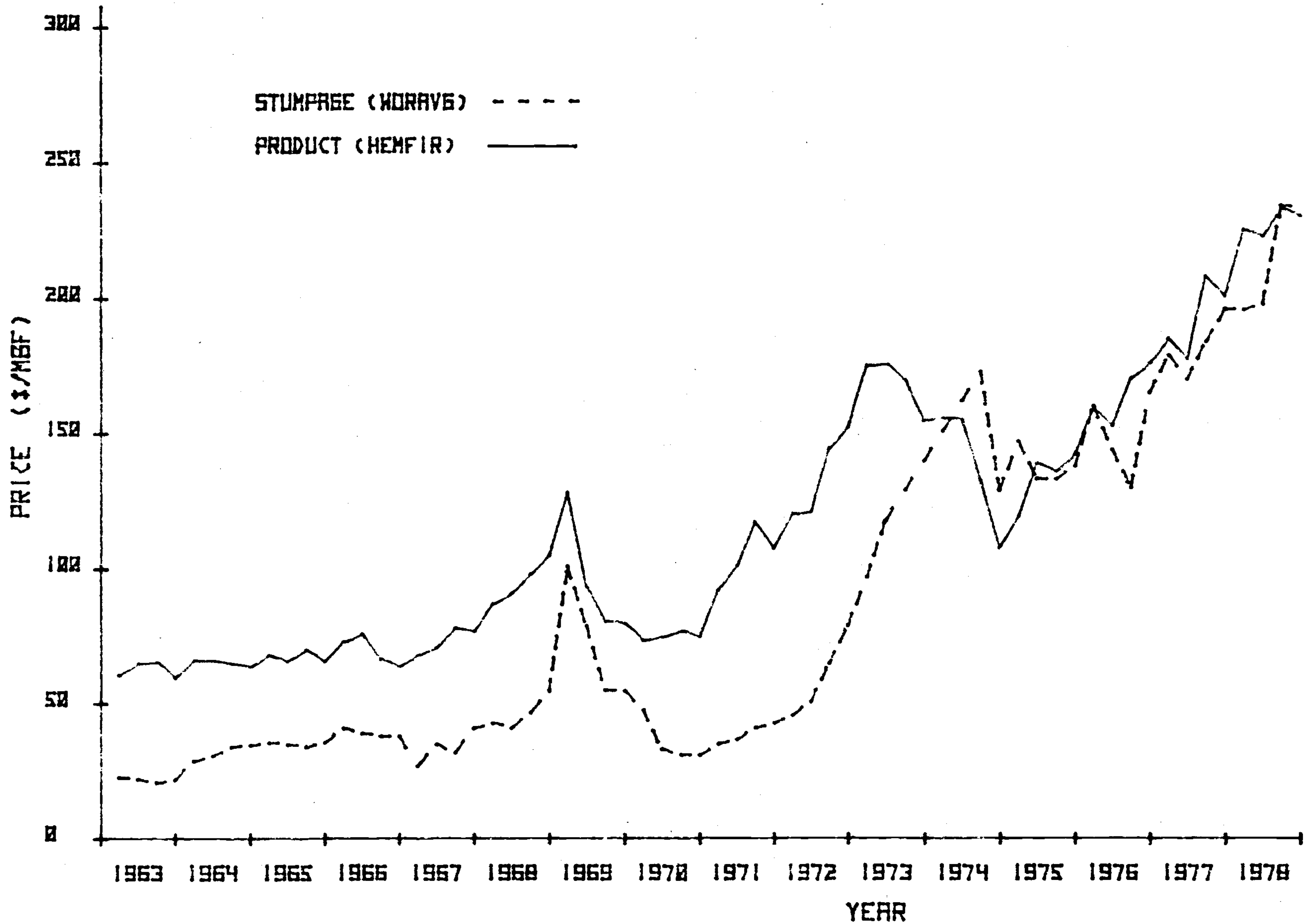

Figure 4. Quarterly western Oregon all agency average stumpage and hemfir lumber cash prices

price changes is especially apparent in the peaks and troughs from 1972 through 1976. A plot of this same type is shown for WORAVG and hemfir lumber in Figure 4.

To test the effect on the correlation coefficient of shifting the product prices relative to stumpage prices, lumber and plywood prices were lagged a quarter at a time for six quarters. The resulting correlation coefficients for each quarter lagged is shown in Table 5. The highest correlations occur between one and four quarters of lag, and under this criterion the best relationship occurs when hemfir lumber is lagged three quarters relative to WORAVG stumpage, yielding an r-value of .951.

None of the west side Douglas-fir to plywood relationships yielded an r-value greater than .90, so this relationship was dropped from further consideration. The remaining three relationships are further examined through least squares regression.

It was felt that lagging the product prices was the best practical way to handle serial correlation for these relationships. The iterative approach to reducing serial correlation in the error terms through the use of transformed variables was considered, but the usefulness and understandability of these relationships would suffer.

The regression models for each of the three relationships defined for zero to three quarters of product price lag are described in Table 6. For each model, the product price, product price squared, and time were made available as independent variables. The squared product price was not significant in all regressions, and in only one relationship was the variable time significant for all time lags. For this equation only are there two independent variables (Table 6a). For each model, the

Table 5. Simple correlation coefficients for two stumpage categories compared with two end product categories, by number of quarters of product price lag.

Quarters to lag (i)	WORAVG hemfir	WORAVG plywood	DFWEST hemfir	DFWEST plywood
0	.921	.908	.902	.863
1	.939	.926	.920	.877 *
2	.947	.927 *	.925	.864
3	.951 *	.917	.931	.858
4	.945	.898	.932 *	.874
5	.919	.882	.915	.879
6	.901	.869	.895	.868

(r-values)

where r = simple correlation coefficient between:

stumpage $price_t$ and product $price_{t-i}$

hemfir - plywood r value: .960   WORAVG - DFWEST r value: .993

* denotes peak value

Table 6a. WORAVG: plywood models for 0 to 3 quarters of product price lag. (Time included in models)

WORAVG $price_t = a + b\ (plywood\ price_{t-i}) + c\ (TIME_{t-i})$ n = 48

Lag (i)	a	b	c	R^2	RMSE	DW*
0	-535.81	.566	7.69	.872	23.15	.53
1	-488.31	.693	6.86	.907	20.59	.80
2	-510.49	.723	7.18	.919	19.91	.90
3	-585.05	.637	8.41	.914	20.52	1.10

DW: Durbin-Watson statistic RMSE: root mean square error
*: Durbin-Watson statistic adjusted for missing WORAVG data

Table 6b. WORAVG: hemfir models for 0 to 3 quarters of product price lag

WORAVG $price_t = a + b\ (hemfir\ price_{t-i})$ n = 60

Lag (i)	a	b	r^2	RMSE	DW*
0	-46.49	1.12**	.848	24.53	.57
1	-52.13	1.21**	.892	21.52	.74
2	-55.58	1.27	.914	19.92	1.11
3	-57.00	1.32	.924	19.28	1.10

* Durbin-Watson statistic adjusted for missing WORAVG data.
** Time significant at .05 level in this model, but not added to model due to marginal contribution.

Table 6c. DFWEST: hemfir models for 0 to 3 quarters of product lag

DFWEST $price_t = a + b\ (hemfir\ price_{t-i})$ n = 64

Lag (i)	a	b	r^2	RMSE	DW
0	-55.05	1.37**	.813	33.53	.36
1	-61.62	1.46	.859	30.22	.51
2	-64.69	1.52	.877	29.07	.83
3	-67.03	1.58	.894	27.72	.87

** Time significant at the .05 level, but not added to model.

coefficient of determination the root mean square error (a measure of variation) and the Durbin-Watson statistic is shown. As serial correlation is reduced by lagging product price, r^2 (R^2) is increased, RMSE is reduced, and the Durbin-Watson statistic gets closer to 1.5.

In the models themselves, stumpage and product price variables are average quarterly prices in dollars, and time is expressed by quarter in terms of year (i.e. the third quarter 1968 is noted as 68.75).

Prediction of average aggregate stumpage prices is possible up to three quarters in advance. Confidence intervals at the 95 percent level range from about 40 to 50 dollars of the predicted WORAVG value using fourth quarter 1978 product price data, and from 60 to 70 dollars of the predicted DFWEST value. Intervals are widest using the no-lag models.

The two models with single independent variables (6b & 6c) are plotted as a range in Figure 5. This gives an idea of the relative effect of lagging product price upon the slope of the function. Only the extremes are shown here.[9/]

Figure 6 shows a plot of quarterly stumpage price measures used, WORAVG and DFWEST. Correlation between these two measures is very high, about .993, due to the large component of west side Douglas-fir included in the western Oregon all agency measure.

[9/] Individual regression functions and scatter plots of each simple linear model are presented in Appendix D.

