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TIMBER VALUE-a matter of choice

A study of how end use assumptions affect timber values

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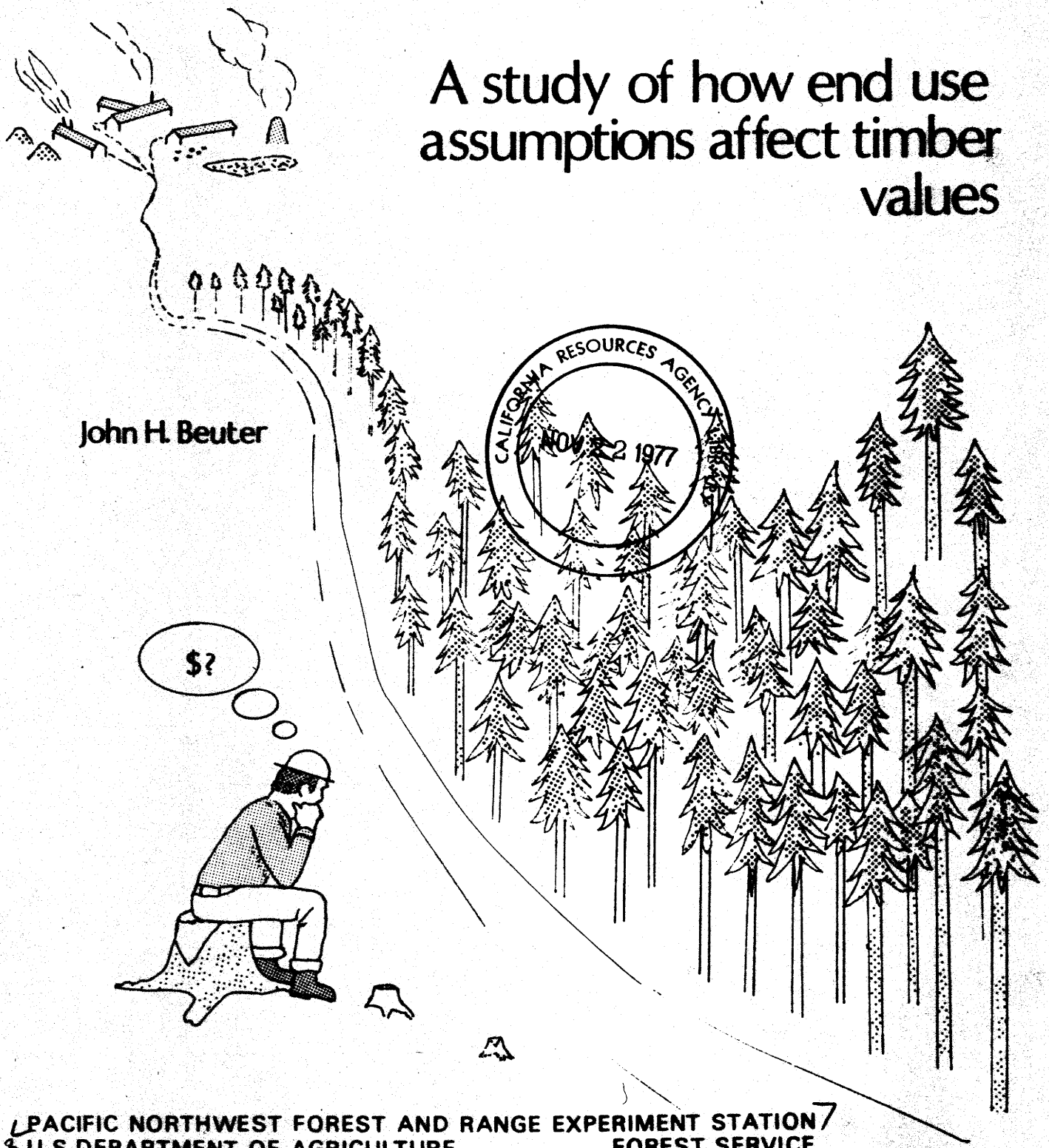

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE
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ABSTRACT

The relationship between estimated timber values and actual timber prices is discussed. Timber values are related to how, where, and when the timber is used. An analysis demonstrates the relative values of a typical Douglas-fir stand under assumptions about timber use.

John Beuter is now at Oregon State University, Corvallis.

Keywords: Forest appraisal, forestry business economics, timber value, stumpage price.

INTRODUCTION

There are many reasons why someone might want to know a value for a stand of timber. A seller wants to determine the minimum price below which he won't sell; a buyer wants to determine a maximum price above which he won't buy. The tax assessor wants to determine the stand's taxable value, and the banker wants to know its collateral value. The accountant uses the book value, and the economic analyst talks of the relative values for a set of alternative stand treatments. Different people, different objectives. Can it be expected that each will arrive at the same estimate of value for a given stand of timber? If they don't arrive at the same estimate of value, how do we know whose estimate is best? What is the relationship of price to their value estimates?

