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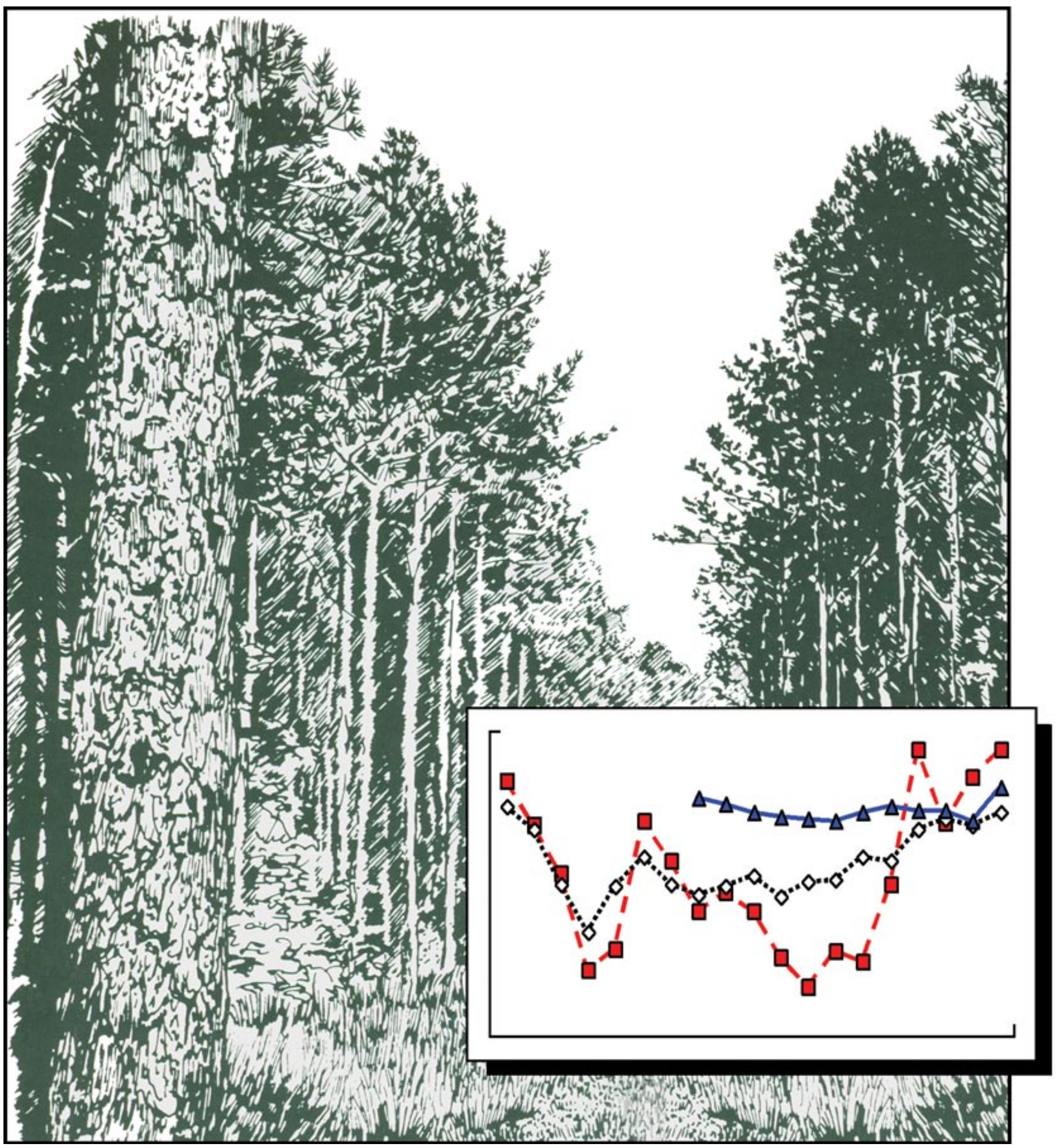
Review of Alternative Measures of Softwood Sawtimber Prices in the United States

Henry Spelter



Abstract

This study compares prices from various timber market reports and an estimate of timber value derived from product-selling prices and manufacturing costs. In the South, two primary sources of timber price information are Forest2Market (F2M) and *Timber Mart-South* (TMS). Comparisons showed that F2M prices are generally higher than TMS prices for both stumpage and delivered timber. Residual value (RV) estimates tended to vary from these at any given time. Over 5 years, however, the negative and positive deviations largely offset each other, resulting in roughly the same average price levels, at least compared with TMS. The RV estimates also tended to lead the direction of reported prices and were useful as leading indicators of reported market price directions.

Comparison of various price reports from public and private agencies in the West showed that Forest Service prices were substantially lower than those recorded by other agencies and RV calculations. The discounts appear to reflect lower quality offerings and more restrictive harvest regulations that increase harvest costs.

This report proposes a method of pricing timber based on RV calculations as one means to reduce the variability in lumber sawmilling profits.

Keywords: softwood timber prices, residual value, stumpage, delivered logs, lumber manufacturing costs.

Contents

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Review of Alternative Measures of Softwood Sawtimber Prices in the United States

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Background

Shares of thousands of companies trade daily in the stock market. Because simultaneously tracking the movements of all stocks is impossible, representative indicators that give a timely sense of the market's general direction are useful. Numerous such indexes mirror the movements of the stocks they were designed to characterize.

The market for timber is similarly diverse. The value of individual timber stands is influenced by many variables such as tree size, tree quality, species mix, sales volume, quantity per acre, logging conditions, nearness to roads, distance to mills, and intended end product. As with stocks, both buyers and sellers need general indicators of timber prices by which to measure the value of specific sales. A difficulty in developing such an indicator is that, unlike with stocks, there is no central exchange where all transactions are tallied and reported. Timber markets are therefore less transparent, imposing fact-gathering costs on market participants. Those needing a sense of direction in timber markets have several options.

One option is to track movements in transactions data periodically compiled and published by public agencies that manage large tracts of timberland. Most published data represent recent weighted average contract prices from an agency's timber sales program. Sometimes prices paid for harvested timber are also reported. Harvested timber data represent sales prices contracted at earlier times, adjusted for market changes in the meantime where escalation clauses in the contract allow for modifications. Final harvest prices can vary from current contract prices and some view them as better indicators because of opportunities for arbitrage in the stumpage market (Adams and Haynes 1989).

Another option is to obtain data from market reporting services that gather stumpage prices (analogous to contract prices for timber sales above) and delivered log prices (similar to, but not the same as, final timber harvest prices). Market reporting services incorporate data on timber transactions from consulting foresters, timber brokers, and sawmill operators and reflect both posted list prices and actual contract prices from summary reports of recent timber sales.

A third option is to obtain reports compiled and averaged by state forestry agencies and marketing extension offices, which are gathered from sources similar to the market reporting services previously mentioned.

Various reports suffer from assorted handicaps. They employ different sampling methods and obtain data from different subpopulations, which introduce variability and complicate comparability among them. As some appear with a lag of several quarters or months, timeliness is often an issue. Different agencies also operate with dissimilar fiscal years, and some data are based on timber appraisals while other data are based on actual sale receipts. Some reports do not segregate different products and oftentimes combine different units of measure. Consequently, each report provides its own version of market reality. In this report, therefore, I review various regional reports and compare them to examine the degree to which their signals about timber price levels and directions are consistent.

