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# Improving the Efficiency of Federal Timber Sales Procedures

## INTRODUCTION

In the United States,  $1.008 \times 10^{15}$  board feet or 50.85 percent of all softwood sawtimber volume on commercial timberland is found on the 155 national forests and falls under the jurisdiction of the U.S. Forest Service.<sup>1</sup> Economists generally agree that the Forest Service, acting as a trustee for the American people, has two broad responsibilities in managing these resources. One of its first responsibilities is to see that public resources are utilized in an economically efficient fashion. Economic efficiency, when applied to public timberlands, requires that the value of these resources to current and future generations be maximized. This implies that public timberlands be placed in their highest valued end use, with necessary production processes proceeding at the minimum cost possible.

Another of its responsibilities, an equity issue, is to collect fair compensation from the sale and/or use of these resources. Government timber sale policies affect the ultimate market value of timber resources and the ability of government to collect this value. In this paper, we analyze the methods employed by the Forest Service in selling public timber. Part I outlines the current sale methods. This is followed in Part II by a description of the economic criteria for judging these procedures. Finally, in Part III, we analyze existing sale methods and suggest how these methods might be improved.

## I. EXISTING FEDERAL TIMBER SALE PROCEDURES

Once a tract of timber is designated for sale, the Forest Service conducts an appraisal to determine its fair market value.<sup>2</sup> The Forest Service uses the appraisal process to estimate the volume, market value, and conversion cost of each species present in the sale. On completion of the ap-

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1. Board feet measured in international quarter inch log rule. U.S. DEP'T OF AGRICULTURE, FOREST SERVICE, FOREST STATISTICS OF THE U.S. 40 (1977).

2. The fair market value is defined in the FOREST SERVICE MANUAL, § 2523.12 (1981) as "the price acceptable to a willing buyer and seller, both with knowledge of relevant facts and not under pressure or compulsion to deal."

praisal, the Forest Service advertises a sale for at least thirty days at the end of which time an auction is conducted among prospective buyers. Bidding is organized by species, with the level of each bid determined by multiplying the vector of species bids, expressed in dollars per thousand board feet (mbf), by the vector of estimated species volumes. Algebraically this is given below:

$$B = \sum_{i=1}^n R_i \cdot Q_i \quad (1)$$

where B is the bid level

$R_i$  is the log scale<sup>3</sup> species bid for the  $i$ th species

$Q_i$  is the appraised volume of the  $i$ th species

$n$  is the number of species

The Forest Service awards the sale to the firm whose log scale species bids result in the highest value for B.<sup>4</sup> A firm winning a sale obliges itself to remove the specified timber prior to a predetermined date.<sup>5</sup> Failure to do so can result in punitive actions by the Forest Service. While the Forest Service has some latitude in setting the method and timing of payment, in most cases the payment, which is due at the time of harvest, has been calculated as the product of winning log scale bid rates and the actual volume removed from the sale site.<sup>6</sup> This method of payment is generally referred to as log scale payment.<sup>7</sup>

## II. ECONOMIC CRITERIA FOR EVALUATING PUBLIC TIMBER SALE METHODS

As noted earlier, the government's economic goals of timber sale policies seek to promote the efficient use of the resource and to collect fair

3. Log scale is a measure of the board foot content of roundwood generally using the international quarter inch log rule. As used here, a log scale bid is a bid rate expressed in dollars per mbf.

4. FOREST SERVICE MANUAL § 2430.17 (1981).

5. FOREST SERVICE MANUAL § 2430.12 (1981).

6. Log scale bid rates may be subject to escalation by a percentage of any change in a predetermined index of market prices which occurs between the sale date and the date in which the logs are removed from the forest. Additionally, for sales of more than three years duration, discounts are being offered on a trial basis in the Pacific Northwest for timber harvested prior to the last year of the contract. For details of the discount see New National Forest Timber Procedures; Final Policy, 47 Fed. Reg. 16,178 (1982) (To be codified at 36 C.F.R. § 223).

