Deterring Bid Rigging In Forest
Service Timber Auctions

by

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Abstract:

Bid rigging in Forest Service auctions continues to be a serious problem. The purpose of this paper is to suggest changes in the way that timber is auctioned that would deter bid rigging. Some of the suggested changes could have adverse affects on competition when firms do not collude. We discuss ways to implement the changes that would reduce their possible adverse affects.

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I. INTRODUCTION

Bid rigging in Forest Service timber auctions is a difficult crime to successfully prosecute. Successful bid rigging cases are usually built on evidence about exchanges of information to rig bids or allocate markets. This type of evidence is not likely to be found in timber markets because conspirators can allocate markets without explicitly exchanging information. Furthermore, this type of conspiracy is difficult to detect. Any data screening methodology capable of identifying conspiracies is likely to generate a large number of false leads so that its use would not be cost effective. To deter bid rigging, we suggest that some simple changes in auction procedures used by the Forest Service to let its timber would make it much more difficult for conspiracies to rig bids or allocate markets. Specifically, we have identified five changes that would reduce the likelihood of collusion:

> 1. Conceal the identities and respective strengths of the bidders from one another;
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> 2. Lease tracts by sealed bidding;
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> 3. Bundle tracts so that fewer and larger tracts are being let at one time;
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> 4. Raise the reserve price (minimum acceptable bid) of timber tracts;
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> 5. Replace the small business set-aside program with a program that grants a five percent advantage to small firms when they bid against large firms.

It is our belief that these reforms would discourage anticompetitive behavior and would result in higher revenues from timber sales. However, if some sales are already bid competitively, then some of these reforms could have adverse affects on competition. We

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discuss ways to implement these reforms that minimize their adverse effects on firms that legitimately compete with one another.

We conclude the the paper by suggesting a new bid letting strategy. This new bid letting process would obviate the need for many of the individual reforms mentioned above. This proposal represents a substantial departure from current practice but could be easily implemented by the Forest Service.

II. FOREST SERVICE TIMBER MARKETS

In this section the paradigm of the Justice Department's Merger Guidelines is used to define relevant markets for Forest Service timber. The Guidelines would define a timber market by posing the question, "would a hypothetical monopsonist in a given area reduce prices paid for timber significantly, or would bidders in adjacent areas, attracted by the low prices, enter the bidding competition to thwart the monpsonist's attempt to lower price?" If the latter is the case, then more areas and more bidders need to be included in the market. This hypothetical exercise is repeated for larger areas and larger groups of bidders until an area is found in which a monopsonist would significantly reduce price. Then that area is the relevant market timber market for antitrust purposes. The competitors in this market are those firms that currently bid in the area.

The Forest Service sells timber at auction, usually on a royalty basis (the bidder pays only for the timber that is harvested). The bidders are timber mills or independent loggers who sell cut logs to the mills. The mills turn the logs into lumber which, due to its relatively low transportation costs, is then sold in a regional or national market. Timber, in contrast, is sold in local markets because transporting timber is much more costly than transporting lumber. In a given area there may be only a handful of mills close to a tract being leased that compete against one another for the right to harvest the timber. Mills farther away are at a substantial disadvantage because of the higher transportation costs.

Independent loggers are not independent competitors because the price they are willing to pay for a tract of timber is implicitly set by the price that the mills are willing to pay for the logs, i.e. mills typically have more bargaining power than loggers because mills are the "scarce resource" in the system. Interpretation of bidding data is therefore very difficult because the number of observed bidders is a poor proxy for the number of

potential bidders. Not all potential bidders bid on each tract and not all observed bidders are independent competitors. Even the number of mills may overstate the competitiveness of a given market because not all mills compete directly with one another. For example, a saw mill bidding on a tract may be interested in only hemlock logs while a veneer mill, bidding on the same tract, may be interested in only Douglas fir logs. If a tract contains a preponderance of Hemlock that is more valuable than Douglas fir, the saw mill may be unwilling to compete with the veneer mill for the tract.

Entry by small mills in a given area appears fairly easy but large mills may have difficulty obtaining enough timber to run their mills due to the way the small business set-aside program is administered. We address this point at greater length below. And although entry may be easy for small mills, it may also be unlikely. High transportation costs and the existing geographic configuration of mills in a given area may make it difficult for an entrant to find a profitable location. In addition, the way that timber is let, in oral auctions, can defeat attempts by entrants to enter in response to an anticompetitive price fall. Again, this point is addressed at greater length below.

It is difficult to generalize about the size and characteristics of timber markets. In some areas, timber markets very roughly correspond to Forests or drainages within a Forest but each market has its own peculiar features that must be taken into account.

III. ANTICOMPETITIVE BEHAVIOR IN TIMBER MARKETS

Several features of local timber markets may make them susceptible to collusion. The repeated competition that occurs between mills in a given area is the most important. A mill knows that if it bids aggressively on one tract against a rival, the rival will have an opportunity to bid aggressively on the next one. It is not hard to imagine that in local markets with a small number of bidders, mills soon realize that profits would rise if they stopped bidding aggressively. Without direct communication, they could reach agreements to not compete based on the location of the tract being leased. One mill would not bid aggressively on tracts close to its competitor in return for the same type of consideration. This type of agreement, if not made explicit, is very difficult to prosecute and convict. The parties to a tacit agreement do not have to meet to allocate markets due to the existence of natural "focal points" for collusion. Firms can figure out which tracts

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would be won by which firms if the firms were to bid competitively based on the location of and species comprising the tract. Once they figure this out, refraining from competitive bidding on these tracts can be accomplished without explicit agreement.

Note that the collusive and competitive outcomes look very similar in this case. In both cases, each mill wins the tracts nearest to its own milling facility. The difference is that the winning bids are much lower in the collusive case than they are in the competitive one.

There is some evidence that bidding behavior in some markets is not competitive. Markets that are likely to be most susceptible to anticompetitive behavior are located in areas where there is less rainfall and consequently less timber and fewer mills. Examples are forests and drainages on the eastern slope of the Cascade mountain range and in the Southern Sierra Nevada mountain range. In these areas, there are fewer mills in a given geographic market than elsewhere. Mills competing for access to a single tract are likely to have substantially different transportation costs. The difference in costs makes it less likely that one mill will be able to exercise price discipline on the other.

