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# A Break-even study of in-woods merchandising opportunities for hardwoods in the Alabama-Mississippi-Tennessee region

David Kinbrough

Steven H. Bullard
*Stephen F. Austin State University, Arthur Temple College of Forestry and Agriculture*, bullardsh@sfasu.edu

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# A BREAK-EVEN STUDY ON IN-WOODS MERCHANDISING OPPORTUNITIES FOR HARDWOODS IN THE ALABAMA-MISSISSIPPI-TENNESSEE REGION

David Kimbrough and Steven H. Bullard[1]

## ABSTRACT

In most areas of Alabama, Mississippi, and Tennessee the recent arrival and dramatic growth of the hardwood chipping industry has created concerns among some members of the hardwood manufacturing industry. Hardwood sawmill and furniture manufacturing personnel are concerned that marginal sawlog/pulpwood material is increasingly processed as chips rather than sawn into lumber. The potential exists for increased in-woods merchandising of hardwoods, and this paper evaluates how transportation costs and pricing differences between hardwood pulpwood and sawlogs affect merchandising and hauling decisions. A model was developed to assist individual users in evaluating their merchandising and transportation options.

## INTRODUCTION

During the past decade the hardwood chipping industry has rapidly expanded in the Southeast. A revised version of Knight's survey in 1990 shows that by the summer of 1991 there were 41 hardwood chip mills in place or in the planning stages in the Alabama-Mississippi-Tennessee region (Figure 1).

Hardwood chip mills have found the Alabama-Mississippi-Tennessee region especially attractive due to relatively low stumpage prices for hardwood pulpwood and relatively inexpensive water transportation available along the Alabama, Black Warrior, and Tennessee Rivers, and the Tennessee-Tombigbee Waterway system. The Tennessee-Tombigbee Waterway and its feeder system have created opportunities for exporting hardwood chips world-wide through the port of Mobile, Alabama.

According to Hagler (1990), the export market for hardwood chips did not fully develop until 1987, but in 1989 almost 1.9 million short tons of hardwood chips valued at $161,865,000 were exported from the South (Knight 1990). The majority of these hardwood exports were destined for Japan, with Taiwan and South Korea receiving smaller portions. These foreign mills are interested primarily in oak and are attracted by the South's high

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[1]The authors are graduate research assistant and associate professor, respectively, in the Department of Forestry, Mississippi State University.