7. This payment format has since been amended to require that a portion of the payment for the sale be made not later than half through the contract period. Specifically, the following provisions were implemented for sales conducted after April 15, 1982: (1) The winning bidder is required to make a cash deposit of 5 percent of the total bid value of the sale within 30 days of the sale. The deposit may be used as payment for timber removed after 25 percent of the appraised volume has been presented for scaling. (2) For sales of more than 3 years duration, the winning bidder must have paid the greater of (a) 50 percent of the bid premium, or (b) 25 percent of the anticipated contract price, by approximately the midpoint of the sale contract. For details see 47 Fed. Reg. 16,178 (1982). While these provisions somewhat alter the timing of payments, they do not change the general log scale nature of the payments. We assume here that payment is made at the time of harvest. The results of our analysis are not significantly affected by this simplifying assumption.

value for its use. To determine whether current sale methods achieve these objectives, one operational method measures the extent to which they maximize and collect the economic rent from the resource. Economic rent is defined as a payment to a factor of production in excess of that necessary to keep it in its current use.<sup>8</sup> In the context of timber resources, economic rent can be expressed as the value of logs produced less total necessary cost of production including a normal rate of return for the developer. Timber sale policies influence the amount and collection of economic rent.<sup>9</sup> For example, a timber sale procedure which results in a tract being harvested too late (or too early) will reduce the present value of net revenue, and consequently the economic rent, from the acreage. Similarly, a policy which selects a firm other than the most efficient firm to harvest the sale increases production costs above the minimum level necessary. Holding revenue constant, these excessive costs fall against economic rent. Sale policies which also require unnecessarily large public administrative expenditures dissipate economic rent. Thus in a social sense, the objective of resource management is to maximize the present value of economic rent which is given as:

$$\text{Rent} = [R(Q,T) - C(Q,T)]e^{-rT} \quad (2)$$

where  $R(Q,T)$  is the total revenue collected if volume  $Q$  is harvested at time  $T$

$C(Q,T)$  is the total cost incurred in harvesting volume  $Q$  at time  $T$

$Q$  is the volume to be harvested

$T$  is the harvest date

$r$  is the discount rate

Maximizing rent with respect to the two choice variables,  $Q$  and  $T$ , yields the following familiar results. First, having selected a harvest date, logging should continue until the marginal net benefit of an additional log is zero (i.e., where the marginal revenue of an additional log equals its marginal harvest cost). Second, for a given harvest volume, the percentage rate of growth of economic rent over time must equal the discount rate. In short, maximizing economic rent implies that the timber be left standing as long as the marginal benefit from delaying the harvest is greater than the interest earned if the stand is cut and the proceeds invested at the discount rate. We define an efficient sale policy as one which leads to volume and harvest timing decisions which are commensurate with these conditions and which simultaneously collects the resulting economic rent. Existing timber sale procedures will be judged on this basis.

8. Jones, Mead, & Sorensen, *Outer Continental Shelf Lands Act Amendments of 1978*, 19 NAT. RES. J. 885 (1979).

9. W. MEAD, M. SCHNIIPP, & R. WATSON, *THE EFFECTIVENESS OF COMPETITION AND APPRAISALS IN THE AUCTION MARKETS FOR FEDERAL TIMBER IN THE PACIFIC NORTHWEST* (1981).

### III. AN ANALYSIS OF EXISTING SALE PROCEDURES

A fundamental problem of log scale bidding is that it leaves unresolved the total payment to the government. Paradoxically, the firm which appears to be the high bidder based on the level of log scale payment, (1) may not provide the highest return to the government, (2) may not be the most efficient in terms of harvesting and marketing the timber at the lowest cost, and (3) may not plan to harvest the stand at the optimal time. By selecting the less than most efficient firm, the Forest Service reduces the economic rent.