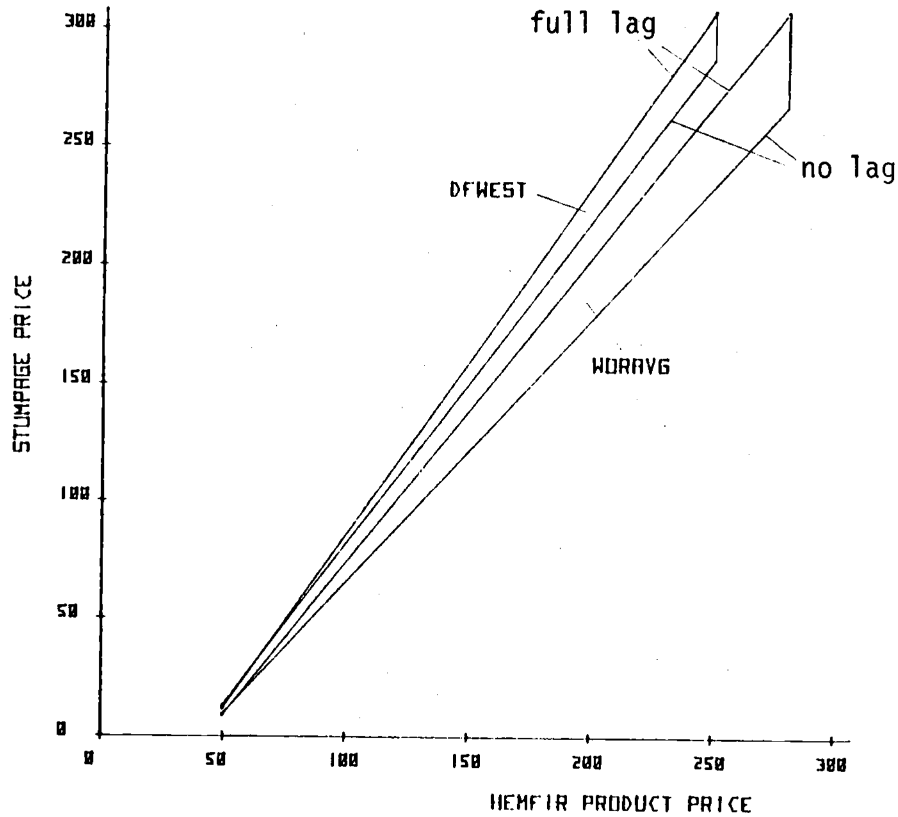

Figure 5. Range of linear relationships described in Tables 6b and 6c. WORAVG corresponds to 6b, DFWEST to 6c.

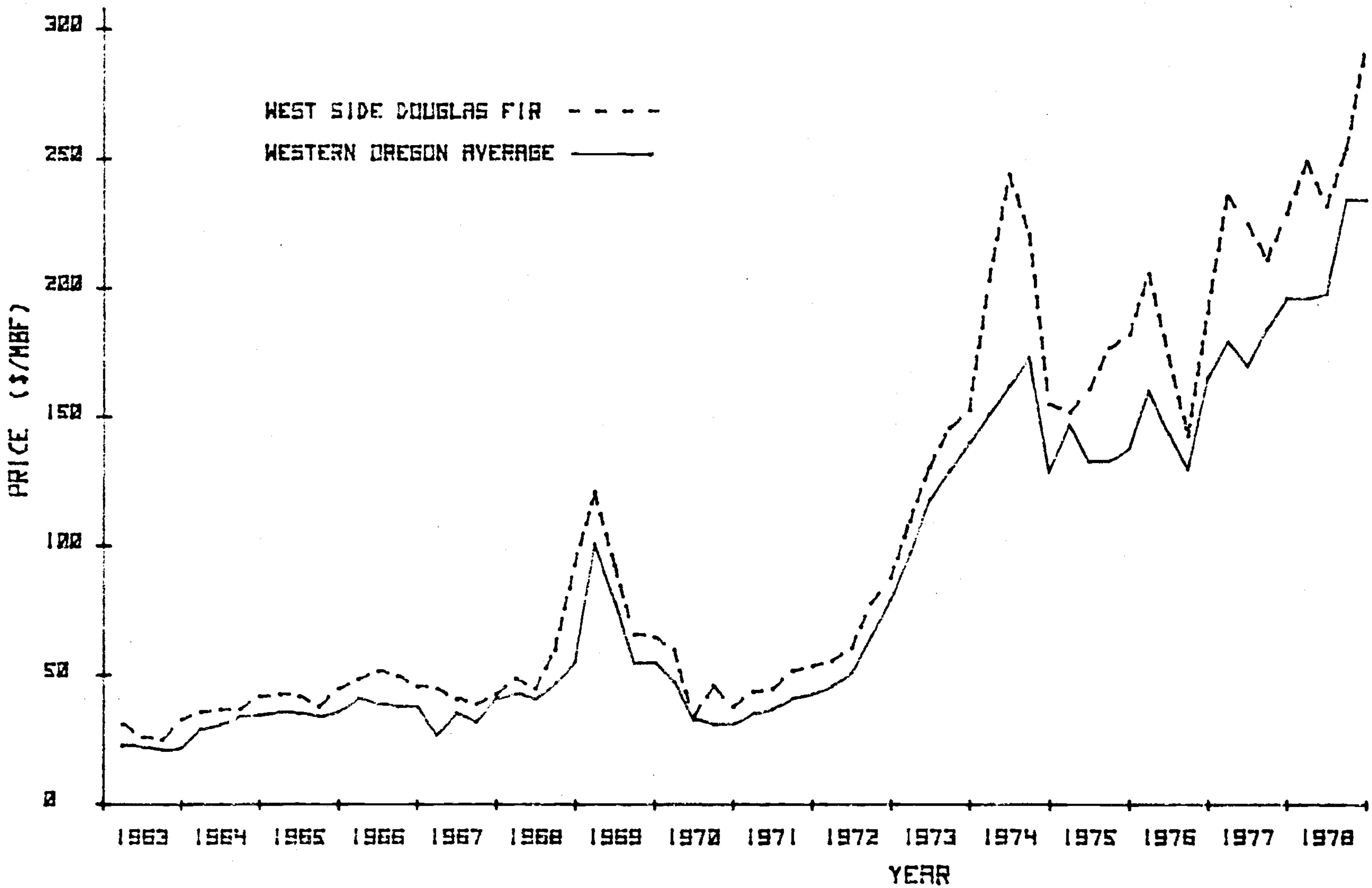

Figure 6. Quarterly DFWEST and WORAVG stumpage prices (1963 to 1978)

Results

Three regression models for predicting stumpage prices in the Pacific Northwest for up to three quarters in advance are provided, and stumpage to end product price relationships are defined. Two of the models predict an all-agency western Oregon average stumpage price, and the third predicts west side Douglas-fir stumpage price.[10/] Stumpage prices increase from 20 to 50 percent greater than the product prices for the period.

Although these historical relationships are highly correlated (they have higher correlations than many product to product price relationships), their chief value is not in prediction but in determining the stumpage price time lag. Stumpage prices changes tend to lag two or three quarters beyond product price changes.

An example will show how these price relationships can be used. In the example, a strategy is developed based on historical seasonal price trends, and actual data for the period 1975 into 1979 is used to demonstrate the results of the hedging strategy.[11/]

[10/] As measured, recorded, and compiled by U.S. Forest Service Region 6 (Ruderman, 1978).

[11/] Chicago Merchantile Exchange, annual yearbooks.

Example Based on Historical Data

Stumpage and end product prices tend to vary in a predictable seasonal pattern, with average product prices bottoming out in the second quarter, and peaking in the third and fourth quarters. Average stumpage prices also tend to reach lows in the second quarter (spring), and peak in the fourth (fall). There is variation by different measures of stumpage and product price, but the pattern is stable. Figure 7 shows price "profiles" for the four measures used in the models described earlier. These profiles have inflationary bias built into them (distorting them somewhat upwards to the right), but the seasonal patterns remain the same.

Futures prices also tend to exhibit a seasonal pattern. Lows usually occur in midsummer to early fall, and highs in late winter and early spring. Using this information in conjunction with the stumpage-product price relationships developed earlier, a cross hedging strategy can be formulated.

Table 7 depicts outcomes of one such strategy using historical data. The following description covers the strategy (which remains the same from year to year for the four seasons covered) for the 1975-76 season.

July/August:

A lumber mill schedules its supply needs several years in advance, and determines its stumpage sale needs to be acquired the following year at current stumpage prices($161/Mbf). Once this need is determined, an anticipatory long hedge is initiated in March lumber futures ($155/M) up to the full amount of stumpage volume required (i.e. one contract per 100 Mbf of stumpage equivalent volume).

Figure 7. Average quarterly price profiles: contract-grade hemfir and plywood, and western Oregon (WORAVG) and west-side Douglas-fir (DFWEST) stumpage. 1963 - 1978.