A parallel objective is to develop a complementary indicator of timber value that provides an alternative point of reference based on more transparent downstream product markets. By subtracting the cost of processing from final product prices, estimates of timber's residual worth can be derived. Such constructed residual value (RV) estimates offer an additional timely source of information on potential timber value.

Sources of Stumpage and Delivered Log Prices

U.S. South

In the U.S. South, about 90% of the timber comes from private timberlands. A widely used reference for prices since 1976 is the publication *Timber Mart-South* (TMS). The TMS collects data using standard forms provided to a broad cross section of reporters in the timber industry, but it also accepts and uses any available information that reasonably reflects timber transactions (see Appendix A for a copy of forms). The reporting pool includes companies and individuals actively engaged in the day-to-day operation of selling and buying timber on the stump or delivering it to yards and mills. From the reports returned each quarter, the data are sorted and tabulated to arrive at a grouping of ranges for low and high prices, and from these a simple average is obtained for each state, parts of states, and product. Four product grades are reported: veneer, sawtimber, chip-n-saw, and pulpwood.

More recently, timber price data have become available from a web-based firm, Forest2Market (F2M). The F2M obtains ongoing timber sales data from a cross section of industry participants on prices and 17 other attributes associated with each sale, the most important of which is average sale diameter. Each report is scrutinized by a forester and analyzed to ensure data quality. If the report passes scrutiny, then the data are assigned to one of 39 micro markets, reflecting well-defined homogeneous timber baskets that often cross state boundaries. The files are updated continually so clients have access to information more akin to real time by product category and region, down to the county level if desired. The F2M also produces printed reports in which volume-weighted regional price averages are published.

U.S. West

In contrast to the U.S. South, a large part of timber supply in the U.S. West originated from Federal forests, of which the National Forests managed by the U.S. Department of Agriculture Forest Service (Forest Service) provided the bulk. Because of the once large volume of timber involved, price data on Forest Service sales and harvests were historically relied upon to measure timber pricing trends. Around the early 1990s, however, both the quantity and quality of Federal timber sales began to decline. Federal timber sales thus became less representative of the timber used by most mills, with resulting prices that departed from the mainstream. To fill the void, a number of alternative sources emerged. Among these was the report *Log Lines* (LL) published since 1989 by Arbor Pacific Forestry Services, Inc. (Mount Vernon, Washington). This company collects market price information monthly from over 100 producers and purchasers of logs in six western Oregon and Washington regions. Prices reflect both offered and actual prices for delivered loads of unsorted logs and are based on long log scale using the Scribner decimal C system. Each listing represents an unweighted average of prices reported by a minimum of three sources. The reporting is specific to various grades and species of timber.

A similar service has been provided since 1977 by the Oregon Department of Forestry, which publishes prices on domestically processed logs delivered to mills (Pond Value) within four coastal Oregon regions. Mills report the data.

In the interior West, two widely referenced sources are from the University of Montana Bureau of Business and Economic Research (BBER) and Northwest Management, Inc. (NMI), a private forest management company. The BBER report provides a summary of recent prices in Montana reported by primary wood processors. The prices are averages of individual quotes. The NMI obtains prices from many of the same sources, but it sorts the data into high and low categories and determines an average for each rather than a universal average. Coverage extends to Idaho and eastern Washington.

Sawtimber Residual Value

An alternative measure of timber worth is the residual value obtained by subtracting manufacturing costs from end-product prices. This approach was traditionally used by the Forest Service to set minimum bids on timber sales. To generate these benchmarks, the Forest Service periodically sampled mills to obtain current manufacturing costs. These, along with margins for profit, risk, log harvesting, and transportation costs, were then subtracted from indexes of mill realizations (net selling prices) to arrive at an implicit value of standing sawtimber. This method was abandoned in the 1980s, as the cost and administrative burden of the data gathering were deemed excessive. In its stead, transactions evidence, a method based on statistical analysis of many recent sales, was adopted. Residual value estimation, however, remains a useful metric for those, such as occasional timber sellers, who do not have access to a large body of current timber sales data.

A lower-cost way to derive an RV estimate is to model the costs of representative mills. Sawmills number in the thousands and exhibit a wide spectrum of costs. However, the bulk of the timber is processed by a relatively few high-volume commodity-oriented operations. In Washington, for example, 85% of the sawtimber is processed by mills with 8-hour shift capacity of 120,000 board feet or more (Larsen 2002). Modeling a composite mill from this group is an alternative to survey-intensive data gathering. For this study, I have derived inferred dollar values for delivered logs and timber on the stump (stumpage) for three southern and two western representative states. Background on the derivations is provided in Appendix B. Current updated values are posted every quarter on the Forest Products Laboratory website (www.fpl.fs.fed.us).

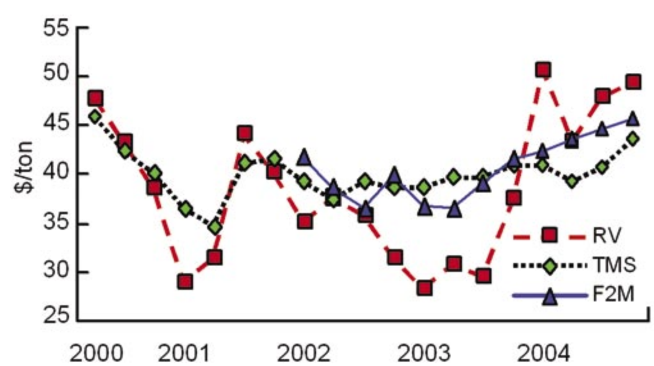

Figure 1— Georgia sawtimber stumpage price trends (2000–2004), by source (RV, residual value; TMS, *Timber Mart-South*; F2M, Forest2Market).

Table 1—Differences and correlation coefficients in average stumpage prices between prices reported by different sources

State and region of state	Q 1, 2002–Q 4, 2004 Difference (%) F2M[a] – TMS[b]	Q 1, 2002–Q 4, 2004 Correlation coefficient (%) F2M – TMS	Q 1, 2000–Q 3, 2004 Difference (%) State[c] – TMS	Q 1, 2000–Q 3, 2004 Correlation coefficient (%) State – TMS
Virginia-west	36	62		
N. Carolina-west	32	49		
Louisiana-north	31	45	3	49
Arkansas-north	27	–26		
Louisiana-south	22	–17	17	16
Texas-north	22	61	–2	78
Florida-west	21	29		
Arkansas-south	17	45		
Georgia-north	14	38		
S. Carolina-east	9	77		
Texas-south	9	26	9	28
Virginia-east	9	24		
N. Carolina-east	9	65		
S. Carolina-west	8	12		
Florida-east	4	29		
Alabama-north	3	–38		
Mississippi-south	–0	46	–1	63
Mississippi-north	–1	42	–1	79
Alabama-south	–2	1		
Georgia-south	–7	17		
South[d]	12	59		

[a]Forest2Market timber price information.
[b]*Timber Mart-South* timber price information.
[c]State data available from Louisiana, Texas, and Mississippi.
[d]The South as a whole. This is the average for all states and regions listed above.