The problems result from the fact that the highest log scale bid at the sale date determines the winning firm regardless of when the sale is harvested. The present system makes no attempt to reconcile planned differences competing firms may have for the harvest date. To illustrate this problem consider the following hypothetical example. Two firms are formulating bids for a stand of Douglas fir. Both firms agree with the government appraisal of the volume of timber in the stand. Firm 1 plans to harvest the stand in two years, at which time it will derive \$450 per mbf in gross revenue while incurring \$175 per mbf in production costs. Consequently, it is willing to bid \$275 per mbf ( $\$450 - \$175$ ) for the right to harvest the timber. Firm 2 plans its harvest in four years, at which time it anticipates \$520 per mbf gross revenue, \$220 per mbf in production costs, and is therefore willing to bid \$300 per mbf for the tract. On the basis of these bids, Firm 2 would be granted the rights to the stand. Comparing the bids in terms of their present value, however, yields the opposite ranking. Assuming a discount rate of 10 percent, the present value of Firm 1's bid is approximately \$227 per mbf, while the present value of Firm 2's bid is \$205 per mbf. In addition, note that, in terms of present value, Firm 1 foresees a higher valued end use for the timber (\$372 per mbf versus \$355 per mbf) and can achieve this end at a lower cost (\$145 per mbf as opposed to \$150 per mbf).<sup>10</sup> By not selecting Firm 1, the government receives less than fair value for the resource because it does not select the true high bidder. It also reduces economic rent by selecting Firm 2; the resource is not placed in its highest valued end use, and production does not proceed at the lowest possible cost, nor at the proper time.

Additionally, payment to the government at harvest can result in aggressive bidding on the part of interested buyers. This is an advantage

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10. Present values are computed using the following formula:

$$P.V. = (\text{Future Value})(1+r)^{-n}$$

The figures given for firm 1 will, therefore, generate the following results:

$$P.V. \text{ of Bid: } (\$450 - \$175)(1 + .10)^{-2} = \$227$$

$$P.V. \text{ of Estimated Gross Revenue: } \$450(1 + .10)^{-2} = \$372$$

$$P.V. \text{ of Estimated Conversion Cost: } \$175(1 + .10)^{-2} = \$145$$

of the sale method in that it promotes competition which, in turn, leads to higher bids. When carried to an extreme, however, it can lead to excessive sale defaults. Under traditional sale procedures, the speculative buyer could bid aggressively, since relatively little payment is required until the harvest begins. If financial conditions meet with, or exceed, the firm's expectations, the sale is harvested. Otherwise, the firm defaults the sale and may even seek the protection of bankruptcy laws. Of course no individual firm can default on sales repeatedly, because the Forest Service would ban them from future auctions. This confers a bidding advantage on small, transient firms relative to larger established firms. The larger firms face a greater potential loss if they incur the wrath of the Forest Service or file for bankruptcy, and, therefore, must temper any speculative tendencies they may have. Smaller firms do not face this problem. In response to recent increases in sale defaults, the Forest Service has altered its sales procedure by accelerating payment and assessing damages for costs incurred by the government caused by harvest delays including foregone interest.<sup>11</sup> While these provisions will reduce the frequency of sale defaults, their enforcement will increase administrative costs and consequently reduce available economic rent.

To this point, we have identified two major problems of current sale procedures. First, they do not unambiguously select the true high bidder, and second, they may lead to excessive sale defaults. Even if we assume that these shortcomings can be circumvented, however, additional problems in current sale procedures arise from the calculus of profit maximization. The present value of the profit of the winning firm at the time of the auction is given by the following expression:

$$\pi = [R(Q,T) - C(Q,T) - \tau Q]e^{-rT} \quad (3)$$

where  $\tau$  is the log scale bid rate.