Previous studies of the competitiveness of timber markets have used the number of tracts let at bids of less than one percent over the minimum acceptable bid as a measure of competition. In the Douglas fir region, the most competitive region in the National Forests, anticompetitive sales have been estimated to account for as high as 13% of all sales in some forests between 1980-1983. In the less competitive Ponderosa pine region, anticompetitive sales have been estimated to account for as high as 30% of all sales in some forests.[1] It should be noted that due to the high inflation during this period, most minimum acceptable bids ("appraisals") were much lower than the market value of the timber. Given the relatively low appraisals, this measure of competitiveness probably overstates the true competitiveness of an area.

We do not mean to suggest that all or even most Forest Service auctions are characterized by anticompetitive behavior. In some areas, sales are typically very

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1. This measure of competitiveness was developed by W. Mead, M. Schneipp, and R. Watson, "The Effectiveness of Competition and Appraisals in the Auction markets for National Forest Timber in the Pacific Northwest," 12-13 (September 30, 1981) (U.S. Forest Service Contract No. 53-3187-43).

competitive but in others they are not. It is on these less competitive areas that we focus our attention.

IV. DETECTION AND PROSECUTION OF BID RIGGING

The first and most obvious way to better deter bid rigging is to raise the expected penalties for bid rigging. One can do this either by raising the penalties for convicted bid riggers, or by increasing the probability of being caught. The first change would necessitate legislative action and we consider such a change beyond the scope of this paper. However, it is possible to increase the probability of detecting bid rigging by devoting more enforcement resources to the detection and prosecution of bid rigging. One of the most obvious ways to begin is to screen bidding data for suspicious patterns in the data. The purpose of this section is to examine successful bid rigging prosecutions of the past decade to identify patterns that would show up in bidding data.

There have been very few successful prosecutions of bid rigging. In the Pacific Northwest, there have been only three successful timber bid rigging cases brought since 1970. The cases were markedly different. In United States v. Champion (1975), seven companies operated a classic bid rotation scheme; competitors refrained from bidding on tracts in which one of them had stated an "interest." In the second case, United States v. Walker (1981), Walker convinced two competitors to refrain from bidding on certain tracts and, in return, he subcontracted some of the work to these companies as payoff for their cooperation. In the third case, United States v. Astoria Plywood (1987), one mill agreed to pay off two co-conspirators, for not bidding competitively, with cash and logs.

None of these cases would have been easy to spot by looking at bidding data. The problem is that there are many different types of conspiracies. All conspiracies feature low winning bids but, as noted above, there are many tracts in many areas that are let at or near the appraisal. Data screening to pick up anticompetitive behavior based on bids near the appraisal would result in a large number of false leads.

Another feature common to all conspiracies, is that all of the members must benefit. In the Champion case this was accomplished by bid rotation. The bid rotation scheme would show up in the data if the tracts were grouped into relevant markets but again, this type of data screen would generate a large number of false leads. The bidders

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agreed that each conspirator should win the tracts located nearest to its mill. This type of bid rotation looks very similar to competition because the mill closest to a tract has a cost advantage over mills located farther away. If the mills are competing, then the one with the lowest costs will usually win.

In the Walker case and in the Astoria case, the winner paid off his co-conspirators with lucrative subcontracts, logs, or cash. This type of conspiracy would not be picked up by a data screen because this information is not collected after the timber is let.

Even in the best of all possible worlds, one where tracts were grouped into markets, identification of the relevant competitors were possible, and the exact form of the conspiracy were known, screening data for bid rigging could have only a temporary impact. Once it became known that the data were being screened, conspirators could easily change their behavior to disguise the conspiracy. For example, because appraisals are typically far below the competitive value of timber,[2] conspirators would have room to raise their bids over the appraisal without significantly reducing profits. Bids above the appraisal look more competitive than bids right at the appraisal.

For these reasons, computer based bid monitoring seems like a poor use of enforcement resources. Any data screen is likely to generate a large number of false leads and fail to pick up disguised conspiracies.

V. POLICIES TO DETER CONSPIRACIES

A. Lease Tracts by Sealed Bidding

Conspiracies in timber markets profit by buying tracts more cheaply than competition would allow but face an enforcement problem common to all cartels. Typically, the cartel purchases timber at the minimum acceptable bid, or "reserve price," set by the Forest Service and at this price, many or all of the cartel members desire the timber. Then how does the cartel prevent a single member from bidding slightly higher and winning the timber for himself?

Cartels solve this problem by implicit or explicit threats. To deter a bidder from

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2. Prior to the Champion conspiracy, bids were typically 200% over the appraised value of the timber.

defecting from the cartel policy of bidding the reserve price, the cartel threatens to bid competitively on future tracts. If the lost future profits from competition (instead of collusion) exceed current period profits derived from defecting, then it is not profitable to leave the cartel. The cartel members will adhere to the cartel policy of bidding the reserve price.

In an oral auction, the cartel can detect and respond immediately to defections from the cartel policy. It is never profitable to defect since if a potential defector raises its bid, the cartel can respond by bidding competitively in the current auction. On the other hand, if a defector raises its bid in a sealed bid auction, the cartel cannot respond until the next auction, since by the time they detect a defection, the bids are already submitted. Thus, oral auctions facilitate cartel enforcement.[3]

In addition oral auctions make it unlikely that potential competitors would find it profitable to enter auctions to take advantage of low anticompetitive bid prices. The potential entrant knows that if it shows up at an oral auction, and bidding becomes competitive, then the low cost firm wins at a price slightly lower than the costs of the second lowest cost firm. If the potential entrant is located further away and faces a transportation cost disadvantage, then there is no incentive for the entrant to participate in the auction because it will never be the low cost bidder. Sealed bidding could provide the incentive for potential entrants to participate in auctions in which the bids are rigged.

B. Conceal the identities of bidders from one another.

Currently, the Forest Service uses two rounds of bidding to let timber. In the first round, firms submit "qualifying bids" at the reserve price to qualify them for the second round of competitive bidding. Firms need to be qualified to insure performance if they win the tract at the second round of bidding.