The purpose of this paper is to relate the concept of timber value to people and their objectives. The discussion is not about appraisal technique or methodology but rather about concepts underlying the determination of timber value. It is not directed solely at timber appraisers but at anyone who has had to think about timber value either as a buyer, as a seller, or as an analyst of alternatives which include the consideration of timber values.

The paper is divided into three parts. The first part deals with the concept of value and the relationship of value to price. The second part is a discussion of the underlying influences of timber values which are relevant to buyers and sellers of timber. The third part is a demonstration of the effects on timber value of differing assumptions of how, where, and when the timber will be used.

VALUE AND PRICE

Values Don't Exist Without People

The whole concept of value is meaningless without the existence of a decisionmaker. People estimate value to make decisions about exchange rates between commodities and the allocation of scarce resources. A value estimate reflects the specific objectives and knowledge of the estimator, i.e., the decisionmaker or his representative. A common misconception concerning value is that there is *a* correct and indisputable value for anything. In fact, there can be as many "correct" values as there are people to have them.

It is well known that value estimates can differ because different people use different data and data processing methods to develop them. Taking only this into account, it can be argued that one estimate of value is better than another because of better data or technique.

What is often overlooked, however, is that different people using the same basic data and technique can come up with different value estimates. These differences are due to differing objectives, assumptions, limitations, and judgment among the people estimating value. For example, assume my competitor and I both estimate the value

of a timber stand by using identical data from identical sources and that our basic valuation technique is the same. I judge that 30 percent of the volume will be used for veneer and the rest for lumber, and my competitor judges that all of the timber will be used for lumber and none for veneer. Even though we used the same price and cost data, our value estimates differed because of the differing weights we assigned to the alternative products which could be produced from the timber, i.e., we arrived at different value estimates because our assumptions were different.

Some people have difficulty conceding that alternative values for a commodity exist. This difficulty is usually associated with the belief that the ultimate value for something is defined by its price.

How Is Value Related to Price?

The following distinction is made between value and price:

1. Value is an *estimate* of the amount (usually dollars) that will be paid by a buyer or accepted by the seller in exchange for a thing. The estimate is subject to the objectives, assumptions, limitations, and judgment of the person making it.

2. Price is the actual amount paid by the buyer and accepted by the seller in exchange for a thing at the instant in time that a transaction takes place.

For a particular transaction, there can be many values, but only one price. A transaction takes place when a buyer and the seller reach a compromise within a range of values. The range of values results from the buyer's inherent desire to minimize the price he pays for an item and the seller's inherent desire to maximize the price he receives for the item. Prior to the transaction, the seller usually determines a value that represents a minimum price below which he won't sell. Potential buyers determine values, which represent the maximum prices above which they won't buy. A transaction is possible at a price greater than or equal to the seller's value and less than or equal to some buyer's value (fig. 1). If the seller's value exceeds all buyers' values, there can be no transaction (fig. 2).

The actual process of how a price is reached differs with market situations and products. For some items such as chewing gum, an apparent market value, i.e., a "going price," is easily determined. For other items such as real estate or a timber sale, each sale involves a unique set of circumstances which makes it very difficult to predict the price which will finally result.

Much of the confusion about the concepts of value and price originates from confusion about the objectives of making value estimates. Consider the following definition[1/] of market value:

> ...the highest price in terms of money which a property will bring if exposed for sale in the open market allowing a reasonable time to find a purchaser who buys with knowledge of all the uses to which it is adapted and for which it is capable of being used--said purchaser being under no compulsion to deal.

[1] American Institute of Real Estate Appraisers. Appraisal terminology and handbook. Chicago, 268 p., 1967.

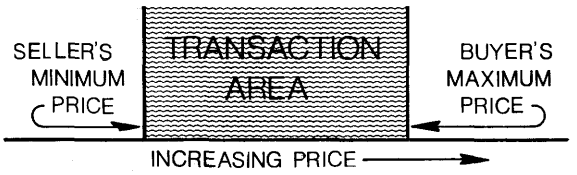

Figure 1.–Relationship of seller's and buyer's valuation when a transaction is possible.

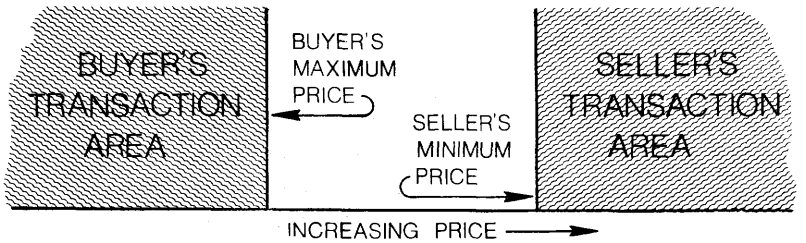

Figure 2.–Relationship of seller's and buyer's valuation when a transaction is impossible.