Timber Price Comparisons

The comparisons here generally cover the period from the first quarter of 2000 to the fourth quarter of 2004. Data from F2M, however, were available only since the first quarter of 2002.

U.S. South

Stumpage

Figure 1 illustrates relative quarterly price trends in Georgia for timber on the stump, as indicated by the two southern market reports and our RV calculations. Between TMS and F2M, differences in a given quarter could be significant, but they largely evened out over the entire 12 quarters in Georgia. The variation was as much as +11% to –8%, but the average F2M price was just 2% higher than TMS.

The tendency for F2M prices to be higher than TMS was evident in most states over the 3 years in which both sets of data were available. Table 1 indicates disparities of +36% to –7%, with an average of +12% for the 10 southern states combined, a statistically significant difference.

As shown in Table 1, data are also available for subregions of states, and these illustrate how variability increases as the focus of reporting narrows. In northern Georgia, for example, F2M averaged 13% higher than TMS, whereas in coastal southern Georgia it was 7% less.

Quarter-to-quarter correlations in prices between the two sources were rather weak. In many regions correlation coefficients were insignificant or even negative. That means movement in one direction by one source was often not matched or was even contradicted by the other.

In comparisons with residual value estimates, in any given quarter the differences between reported stumpage prices and calculated RV could be quite high. Georgia's 22% greater to 28% less than TMS was typical. Especially noticeable is the tendency of the discrepancies to be cyclical, with long periods of lower values alternating with extended periods of higher values. However, over the entire 19 quarters (Quarter 2, 2000–Quarter 4, 2004), the differences largely canceled. Overall aggregate differences in three states (Table 2) were rather small, indicating that timber prices, as reported by market observers, tend to balance out over longer time spans with value estimates derived from product selling prices through RV calculations.

Comment on Stumpage

An important metric for appraisal of softwood timber is prices of other sales. Generally, benchmarks should be current and local. But timeliness and local relevancy involve tradeoffs. As the focus narrows to a given area and time, the amount of available data necessarily drops. Conversely, for larger areas or longer time spans, the data and their reliability increase, but their relevancy as a guide to contemporary

Table 2—Differences and correlation coefficients between estimated residual value (RV) and reported stumpage prices, dollars per ton

	Q 2, 2002–Q 4, 2004			
Market region	Difference (%) RV – TMS[1]	95% confidence interval Lower bound	Higher bound	Correlation coefficient (%) RV – TMS
Alabama	–4	–11	+2	37
Georgia	–4	–11	+3	71
Texas	6	–3	+14	50

[1]*Timber Mart-South* timber price information.

local conditions diminishes. For most reports, quarterly reporting was found to best balance concerns over timeliness. Area coverage is usually broken down into micro markets or other substate agglomerations, as procurement radii tend to be less than 100 miles for most mills (Spelter 2003).

Estimates of sawtimber prices from the two main southern price reports were often quite different. One possible reason is that F2M prices are tied strongly to diameter, and their reported prices generally rise and fall as diameters increase or decrease. In relying on expert opinion for high and low estimates, TMS is apt to get results in which reporters average variations related to diameter and other factors and give figures for “typical” sales, omitting some of the variation inherent in F2M data. Weighting sale prices by volume is another potential factor because large sales, which would normally command a premium because of harvesting economies, carry more weight in F2M than in TMS.

Other methodological variations include volume conversions. The F2M prices are converted to weight on the basis of sale-specific conversion factors supplied by the data sources. In recent years, TMS has also been requesting price data to be reported by weight but uses generic constants to convert from various scales to a common platform where weight is not supplied. Conversion factors vary considerably, as can be seen from Texas state data (Texas Forest Service 1982–2004) where volumes are provided in both local scale and by weight (Fig. 2). If the 15,000 pounds per thousand board feet (Scribner) factor used in TMS conversions is too high, then resulting prices per weight will be too low compared with actual conversions.

In comparing F2M to TMS, one further noticeable trend is the narrowing of differences between them. Overall, the arithmetic average of F2M prices in the 10 states was 12% higher than TMS, but the largest discrepancies were in the first year that F2M was in full operation (Fig. 3). Since then, the differences have narrowed to smaller though fairly constant levels.

Larger discrepancies exist at the substate level of detail, as the samples upon which the averages are based decrease. In the case of F2M, its 12 quarters of data were based upon 15,515 entries, which average to 1,293 per quarter. When further broken down into the 20 subregions, the average falls to 65. As the data are further divided among reports for pulpwood, chip-n-saw, sawtimber, stumpage, and delivered prices, additional data dilution inevitably increases the influence of outliers. This is no less the case for TMS, and both TMS and F2M exhibit occasional erratic changes in prices as their focus narrows.

Correlations between the two sources were low, but this is unsurprising given the short period over which both data sets were available. Over longer intervals, the correspondence would likely improve because of greater exposure to common cycles and trends. This notion is reinforced by six comparisons with state data from Louisiana, Mississippi, and Texas, which provide additional benchmarks. State-published Louisiana prices (Louisiana Department of Agriculture 1980–2005) were originally reported in dollars per thousand board feet (Doyle scale). These prices align well with TMS data when converted here to weight using a conversion factor of 18,300 pounds per thousand board feet. Prices provided by Mississippi (Mississippi State University 1990–2005) align equally well with both reports. Prices reported by the state of Texas (Texas Forest Service 1982–2004), on the other hand, show better correspondence with the higher F2M averages.

In relation to reported prices, RV estimates in three selected states show much greater variability. The RV estimates derive from product sales prices. The link between product and raw material markets is not exact over short intervals, and this is reflected in the tendency for RV values to show greater swings in extremes from highs to lows. Whereas discrepancies are large, they also tend to be cyclical, and as such, often lead trends in reported prices (Figs. 1 and 3). When the RVs are lower, reported prices tend to eventually follow; when the opposite is true, reported market prices tend to rise. In that sense, RV estimates have utility as leading indicators of market direction.

Which market reports provide the better coverage? As there is no absolute standard of prices against which the reports can be compared, this question is impossible to answer. Timberland owners and timber users with their own transaction records can determine how these alternatives correspond to their experiences and best serve their needs. The RV estimates developed here do provide another point of reference and show closer correspondence overall with TMS data, but F2M data were not available over the same period; thus the comparison is not determinative. The F2M does bring a new dimension to timber price reporting through continuous updating and posting of its information. The level of detail available in sale attributes also allows for compartmentalizing prices to better fit the particular circumstances of a sale in a way that general indexes do not.

Delivered

Figure 4 illustrates the relative quarterly price trends for delivered timber as indicated by TMS and F2M data and RV calculations. For Georgia, F2M prices were consistently above TMS, with the average 9% higher than TMS. By 2004, however, the two series had nearly converged.

By contrast, following the pattern in stumpage, Georgia RV and TMS prices averaged at about the same over the entire 5-year period, with TMS just 2% higher. Likewise, the differences tended to be cyclical, with long periods of lower RV values followed by extended periods of higher values. The variation in any given quarter is as much as +14% to –20%, but the overall correlation was high at 83% (Table 3). For the other two states where RV and TMS comparisons were made, the results were similar except the correlations were not as high.