Note that payment to the government is made when the timber is harvested and is therefore discounted along with revenue and cost. The profit maximizing firm will harvest an additional log as long as its marginal net benefit is positive. Thus, in the absence of the payment to the government,  $\tau Q$ , a firm will remove an additional tree from the forest as long as the marginal revenue derived from the tree exceeds its marginal production cost. This is illustrated in Figure 1 by volume  $Q^*$  where the marginal net benefit is zero. With a log scale payment, the profit maximizing volume is found where the marginal net benefit is equal to the marginal payment to the government,  $\tau$ . From the point of view of the firm, the stumpage payment is an addition to marginal production costs even though

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11. See 47 Fed. Reg. 16,178 (1982).

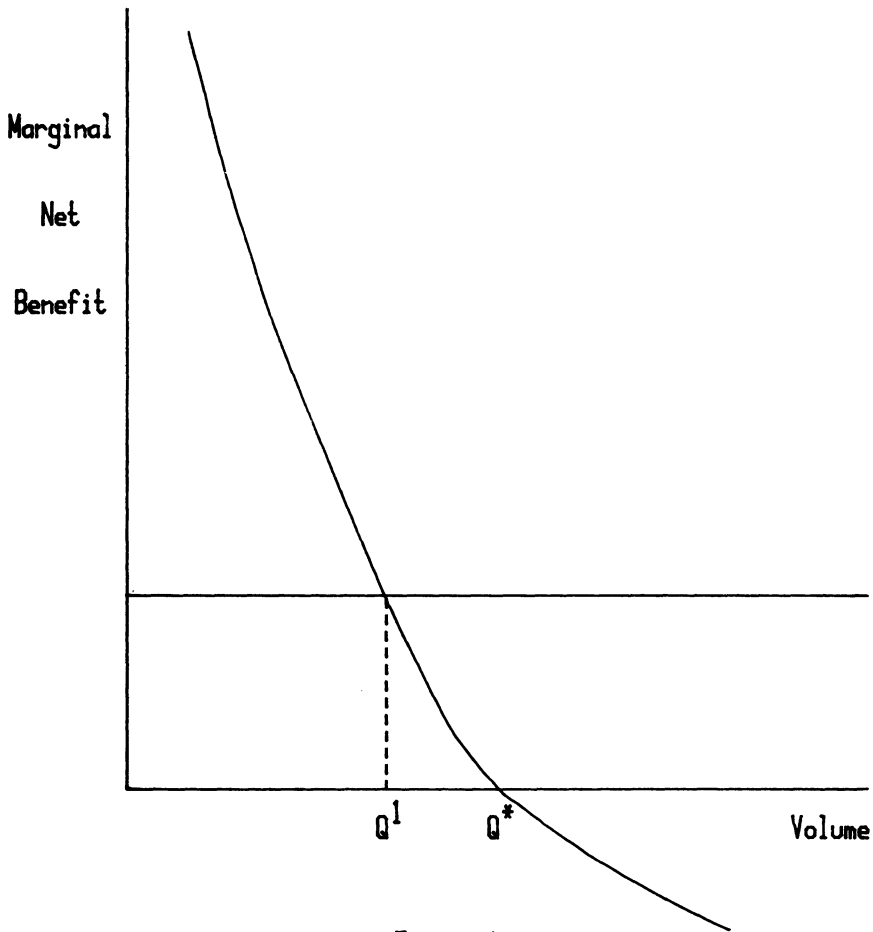


Figure 1

such payments are actually transfers from the private to the public sector. The additional fee makes some trees, which are economically attractive without the fee, appear sub-marginal. The result is a reduction in total volume from  $Q^*$  to  $Q^1$ . In short, these residual payments entice the firm to leave behind some logs which otherwise would have been removed from the forest. In the extreme, this can lead a firm to default a sale which would have been completed otherwise. This has been particularly relevant recently when actual stumpage prices over entire contract periods have been below the expectations held by winning firms at the time of the sale.<sup>12</sup> Current contract provisions require a winning firm to remove all merchantable volume designated in the Forest Service appraisal re-