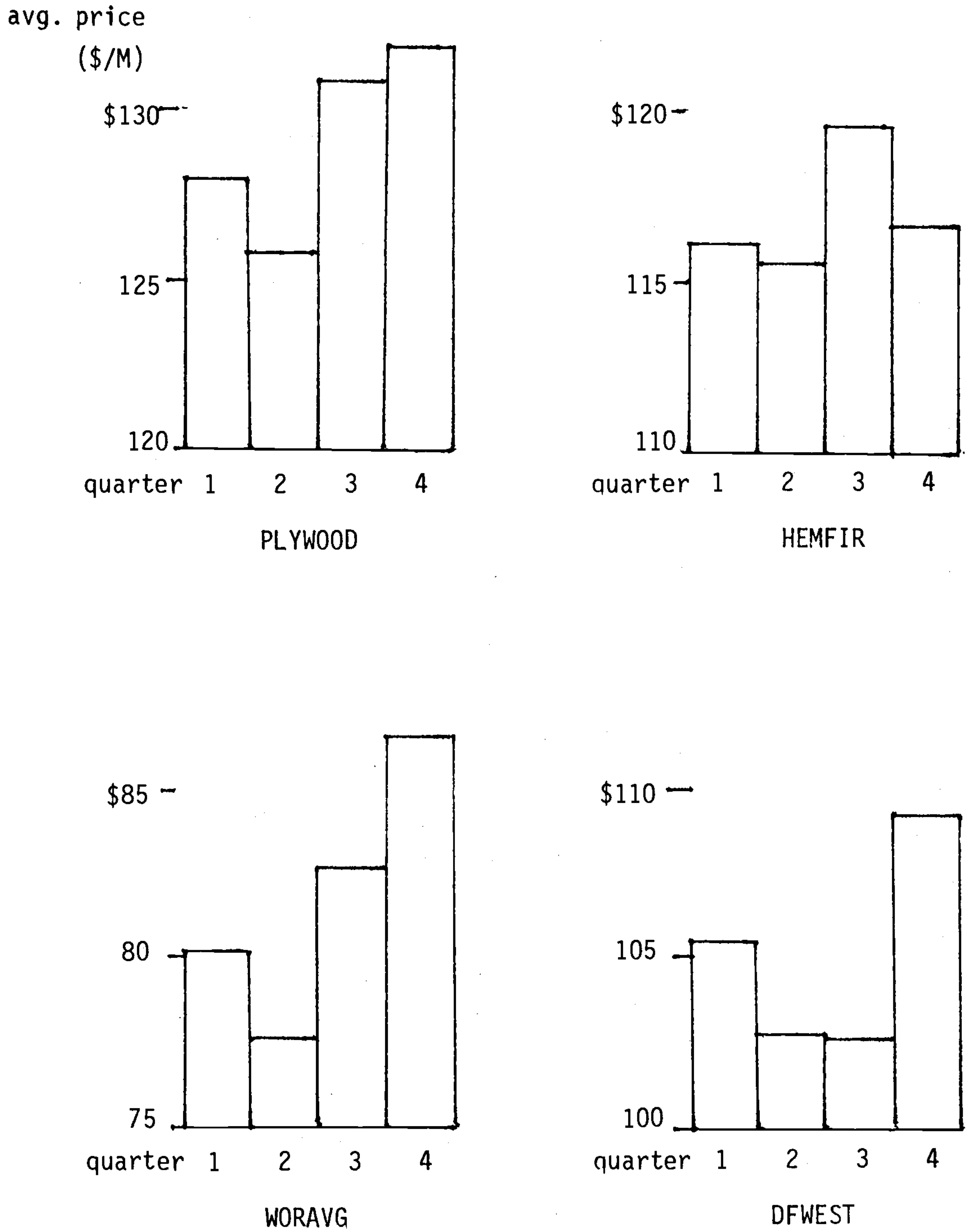

Table 7. Cross hedging examples for the period 1975 - 1979 based on historical cash and futures prices. (commissions and interest ignored)

Year:	75-76		76-77		77-78		78-79	
Period	Cash (stumpage)	Futures (lumber)	Cash	Futures	Cash	Futures	Cash	Futures
July/ August	schedule @ $161/M	B $155/M	$174/M	B $165/M	$225/M	B $195/M	$232/M	B $185/M
February/ March		S $165/M		S $190/M		S $215/M		S $230/M
Spring thru summer	purchase @ $159/M		$218/M		$243/M		($290)	
Gain, loss	+2	+10	-44	+25	-18	+20	(-58)	+45
Net/M	+ $12		- $19		+ $2		(- $13)	

B: buy, S: sell. Figures in parenthesis are estimates based on model projections.
Stumpage purchase prices are average 2nd and 3rd quarter west side Douglas-fir historical prices.
Futures prices are average March lumber prices for the indicated periods.

February/March:

The futures contracts are sold ($165/M) yielding a gain of $10/M, or $1000 per contract. These gains would be deposited into an interest earning fund or converted into short-term marketable securities (such as U.S. Treasury bills).

Spring/summer: (June through August)

Stumpage purchases are made as required ($159/M), thus closing the hedge. In this case, a gain was made on stumpage as well as futures, for a net gain (ignoring commissions and interest) of $12/M, assuming the cash position was fully hedged.

At this time, the scheduling process begins again for the following 1976-77 season. Note that if the mill did not need the amount of stumpage hedged earlier, the hedge could be rolled over into the current March contract, thus extending it another season.

This example has been extended into the future with the current 1978-79 season, with predicted average spring and summer 1979 stumpage prices shown in parentheses.

In the above example, the average loss per Mbf through hedging was $1.67 per year, compared with a $20 per year loss for the cash position without hedging (excluding 1979). Historical data confirms that cross hedging of stumpage on a systematic basis is effective for forward pricing.

Since this producer hedged according to expectations of price changes (in this case an increase), this is technically called anticipatory hedging (see glossary). In practice, an anticipatory hedge is usually also a partial hedge (part of the anticipated cash position is unhedged), which effectively varies the degree of exposure to price risk.

To continue with the example, the purchaser might sell futures against anticipated lumber production if he expects lumber prices to drop (an anticipatory short hedge). Referring back to figure 1, this activity is diagrammed with the mill in the role of supplier, A time span problem arises with this scheme, however, as the most distant futures contract will probably fall short of the time required for logging and milling the standing timber. Plywood futures contracts currently extend 18 months, while lumber contracts extend 12 months. To effectively extend a hedge beyond these periods would require rolling contracts over.

CONCLUSION

Cross hedging stumpage appears to be feasible, as illustrated in the historical data example. Using historical data to prove a point is one thing, however, and actually implementing a new process involving a large potential commitment of funds is another. As the preceding example demonstrates, the process is somewhat complex, due to the stumpage to cash product basis, and to the time lag component. To put cross hedging of stumpage into perspective for application, a listing of the perceived advantages and disadvantages would be useful.

Advantages:

1) The process stabilizes earnings by establishing a predetermined price for stumpage, within the bounds of stumpage to cash product price basis.
2) The process allows the transfer of unwanted risk of adverse stumpage price changes. The degree of risk exposure is controllable with partial hedging.
3) The process allows more latitude in timing purchases of stumpage, and therefore more control over the prices paid. Stumpage prices vary considerably over time.

Disadvantages:

1) The basis risk is difficult to define, as it has two components: stumpage to produce price basis and a time lag component.
2) The time frame required for hedging stumpage can exceed the horizon of the most distant futures contract, requiring roll-overs to maintain the hedge.
3) Trading in distant futures is light. Establishing a large position in these contract months may be difficult without driving prices up or down substantially, thereby offsetting the effectiveness of the hedge. The use of nearer contract months having a larger open interest, along with rolling the contracts over may eliminate this problem.

Some questions still unanswered include the effect of cross hedging of stumpage on timing of tax liability, and questions on the correct accounting methods for the process.

The survey conducted in April, 1979 (see Appendix B), indicates that hedging activity by medium to large independent producers of lumber, veneer and plywood in western Oregon is light. Over the past five years, which encompasses one business cycle, only 14 percent of all firms in this group hedged forest products. None of these firms did so for purposes of cross hedging stumpage.

There appear to be several reasons for the limited involvement in hedging over the last five years:

1) Misinformation on the process of hedging

2) Mistrust of the commodity markets

3) Many producers are not involved with contract grade

4) A feeling that hedging is only for large producers.

The sample was not stratified by product type, mill size, or annual volume of product, so no generalizations can be made about different levels of hedging activity within the survey.

In my judgement, this general avoidance of hedging forest products would have to be overcome before cross product hedging of stumpage is implemented on a wide scale. For the individual producer, the question of application boils down to deciding whether the risks of adverse stumpage price changes are greater than the basis risks involved with cross hedging stumpage, given the objectives and policy constraints of the firm.

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APPENDICES

APPENDIX A

Glossary of Commodity Futures Terms

ANTICIPATORY HEDGE[a/]	Buying or selling futures against anticipated positions in the cash markets, guided by price expectations of the cash commodity. For the producer, an anticipatory long hedge involves purchasing futures to cover raw material requirements, while an anticipatory short hedge involves sale of futures in advance of actual production. The purpose of anticipatory hedging is to take advantage of a current price (forward pricing). If a portion of the anticipated cash position is hedged, then it is a partial anticipatory hedge.
BASIS	This term can take on several meanings, all concerning the difference between two prices. The common definition is the difference between the contract cash and futures price at a given time. In cross product hedging, basis refers to the difference between the contract grade cash price and the off contract grade price.
CASH POSITION	The status of a hedger's possession of the actual physical commodity.
CROSS PRODUCT HEDGE (CROSS HEDGE)	Hedging non-contract cash commodities in the futures markets
DELIVERY DATE	The date of contract expiration. All open contracts on this date must be delivered against.
FORWARD PRICING	Setting a price for production or required supplies through a sell hedge or a buy hedge under uncertainty (the hedger has no expectations concerning the direction of price changes)
FUTURES	A term used to designate all contracts covering the sale or purchase of commodities for future delivery on a commodity exchange.