The first round of bidding has the unfortunate side effect of identifying the bidders to one another before they bid. It is impossible to rig bids or allocate markets unless you

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3. A private timber management company in the West uses one round of sealed bidding to let their tracts. To the best of their knowledge, they have never had problems with bid rigging. Also see, e.g., Marc Robinson, "Collusion and the Choice of Auction," Rand Journal of Economics, 16 (Spring, 1985) 141-145.

know who your competitors are. If the Forest Service were to eliminate this first round of bidding, it would be more difficult for a cartel to organize its members to rig bids.

C. Bundle tracts so that larger tracts are let less frequently.

If bidders cannot communicate with one another, the highest profit level that a cartel can enforce is the level at which the immediate gains from defecting (i.e. profit on the current tract) do not exceed the future profits lost if the colluders quit colluding. The future profits must be discounted by the interest rate, since money received in the future is not worth as much as money in the present.

Consider a bid rotation scheme, where the cartel alternates among members, letting each win one tract at the reserve price, and suppose for example that there are five members and five tracts let every year. When your turn arises, you win the tract at the reserve price. Then you must wait a year for four tracts to go by before you get to win another tract.

This type of bid rotation scheme might be broken up by increasing the size of the tracts and tendering them less frequently. This increases the value of defecting from the cartel because each tract is larger. It also decreases the value of cartel membership because benefits of continued membership in the cartel, relative to current period cheating on the cartel, occur farther in the future. For example, suppose that in the cartel above, the size of tracts were doubled so that five tracts were let every two years instead of every year. The value of current cheating doubles and the value of future cartel membership decreases because benefits occur twice as far in the future. When collusion is suspected, tract size should be increased.

D. Raise the reserve price.

One of the most obvious actions that the Forest Service can take to minimize the adverse effects of an auction conspiracy is to raise the reserve price of timber when collusion is suspected. Since the bidding ring will bid as low as it can, raising the reserve price will raise the price that the cartel must pay for timber. However, it is difficult to know exactly how high the reserve price should be raised.

In auctioning off timber, the government may have two objectives in mind, and

these objectives are not entirely compatible. The first objective is efficiency; the government would like to sell timber to the firm valuing it the highest (whenever the price justifies the sale of the timber). The second objective is that of revenue raising[4]; the government wants to make as much money from the sale of the timber as possible, even if this means some timber is left unsold. The tension between these two objectives arises only in the circumstance where the value of the timber is not known with certainty. Unfortunately this is characteristic of most sales so that, in posting a reserve price, the government typically faces a tradeoff between the two objectives.

As an illustration of the tradeoff, consider the simple case where the value of a tract could be either $100,000 or $250,000, each with equal probability. The Forest Service does not know which value is appropriate, due to uncertainty concerning logging costs, manufacturing costs, and the future value of the lumber. If a reserve price of $100,000 is posted, the Forest Service sells with certainty and, if facing a collusion, obtains the minimum price of $100,000. If a reserve price of $250,000 is posted, the Forest Service sells the timber only one half of the time (when the value is $250,000) and thus earns $125,000 on average. Thus the goal of revenue raising dictates that timber be sold less often than that would be dictated by the goal of efficiency.

Raising the reserve price may be a difficult policy to implement because it requires a credible commitment on the part of the Forest Service to hold timber off the market. If such a commitment is not written into Forest Service regulations, it may not be credible. In the example above, if the Forest Service sets a reserve price of $250,000 and receives no bids, this means that no firm valued the timber at more than $250,000. Based on this information, the Forest Service would like to relet the timber at a new reserve price of $100,000. However, reletting the timber creates an incentive for the the bidding ring to not bid at the higher reserve price if failure to bid would result in the timber being relet at the lower reserve price.

In order to use higher reserve prices to effectively combat the adverse effects of

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4. Since revenue is raised using distortionary taxes, the opportunity cost of $100 in lost revenue may be as high as $150. See Ballard, C., Shoven, J.B., and J. Whalley, National Tax Journal 38 (June, 1985) 125-140.

collusion, the Forest Service must make a strict policy of not reletting timber at a lower reserve price. Only if a cartel is convinced that the Forest Service will adhere to such a policy, will it bid the higher price when the value of the timber justifies such a bid.

E. Change the Small Business Administration set-aside program.

The small business set-aside program is triggered when the small businesses in an area do not win enough timber tracts. If, in a given year, small business purchases fall below their historical five year average, then the Forest Service sets aside tracts on which only small businesses can bid. After the program is triggered, small businesses can still bid on open tracts and these purchases add to the historical share of small businesses. Small businesses are defined by the Forest Service as firms with less than five hundred employees. A single firm may own mills in several different timber markets and thus be classified as large even though it owns a mill the same size as a small business mill in the same market.

Loggers may be classified as small businesses and as such are able to bid for set-aside tracts. However, if they win the tract, they must sell at least 70% of their logs to a small business mill. The price that the loggers can bid for the tract is effectively set by what the small mills are willing to pay for the logs. For this reason, independent loggers are not independent competitors who can bid up the price to a competitive level. Only the mills can do that.

The small business set-aside program has several anticompetitive effects. One is the creation of incentives for mills to not compete against one another. Small mills have less incentive to bid on open tracts against large mills because failure to bid will ultimately trigger the small business set-aside program. Once the program is triggered, small businesses face competition only from other small businesses. And if small businesses do not bid on open tracts then large businesses compete with only other large businesses. This segmentation of the bidder pool into two groups that do not compete against one another can effectively eliminate competition in areas where the only meaningful competition is between the two groups.

The other undesirable effects of the Forest Service small business set-aside

program are obvious and seen in other industries with set-aside programs, e.g. government procurement. Small businesses have an incentive to stay small even though it may be more economically efficient to increase their size. And large efficient firms may be prevented from entering a market because there is an effective cap on the amount of timber that they are able to buy. Furthermore, large firms have less incentive to buy an existing small business mill because doing so would reclassify the mill as large by virtue of its affiliation with the large firm. The reclassification would prevent it from bidding on the set-aside tracts. In fact, the set-aside program creates incentives for large firms to sell mills to small firms because doing so would qualify a mill for participation in the set-aside program and thus raise the value of the mill to the small firm.

There is considerable evidence that the small business set-aside program lowers the bids that the Forest Service receives from letting its tracts. One study estimates that the small business set-aside program cost the U.S. Treasury $180 million dollars (in 1982 dollars) between 1973 and 1981 in the west slope of Region Six.[5] The west slope of Region Six accounts for much of the Forest Service timber let in the United States.