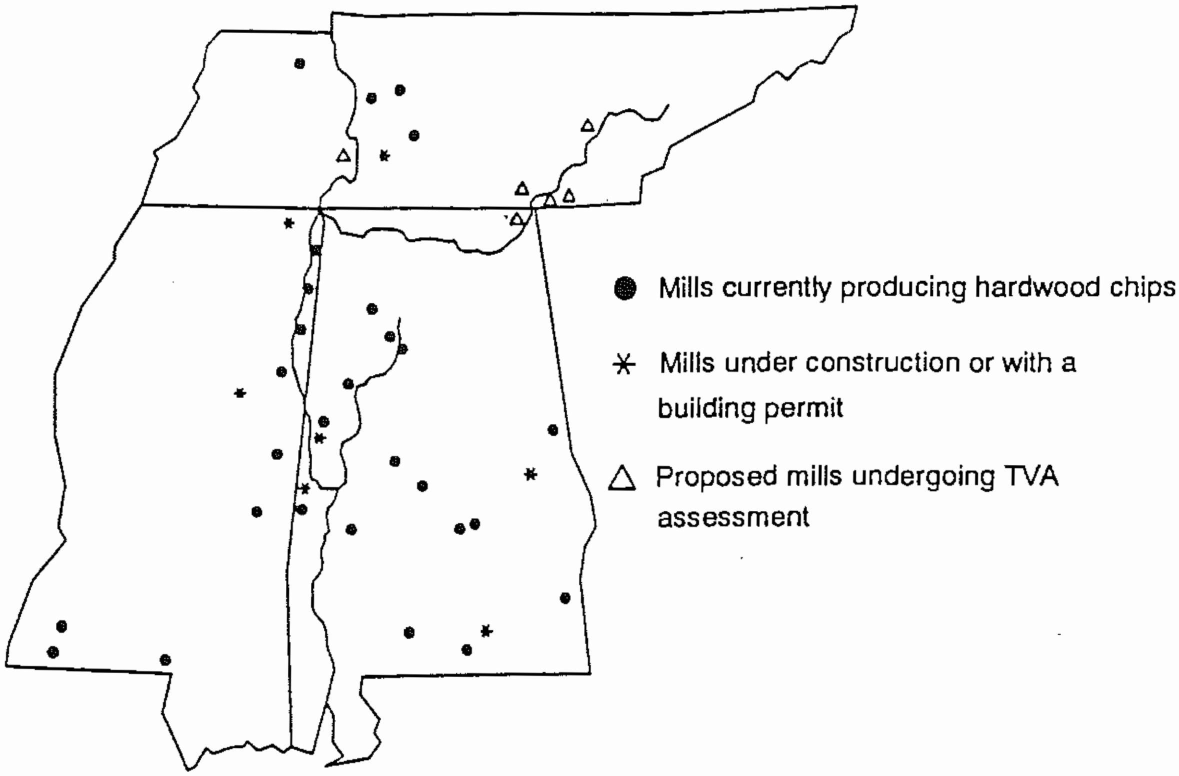


Figure 1. Hardwood chip mills in Alabama, Mississippi, and Tennessee in the summer of 1991.

levels of oak inventory (Faulkner and Hyman 1989). Barrett (1990a) estimated that providing these chips for export required the equivalent of over 748 million board feet of small, sawtimber sized trees.

In some areas of the South, including many of the counties affected by the Tennessee-Tombigbee Waterway, hardwood removals have increased quite dramatically in recent years. Serious concerns have arisen that the resource base may not be adequate to sustain the increased harvests (Autry 1991). Hardwood lumber and dimension stock producers are particularly concerned with pulpwood harvests of higher quality sawtimber, and of timber that would become merchantable as sawtimber within the relatively near future (Barrett 1990b). Other low grade lumber users such as pallet manufacturers and railroads are also showing increased concern over the availability of lumber and cants in the future (Barrett 1991). This paper addresses the potential for in-woods merchandising of hardwood timber that is currently being chipped, but could be utilized at the sawmill instead.

## DEFINING THE COSTS AND REVENUES OF MERCHANDISING

To assess all relevant costs and revenues associated with in-woods merchandising, several hardwood harvesting operations and hardwood mills were visited within the general study area. These operations provided insight on how merchandising decisions were made in the field, and how transportation costs affected these decisions. To perform a break-even analysis for these operations, three inputs were required: (1) a fixed cost, (2) a variable cost, and (3) a price or price difference between products. After these inputs were obtained, a break-even model was developed to assist in decisions on delivering individual loads of hardwood timber to sawmill or pulpmill facilities.

### Fixed Cost

After observing several hardwood logging operations it was assumed that total harvest costs would be essentially equivalent regardless of mill destination for certain tree-length loads of marginal pulpwood/sawlog material, i.e., it should cost the same amount to fell, skid, load, and haul marginal stems to the nearest mill. The fixed component of costs therefore included the transportation cost incurred while driving to the nearest processing facility. This implied that relevant variable costs, i.e., marginal costs, were not initiated until the truck drove past mill #1 and started hauling to a more distant mill #2. This means that the initial harvesting cost was essentially "fixed" for the purpose of the analysis and was not necessarily needed for making marginal decisions.

Realistically, there will probably be slight discrepancies in total harvesting costs, mainly because of some extra sorting done by the loader. However, this cost should be relatively minimal on a per ton basis, and would vary with the size and quality of trees being harvested. Since this study is best suited for marginal pulpwood/sawlog stands of relatively "moderate-sized" tree-length stems (14"-22"), the assumption of a minimal cost difference should be valid.

### Variable Cost

The extra cost of hauling logs to a more distant mill location was considered the "variable" cost in the present study. Added transport cost was calculated in the manner applied by Sundberg and Silversides (1988), i.e., by dividing the cost of the vehicle per unit of time by the product of the payload and the average speed of transport. Before the payload estimate was used, however, it was divided in half, since trucks were assumed to return empty on the roundtrip. Unique variable costs were then calculated in a decision-making model developed in Lotus 1-2-3[2] which determined the most profitable destination for individual loads of hardwood sawlog/pulpwood material.