The definition implies that the objective of estimating market value is to predict price. However, the predicted price is subject to certain assumptions and limitations which are not likely to pertain to many actual transactions. It should not be surprising if the actual price turns out to be different from the estimated market value. The definition of market value covers only what the price *ought to be* under the restrictive set of market conditions which are specified. The actual price is the amount paid, regardless of whether the transaction took place while the seller or buyer held a gun at the head of the other!

Market value is just one example of a value estimate. The American Institute of Real Estate Appraisers lists 38 different kinds of value associated with real property.[2] Many of these are not related to a specific price. For example, taxable value may be linked to some average price over a number of similar transactions rather than a specific transaction price.

In summary, the relationship of price to value is not clearcut. Price represents a point within a range of values for a particular transaction. Other values for an item may or may not be related to a particular price depending on the objectives, assumptions, limitations, and judgment associated with them.

What Constitutes an Acceptable Value Estimate?

The ultimate criterion for the acceptability of a value estimate is how useful it is to the decisionmaker. The estimate gives the decisionmaker a market perspective--it affects his strategy. Successful value estimation requires knowing for whom and why the appraisal is being made. The successful appraiser knows what influences human behavior in the marketplace and recognizes significant changes in the influencing factors. He knows that what was true yesterday may not be true today, and he is constantly reacting to changing conditions. Above all he knows that he is not just coming up with a number, but that he is helping to evolve a strategy.[3]

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[2] Arthur A. May. The valuation of residential real estate. New York, Prentice-Hall, Inc., 2d ed., 286 p., 1953.

[3] For a more detailed discussion of the role of appraisers, see Richard U. Ratcliff. A restatement of appraisal theory. Wis. Commer. Rep., Vol. III, No. 1. Madison, Univ. Wis., 50 p., 1963.

Regardless of how accurate value estimates are when measured against some standard, if they are not contributing to a successful strategy by the decisionmaker using them, then they are not acceptable value estimates.

FRAMEWORK FOR DETERMINING ALTERNATIVE TIMBER VALUES

At a point in time, a timber buyer can have a range of values for a stand of timber depending on the number of alternative uses that he recognizes for the timber. A timber seller also can have a range of values, but his alternative uses are likely to be restricted to retaining the timber as an investment in growing stock or exchanging the timber for something else of value to him--money, for example. The seller's value could be based on his costs of production; however, once the decision is made to sell the timber, these costs are irrelevant since his decision assumes at least one potential buyer exists whose value is greater than the cost of production. The seller's value at a point in time is derived from the value-generating uses of the potential timber purchasers.

Determining alternative values for a stand of timber at a point in time requires that all relevant uses for the timber be considered. Basic uses are usually obvious. For a versatile species like Douglas-fir, basic uses might include lumber, veneer and plywood, and pulp and paper manufacture, poles and piling, or log export.

Since a stand of timber is a bundle of logs and pieces of variable sizes and quality, it is likely that the disposition of the timber will involve several basic uses. It may therefore be relevant to consider combinations of basic uses in determining alternative timber values. This will usually involve the assumption of a decision rule for log use such as: each log will be channeled to the basic use that yields the highest net return.

As the number of basic uses increases, the number of possible timber values increases exponentially. Consider the case where three basic uses have been identified for a stand of timber that is to be sold. The buyers representing the three basic uses are identified as B_1, B_2, and B_3. Either B_1, B_2, or B_3 might buy and use all the timber in his own mill, accounting for three possible uses. If B_1 is the purchaser, he can resell all or a portion of the timber to B_2 or B_3 or to both of them. Thus B_1 has four options:[4]

1. Use all the timber himself.
2. Resell all or a portion of the timber to B_2.
3. Resell all or a portion of the timber to B_3.
4. Resell all or a portion of the timber to B_2 and B_3.

Since B_2 and B_3 also have four options each, there is a total of 12 possible combinations for timber use.

[4]These options assume a fixed strategy for apportioning the timber among basic uses, e.g., each log will be used where it has highest net value. The main point for this discussion is that the option to resell timber is recognized, whether the amount resold is 5 percent or 95 percent of the volume in the timber sale.

The number of possible values associated with use combinations can be generalized for any number of basic uses.[5] The relationship between basic uses and possible values for up to five basic uses is as follows:

Number of basic uses	Possible number of stand values
0	0
1	1
2	4
3	12
4	32
5	80

The possible number of stand values would increase if additional complications were added to the model. For example, higher order reselling could be considered as when B_1 sells to B_2 who in turn sells to B_3. One incident has been reported where a log that was resold from a millyard deck eventually turned up in the same millyard after a series of resales!

So far the discussion has been limited to a cross section of values at a point in time. That is, at some given time the basic uses for a stand of timber are identified and located, and corresponding values are calculated based on the costs and returns of the possible use combinations. What happens if the restriction "at a given time" is relaxed?

Time or timing enters into timber valuation in several ways. The primary consideration is when the timber will be used. Since the value generated in use varies over time due to changes in economic conditions, it follows that timber values will also change over time.

The time at which a value estimate is made does not usually coincide with the time the timber is used; therefore, value estimation might also involve the projection of value-influencing factors to the anticipated time of use. These factors include wood product prices, technology, standards, or perhaps even human behavior.