A simple change in the way that the small business set-aside program is administered would do much to alleviate the anticompetitive problems currently associated with the program: replace the trigger with a policy that would eliminate tracts dedicated to small businesses but would give small businesses an advantage when they bid against large businesses, i.e. a small business could win a tract from a large business if it bid within a certain percentage, say five percent, of what the large business bid.

This simple reform would assure that the full range of bidders on any tract would influence the price because the bidder pool would no longer be segmented. Small businesses could not take advantage of a set-aside program by refusing to bid on open tracts. To win tracts, they must be willing to bid within five percent of what a large business bids. This reform would restore effective competition between the two groups while preserving special treatment for the small firms. Pooling all the bidders is

5. Schneipp, M., "The Economic Consequences of the set-aside Program in the Douglas Fir Regions of the Pacific Northwest," in Forestlands: Public and Private, edited by R. Deacon and M. B. Johnson, (Cambridge, Massachusetts, Balinger).

sometimes the only way that competitive prices for timber can be determined--especially in areas where the only possible competition is between large and small firms.

The reform also has the secondary benefit of encouraging higher bids by large firms than those they would otherwise make. If large firms have lower costs than smaller firms, a policy of giving the small firms a small break on price increases the revenue raised in the auction. Large firms have an incentive to bid higher because they face more aggressive bidding by smaller firms.[6] For example, suppose that there are two firms, one large and one small, bidding on a tract. Suppose further that the large firm has a cost advantage over the small firm. The large firm will win the tract at auction and pay a price, on average, equal to the highest price that the small firm is willing to pay. Giving the small firm a small advantage on the winning price will raise the price it is willing to pay by the size of the advantage. This has the effect of raising the price that the large firm has to pay to win the tract. In a series of simulations, McAfee and McMillan find that a bidding preference to small firms of about one third of the cost difference between large and small firms raises the most revenue for the Government.[7] If the cost differential between large and small firms is greater than fifteen percent then the recommended five percent bidding preference should be increased.

With the small firm bidding preference, the other two anticompetitive problems of the set-aside program are alleviated. Small businesses no longer have an incentive to stay small if being small means being too inefficient. They must grow to a size that permits them to submit bids within five percent of what large businesses are willing to pay. Furthermore, entry by large firms is no longer prevented. Large firms can bid on as many tracts as they want.

These proposals could be implemented with only modest changes in Forest Service regulations. The statute governing timber auctions[8] gives the Secretary of

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6. McAfee , R. P. and McMillan, J. "Auctions and Bidding," Journal of Economic Literature, June, 1987

7. McAfee, P. and MiMillan, J. "Objectives in Government Procurement: Analysis and International Comparisons," Report to the Department of Supply and Services, Ottawa, Canada.

8. 16 U.S.C. §#472a

Agriculture broad discretion in selling timber and contains no small business set-aside provision. The regulations of neither the Small Business Administration nor the Forest Service seem to mandate set-asides. However, Forest Service regulations that would not permit the award of timber to a small firm that did not submit the highest bid, must be changed.[9]

The program could be implemented in many different ways. The 5% level could be adjusted up or down to insure that small mills receive an appropriate quantity of timber. Moreover, the program could be phased out, e.g. a small mill might receive bidding preferences that decline over time, encouraging it to reach an efficient size. For example, small mills might receive 10% for the first year, 8% for the second, and so forth, so that they receive no protection in their sixth year.

VI. General Considerations

The reforms of the bid letting process discussed above are designed to deter collusion. However, the Forest Service has goals, in addition to deterrence, that it wants to achieve through its timber auctions. This section discusses these goals, and how they may be achieved, without making the bid letting process susceptible to collusion. We discuss competition in auctions and how competition is affected by changes in the bid letting process. In general, the effects of the choice of auction procedure depend on buyers' attitudes towards risk and uncertainty. In particular, buyers prefer more information and less risk. It is important to design auctions with these considerations in mind.

A. The auction mechanism.

If the Forest Service knew that it faced conspiracies in its auctions, it could use mechanisms other than auctions to sell timber that would not be subject to abuse by a conspiracy. In particular, it could either bargain face-to-face with a designated member of the conspiracy or simply set a "take-it-or-leave-it" price. However, it is difficult to detect

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9. See, e.g. 36 C.F.R. §§ #223.100-223.101

conspiracies, and when not facing a conspiracy, auctions are better mechanisms for selling timber than bargaining or take-it-or-leave-it pricing.

The advantage of auctions is that they are good at establishing the market value of an item that would be otherwise unknown. Items whose values are unknown are unique items or items whose utility depends on an unknown future state of the world. The problem facing the seller is that he knows neither which buyer values the item the highest, nor how much he is willing to pay. If the seller had this information, he could set a price or simply bargain with the high-value buyer. In the absence of such information, an auction is an efficient selling mechanism. Through an auction, the buyers' value is revealed to the seller and all of the buyers are involved in determining the value of the item. In addition, the auction price is quickly realized, and the item is sold to the buyer who values the item most highly. In other words, the outcome is efficient.

B. Sealed bid vs. oral auctions.

Two major types of auction are used in the United States, sealed bid auctions and oral auctions. Sometimes a minimum acceptable bid, or reserve price, is established and the seller sells only if the highest bid is at least as high as the reserve price. In the sealed bid auction, the buyer may or may not know the reserve price but in an oral auction, the bidding begins at the reserve price.

Consider first an oral auction. Suppose the current bid is "p" and the buyer has observed some of the other buyers drop out (or quit bidding) while others are still active. The buyer must decide if he expects the item to be worth p or not, given whatever information he has about the item's value (e.g., an estimate or "cruise" of the available timber on a particular tract) and information he has gleaned from other buyers' behavior at the auction. In particular, the bidders that are no longer active may be presumed to value the item at less than p, while bidders that are still active must think the item is worth at least p. This information will generally cause the buyer in question to revise his estimate of the value of the item. For this reason, bidders sometimes try to disguise their behavior at auctions.

Eventually, the price reaches a point where only two bidders remain, and when

the second to last bidder drops out, the last bidder wins the object. Furthermore, the second to last bidder drops out at a price at which he would break even. Thus, the winning bidder wins at a price equal to the value the second to last bidder puts on the item. It is important to remember, however, that this bidder takes into account the behavior of other bidders and when they drop out, he learns that they value the item less than the price at which they stop bidding. In general this information has caused him to reevaluate his own estimate of the item's worth.