Merchandising decisions for individual loads are subject to change, depending on the different speeds, distances travelled, payloads, truck costs per hour, and differences in prices applicable to each load. Therefore, the model was constructed so that each of these factors would provide some sensitivity when deciding between two mill destinations.

## Prices and Price Differences

Price ranges used in the analysis were calculated from Timber Mart-South data from the first quarter of 1988 through the fourth quarter of 1991 (Timber Mart-South 1988-1991). Areas covered by the study included all price areas for Alabama, Mississippi, and Tennessee, except the Mississippi delta region which was omitted due to a lack of chip mills. Prices for oak sawlogs, mixed hardwood sawlogs, and hardwood pulpwood were converted from board foot and cord figures to a per ton basis. This conversion not only provided a common denominator for comparison but was also deemed necessary since most chip mills and tree-length sawmills now buy wood on a ton basis. Price differences between products were then obtained by subtracting the price of hardwood pulpwood from the price of mixed hardwood sawlogs, as well as from the price of oak sawlogs. More emphasis was placed on price differences between mixed hardwood sawlogs and hardwood pulpwood since these two products are more closely associated in terms of quality than are oak sawlogs and hardwood pulpwood. From these calculations, a relevant range of price differences was established for further use in the decision model.

In Alabama, price differences between mixed hardwood sawlogs and hardwood pulpwood have ranged around $4 per ton (Figure 2). The differences in North Alabama have typically been more volatile than in other regions of the state. Increased pulpwood prices have been part of the reason, especially in 1989 and 1990. During the first two quarters of 1990, pulpwood prices soared due to wet weather conditions, actually causing prices for pulpwood to exceed those for mixed hardwood sawlogs. Generally, sawlog prices in North Alabama have historically been lower than prices in the southern part of the state. Part of the explanation for lower prices can be derived from the lower quality stems which are more prevalent in the upland areas of North Alabama. The large hardwood sawmills located in central Alabama refuse to pay premium prices for these upland hardwoods.

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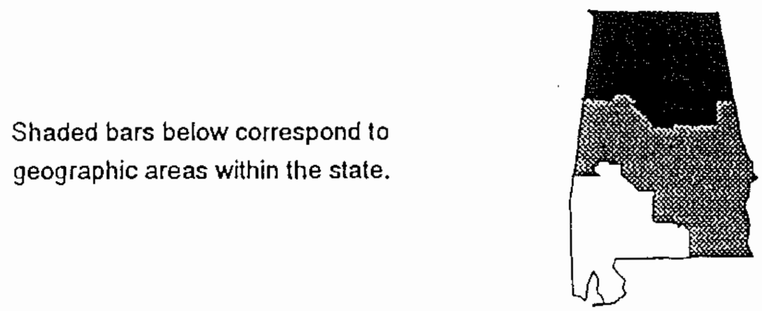
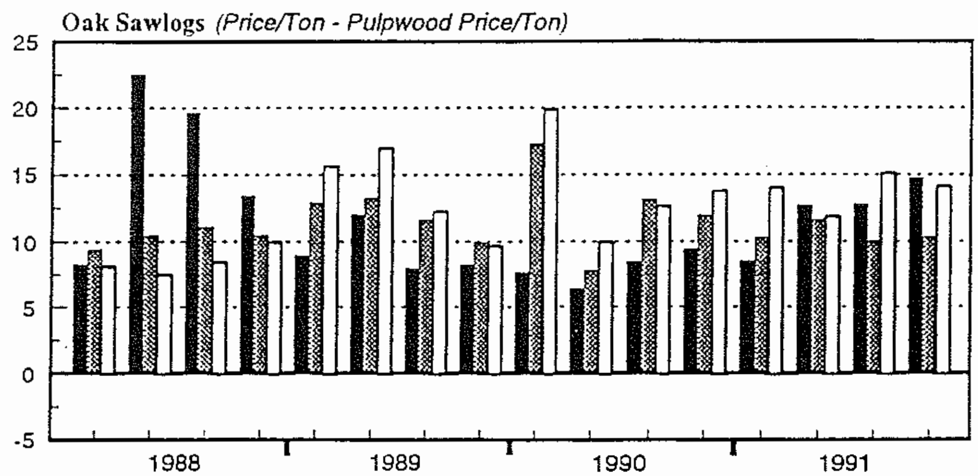
[2]Lotus 1-2-3, Lotus Development Corporation, 55 Cambridge Parkway, Cambridge, MA 02142.