[a/] Derived from Working (1962).

HEDGE	The purchase or sale of a futures contract as a temporary substitute for a merchandising transaction to be made at a later date. Usually it involves opposite positions in the cash market and the futures market at the same time.
INVERTED MARKET	A futures market in which the nearer months are selling at higher prices than the more distant months.
LIQUIDATION	Same as "evening up" or offset. Any transaction which offsets or closes out a long or short position.
LONG	One who has bought a futures contract to establish a market position and who has not yet closed out this position through an offsetting sale. Opposite of short. It is, of course, also possible to be long in the cash commodity.
LONG HEDGE (BUY HEDGE)	The purchase of a futures contract to offset the forward sale of an equivalent quantity of a commodity not yet owned. Used by processors or exporters as protection against an advance in the cash price.
MARGIN	A cash amount of funds or securities which must be deposited with the broker for each contract as a guarantee of fulfillment of the futures contract. It is not considered as part payment of purchase, but rather as "earnest money".
OPEN CONTRACTS	Contracts which have been bought or sold without the position having been liquidated by subsequent sale or repurchase, actual delivery, or receipt of commodity.
OPPOSITE POSITION	The opposite position to cash is the holding of a futures contract in a given commodity, and vice-versa.
POSITION	An interest in either the cash or futures market, long or short, in the form of open contracts or quantities of physical commodity.

PARTIAL HEDGE	The use of futures to cover part of an existing or anticipated cash position.
ROLL OVER	Extending the life of a hedge by exchanging a near contract for a farther contract.
SELECTIVE HEDGING[a]	The practice of either hedging or not hedging existing commodity stocks (the cash position) according to price expectations. When prices are expected to decline, stocks are hedged to avoid loss. When prices are expected to rise, stocks are left unhedged to gain from the cash position. If part of the existing cash position is to be hedged selectively, it is a partial selective hedge.
SHORT	One who has sold a futures contract to establish a market position and who has not yet closed out this position through an offsetting purchase. The opposite of being long.
SHORT HEDGE (SELL HEDGE)	The sale of futures contracts to eliminate or lessen the possible decline in value of ownership of an approximate equal amount of the actual commodity.
SPECULATOR	One who attempts to anticipate price changes and through market activities make profits; he is not using the futures market in connection with the production, processing, marketing or handling of a product.
TENDER	Delivery against futures.

[a] Derived from Working (1962).

From: "Commodity Futures Terms", Chicago Mercantile Exchange.

APPENDIX B

Survey of Producers

A survey of Western Oregon lumber and plywood producers was conducted as a means of determining whether cross product hedging for stumpage had been systematically attempted. The survey was by telephone, and consisted of two "yes-no" questions.

The target population of interest in this survey was the large to medium-sized independent producer. Producers of this size class would probably have little or no timber base, and therefore stand to gain the most from cross-hedging stumpage, as they would be forced to buy public timber. Large, integrated forest products corporations were not surveyed. The sample was drawn from the 1977 Directory of the Forest Products Industry, and the May 30, 1978 Forest Industrial Annual Lumber Review for 1977. All softwood lumber companies producing from 10 to 100 million board feet of lumber in 1977 were included, as well as all softwood veneer and plywood producers. This was a survey of producers, so total company production, not individual mill output, was the volume criterion.

These sources provided 69 companies operating primarily in western Oregon within these output limitations. Ten of these producers, once contacted, did not truly fit the criteria, had gone out of business, or had been absorbed by another company.

The survey, conducted in April 1979, asked two questions:

1) Has your firm bought or sold lumber or plywood futures contracts for hedging in the past five years?

2) Were any of these contracts bought or sold expressly for the purpose of hedging against adverse stumpage price changes?

A "no" answer to the first question precluded the asking of the second. The results are tabulated below:

Table B1. Survey results

Response	Question 1 frequency	Question 2 frequency
Yes	7	0
No	41	7
No response	2	0
	50	7
NC *	9	
Total attempted	59	

* No contact made. Person in firm qualified to answer questions not contacted after two calls on subsequent days.

Table B2. Statistical analysis

Statistic	Question 1	Question 2
Proportion of "yes" responses (p)	14.6%	0%
Variance (s^2)	.127	
Standard error with assumed N=70 ($s_{\bar{x}}$)	.029	
95% confidence interval about mean *	14.6% $\pm$ 5.8%	

* With an assumed N of 100, the confidence interval broadens to $\pm$ 7.5%: the true population of this category of producer is most likely between 70 and 100 (Howard and Hiserote, 1978).

APPENDIX C

Price data and
additional plots

Price data: four measures of stumpage, 1967 - 1978. ($/Mbf)

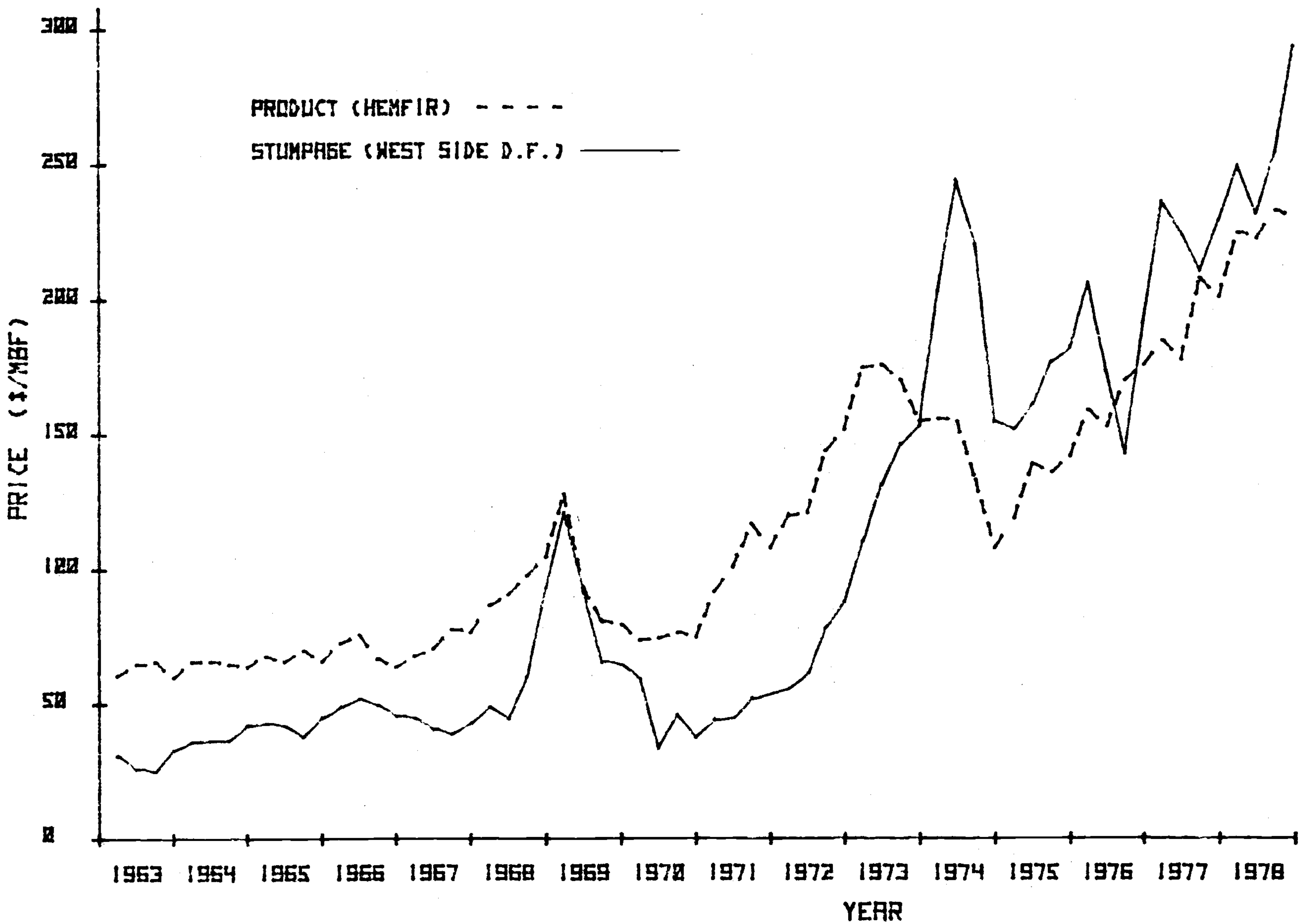
Year and quarter	East-side Douglas-fir	Western hemlock	White fir	Ponderosa, Jeffrey pine
1967.25	5.80	26.40	16.70	15.00
1967.50	10.00	16.90	10.00	18.10
1967.75	9.40	23.10	16.80	19.80
1968.00	9.40	28.90	17.40	21.90
1968.25	14.40	36.40	24.00	23.80
1968.50	15.70	31.70	22.00	21.70
1968.75	22.40	34.20	33.00	21.30
1969.00	25.40	41.50	44.50	33.50
1969.25	49.60	69.90	77.20	50.40
1969.50	44.80	48.30	55.00	55.90
1969.75	17.30	39.70	31.40	43.20
1970.00	15.10	30.30	22.30	34.50
1970.25	15.30	29.70	28.10	25.60
1970.50	7.30	17.20	7.50	20.00
1970.75	7.30	20.20	19.80	24.50
1971.00	2.80	16.90	11.00	14.50
1971.25	2.20	17.30	7.50	11.60
1971.50	3.90	18.20	8.20	16.30
1971.75	5.20	13.50	13.80	23.70
1972.00	5.60	30.30	23.40	37.90
1972.25	6.80	30.20	25.10	27.30
1972.50	13.40	30.90	23.00	38.20
1972.75	15.70	44.00	42.50	47.20
1973.00	28.90	73.00	43.40	50.00
1973.25	40.50	101.60	67.60	64.60
1973.50	63.20	81.20	78.30	56.50
1973.75	65.30	106.90	119.30	93.00
1974.00	65.60	117.10	80.50	84.30
1974.25	90.80	114.10	78.40	136.20
1974.50	61.40	124.10	86.40	135.00
1974.75	84.40	140.00	72.60	113.20
1975.00	57.40	78.40	77.40	67.90
1975.25	27.20	38.30	57.40	49.60
1975.50	38.50	78.00	47.30	40.60
1975.75	12.90	54.90	25.50	44.00
1976.00	31.10	74.10	49.10	37.00
1976.25	10.90	78.60	67.20	94.80
1976.50	33.30	75.50	41.10	66.60
1976.75	40.90	73.00	67.10	86.60
1977.00	71.40	92.70	36.40	90.40
1977.25	99.30	91.70	97.30	134.60
1977.50	59.20	65.40	74.60	119.50
1977.75	62.70	89.60	74.90	150.00
1978.00	65.10	85.40	115.30	159.10
1978.25	122.30	95.80	90.50	106.00
1978.50	69.00	82.80	91.70	183.90
1978.75	67.40	125.30	100.60	249.30
1979.00	65.70	147.70	158.10	254.30