In a sealed bid auction, by contrast, the winning bidder learns only that the other bidders did not evaluate the item as highly as he did. He learns this only after the auction is over, when it is too late to withdraw from the bidding competition. Thus, each bidder, when submitting a bid, must worry about the fact that, if he wins, his evaluation was the highest. Consequently, bidding strategies take into account the dramatically named phenomenon called the "winner's curse." It refers to the fact that the winner is the bidder who most overestimated the item's value. Thus in a sealed bid auction, bidders submit sufficiently low bids so that if they win, they still anticipate a profit--even if their private estimate of the value of the timber is too high.

There are two factors to consider when comparing oral and sealed-bid auctions--information and risk. A bidder in an oral auction can typically deduce more about the evaluations of the other bidders. Thus, the oral auction provides more information to a bidder than the sealed bid auction. Consider the sale of a tract of pine. All of the bidders have cruised the tract, and have learned something about the amount of pine present. In formulating a sealed bid, a bidder knows only the results of his own cruise but in an oral auction, the ultimate winner will have observed whether the bidding was vigorous (indicating that others had good results from the cruise) or lackadaisical (indicating poor results) and is thus better informed about the result of other bidder's cruises of the tract.

The release of such information sometimes increases and sometimes decreases the selling price, but on balance, if the bidders don't care about risk, the average effect is to increase the selling price. Informed buyers will tend to drive the price near the true value of the tract. Poorly informed buyers will, on average, underestimate the value of the tract and bid correspondingly low. The public release of information drives up the price.

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The Forest Service should release any information it has about the value of the tract.

A second policy prescription is that, if the bidders don't care about risk, the seller should use an oral auction to extract the highest selling price. As mentioned above, oral auctions release more information than sealed bid auctions and the release of information is unambiguously good.[10] We are careful to draw a distinction between the release of information about the tract and the release of information about competitors. The former is good; the latter is not.

When bidders care about risk the analysis is changed. An auction of a stand of timber presents the buyer with two types of risk. First is the risk that the tract will be worth less than the buyer anticipated and second is the risk that someone else will outbid him. Oral auctions present the bidder with less of the first type of risk but more of the second type than does a sealed bid auction. The reason for this is that a bidder who is bidding aggressively will, in general, cause other bidders to revise their estimates of the item's worth with the effect. In general it is more difficult for an aggressive bidder (one who values the item highly) to win in an oral auction. On balance, the second effect outweighs the first so that the net effect of an oral auction is to present bidders with more risk. This causes bidders to lower their bids (buyers must be compensated for bearing risk) so that on average sealed bid auctions return higher prices when firms are very averse to risk.[11]

To sum up, when firms compete, the choice of auction is a balancing act. If firms are very averse to risk, the sealed bid auction is better, but if firms are not averse to risk and information release is important, the oral auction is preferable. However, as mentioned above, when there is a risk of collusive behavior, sealed bid auctions are better.

C. The effects of concealing the number of bidders

Eliminating the first round of qualifying bids, in addition to making collusion more difficult, has beneficial effects when firms compete against one another. Keeping the

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10. Milgrom, P. and Weber, R. "A Theory of Auctions and Competitive Bidding," Econometrica, (November, 1982).

11. McAfee, P. and McMillan, J., "Auctions with a Stochastic Number of Bidders," Journal of Economic Theory, forthcoming.

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number of bidders concealed from one another presents the bidders with uncertainty about the strength of the competition they face for access to a tract. Risk averse bidders will respond to this uncertainty by raising their bids with the result that the total revenue raised is higher.[12] Higher revenue for the government means lower profits for the the bidders who may be expected to oppose such a policy.[13]

D. The effects of bundling tracts.

Large tracts are inherently more risky than smaller ones. The effect of bundling tracts is to present each bidder with more risk than if the tracts were smaller. Consequently, risk averse bidders submit lower bids and the Forest Service earns less revenue. As noted above, sealed bid auctions present buyers with less risk than oral auctions so they can be used to counter the adverse effects of risk. This leads to the prescription that for risk averse firms, sealed bid auctions are more appropriate for larger tracts than for smaller ones. This is exactly opposite from current Forest Service policy (currently sealed bid auctions are used only for small tracts.)

E. Incentive schemes

Some of the proposed reforms to reduce collusion present the timber purchasers with increased risk (such as bundling tracts). Fortunately, there are ways to reduce the level of risk faced by purchasers that do not increase the likelihood of collusion. In this section, the effects of incentive schemes on bidding competition are analyzed. Incentive schemes are procedures that link payments by the timber purchaser to the amount or value of timber harvested. In general, incentive schemes have two effects: they allocate risk between the timber buyer and the Forest Service, and they induce changes in the amount of timber harvested. An efficient incentive scheme will balance these effects so that risk is reduced to the timber buyer without significantly reducing the buyer's incentive

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12. See, e.g. Matthews, S., "Comparing Auctions for Risk Averse Buyers: A Buyer's Point of View," Econometrica, (May, 1987).

13. This is the case even though the concealing policy presents decreasing relative risk averse buyers with less risk. See, Matthews, supra note 12.

to harvest timber.

Incentive schemes can be characterized as payments where the Forest Service receives a fixed payment and a proportion of the revenues (or profits). These schemes take the following form:

payment = F + sP

where "F" is a fixed level of payment, "s" is the share ratio, and "P" is profits or revenues. For example a salesman receives a base salary (F) and a share (the commission rate s) of his sales (P). Incentive contracts are a middle ground between the extremes of "fixed price" contracts (s=0) where an amount independent of the outcome is paid, and "cost-plus" contracts (s=1) where all costs are covered. Incentive contracts represent a compromise between these two extremes.

Timber sales are similar to oil leases, and the motivation for considering them is the same in both cases. Oil leases are let at auction by the federal government and, like timber, the bidders are only partially informed about the potential value of the tract. For oil leases, the share ratio is 16% so that the federal government receives a lump sum bid (F) plus 16% of the revenues derived from the oil.