The relationship over the shorter available period between RV and F2M values in Georgia was not as strong, showing a correlation coefficient of only 43%. The F2M averaged 13% higher than RV.

For the 10 southern states combined, F2M averaged 15% higher than TMS and 11% higher than RV. In every comparison, average F2M prices were higher.

The quarter-to-quarter correspondences between TMS and the other two sources, as measured by correlation coefficients, were weak. Only Texas showed a strong correspondence between TMS and F2M. Several of the others had correlation coefficients close to zero or negative (Table 3).

Comment on Delivered

As was the case with stumpage prices, F2M delivered prices tended to be higher than other estimates. The F2M prices showed a looser connection to product prices as reflected in RV prices. The TMS values exhibited less variability and a moderate tendency to follow RV levels. Over time, F2M prices have tended to get closer to TMS, but gaps remain in most regions.

Over the course of a business cycle, the often wide discrepancies between reported timber prices and derived RV values (for both stumpage and delivered logs) largely cancel. The RV approach to valuation assigns value to timber on the basis of final product prices and costs and assumes constant downstream profit rates. In actual timber markets, these forces are opposed by supply influences, such as timber management costs and timber-owner expectations. This reduces the responsiveness of timber markets to developments in product prices and results in the well known cyclicality in wood-product profit margins.

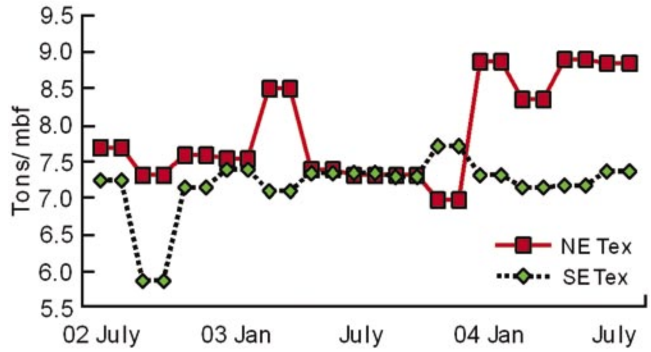

Figure 2—Average weight per thousand board feet (mbf) (Doyle) for Texas sawtimber.

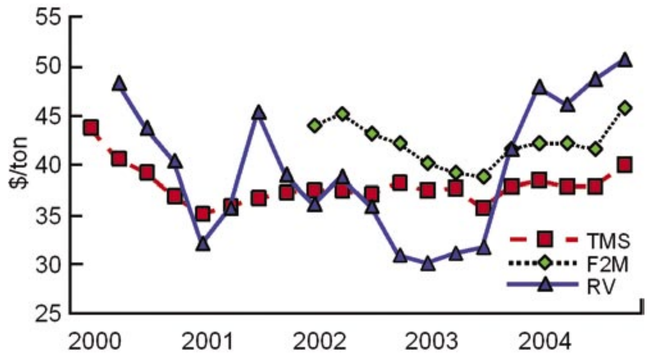

Figure 3—Average sawtimber stumpage price trends (2000–2004) southwide by source (RV, residual value; TMS, *Timber Mart-South*; F2M, Forest2Market).

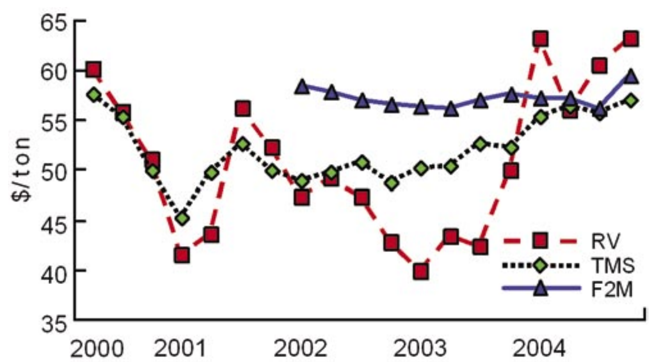

Figure 4—Georgia delivered sawtimber price trends (2000–2004) by source (RV, residual value; TMS, *Timber Mart-South*; F2M, Forest2Market).

Table 3—Differences and correlation coefficients in average delivered timber prices between prices reported by different sources, dollars per ton

	Q 1, 2002–Q 4, 2004		Q 2, 2000–Q 4, 2004	
State and region of state	Difference (%) F2M[a] – TMS[b]	Correlation coefficient (%) F2M – TMS	Difference (%) RV[c] – TMS	Correlation coefficient (%) RV – TMS
Virginia-east	38	10		
Virginia-west	33	28		
N. Carolina-west	31	–46		
Florida-west	30	–5		
Louisiana-south	24	8		
S. Carolina-east	17	–54		
N. Carolina-east	16	44		
Louisiana-north	16	–22		
S. Carolina-west	15	24		
Georgia-north	12	–2	–2	83
Mississippi-south	11	–64		
Arkansas-north	11	–0		
Texas-north	10	50	–5	18
Arkansas-south	10	43		
Florida-east	9	62		
Texas-south	8	84	–5	18
Alabama-south	7	2	–2	79
Georgia-south	7	44	–2	83
Mississippi-north	5	–14		
Alabama-north	4	62	–2	79
South[d]	15	10	3	20

[a]Forest2Market timber price information.
[b]*Timber Mart-South* timber price information.
[c]Residual value estimates. Data for RVs are for entire states only and repeat within each part of a state.
[d]The South as a whole. This is the average for all states and regions listed above.

The limited ability to pass through changes in input costs to product prices, or its inverse, the limited ability to impose changes in product prices on inputs, is encapsulated in a sector's elasticity of price transmission—the average percentage change in one market (lumber) relative to a percentage change in its associated market (timber). That has been estimated for southern yellow pine lumber by researchers at different times with values ranging from 0.36 to 0.64 (Haynes 1977). Employing the TMS data for the three southern states to estimate this statistic results in values that fall into the lower end of that range (Table 4). This means that the prices reported to and processed by TMS tend to lag product prices both on the way up and on the way down. The stickiness in pricing manifests itself in and is a major contributor to the corresponding swings in downstream product profitability.

Table 4—Estimates of the elasticity of price transmission for southern yellow pine

Source	Elasticity of price transmission
Haynes	0.64
Holley cited in Haynes	0.60
Adams cited in Haynes	0.36
Present study	
Georgia	0.36
Alabama	0.35
Texas	0.30

U.S. West

Stumpage

Figure 5 shows quarterly Forest Service and State of Oregon sawtimber price trends on the stump in coastal Oregon compared with RV estimates.

Forest Service reports do not differentiate timber sales by grade beyond generic categories such as sawtimber, pulpwood, and firewood. Total volume sales and offerings per sale were small in this period. Between 2000 and 2003, the Forest Service in the Pacific Northwest, Region 6, made 98,511 sales in which it sold 1.3 billion ($\times 10^9$) board feet of timber for an average per sale amount of 12.8 thousand board feet. By contrast, between 1987 and 1990, 236,281 sales were made in which 17.1 billion ($\times 10^9$) board feet of timber were sold for an average per sale figure of 72.5 thousand board feet. These recent sales tended to emphasize salvage and thinnings (material that would normally fall into lower grades), and prices were not very representative of underlying market conditions as reflected by RV calculations. On average, residual value estimates were 79% higher than Forest Service sales. There was also no significant correlation between the two series.