It is beyond the scope of this paper to discuss changes in specific variables over time and their effects on timber values. It should be stressed, however, that each decisionmaker can use time-related factors differently to make value estimates, thereby adding to the possible number of values for a timber stand.

In general, there are three basic considerations in determining timber value: *How*, *where*, and *when* will the timber be used? If standards (quantity and quality measures) and decisionmaker judgment are held constant, differences in timber value estimates are due to differing assumptions with regard to one or more of these basic considerations.

[5] The number of possible values for n basic uses is $n2^{n-1}$.

APPLICATION TO A REAL SITUATION

A simplified Douglas-fir marketing situation can be used to illustrate how a decision-maker's objectives and his assumptions affect timber value estimates.[6] In this study, a typical stand of Douglas-fir timber is to be sold as stumpage and there are two possible uses for the timber: lumber and veneer. The assumptions for timber use are as follows:

1. All the timber is used for lumber.
2. All the timber is used for veneer.
3. Some of the timber is used for lumber and some is used for veneer with each log being used where it has the highest value at a point in time.
4. Some of the timber is used for lumber and some is used for veneer with "peeler" grade logs being peeled for veneer and "sawmill" grade logs being sawed for lumber.

The framework underlying the study is that described in the preceding section. Timber values are influenced by assumptions of how, where, and when the timber will be used. Standards and judgment are held constant.

It was initially assumed for the study that location was not a factor in defining a basic use, i.e., transportation costs were assumed to be zero.

How Will the Timber Be Used?

The stumpage values for the stand were calculated monthly for the period 1960 through 1964 for each of the four use assumptions. Using the assumption of "peelers peeled-saw logs sawed" as a base, the values associated with the other three assumptions were found to vary markedly from the base (fig. 3).[7]

For example, if the assumption of "peeler peeled-saw logs sawed" yielded an estimated stand value of $50 per thousand board feet, some estimated values for the other assumptions would be as follows:

	January 1961	March 1962	November 1964
Peelers peeled-saw logs sawed	$50.00	$50.00	$50.00
Lumber only	57.80	54.35	66.70
Veneer only	41.65	44.40	35.45
Logs allocated to highest value	58.35	55.45	66.75

[6] John H. Beuter. Stumpage appraisal under alternative assumptions of log use: a case study in the Douglas-fir subregion. Unpublished Ph.D. thesis on file at Iowa State Univ., Ames, 150 p., 1966.

[7] The actual values for each assumption will vary depending on logging and manufacturing costs and lumber and veneer recoveries. This study used regional average cost experience appropriate at the time shown as provided by the U.S. Bureau of Land Management and U.S. Forest Service. Lumber and veneer recoveries were averages of three Douglas-fir recovery studies done by the timber quality research unit of the Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. The recovery data were preliminary, and the results of its use as shown here should not be considered representative of any particular mill or group of mills.

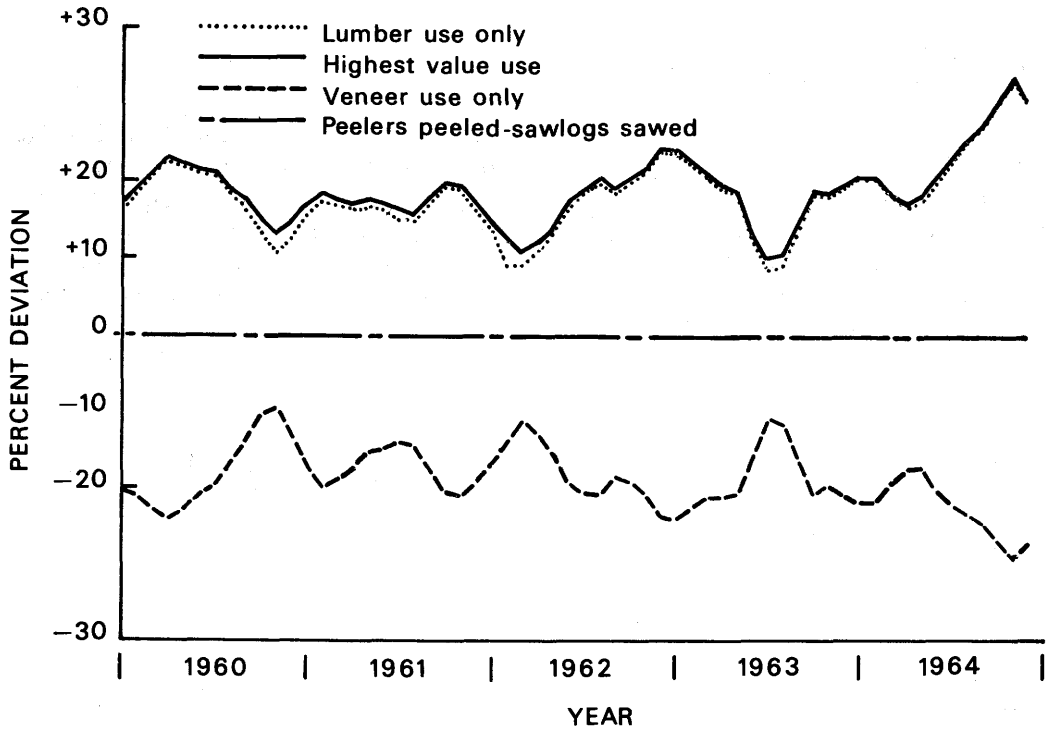

Figure 3.–Percent deviation of sale values made under the assumption of "highest value use," "all lumber use," and "all veneer use" from sale value made under the assumption of "peelers peeled-saw logs sawed," 1960-64.