Incentive schemes like this have two major effects. First and most importantly, they share risk. There is significant risk associated with the purchase of a tract of timber. Prices for lumber might go down, less useable timber might be present than was anticipated, or costs might increase due to bad weather. For a small timber purchaser, this is a major risk. For a government selling huge amounts of timber, and spending over a trillion dollars each year, this risk is negligible. Thus, the government is better able to bear the risk associated with a timber sale than the timber purchaser. Since the timber purchasers must be compensated for bearing risk, the government can expect more revenue (and an increase in efficiency) if it bears more of the risk. Incentive schemes share risk because the government absorbs part of the losses in bad times, and enjoys part of the profits in good ones. Incentive schemes shift some of the risk from the timber purchaser to the government. The higher the share ratio, the more risk is shifted from the timber purchaser to the government.

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Unfortunately, incentive schemes reduce the incentive of the logger to work hard, in the same way that taxes do. Because a logger only enjoys part of the proceeds of his effort, he has less incentive to take every tree from the forest. With an incentive scheme, loggers may harvest only the high value timber. For example, suppose a Forest has only two trees, one worth $100 and the other worth $200 and that it costs $50 to harvest each tree. If the share ratio is greater than 50% of revenue, it will not be profitable for a firm to harvest the low value tree. This is sometimes called "moral hazard" by economists due to the similarity of the effect to that found in insurance markets. Just as an insured motorist is more likely to have an accident because the cost of an accident is lower, so is a logger less likely to harvest all of the trees in a tract because the benefits are lower.[14] A share ratio based on profits (revenue minus costs) instead of revenue will not have this effect. Consequently, an incentive scheme based on profits rather than on revenue is preferable although such a scheme would create incentives for firms to inflate reported costs. If costs are difficult to monitor, then revenue schemes may be better.

Currently, the Forest Service uses a particular incentive scheme that shares risk but encourages inefficient harvesting procedures. Firms bid a royalty rate (per board foot) for the timber in a tract with no fixed payment. This insures mills against the risk that there is less usable timber than anticipated and against the risk of decreases in the price of lumber, since the mill has the option of not harvesting some timber. This particular scheme shifts risk from the mills to the government but has the undesirable side effect of moral hazard. The higher the royalty rate to the firm, the less incentive the firms has to harvest low value trees. If bidding is very competitive on a tract, one would expect that less timber would be harvested.

There are incentive schemes that mitigate such negative side effects. For example, the Forest service could insure against price drops in lumber by allowing firms to bid on a lump sum basis for access to the tract plus a percentage of the revenue of timber extracted, with the revenue calculated at the time of extraction. The advantage of this policy--bidding on access rather than selling prices--is that firms are not induced to

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14. For a discussion of moral hazard in timber contracts see Rucker, R. and Leffler, K., "To Harvest or not to Harvest? An analysis of Cutting behavior on Federal Timber Sales Contracts," Working Paper #86 North Carolina State University (1986).

reduce their extraction as bid prices rise or selling prices fall. Currently, if selling prices of lumber fall, firms will choose to harvest only the timber that is easy to harvest, because the prices for hard to harvest timber does not justify its cost.

F. The appraisal method.

In setting a higher reserve price, the Forest Service needs to know the value of the timber to the government. When the Forest Service asks itself if it should sell a tract to a firm for $100,000, it must ask what it is giving up to do so. This defines the opportunity cost, or value, of the timber. By selling a tract to one firm, the government gives up the ability to sell the tract to a second firm. The value of the timber, in this case, is what another firm would be willing to buy the timber for. The auction mechanism is good at establishing the opportunity cost of timber because, on average, the winning price in an auction is the price that the second highest bidder is willing to pay. This is true whether the auction is an oral or sealed bid auction.

Unfortunately this is not the whole story. The government's alternative use of the timber is to hold on to it and sell it later. For example, if the value of a tract is $100,000 today but officials think that it will be worth $120,000 if it is auctioned in one year (either because the timber is growing or because the demand for lumber is growing), then it is worthwhile to to wait if the interest rate is less than 20%. A good appraisal system should take account of the future value of timber.[15]

Because the Forest Service is such a large supplier of timber there is also the possibility that it could exercise market power by keeping enough timber off the market to drive up the price. While this is not a proper public policy goal because keeping timber off the market to raise price above a competitive level reduces aggregate welfare, the Forest Service should not ignore the effect, in the aggregate, that it can have on price. In a very bad housing market, when demand for lumber (and timber) is low, the Forest Service would be short sighted not to let smaller quantities of timber than when demand is high. When demand is low, the price of the timber may be below the opportunity cost of selling

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15. See Samuelson, P., "Economics of Forestry in an Evolving Society," Economic Enquiry (December, 1976).

timber in the future. Consequently, an efficient appraisal scheme should not only be able to set a reserve price for timber but should give the government some guidance in how much timber to put on the market in any given year.

Another use of appraisals is to provide information to the bidders. This is important because private information collected by the individual bidders serves only to help each of them bid and is thus a social cost with no social benefit. Cruising a tract does not increase the amount of timber available, so that, if all bidders cruise a tract, there is wasteful duplication of effort that serves no productive role. Consequently, it is more efficient for the Forest Service to collect information on a tract and publicize it. This is an important aspect of the appraisal system: accurate, centrally provided information reduces the bidder's incentives to privately collect information, thus reducing duplication of effort.

The two main appraisal systems used by the Forest Service are the residual system and the transactions method. The residual system is an accounting approach to setting reserve prices. The Forest Service adds up the costs of cutting, transporting, and processing timber, and subtracts this (plus a "reasonable" profit) from the derived lumber's value. The residual is the reserve price, or appraisal, set on the timber. The main advantage of the residual system is that it adjusts quickly to changing demand and cost conditions (as the price of lumber changes). However, it provides no information about how much timber to supply to the market (it ignores the value of future use) and it is dependent on industry-provided cost reports. Mills have an incentive to overstate costs to lower the reserve price.