By contrast, the match between State of Oregon timber prices and RV figures was much better, and over the common period of availability, the two series differed by only 3%. The correlation coefficient was 39%, relatively high considering that prices were flat and trendless during the period.

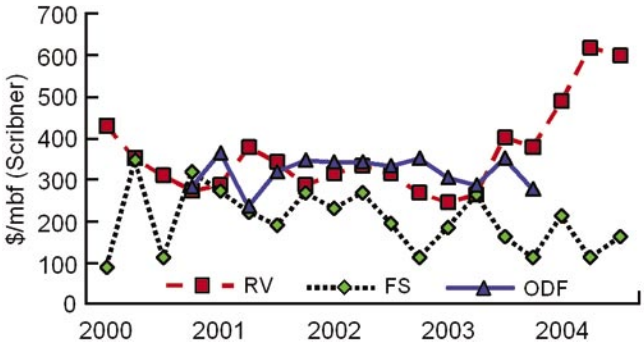

Figure 5—Coastal Oregon stumpage by source (RV, residual value; FS, Forest Service; ODF, Oregon Department of Forestry).

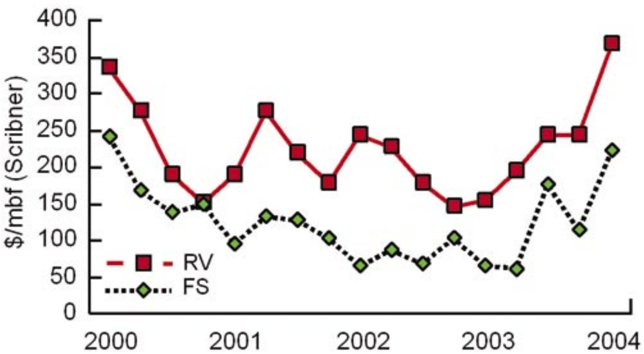

Figure 6—Montana stumpage by source (RV, residual value; FS, Forest Service).

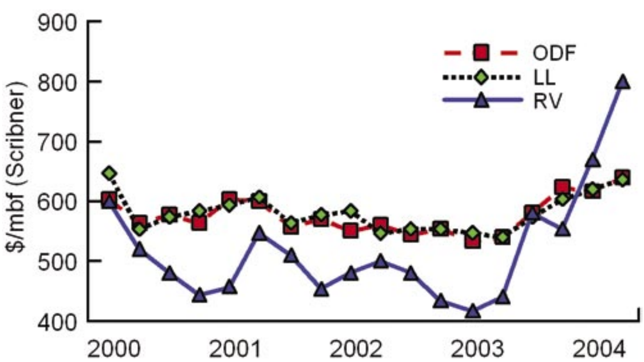

Figure 7— Oregon #2 Douglas-fir delivered log prices by source (RV, residual value; LL, *Log Lines*; ODF, Oregon Department of Forestry).

Higher volume of sales in Idaho and Montana (Forest Service Region 1) makes Forest Service data there more likely to be representative. This is indicated by the higher correlation (72%) with residual value estimates (Fig. 6). But a striking feature of the two data sets is the consistent gap between them. Unlike in the South, where the differences between residual values and private market prices largely evened out over the 5-year period, the discrepancies here persisted. The RV prices were, on the average, 80% higher than prices obtained for Forest Service timber.

Table 5—Comparative stumpage prices for Forest Service (FS) Region 1 and State of Montana timber

	FS Region 1 ($/1,000 bf)	State of Montana ($/1,000 bf)	Difference (%)
FY 2000[a]	227	209	–8
FY 2001	150	195	30
FY 2002	116	184	59
FY 2003	77	157	105
FY 2004	154	220	43

[a]Montana's fiscal year runs from July 1 through June 30.

Comment on Stumpage

Lower quality timber and more environmentally constrained logging are two likely reasons for generally lower Forest Service stumpage values. Especially in Region 1, much of the timber sold after 2000 was fire-killed salvage. Because Forest Service timber sales involve long administrative processes before timber can be harvested, much of the wood became infected with blue stain and experienced weather check. Further, in many cases mandated helicopter logging and other restrictive harvest measures increased costs and therefore decreased the amounts buyers could pay.

The effect of these conditions can be further gauged by comparing Forest Service prices with those obtained by the state of Montana (Table 5). After salvage timber began to dominate sales in 2001, the quicker, more direct harvesting procedures permitted under Montana regulations meant the quality of the timber was less debased and extraction costs were lower. These factors resulted in Montana stumpage prices diverging from those of the Forest Service, from a discount in 2000 to rising premiums that reached over 100% by 2003. During the 4-year period covered by Montana's fiscal years 2001–2004, the Forest Service sold 587 million board feet of sawtimber in Region 1 for $71 million. During the same time, Montana stumpage prices for essentially the same type of timber reaped about a 60% premium. Had Forest Service sales procedures been more like those of Montana and similar prices been achieved, revenues would have been $40 million higher. The environmental benefits captured by the Forest Service sales procedures can be weighed against the foregone revenues implied by comparison with the State of Montana results.

Delivered

Figure 7 illustrates the price of #2 Douglas-fir sawlogs obtained by averaging four regional quotes from *Log Lines* and three Oregon Department of Forestry (ODF) regions (Oregon Department of Forestry 2001–2004). Residual value estimates are also shown, though these are not entirely comparable because they cover a mix of logs. This mix of logs includes lower grades, such as #3, and less valuable species, such as whitewood (hemlock), and therefore has lower aggregate value.

Table 6—Differences and correlation coefficients in average stumpage prices between prices reported by different sources, dollars per thousand board feet (Scribner)

	Q 1, 2002–Q 3, 2004			
Grade and species by region	Difference (%) LL[a] – ODF[b]	Correlation coefficient (%) LL – ODF	Difference (%) BBER[c] – NMI[d]	Correlation coefficient (%) BBER – NMI
Northwest Oregon				
#2 DF[e]	3	95		
#3 DF	–1	85		
#2 WW[f]	3	91		
#3 WW	11	96		
Southwest Oregon				
#2 DF	2	78		
#3 DF	7	63		
South central Oregon				
#2 DF	–2	90		
#3 DF	2	78		
Oregon				
#2 DF	1	92		
#3 DF	3	91		
#2 WW	3	93		
Montana				
DF Sawlogs			0	72

[a]*Log Lines*.
[b]Oregon Department of Forestry.
[c]University of Montana Bureau of Business and Economic Research.
[d]Northwest Management, Inc.
[e]Douglas-fir.
[f]Whitewood/hemlock.

The ODF and LL prices are generally close, and over the entire period their averages are essentially the same (Table 6). The RV estimates, aside from the bias noted above, exhibit a similar relation to published market prices as observed in the southern states—a tendency to cycle about the market prices.

Figure 8 shows three similar prices for Montana. The NMI price was the average of their published high and low quotes. The two market report prices again show close agreement and no significant bias among them. The residual value estimates averaged 6% below the other two. The correlation coefficients were also high: 87% with BBER prices and 80% with NMI quotes.