12. Chase, *Timber Firms Seek Bailout from the U.S.*, Wall St. J. April 1, 1983; at 15, col. 3.

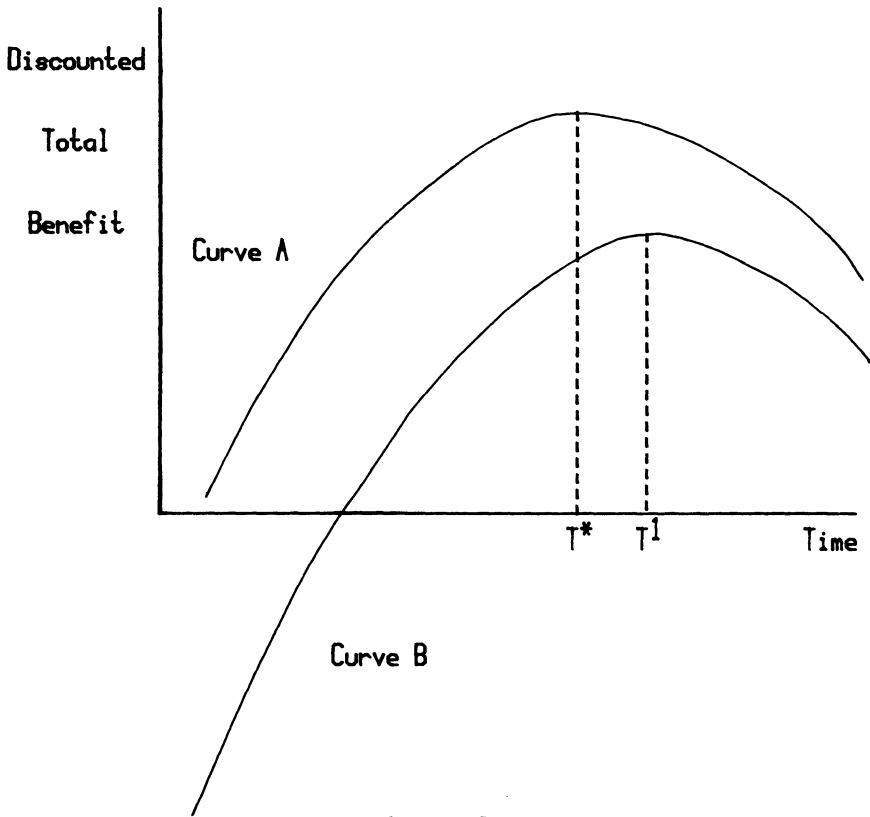


Figure 2

ardless of the firm's opinion of its actual economic value.<sup>13</sup> The above analysis, however, highlights an incentive for firms to adjust actual harvest volume based on marginal decision making criteria. The nature of a logging operation makes such adjustments possible when coupled with the current monitoring practices of the Forest Service.

Log scale payments also influence when a timber stand will be harvested. As noted earlier, the economic objective of resource management is to maximize discounted economic rent. A profit maximizing firm, however, will delay the harvest beyond the rent maximizing date, in order to reduce the present value of the residual payment to the government. Figure 2 illustrates this fact. Curve A represents the discounted net benefit, or economic rent, from harvesting a timber stand as a function of harvest time, and it reaches a maximum at time  $T^*$ . Curve B represents the discounted profit, net of stumpage payments, of the operating firm as a

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13. FOREST SERVICE MANUAL § 2450 (1981).



function of time of harvest. The firm therefore will maximize profits by harvesting at time  $T^1$ . The distance between the two curves represents the discounted payment to the government,  $\tau Qe^{-rT}$ , at any time  $T$ . Note that as  $T$  increases, this distance steadily decreases as the present value of the stumpage payment approaches zero. This implies that  $T^1$  will be greater than  $T^*$  for any positive value of  $\tau$ , or that a profit maximizing firm will delay harvest beyond the time period which would maximize economic rent. This deferral can be thought of as an interest free loan from the U.S. Treasury to the winning firm. In the final evaluation, delaying the harvest results in a net discounted benefit to the firm.