The other method used by the Forest Service to set appraisals is the transactions method. The transactions method forecasts the value of timber from a regression of past bid prices on tract characteristics within the same region. The forecasted sales price is then used to set the appraisal. The main advantages of the transactions method are that it provides some information about how much timber to supply to the market by providing a role for past transactions prices. In addition, it is not dependent on industry reported costs. However, it will be sensitive to whether firms are colluding or not. Past collusive behavior artificially lowers price which, in turn, artificially lowers the predicted appraisal price.
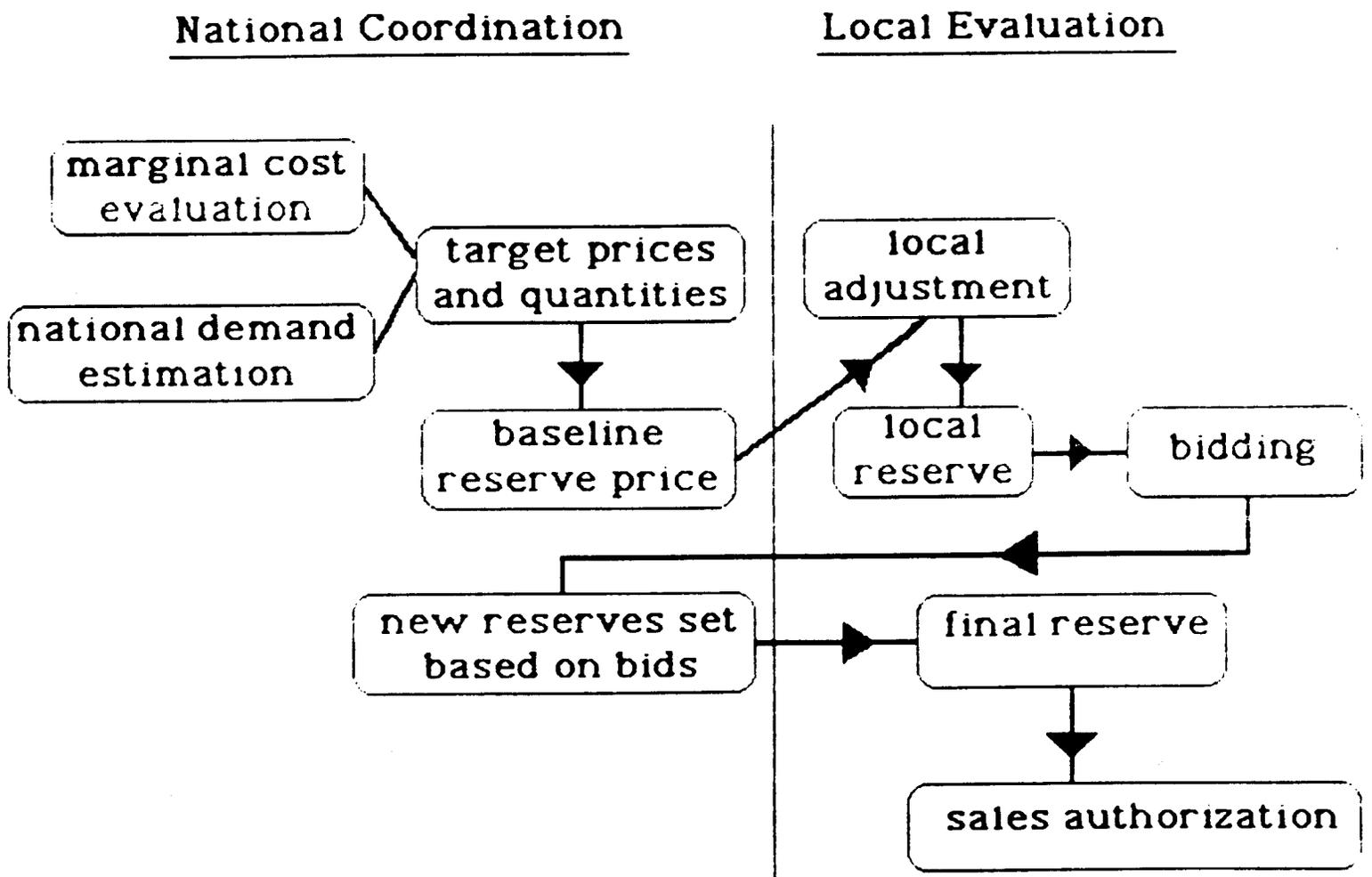
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VII. A new proposal

It would be desirable to utilize the advantages of both the residual and transactions appraisal systems while avoiding their disadvantages. In this section, the piecemeal approach to changing the Forest Service bid letting process is abandoned in favor of a more comprehensive approach. In particular it would be desirable to have a bid letting process that was not subject to abuse by conspiracies, that put the right amount of timber on the market each year, and that was fairly easy to implement. Such a system is illustrated in Figure 1.
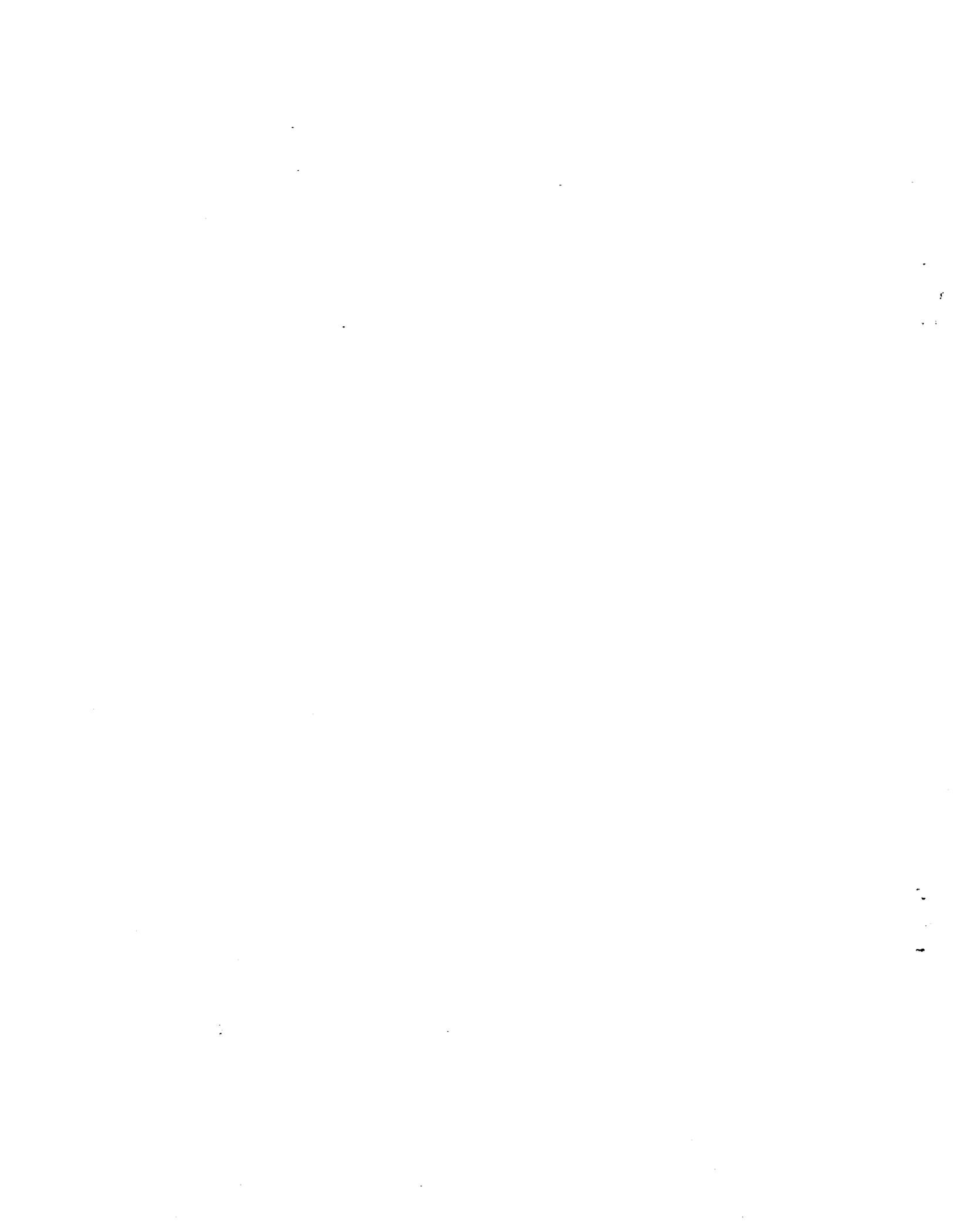
*************************** INSERT FIGURE 1 HERE ****************************