The indicated differences in stand values associated with the use assumption could serve as a partial explanation for two timber-value oriented problems:

Case 1. The buyer who can't understand how his competitor can consistently bid more than he.

Case 2. The seller who can't understand why bids often exceed appraisals by a substantial amount.[8]

Within the context of figure 3, if the buyer in case 1 has a veneer mill and doesn't consider any alternative use for logs in the timber sale, he can be consistently outbid by other buyers who have a lumber mill or an integrated (lumber and veneer) operation.

If the seller in case 2 always assumes that "peeler" logs will be peeled and "saw logs" will be sawed, then a buyer who uses each log where it has highest value would have been able to consistently exceed the seller's estimated value for the stand.

This simplified situation masks the complexity of choosing among possible values, but it serves to illustrate the variability associated with the decisionmaker's assumption of timber use.

[8]For a discussion of bid-appraisal relationships on public timber sales, see Walter J. Mead and Thomas E. Hamilton. Competition for Federal timber in the Pacific Northwest–an analysis of Forest Service and Bureau of Land Management timber sales. USDA Forest Serv. Res. Pap. PNW-64. Portland, Oreg., Pac. Northwest Forest & Range Exp. Sta., 63 p., 1968.

Where Will the Timber Be Used?

The effects of location can be illustrated using the data generated in this study. Under the assumption that each log will be used where it has highest value at a point in time, there is an allocation of the stand volume between possible uses (fig. 4). Since the values were calculated without considering transportation costs, the difference between the value of a log used for lumber compared with veneer has to more than cover the extra cost of handling and transporting the log for resale or allocation within an integrated operation.

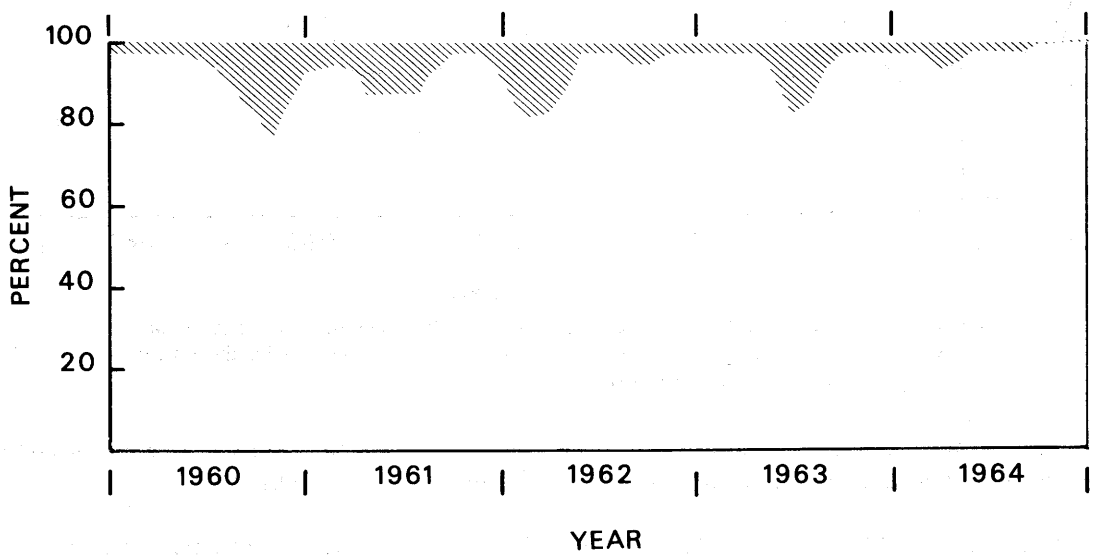

Figure 4.—Allocation of stand volume assuming each log is used where it has highest value, 1960-64. (Shaded area is allocation to veneer; unshaded area is allocation to lumber.)

For example, figure 4 shows that the bulk of the sale volume would have higher value if used for lumber. If a veneer mill operator bought the timber and wished to resell all logs that had higher net value when used for lumber, he would have to consider the margin available for the handling and transportation costs associated with resale. This margin averaged $18.42 per thousand board feet during the period 1960-64, ranging from a low of $13.12 to a high of $26.49 (fig. 5). Thus, the decision of where the timber should be used will vary depending on the relationship of the value differences between uses and the cost of reselling logs.