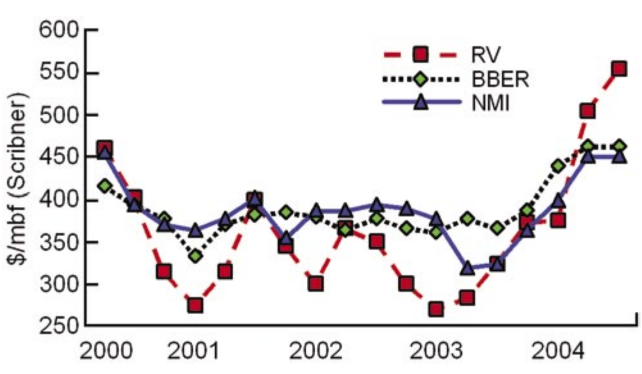

Figure 8—Montana #2 Douglas-fir delivered log prices by source (RV, residual value; BBER, Bureau of Business and Economic Research; NMI, Northwest Management, Inc.).

Comment on Delivered

The close correspondence of data between NMI and BBER is likely explained by large overlap in information sources. In Montana especially, the remaining operating mills are few and limit the size of the sample pool, which means both sources essentially mine the same data.

The elasticity of price transmission for western markets has been estimated from 0.35 to 0.45 (Haynes 1977), indicating a 35–45 % change in timber prices for a 100% change in product prices. The data in this study for our two western states broadly agree with these results (Table 7).

Discussion

Unlike stocks or bonds, timber sales are not interchangeable. Each has its own characteristics, making it problematic to derive a representative index of timber prices. With communications through fax machines and the internet facilitating the transfer of complex information, it is more feasible to assimilate and analyze larger blocks of data. Some of the uncertainty in timber price reports could be eased by reporting, alongside average prices, other sale attributes such as tree diameter, stand-quality, and species mix. Defining attributes that make average timber prices "high" or "low" would be one way to illuminate the meaning of such price characterizations. Information on many sale attributes is already available on web-based data of organizations such as F2M, which thus affords greater insight into timber pricing evaluation.

Table 7—Estimates of the elasticity of price transmission for various western regions

Market region	Elasticity of price transmission	Source
Western	0.45	Haynes
West Coast	0.38	Haynes
Rocky Mountain	0.35	Adams cited in Haynes
West Coast	0.36	Vaux cited in Haynes
Oregon	0.27	Present study
Montana	0.42	Present study

Nevertheless, all price reports are based on samples with all the attendant variability associated with the technique. The difficulty in homing in on a sawtimber price is shown by the disparate estimates from different organizations illustrated in this summary. Occasional statistically large differences and resultant conflicting signals indicate that issues concerning sampling, weighting of data, and converting different log scales to common units remain.

As a complement to timber price reports, another reference point is residual value determination based on prices and manufacturing costs in downstream lumber markets. This metric too is ultimately based on sampling, but from a more transparent market dealing in more fungible products. Indexes of timber valuation that are derived from manufacturing costs and revenues of representative sawmills can add insight of values that are realistic in the context of downstream markets.

An objection to such a constructed measure is that it represents only the timber processor's perspective. Valuation from the timber grower's perspective on the basis of timber growing costs is equally valid, and the contrast of those two views determine bargaining and the ultimate market clearing price. Over the long run, however, I argue that residual values must embody both seller and buyer interests. Timber prices need to be high enough to keep land in timber production. Those costs in turn must ultimately be passed through product prices or capacity erosion will cause supply scarcity, driving prices up. This contention is supported by the near equivalence of RV estimates with timber prices over the span of the 5 years examined. As illustrated, RV estimates are often precursors of trends in timber markets and as such can play a role as an adjunct to timber price reports in the calculus of market price determination.

Based on this logic, a further possible use of RV estimates could be as a vehicle for adjusting prices in long-term timber contracts. The appeal of this to processors is that it would buffer them better against declines in product selling prices. Conversely, it would assure sellers of higher compensation when downstream prices improve. However, timber sellers would likely demur at the prospect of the wholesale transfer to them of market volatility and risk that this would entail. Extreme periods of depressed prices, even if eventually made up, would reduce the attraction of timber growing. In such applications, therefore, some floor and ceiling price levels would likely need to be set relative to reported market prices so as to temper the extreme swings that can result from ties to volatile lumber prices.

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Appendix A—Model Forms Used by *Timber Mart-South* to Gather Timber Market Information

Reporting Form

State		**Date:**	
Area		**Quarter:**	
County		**email:**	tmart@arches.uga.edu
Reported By:			

Stumpage

Product	Market (G = Good, F = Fair, P = Poor)	Stumpage LOW	Stumpage HIGH	Scale S = Scribner, D = Doyle I = International, T = Tons, C= Cords
Pine Sawtimber				
Pine Ply Logs				
Oak Saw Timber				
Mix Hdwd Saw				
Pine Pole Timber				
Pine Chip-n-Saw				
Pine Pulpwood				
Hwd Pulpwood				

Delivered

Product	Market (G = Good, F = Fair, P = Poor)	Stumpage LOW	Stumpage HIGH	Scale S = Scribner, D = Doyle I = International, T = Tons, C= Cords
Pine Sawtimber				
Pine Ply Logs				
Oak Saw Timber				
Mix Hdwd Saw				
Pine Pole Timber				
Pine Chip-n-Saw				
Pine Pulpwood				
Hwd Pulpwood				

Comments:

Appendix B—Residual Delivered Log Value

For the past 5 years, I have been deriving quarterly residual log value estimates for five U.S. regions as an aid to understanding log markets. My focus is on sawtimber, the main use for which is lumber, so the data derived here are from sawmilling alone. Although sawtimber can be used for other products (chiefly plywood), over the past decades the economics of plywood have been superceded by engineered wood (OSB), leaving lumber as the prime user of sawtimber. Therefore, to avoid unduly complicating the analysis, I focus solely on lumber. I selected five states on the basis of availability of reported selling prices specifically tied to a locality: Georgia with reported Southern Pine lumber prices for the southeast, Alabama with lumber prices for the south-central, Texas with prices in the southwest, Oregon with prices for coastal Pacific Northwest, and Montana for prices reported for the inland West.

This estimation process consisted of two steps. First, I estimated net selling values of lumber and its byproducts. Second, I estimated processing costs for a representative sawmill. Subtracting the processing cost from the net selling value yielded the residual value of delivered logs. Tables B1 and B2 show the assumed sawmill configurations and sequence of calculations for 2002 in the regions chosen.

Mill type. Four main types of mills operate in the United States: stud (2-in-thick lumber in lengths of 7–10 feet), dimension (2-in. lumber in varying lengths), timber (5-in. and thicker lumber), and board (less then 2-in. thick). Dimension mills process the bulk of the timber followed by stud mills. These two mills types are broadly similar in terms of product except for the differences in lengths. I therefore chose dimension sawmills as most representative for log valuation purposes in four of the regions. In the fifth I modeled a mill with an output blend of 80% dimension and 20% timber.

Production volume. I selected an annual production volume with a value near the middle of the range among permanent, high-volume mills for each region. For example, in 2002 a coastal Oregon mill with 168 million board feet of output represented the mid-point of that region's cumulative production capacity. In this example, one half of the 5.6 billion board feet of capacity was accounted for by mills with annual capacity of less than 168 million board feet (Spelter and Alderman 2003).