The first stage of the setting of reserve prices occurs on a national level. For each type of timber, marginal costs and demands are calculated. Marginal cost is effectively the replacement cost of timber, which includes the planting, maintenance, and roadbuilding costs of tracts, foregone use of land for other purposes, and administrative costs, for typical national forests. Currently, the Forest Service does no cost accounting for Forests. To implement such a system, cost accounting would be necessary. The national demand for timber is derived from the forecast demand for lumber of various species. The combination of costs and demand yields forecast prices and quantities for the planning horizon (e.g. one year), for lumber. This is translated into prices of various types of timber, by subtracting the logging and processing costs for typical stands. The result is a baseline reserve price for tracts of timber that takes into account the species of wood in the tract.

The next stage occurs at the local level when Forest Service officials calculate the baseline reserve for various tracts ready for sale, by multiplying the baseline reserve by the amount of timber in the tract. This provides a starting value for the tract's reserve price. Then local officials may file deviations forms, similar to the current residual appraisal forms, to request variances from the baseline price. The variances can be justified on several grounds:

Figure 1: Loopback Reserve Price

National Coordination

Local Evaluation

marginal cost evaluation

national demand estimation

target prices and quantities

baseline reserve price

local adjustment

local reserve

bidding

new reserves set based on bids

final reserve

sales authorization

1. local timber is infested or aging and must be harvested soon (lower reserve);

2. local timber can be harvested more cheaply than the national average (higher reserve);

3. local timber can be replanted cheaply indicating a lower replacement cost than the national average (lower reserve); or

4. Officials suspect collusion is present (higher reserve).

These variances are then applied to the baseline reserve price, creating a local reserve price. Bidding is then held (either by sealed bid or oral auction). The results of the bidding are then passed back to the national level, where a demand schedule is constructed for the various types of timber. For example, if we accept a price of $100 per mbf of red cedar, then 35 million board feet will be supplied nationwide, if we accept a price of $95 then 40 million board feet will be supplied. Then, new reserve prices are calculated, so that an appropriate amount of timber of each type is released for sale, according to the demand schedule and the target quantities.

These new reserve prices are passed back to the local officials who recalculate the reserve prices for the tracts. The new reserve prices are compared to the highest bid on the tract (new bids are not allowed), and the timber is sold to the highest bidder if the highest bid exceeds the adjusted reserve price. Otherwise it is not sold.

Because bids are reevaluated at the national level, and thus, the information flows "loopback" to the national level, we call this the loopback appraisal system. The loopback system combines the advantages of the residual system (in computing local variances) and the transaction method (in forecasting demand) while avoiding their major disadvantages. The loopback of information from the local to the national level allows the Forest Service to observe the national demand for lumber before they place timber on the market. Without the loopback, the Forest Service would be relying on estimates of national demand.

In addition the loopback system strongly promotes competition at a national level. Because the final reserve price is unknown at the time of bidding, every bidder must be concerned with competition arising from bidding on a national level for similar tracts. That is, a single bidder on a particular tract, might rationally choose to bid above the reserve

price, to increase the likelihood that his bid is not rejected by the reserve price adjustment to follow. Consequently, the loopback system creates competition on a national level, and local tracts with only one or two bidders still face competition from areas with many bidders, even though they are not bidding on the same tract. This feature of the system is similar to intertract leasing of coal, sometimes employed by the Interior Department. The Interior Department will accept bids, for example, for three tracts of coal but will award only the two tracts that receive the highest bids.

Another advantage of this system is that timber will be harvested only if it is economic to do so. Those areas with particularly high growing and harvesting costs will priced out of the market by national competition. Just as it is inevitable that inefficient firms fail in a competitive market, so it is inevitable that high cost timber tracts are not harvested if the timber is auctioned at competitive prices. To determine if it is profitable to lease timber, the Forest Service must develop a cost accounting system for its Forests.

VIII. Conclusion

Rather than focus on detection and prosecution of bid rigging, we have identified five changes in the way that Forest Service auction mechanisms are designed that would make it more difficult or less profitable for firms to rig bids. We have also analyzed potential efficiency effects of these reforms in auctions where bidders do not collude. Each of these reforms has an independent effect so that any one of them could be implemented by itself to deter bid rigging. Implementing more than one would have additional benefits. A more comprehensive policy is also proposed that would create a national market for Forest Service Timber, and obviate the need for some of the individual changes.

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