Differences in Delivered Prices, *Alabama,* by Geographic Area



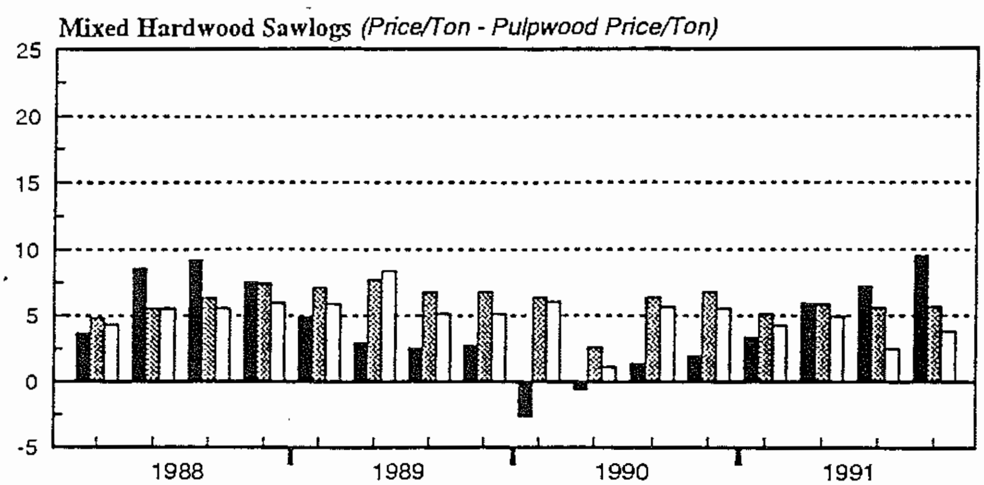




Figure 2. Differences in delivered prices for oak sawlogs and pulpwood, and mixed hardwood sawlogs and pulpwood by geographic area in Alabama, quarterly for 1988-1991.

Another trend in Alabama can be seen in the southwest region, where price differences have generally been lower due to the high concentration of pulp and paper facilities. The presence of these mills has had a direct impact on pulpwood prices; prices for delivered hardwood pulpwood in this area have exceeded the remaining two areas for eleven of the twelve quarters between 1988 and 1991.

Overall, price differences in Mississippi were smaller than those calculated for both Alabama and Tennessee. The price difference between mixed hardwood sawlogs and hardwood pulpwood has averaged about $3 to $4 per ton. For both of the areas measured in Mississippi, especially North Mississippi, sawlog prices have traditionally been lower than in Alabama or Tennessee. A major factor in the lower prices is the lack of big sawmills in the area. The typical hardwood sawmill in North Mississippi is relatively small and depends on tree-length material. These mills produce mostly lower grade lumber, furniture stock, crossties and switchties, and pallet lumber. These primarily lower grade products do not receive the premium prices of higher grade products, and this has been reflected in the delivered price data for logs.

Prices for mixed hardwood sawlogs in Mississippi have been fairly stable since 1988 (between $16 and $19 per ton), while chip mill gate prices have generally edged upwards ($11 to $17 per ton) to nearly equal or at times surpass the sawmill price (as in 1990 in South Mississippi). The export market has allowed several chip mills added flexibility in setting prices, since chip export sales prices have averaged around $90 per ton in recent years (Barrett 1991). It should also be noted that the price of quality oak sawlogs has been surpassed by pulpwood at times. This occurred in South Mississippi in the first quarter of 1991, when the delivered price of oak sawlogs plummeted while the price for pulpwood remained high.

Hardwood pulpwood prices in Tennessee have generally remained lower and much more stable ($11 to $14 per ton) than in Alabama or Mississippi for the four years considered. The lower price for hardwood pulpwood has caused the price difference between products to average around $5 per ton. This price difference usually exceeded those in Alabama or Mississippi. The lower price for pulpwood can probably be attributed to the lack of satellite chip mills in Tennessee. Several of the chip mills that are presently operating are working in conjunction with hardwood sawmills. Another contributing factor to the larger price differences has been the higher sawlog prices paid by the larger mills operating in the state.