Mill sales (realization). Softwood lumber market prices are reported weekly by three independent firms: Crows, Madison's Lumber Reporter, and Random Lengths. Each employs a staff of reporters who survey mills, brokers, wholesalers, distributors, and treaters weekly. The reported prices that emerge from these inquiries reflect the judgment of the staff about the prices of transactions at the producer level (they are not statistical, volume-weighted sales averages). Over time, the prices reported by the three tend to be similar, and for simplicity I used the data from Crows.

Lumber prices tend to be strongly correlated, so to represent mill sales of primary products, I selected only one or two high-volume lumber grades (usually Standard and Better, 2 by 4). I reduced these prices by 6% to account for discounts and lower grades in a typical product mix that would pull the average realization down.

I estimated revenue from byproducts from calculations of the amount of chips and shavings produced, depending on the Lumber Recovery Factor (LRF), discussed below. Chip prices were obtained from a wood fiber price reporting source (IWFR 1994–2005).

Staffing and wages. Each regional mill was assumed to contain the full range of milling processes including log sorting, sawing, grading, drying, trimming, edging, and planing. Staffing levels typical for these functions, based on two shifts, were specified. Supervisory and maintenance staffs appropriate to mill size were also included.

Reference wages were obtained from the 2002 Census of Manufacturers with non-Census years derived by adjusting the reference wage by indexes from the Bureau of Labor Statistics. Cost estimates are fully loaded and included vacation pay, unemployment insurance, retirement, Social Security payments, and health insurance costs.

Table B1—Model sawmill configurations for five regions, 2002

	Region and mill type				
	W. Oregon dimension	Montana dimension	Georgia dimension	Texas dimension	Alabama dimension and timber
Production (mmbf[a])	168	106	105	120	90
Line workers	163	142	139	150	122
Cost/worker ($/wk)	958	882	752	749	762
Log diameter (in.)	10	10	10	10	10.5
Electricity (kwh/bf[b])	0.12	0.17	0.17	0.17	0.17
Fuel cost ($/mbf[c])	2.2	2.2	2.2	2.2	2.2
Depreciation of assets (millions of dollars)	18	13	15	16	11

[a]Million board feet
[b]Kilowatt hours per board foot
[c]Dollars per thousand board feet

Table B2—Model sawmill costs for five regions, 2002[a]

	W. Oregon	Montana	Georgia	Texas	Alabama
Lumber value	296	285	298	285	313
+ Chip value	29	31	28	31	28
+ Shavings	11	10	7	7	7
= Revenues	335	326	333	323	348
Profit and risk	17	16	17	16	17
+ Line labor	46	59	50	47	52
+ Electricity	5	9	9	9	7
+ Fuels	2	2	2	2	2
+ Supplies	9	9	10	9	9
+ Administrative	9	10	9	8	9
+ Depreciation	15	17	20	18	17
= Manufacturing costs	104	123	117	110	113
Residual	231	204	216	213	235
× LRF[b]	7.9 bf/ft^3	7.7 bf/ft^3	7.5 bf/ft^3	7.5 bf/ft^3	7.5 bf/ft^3
= \$/ft^3	1.83	1.57	1.62	1.60	1.81
÷ Conversion factor	3.85 bf/ft^3	4.79 bf/ft^3	4.79 bf/ft^3	4.79 bf/ft^3	4.90bf/ft^3
= Residual log value	477	327	339	335	369

[a]Revenue, value, and cost factors are shown in dollars per thousand board feet.
[b]Lumber recovery factor.

Energy. Average electricity use by sawmill was estimated from Census of Manufacturers and energy usage studies (Grist and Karmous 1988). For mills drying all their lumber, the level was set at 170 kilowatt hours per thousand board feet. For Oregon, where up to half of output is sold green, a lower level of kilowatt hours per thousand board feet was set. Electricity costs to industrial users, by state, were obtained from the U.S. Department of Energy (2005).

Fuel costs. Purchased fuel costs per thousand board feet of output were calculated from Annual Survey of Manufacturers (U.S. Census Bureau 1958–2003).

Supplies. The cost per unit of materials, components, containers, and parts were calculated from the 2002 Census of Manufacturers. The Producer Price Index was employed to extend the 2002 estimate to other years.

Administrative costs. This includes general administrative costs for items such as insurance, property taxes, communications, and office personnel. Costs were estimated on the basis of assumptions for staffing and expense items.

Depreciation. An overall industry-wide estimate of the gross value of depreciable assets is contained in the 2002 Census of Manufacturers. I adjusted this for specific mill types to take into account plant scale. I calculated the annual depreciation charge on the basis of a 10-year write-off period. I included the opportunity cost of the capital tied up in the facility (the interest paid or the interest revenue foregone) based on contemporary rates for bonds rated Baa.

Total revenues, less the total costs, gives the residual value of the timber, stated in dollars per thousand board feet, lumber tally basis. To convert these to log scale basis, two additional metrics are needed.

Lumber recovery factor (LRF). The recovery rate of lumber per cubic foot of log for most mills lies in the 7–8 (nominal) board feet per cubic foot range (Steele and others 1988). Recoveries depend on the inherent capabilities and the maintained condition of the equipment, the size of the logs (the smaller the log, the lower the LRF) and the number of sawlines (large timbers requiring fewer cuts lose less volume to sawdust than thin boards). Over the years, as scanning and optimization capabilities advanced, LRFs tended to benefit from the increased ability to find optimal cuts based on log shape. Also important were similar technologies applied to the edging of boards, as the ability to fully exploit permissible wane allowances could significantly boost recoveries.

The average log diameter was assumed to be 10 in. for dimension mills, whereas 10.5 in. was chosen for the partial timber mill. The LRFs for the larger western mills were assumed to be nearer the high end of the range, whereas southern mills were placed in the middle. Because of its product mix and larger log size, the combination dimension–timber mill was given a slightly higher LRF.

Board-to-cubic conversion factor. The board-foot to cubic-foot conversion factor is mainly a function of log diameter and the log scale (log length, taper, and defects also play roles). Here the Scribner log scale was used as the frame of reference, but on the basis of the scaling protocols employed in particular regions.

For a given log diameter, conversion factors in the coastal Pacific Northwest are lowest because the conservative measurement rounding conventions and the longer log lengths underestimate the board feet contained within a log. In the other regions, where shorter logs are the norm, the volume omission is relatively lower, and thus the projected board footage is higher. The relevant conversion factors in each region were derived from the assumed log sizes using published equations relating the conversion factor to average log diameter of a population of logs (Cahill 1984).

Multiplying the residual board foot, lumber tally price value by the LRF and dividing the result by 1,000 yields the equivalent price per cubic foot. Dividing this by the board-to-cubic conversion factor and multiplying by 1,000 generates the residual value in terms of the local board-foot log scale. Appendix C contains the annual estimates for the regions over the period 2000–2004. For these price calculations over time, improvements in mill output efficiency of about 2% per year were factored in.