Finally, log scale payments are relatively costly to administer. To guarantee that the government receives full payment from timber sales it must monitor the actual production from the forest. The cost of the resulting bureau dissipates economic rent. A significant portion of the revenue collected under log scale bidding is expended in administering the program.

In summary, species log scale bidding, with payment at harvest, is not effective in maximizing and collecting economic rent. It may cause a sale to be awarded to a firm other than the true high bidder. Even if the most efficient firm is selected, current sale methods reduce the total value of the forest by inducing harvest at a suboptimal time and by causing some socially desirable trees not to be removed from the forest. Current policies may also lead to extremely aggressive bidding, which has recently resulted in excessive numbers of defaulted contracts, and are costly to administer. A solution to these problems is to conduct timber sales using lump sum bidding, with payment at time of sale. In this bidding format, the total payment for the sale is determined prior to actual harvest. As a consequence, it is not viewed as a marginal production cost but rather as a sunk cost by the firm. Sunk costs do not affect marginal logging decisions and, therefore, the problem of abandoning socially desirable trees is circumvented. This payment method will reduce greatly the incentives which lead to sale defaults, rendering recent alterations in sale procedures addressing this problem unnecessary. Furthermore, lump sum bidding with payment at time of harvest clears the ambiguity as to the "high" bidder, which stems from different harvest dates contemplated by rival firms, because all bids are stated in present values. Finally, since the proposed lump sum payment eliminates the need for the scaling process, administrative costs are kept to a minimum. We recommend cash lump sum bidding as a more effective alternative to log scale species bidding.

While lump sum bidding is of considerable merit with regard to economic efficiency, it has several alleged drawbacks. A primary criticism of such a system is that it places small firms at an unfair disadvantage in competing for sales. The disadvantage stems from the potentially large

cash sums necessary to compete. An argument exists that large firms can raise funds in capital markets more easily (at less cost) than their smaller counterparts. As a result, large firms may be able to outbid smaller firms and still earn a superior rate of return. A second criticism of the lump sum bidding format is founded on the manner in which it shifts the uncertainty of timber development to private firms. It has been argued that the government should bear the risk associated with federally owned assets.<sup>14</sup> Unlike log scale payments, which are contingent on future production, lump sum bidding shifts the uncertainty of future stumpage price changes, future technological developments, future government regulations and the like to the winning firm. To the extent that private firms are risk averse, they will adjust their discount rates upward in calculating their bids. This has the effect of lowering lump sum bid levels.

The degree to which these factors reduce bid levels has been studied empirically.<sup>15</sup> While this sale method has not been employed for timber sales, the federal government has experience with a similar sale method used to issue Outer Continental Shelf (OCS) oil and gas leases.<sup>16</sup> The bid variable employed at OCS lease sales is a cash lump sum payment (called a bonus payment) due at the time a lease is issued. Additional royalty payments of one-sixth of any future gross revenue are required. The bonus payments necessary to win these sales are extremely large, averaging \$2.2 million for leases issued from 1954 through 1969.<sup>17</sup> Even with such large "front end" payments, however, empirical analysis of the 1,223 Gulf of Mexico OCS leases issued over that period indicates that large firms have not had an advantage at OCS auctions.<sup>18</sup> The after-tax profitability of leases owned by the eight largest companies<sup>19</sup> (10.37 percent) was not substantially different than that earned by the big 9-20 firms (11.26 percent) and the non-big-20 firms (11.15 percent) over the same period. These results suggest that the larger firms have not had an advantage relative to smaller firms.

An examination of the OCS lease sale record shows that firms have not used an inordinately high discount rate in formulating their bonus

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14. See Arrow and Lind, *Uncertainty and the Evaluation of Public Investments*, AMER. ECON. REV. 364 (1970).