Price data source: Ruderman (1978) and Random Lengths (1979).

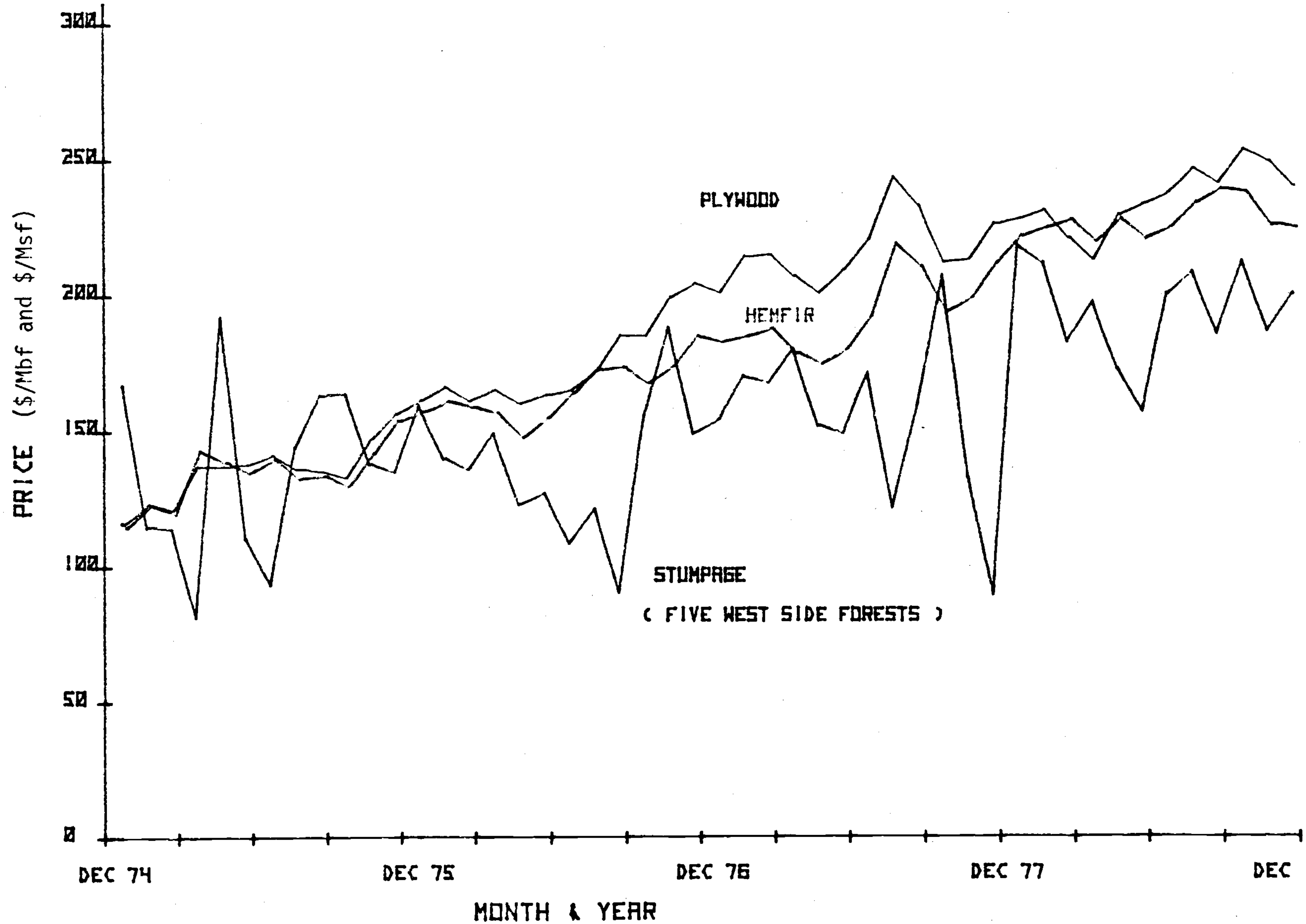
No data available for missing entries.

Price data: two measures of stumpage and two measures of product ($/Mbf)