The average value differences depicted in figure 5 resulted from combining a variety of log sizes and grades. The fact that some logs can have value differences far in excess of the average is obscured. Operators who are prepared to analyze value differences for specific log grades and sizes could influence the value of a timber sale to

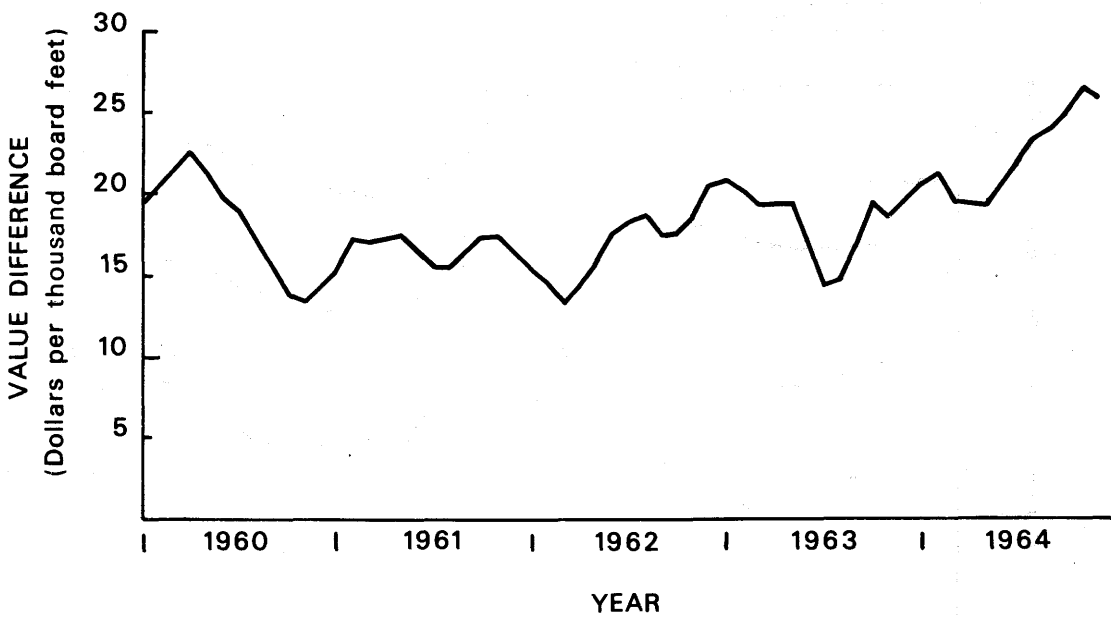

Figure 5.–Average value differences per thousand board feet for log volume having highest value used for lumber compared with use for veneer, 1960-64.

themselves by reallocating or reselling logs up to the point that the value difference of the next log or load of logs is less than the costs of extra handling and transportation.

When Will the Timber Be Used?

The changes in the relative values associated with the timber use assumptions over time are obvious (figs. 3-5). Relative changes in lumber and plywood prices result in some logs shifting from having highest value when used for lumber to highest value when used for veneer, or vice versa. For example, plywood prices were generally lower during 1960-64 than they were during 1957-59, and lumber prices remained fairly steady. This decrease in plywood prices relative to lumber prices resulted in timber stand values associated with veneer and plywood use moving relatively lower than the stand values associated with lumber use. The average percent of the stand volume allocated to veneer use under the assumption of each log being used where it has highest value would have been 18 percent during 1957-59 compared with 6 percent during 1960-64. The decisionmaker who is considering alternative uses in determining timber values should review his strategy periodically as significant changes in relative prices among alternative uses are noted.

The method by which the decisionmaker accounts for changes over time is important to his choice of timber values. The value estimates made by a decisionmaker during a year could vary significantly depending on how he accounted for changes over time. For example, there were significant changes in values during 1963 for each timber use (fig. 6).