15. W. MEAD, A. MOSEIDJORD, D. MURAOKA, & P. SORENSEN, ADDITIONAL STUDIES OF COMPETITION AND PERFORMANCE IN OCS OIL AND GAS LEASE SALES, 1950-1975 (1980) [hereinafter cited as ADDITIONAL STUDIES].

16. 43 U.S.C. § 1337(A) (1976).

17. ADDITIONAL STUDIES, *supra* note 15, at 11.

18. These results are reported in Mead, Muraoka & Sorensen, *The Effect of Taxes on the Profitability of U.S. Oil and Gas Production: A Case Study of the OCS Record*, XXXV NAT. TAX J. (No. 1, March 1982). Leases issued after 1969 were not included in the study because the record of production from such leases was not sufficient to gauge their profitability.

19. The eight largest companies ranked by worldwide sales in 1969 were Exxon, Mobil, Texaco, Gulf, Standard Oil of California, Shell, Standard Oil of Indiana, and Arco.

bids.<sup>20</sup> The after tax internal rate of return earned on the OCS leases (10.74 percent) was not substantially different from the average after tax rate of return on stockholder equity for all U.S. manufacturing corporations reported by the Federal Trade Commission over the period from 1954 through 1980 (11.8 percent).<sup>21</sup> While bonus bidding shifts the uncertainty of oil and gas production toward the lessee, it has not allowed firms to profit on highly risky OCS investments. One possible reason for this has been the allowance of coalitions of smaller firms to submit joint bids. This enables smaller firms to spread uncertainty and lessen the potential barrier to entry posed by the large front end payments. This approach might also be followed in timber sales. On balance, cash bonus bidding has been effective in collecting the economic rent from OCS leases. There is no reason to believe that lump sum bidding would be less efficient for federal timber sales.

### SUMMARY AND CONCLUSIONS

In analyzing current timber sale procedures, we have identified three areas in which problems exist. First, the current system of log scale bidding and deferred payment fails to identify unambiguously the true high bidder at a given sale. By not considering the time period in which each competing firm plans to harvest the stand, ranking of current period bid values is meaningless. The proper method to compare bids is by calculating their present value and to date this has not been done. Second, even if the true high bidder, and consequently the most efficient firm, is awarded the sale, current provisions create an incentive to delay harvest beyond the socially optimal time. Third, current payment methods create an incentive for firms to leave behind some logs which might otherwise have been harvested. Under some circumstances, this has been shown to lead to defaults of sales as a whole. This scenario has presented real problems for the Forest Service recently.

The social impact of these issues is reflected in a reduction of the available economic rent collected by the government. This loss may take the form of an actual loss in revenues collected, or it may take the form of increased costs as a result of policing activities required to ensure compliance with sale regulations. In either case, the loss is real and can be avoided.

We recommend an alternative sale method which solves these problems by creating an incentive for firms to behave in a socially optimal manner. This differs from current practice in which the Forest Service has attempted to force firms to comply with increasingly restrictive and complex

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20. Mead, Muraoka & Sorensen, *supra* note 18, at 26-27.

21. *Id.*

regulations. Consider the case of a firm abandoning the marginal log rather than harvesting it. Current practice requires its removal through regulation and monitoring of the logging operation. A more efficient method would be to create an economic incentive for the firm to harvest as much of the resource as it would if it owned the land itself. We believe that our methods would accomplish just that. We propose a system characterized by lump sum bidding with the associated payment at time of sale. This would result in bids expressed in terms of their present value, thus removing the ambiguity as to the true high bidder. It would also remove the marginal production cost nature of the current log scale payment which leads to delayed harvest and the premature abandonment problem. By removing the incentives for inefficient behavior on the part of firms, this system would result in greatly reduced administrative costs and, therefore, increase the available economic rent associated with public timber resources.