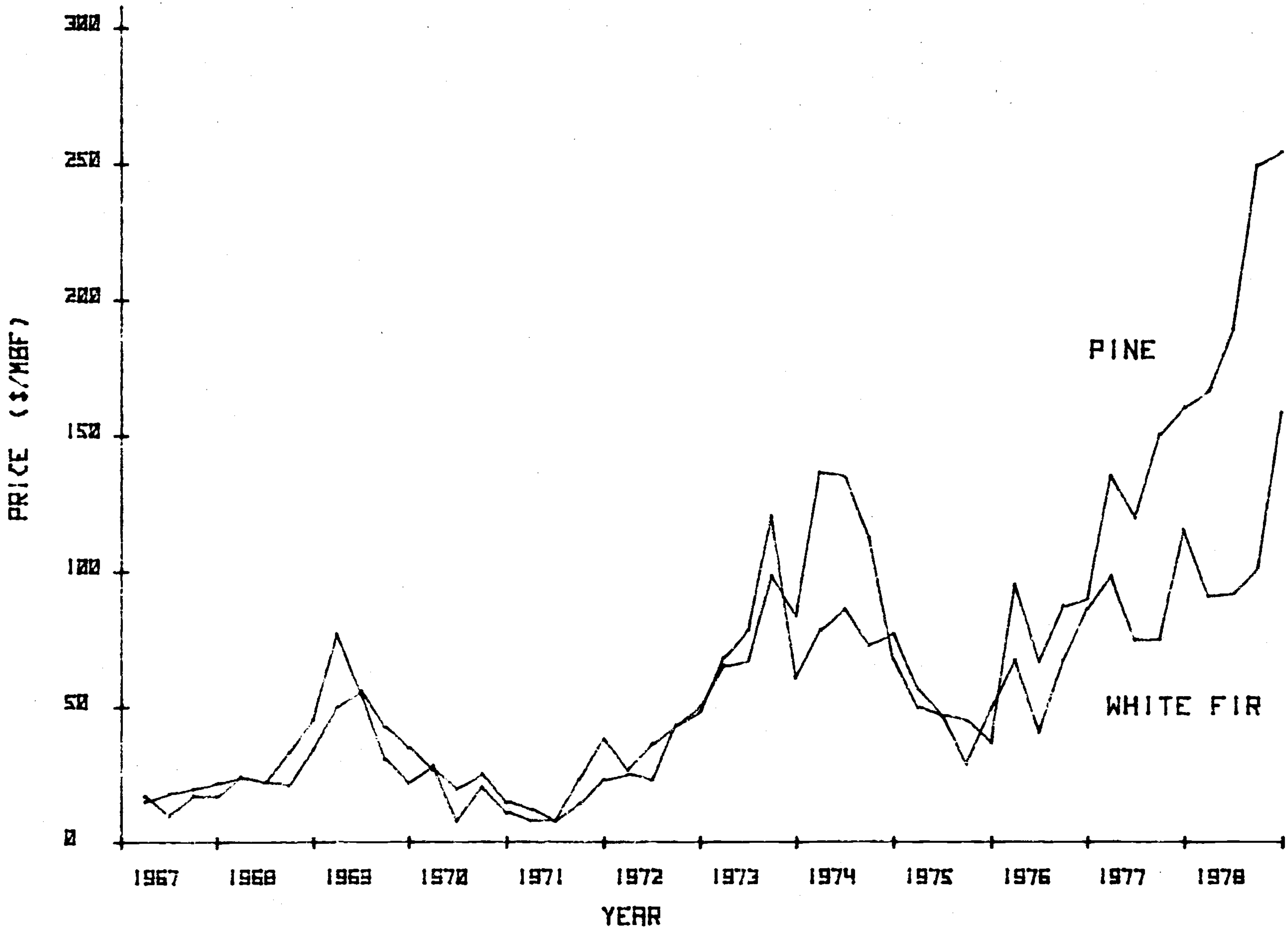
Year and quarter (TIME)	West-side Douglas-fir (DFWEST)	Western Oregon average (WORAVG)	Hemfir lumber	½" CDX plywood
1963.25	31.00	23.11	61.33	
1963.50	25.90	22.23	55.00	
1963.75	24.80	21.06	66.33	
1964.00	32.90	22.16	60.33	
1964.25	35.90	28.65	66.33	
1964.50	37.00	30.83	56.00	
1964.75	37.00	34.09	65.00	
1965.00	41.60	34.86	63.67	
1965.25	42.80	35.99	68.33	
1965.50	42.40	34.76	66.33	
1965.75	38.40	34.24	70.33	
1966.00	45.20	36.33	66.00	
1966.25	49.30	40.95	73.00	80.67
1966.50	52.20	39.06	75.33	83.33
1966.75	50.20	37.56	67.00	66.67
1967.00	45.80	37.90	63.66	72.00
1967.25	45.10	27.09	67.67	71.57
1967.50	40.90	35.04	71.00	72.67
1967.75	38.70	32.23	78.33	82.33
1968.00	42.70	41.08	75.67	73.57
1968.25	48.70	42.63	87.00	78.67
1968.50	45.30	40.77	90.67	86.67
1968.75	59.90	46.81	93.00	103.33
1969.00	92.90	54.68	105.00	124.33
1969.25	120.90	100.56	123.30	134.00
1969.50	93.20	73.50	93.67	88.00
1969.75	65.10	54.75	81.33	82.00
1970.00	64.60	54.77	80.33	80.33
1970.25	59.50	46.00	74.33	75.33
1970.50	34.40	33.32	74.67	79.67
1970.75	45.70	30.93	77.00	87.00
1971.00	37.50	31.45	75.33	73.33
1971.25	43.50	34.74	91.67	87.67
1971.50	45.30	36.75	100.70	86.67
1971.75	52.00	40.72	116.70	99.33
1972.00	54.00	43.39	108.00	94.33
1972.25	55.20	45.90	119.70	109.33
1972.50	60.70	51.13	120.70	121.67
1972.75	77.70	64.70	143.70	156.00
1973.00	83.30	79.08	152.00	156.00
1973.25	109.80	97.11	175.00	175.33
1973.50	131.20	117.51	175.70	149.00
1973.75	146.20		170.00	114.33
1974.00	152.60		155.00	120.00
1974.25	203.10		156.00	132.00
1974.50	243.70		155.00	138.00
1974.75	220.90	173.48	133.00	122.33
1975.00	155.40	129.36	103.30	110.33
1975.25	151.50	146.47	119.30	120.00
1975.50	160.90	133.36	139.00	137.33
1975.75	177.00	133.01	135.70	137.33
1976.00	182.40	138.23	142.00	145.33
1976.25	205.80	159.51	159.00	162.67
1976.50	173.80	144.41	153.30	162.67
1976.75	142.60	130.24	170.30	174.00
1977.00	190.50	164.57	176.00	195.00
1977.25	236.00	179.27	185.30	210.00
1977.50	224.50	169.95	173.00	205.67
1977.75	211.30	154.34	208.30	232.00
1978.00	229.10	196.44	201.30	217.00
1978.25	248.80	195.98	225.00	225.67
1978.50	232.40	197.80	223.00	225.00
1978.75	253.70	224.38	232.67	241.33
1979.00	292.70	234.41	229.67	247.33



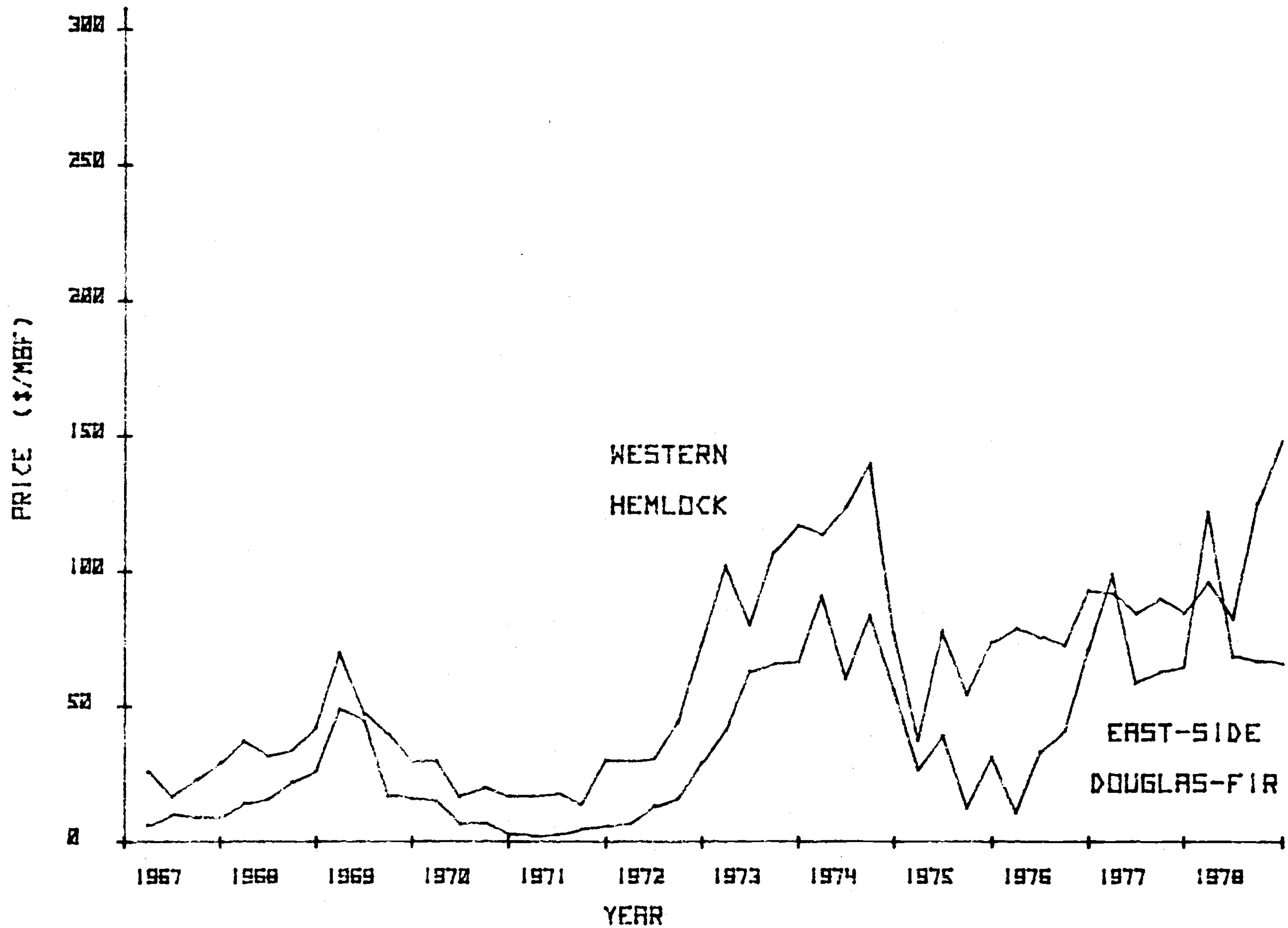
Quarterly hemfir lumber and west side Douglas-fir stumpage cash prices (1963 - 1978)



Monthly stumpage and end product prices (1975 to 1978)



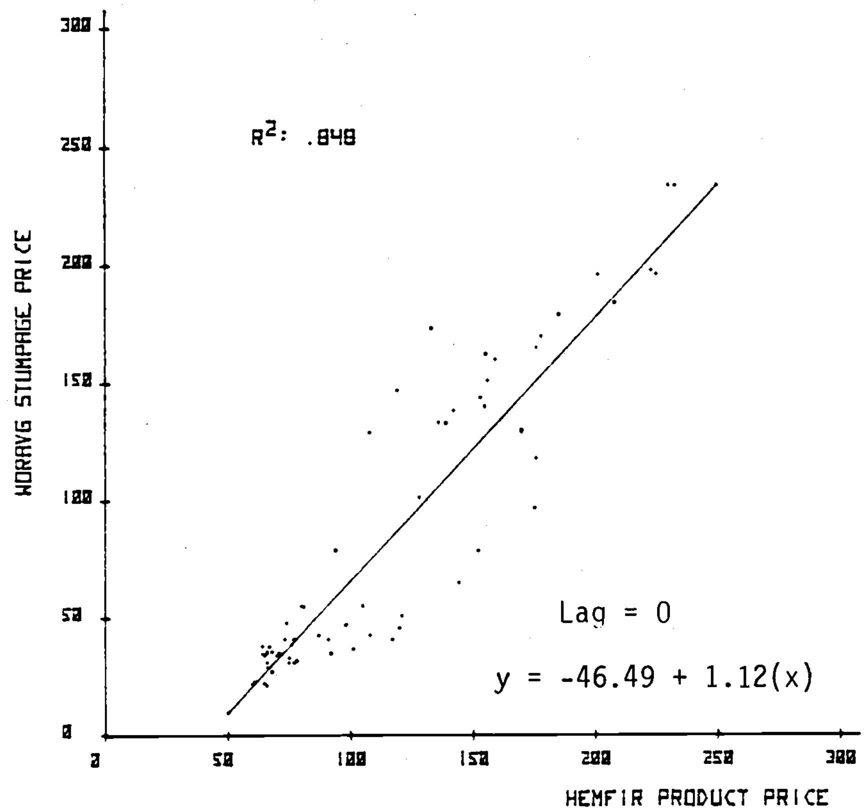
Quarterly white fir and ponderosa pine stumpage prices (1967 to 1978)