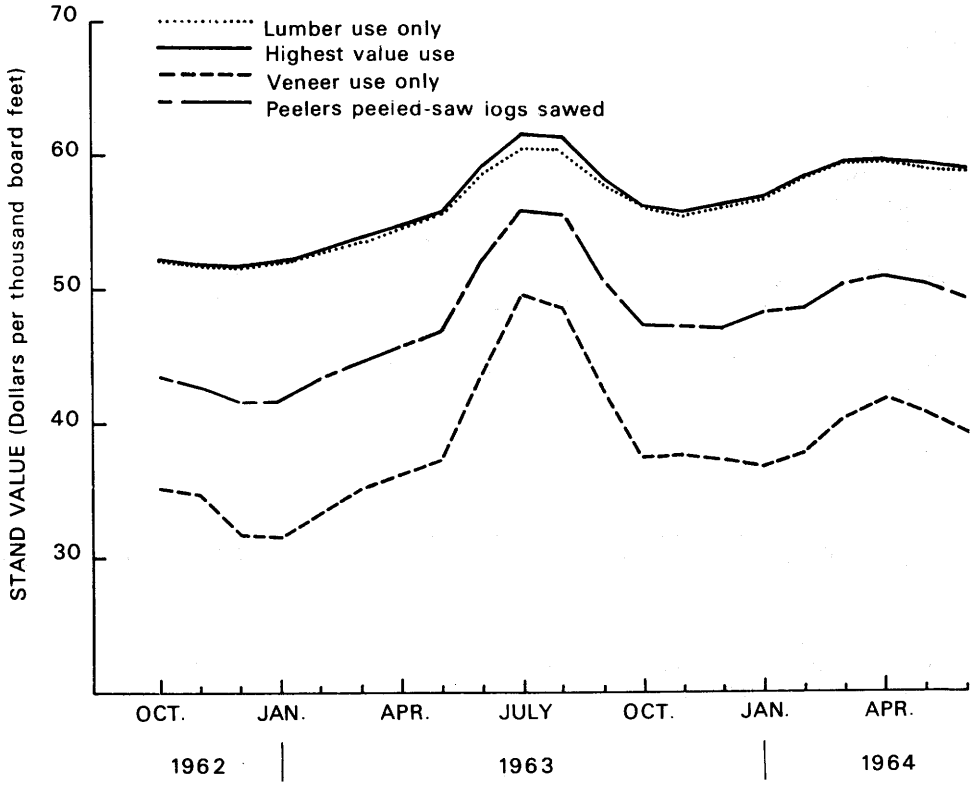

Figure 6.—Stand values by use assumption, 1963.

Assume that it is the end of 1962 and all decisionmakers are given a vision of 1963 which they all firmly believe (fig. 6). Each decisionmaker has certain constraints under which he operates regardless of his knowledge. Assume that the seller is constrained by the following requirements:

1. He must sell the timber during 1963.
2. He must appraise the timber as if "peeler" logs will be peeled and "saw logs" will be sawed.
3. He must base his appraised value on the previous 3-month's average value for the assumed timber use of the buyer.
4. The price he will accept must be greater than or equal to the value he has determined.
5. The timber will be sold on the first day of the month selected.

A buyer exists who has the following constraints:

1. He will use all the timber for lumber.
2. He has limited capacity to log and process the timber such that his expected returns are distributed as follows:
   a. In the first month of operating the timber sale, he can get returns from lumber sales equivalent to processing up to one-eighth of the timber sale volume.

b. In each succeeding month, he can get returns associated with up to one-half of the timber sale volume until the timber volume is exhausted.

3. He has no storage capacity for logs and lumber and no other source of timber such that once he begins logging, the cut volume must be processed and sold at the same rate as the logging is done--with exception that up to one-eighth of the cut timber can be "stored in transit" for up to 1 month.
4. All the timber must be cut within 6 months of the date of purchase so that lumber values up to 6 months from the date of purchase are the only ones pertinent to the timber value determination.
5. He will time his use of the timber to yield the highest value subject to the date the timber is sold.

The stumpage values calculated by the seller and the buyer show that a transaction was possible every month during 1963 (fig. 7).[9] If the seller, with his knowledge of the year's timber values subject to his constraints, wished to sell the timber in the month having the highest appraised value, he would choose September. It so happens that September is the month for which the buyer has calculated his lowest value; however, his value is still above the seller's so he could buy the timber. The buyer would have preferred that the timber be sold sometime between March 1 and June 1.

The point that has been illustrated is that the stumpage values calculated by sellers and buyers can be inherently different due to differing assumptions of timber use and differing methods of accounting for value changes over time. These differences have

[9]The seller and buyer both include allowances for profit and risk, and all cost data are compatible. As a result of this, seller and buyer values for a given month are comparable in every regard except use assumption and the accounting for time.