Residual stumpage value. The next step in obtaining stumpage values is to deduct additional costs for converting standing trees to delivered logs. These include tree felling, delimbing, bucking, skidding, loading, and hauling. The variability in these costs, however, depends on a multitude of logging and tree conditions. These can result in highly automated or labor-intensive logging operations and variability that is substantially greater than mill manufacturing costs. Stump-to-truck costs can vary from an average of $87 per thousand board feet for a mechanical ground-based system to $164 per thousand board feet for an uphill skyline cable system. Helicopter logging boosts them further to $233 per thousand board feet (Keegan and others 1995). Data on average industry conditions relating to these variables are lacking; thus, modeling these costs along the lines above to obtain a representative industry average would be largely conjectural regarding average conditions.

A simpler approach is to compare available reported data on stumpage and delivered wood costs. Although not accurate in the short term because logs delivered often reflect stumpage prices paid in the past, a long-term analysis with several wood market cycles would tend to average out and minimize this lag effect.

Where such data were not available, as in the West, historical Forest Service estimates were brought forward in time by using an index of logging costs provided by the Bureau of Labor Statistics.

Appendix C—Model Sawmill Costs and Residual Values for Five States

The tables below (C1–C5) show the annual estimates for the regions over the period 2000–2004. For these price calculations over time, improvements in mill output efficiency of about 2% per year were factored.

Table C1—Model sawmill costs for Oregon 2000–2004[a]

	2000	2001	2002	2003	2004
Lumber value	306	300	296	307	418
+ Chip value	35	34	29	29	29
+ Shavings	11	11	11	11	11
= Revenues	352	344	335	347	458
Profit and risk	18	17	17	17	23
+ Labor	45	46	46	47	48
+ Electricity	4	5	5	7	7
+ Fuels	2	2	2	3	4
+ Supplies	9	9	9	9	9
+ Administrative	9	9	9	9	9
+ Depreciation	18	16	15	14	14
= Manufacturing costs	104	104	104	106	115
Residual	248	240	231	240	343
× LRF[b]	7.9 bf/ft^3	7.9 bf/ft^3	7.9 bf/ft^3	7.9 bf/ft^3	7.9 bf/ft^3
= $/ft^3	1.97	1.90	1.83	1.91	2.72
÷ Conversion factor	3.85 bf/ft^3	3.85 bf/ft^3	3.85 bf/ft^3	3.85 bf/ft^3	3.85 bf/ft^3
= Residual log value	512	494	477	496	707

[a]Revenue, value, and cost factors are shown in dollars per thousand board feet.
[b]Lumber recovery factor.

Table C2—Model sawmill costs for Idaho and Montana 2000–2004[a]

	2000	2001	2002	2003	2004
Lumber value	313	290	285	284	405
+ Chip value	40	38	31	31	30
+ Shavings	10	10	10	10	10
= Revenues	363	339	326	325	446
Profit and risk	18	17	16	16	22
+ Labor	59	59	59	60	62
+ Electricity	4	10	9	7	7
+ Fuels	2	2	2	3	4
+ Supplies	9	9	9	10	10
+ Administrative	10	10	10	10	10
+ Depreciation	20	18	17	17	16
= Manufacturing costs	122	126	123	122	131
Residual	242	213	204	203	315
× LRF[b]	7.6 bf/ft^3	7.6 bf/ft^3	7.7 bf/ft^3	7.7 bf/ft^3	7.7 bf/ft^3
= $/ft^3	1.84	1.62	1.57	1.56	2.42
÷ Conversion factor	4.79 bf/cft	4.79 bf/cft	4.79 bf/cft	4.79 bf/cft	4.79 bf/cft
= Residual log value	384	339	327	326	506

[a]Revenue, value, and cost factors are shown in dollars per thousand board feet.
[b]Lumber recovery factor.

Table C3—Model sawmill costs for Georgia 2000–2004[a]

	2000	2001	2002	2003	2004
Lumber value	327	317	298	322	375
+ Chip value	31	29	28	31	30
+ Shavings	7	7	7	7	7
= Revenues	366	354	333	360	413
Profit and risk	18	18	17	18	21
+ Labor	47	48	50	50	51
+ Electricity	7	7	9	12	11
+ Fuels	2	2	2	3	4
+ Supplies	10	10	10	11	11
+ Administrative	9	9	9	9	9
+ Depreciation	23	21	20	20	19
= Manufacturing costs	116	116	117	123	125
Residual	250	238	216	238	288
× LRF[b]	7.5 bf/ft^3	7.5 bf/ft^3	7.5 bf/ft^3	7.5 bf/ft^3	7.5 bf/ft^3
= \$/ft^3	1.88	1.79	1.62	1.79	2.17
÷ Conversion factor	4.79 bf/ft^3	4.79 bf/ft^3	4.79 bf/ft^3	4.79 bf/ft^3	4.79 bf/ft^3
= Residual log value	392	374	339	373	452

[a]Revenue, value, and cost factors are shown in dollars per thousand board feet.
[b]Lumber recovery factor.

Table C4—Model sawmill costs for Texas 2000–2004[a]

	2000	2001	2002	2003	2004
Lumber value	318	309	285	310	366
+ Chip value	34	33	31	32	32
+ Shavings	7	7	7	7	7
= Revenues	360	350	323	349	405
Profit and risk	18	17	16	17	20
+ Labor	44	45	47	48	49
+ Electricity	9	9	9	11	10
+ Fuels	2	2	2	3	4
+ Supplies	9	9	9	10	10
+ Administrative	8	8	8	8	8
+ Depreciation	21	20	18	18	18
= Manufacturing costs	110	110	110	115	119
Residual	249	239	213	234	286
× LRF[b]	7.5 bf/ft^3	7.5 bf/ft^3	7.3 bf/ft^3	7.5 bf/ft^3	7.5 bf/ft^3
= \$/ft^3	1.87	1.80	1.60	1.76	2.15
÷ Conversion factor	4.79 bf/ft^3	4.79 bf/ft^3	4.79 bf/ft^3	4.79 bf/ft^3	4.79 bf/ft^3
= Residual log value	391	376	335	368	450

[a]Revenue, value, and cost factors are shown in dollars per thousand board feet.
[b]Lumber recovery factor.

Table C5—Model sawmill costs for Alabama 2000–2004[a]

	2000	2001	2002	2003	2004
Lumber value	355	332	313	325	385
+ Chip value	29	28	28	29	31
+ Shavings	7	7	7	7	7
= Revenues	392	367	348	361	424
Profit and risk	20	18	17	18	21
+ Labor	50	50	52	52	54
+ Electricity	7	7	7	9	9
+ Fuels	2	2	2	3	4
+ Supplies	8	8	9	8	8
+ Administrative	10	9	9	10	10
+ Depreciation	20	18	17	17	16
= Manufacturing costs	117	114	113	116	122
Residual	275	254	235	245	302
× LRF[b]	7.5 bf/ft^3	7.5 bf/ft^3	7.5 bf/ft^3	7.5 bf/ft^3	7.5 bf/ft^3
= \$/ft^3	2.12	1.95	1.81	1.88	2.32
÷ Conversion factor	4.9 bf/ft^3	4.9 bf/ft^3	4.9 bf/ft^3	4.9 bf/ft^3	4.9 bf/ft^3
= Residual log value	442	408	377	393	485

[a]Revenue, value, and cost factors are shown in dollars per thousand board feet.
[b]Lumber recovery factor.