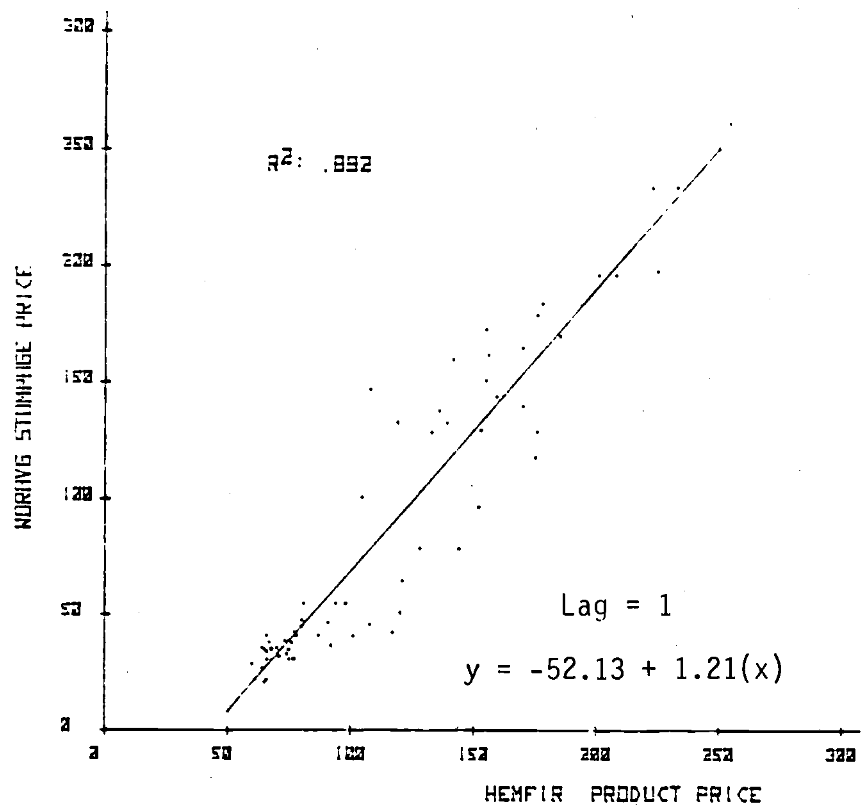


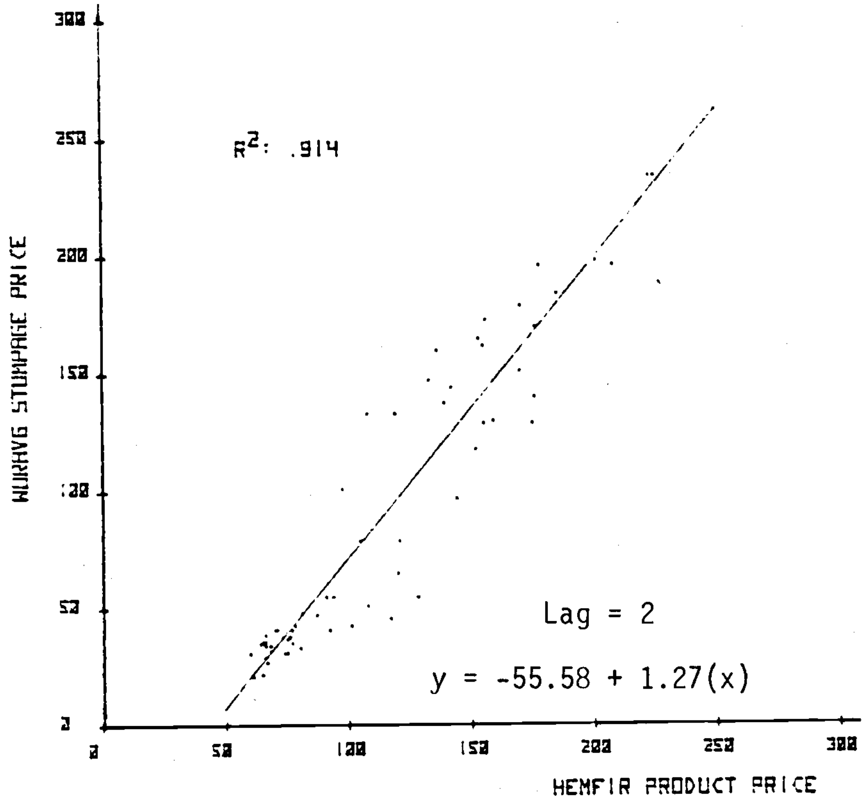
Quarterly East-side Douglas-fir and western hemlock stumpage prices (1967 to 1978)

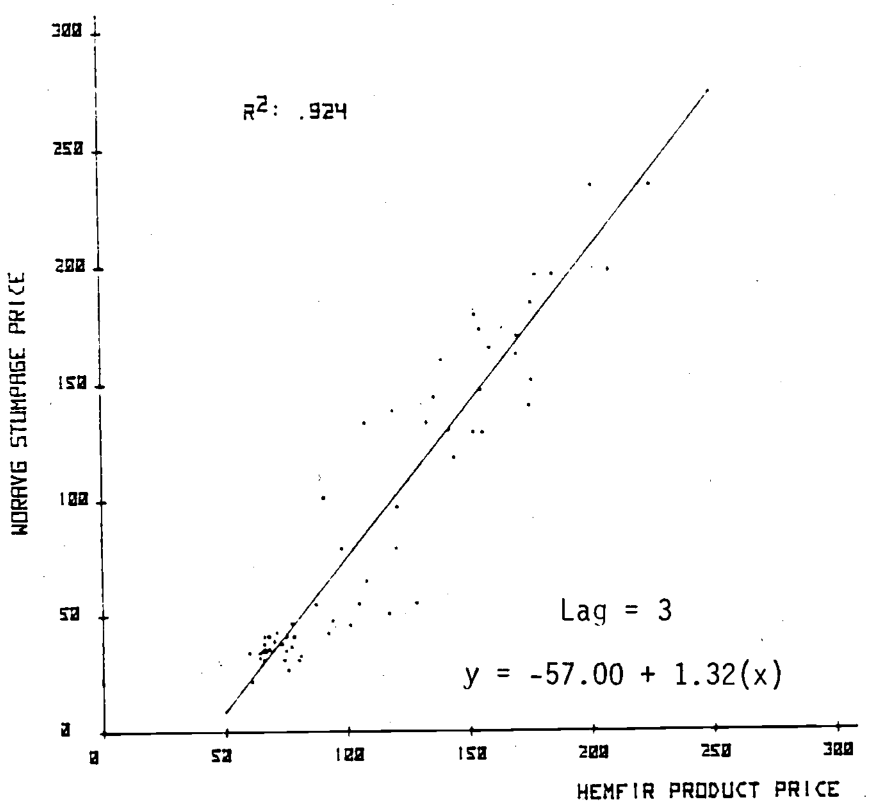
APPENDIX D

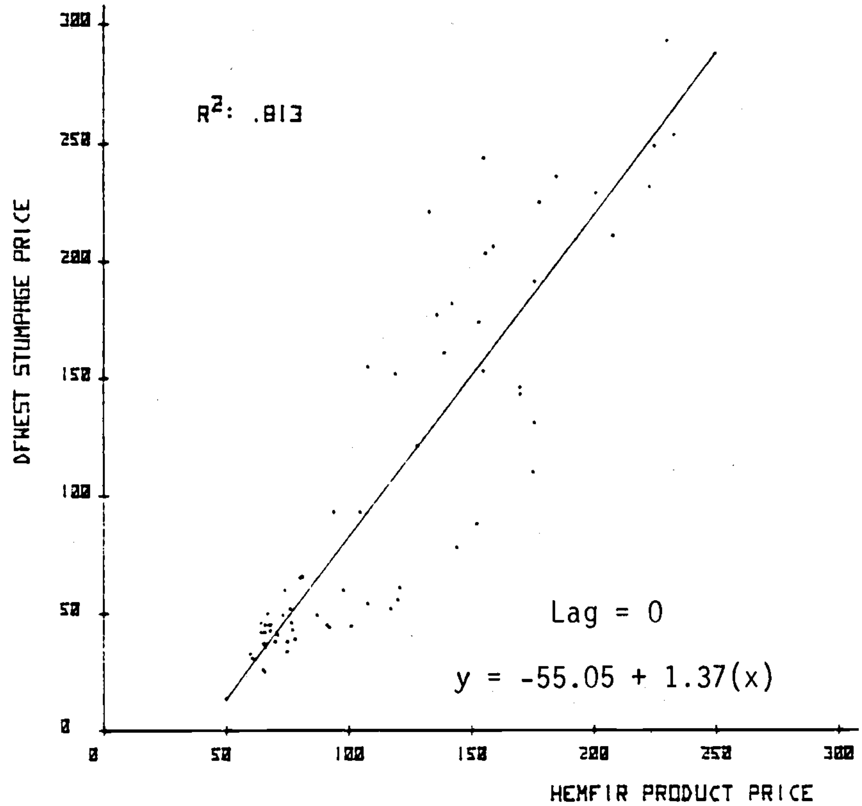
Scatter plots and associated functions described in Table 6b and 6c