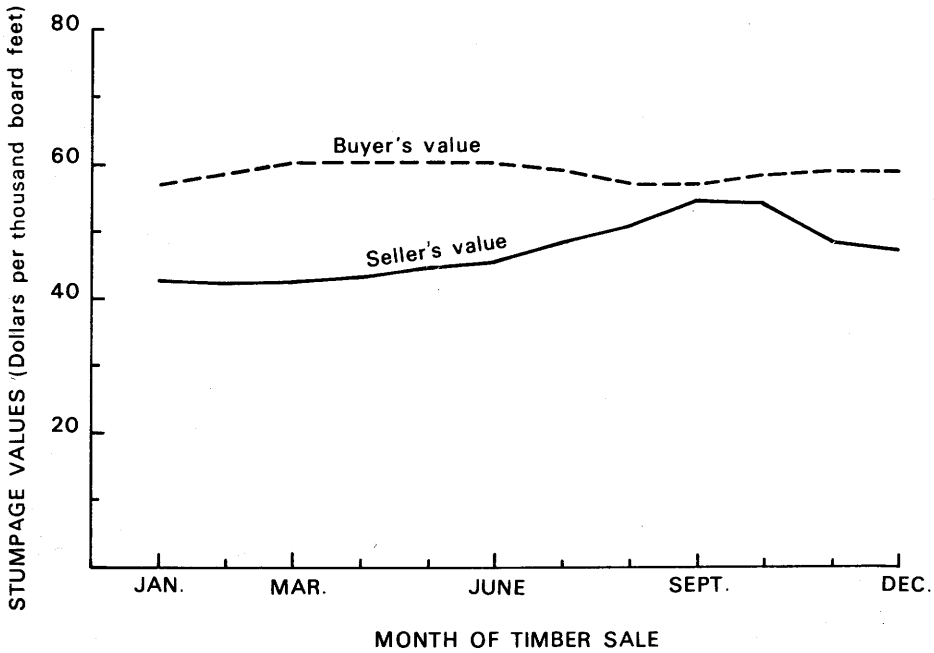

Figure 7.–Monthly stumpage values calculated by the seller and the buyer for the study timber sale, 1963.

important implications for explaining a portion of the disparity in appraisals and bids on public timber sales. To illustrate this, the example can be continued.

If the buyer were forced by competition to bid his full calculated value, the bid-appraisal ratio during 1963 could have ranged from 1.06 in September to 1.43 in March (fig. 8). Remember that this discrepancy between the appraisal and bid is due to different assumptions of how the timber was used and time accounted for. If the effect of differences in accounting for time is removed by assuming that the buyer also calculates his stumpage value by averaging the timber use values for the previous 3 months, the bid-appraisal ratio could then have ranged from 1.10 in September and October to 1.23 in February and March (fig. 8). This discrepancy between the seller's appraisal and the buyer's bid is due only to their differing assumptions of timber use.

This illustration may appear unreal because of the assumption that the seller and buyer know in advance what timber values will be during the year. It is true that the assumption of perfect knowledge is unreal, but the value calculations of the seller and buyer are not far from reality. Many appraisers representing sellers are constrained in the assumptions and knowledge they can use in making appraisals, e.g., the public agencies. On the other hand, buyers account for the future in setting timber values. Even though they don't have perfect knowledge of future values, they anticipate changes in value from the time they bid on the sale to the time they will realize a return from their investment in the timber.

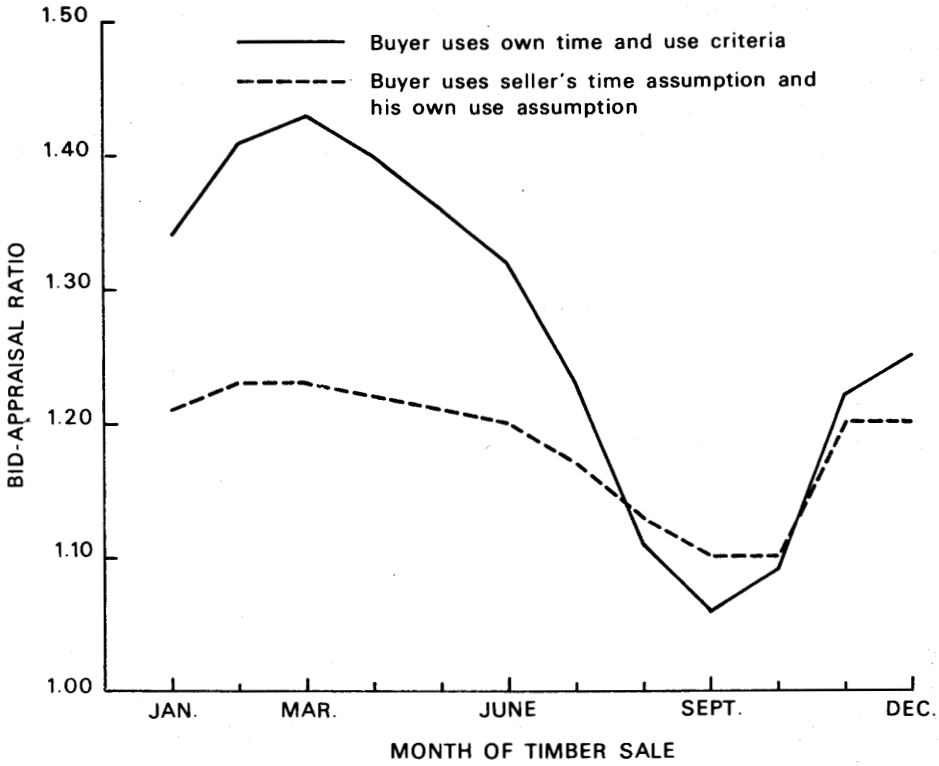

Figure 8.–Maximum bid-appraisal ratios under two criteria for calculating the buyer's stumpage value, 1963.

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1971. Timber value--a matter of choice. USDA Forest Serv. Res. Pap. PNW-118, 13 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

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cisfaction with a particular value estimate objectives of the decisionmaker for whom him to a bad strategy.

ggest particular variables or assumptions valuation procedure. It was intended to ates that are possible under alternative ob- ors related to particular decisionmakers. er understanding of why rational decision- value and why rational value estimates ding should, in turn, underscore the need er valuation systems.

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