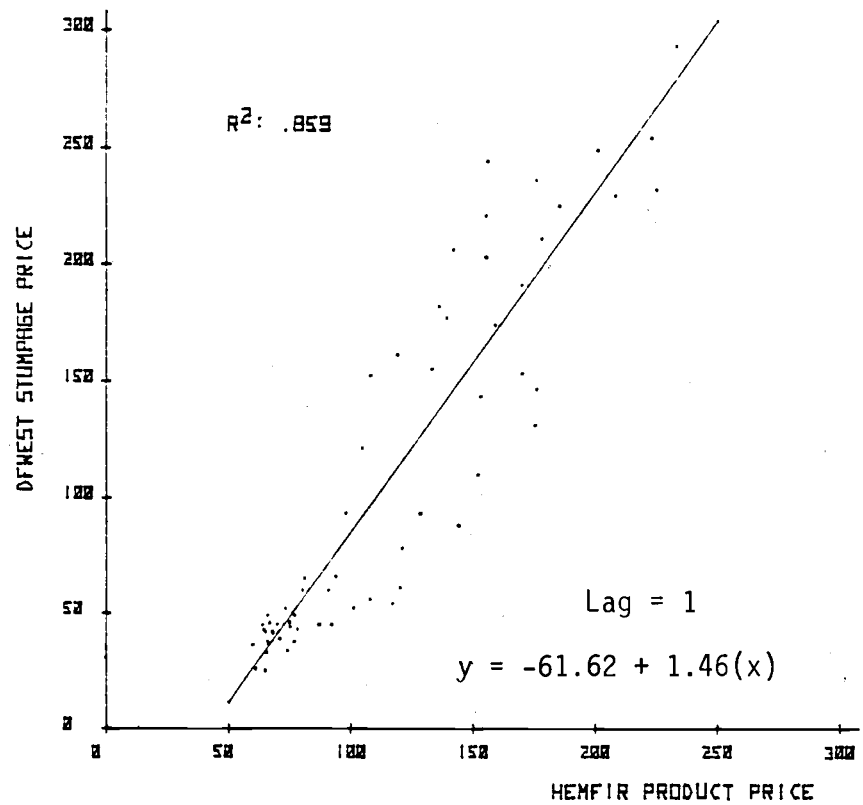

300
250
200
150
100
50
0
R²: .848
NORAVG STUMPAGE PRICE
0
50
100
150
200
250
300
HEMFIR PRODUCT PRICE
Lag = 0
y = -46.49 + 1.12(x)

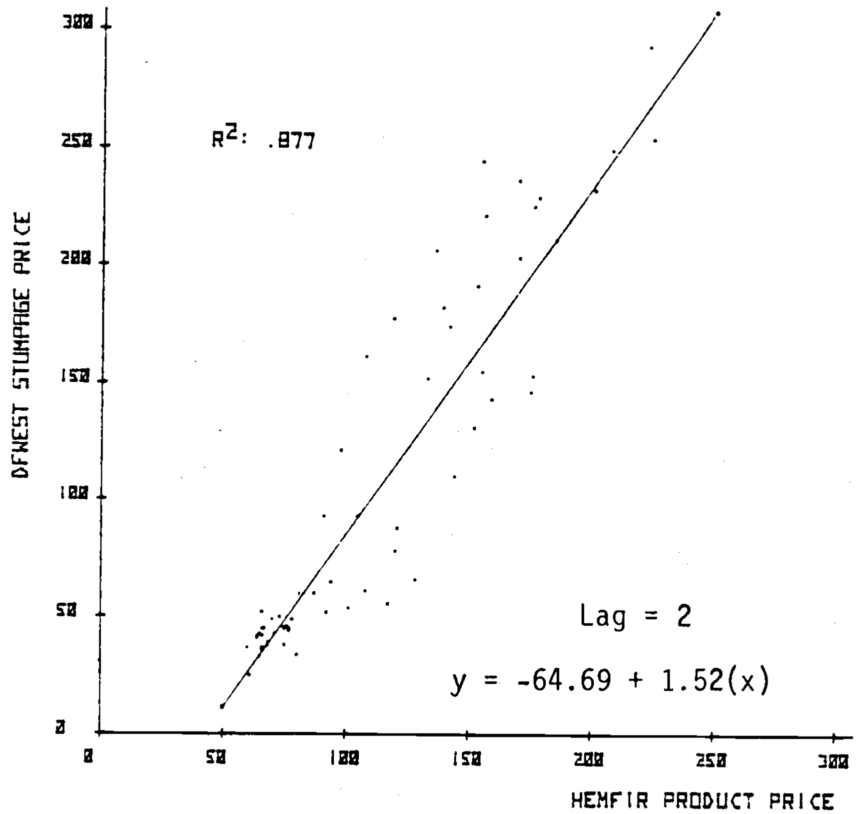

300
250
200
150
100
50
0
R²: .892
NORAVG STUMPAGE PRICE
0
50
100
150
200
250
300
HEMFIR PRODUCT PRICE
Lag = 1
y = -52.13 + 1.21(x)

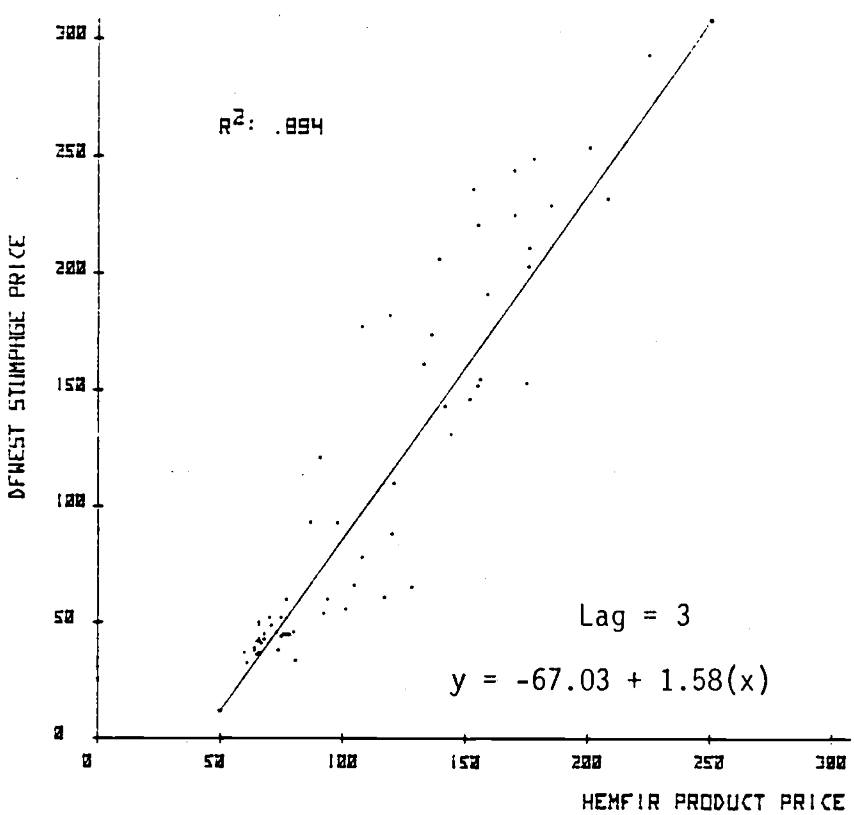

WORAVG STUMPAGE PRICE
R^2: .914
Lag = 2
y = -55.58 + 1.27(x)
HEMFIR PRODUCT PRICE


WORAVG STUMPAGE PRICE
R^2: .924
Lag = 3
y = -57.00 + 1.32(x)
HEMFIR PRODUCT PRICE


R²: .813
Lag = 0
y = -55.05 + 1.37(x)
DFWEST STUMPAGE PRICE
HEMFIR PRODUCT PRICE
0
50
100
150
200
250
300


R²: .859
Lag = 1
y = -61.62 + 1.46(x)
DFWEST STUMPAGE PRICE
HEMFIR PRODUCT PRICE
0
50
100
150
200
250
300


R2: .877
Lag = 2
y = -64.69 + 1.52(x)
DFWEST STUMPAGE PRICE
HEMFIR PRODUCT PRICE
0
50
100
150
200
250
300


R2: .894
Lag = 3
y = -67.03 + 1.58(x)
DFWEST STUMPAGE PRICE
HEMFIR PRODUCT PRICE
0
50
100
150
200
250
300