## BREAK-EVEN ANALYSIS

The basic function of the break-even model was to assess transportation cost increases versus price differences for individual loads of hardwood sawlog/pulpwood material. The decision between mills was therefore based on comparing increased costs and increased revenues for merchandising. In other words, if mill #1 was located 20 miles from the logging site, while mill #2 was located 50 miles away, how much more must mill #2 pay (than mill#1) to justify travelling the 30 additional miles? Table 1 has an example scenario of the break-even model.

Table 1. Transportation decision for an individual load of logs with a payload of 26 tons, a truck cost of $35 per hour, and an average speed of 50 miles per hour.

| | EXTRA ONE-WAY MILES | %MILEAGE | SPEED LOADED | SPEED EMPTY | AVG. SPEED ROUNDTRIP | PMH |
|---|---|---|---|---|---|---|
| WOODS | 0 | 0 | 6.75 | 7.28 | 7.00 | 0.00 |
| GRAVEL | 1 | 0.033333 | 26.68 | 29.64 | 28.08 | 0.04 |
| BLACKTOP | 20 | 0.666666 | 42.96 | 48.31 | 45.48 | 0.44 |
| INTERSTATE | 9 | 0.3 | 61.06 | 62.39 | 61.72 | 0.15 |
| TOT. HAUL | 30 | 1.00 | WT. AVG 47.85 | 51.91 | 49.77 | 0.62 |
| | | | | EXTRA UNLOAD TIME (MIN) | | 10 |
| | | | | EXTRA TRIP TIME (HRS) | | 1.41 |

| # TONS | TRUCK $/HR | COST/TON/MI | COST/MILE | PRICE DIFF. | BREAK-EVEN POINT IN MILES | DECISION |
|---|---|---|---|---|---|---|
| 26 | $35.00 | $0.05409 | $1.40646 | $0.50 | 4.62 | mill #1 |
| 26 | $35.00 | $0.05409 | $1.40646 | $1.00 | 9.24 | mill #1 |
| 26 | $35.00 | $0.05409 | $1.40646 | $1.50 | 13.86 | mill #1 |
| 26 | $35.00 | $0.05409 | $1.40646 | $2.00 | 18.49 | mill #1 |
| 26 | $35.00 | $0.05409 | $1.40646 | $2.50 | 23.11 | mill #1 |
| 26 | $35.00 | $0.05409 | $1.40646 | $3.00 | 27.73 | mill #1 |
| 26 | $35.00 | $0.05409 | $1.40646 | $3.50 | 32.35 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $4.00 | 36.97 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $4.50 | 41.59 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $5.00 | 46.22 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $5.50 | 50.84 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $6.00 | 55.46 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $6.50 | 60.08 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $7.00 | 64.70 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $7.50 | 69.32 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $8.00 | 73.94 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $8.50 | 78.57 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $9.00 | 83.19 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $9.50 | 87.81 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $10.00 | 92.43 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $10.50 | 97.05 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $11.00 | 101.67 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $11.50 | 106.29 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $12.00 | 110.92 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $12.50 | 115.54 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $13.00 | 120.16 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $13.50 | 124.78 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $14.00 | 129.40 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $14.50 | 134.02 | MILL #2 |
| 26 | $35.00 | $0.05409 | $1.40646 | $15.00 | 138.65 | MILL #2 |

Under this scenario the load should not be driven to mill #2 until the price of hardwood sawlogs nears $3.50 per ton higher than mill #1's price per ton for pulpwood. Obviously, if any variable in the analysis was changed, the break-even point might also change.

A clear limitation of the model is that it does not consider the extra number of trips that can be made to mill #1 over the course of a day. The model only considers an individual load of logs. It can still be applied by the decision-maker, however, especially for operations where transportation is not the limiting factor in production.

Realistically, the model can be applied for any set of products, such as marginal decisions between pine pulpwood and chip-n-saw, or chip-n-saw and sawlogs. It could also be used simply to make hauling decisions between alternative mills competing for the same product. A final use of the model would be simply to make hauling decisions for a single mill destination, where actual prices for an individual mill were used instead of price differences between two mills.

## EFFECTS OF INDIVIDUAL VARIABLES

Hourly truck cost estimates were made for the tandem tractor, tandem semitrailer truck configuration typically used in tree-length harvesting operations. Average truck costs per hour were calculated using both the machine rate and before-tax cash flow approaches. After the initial calculations, the individual effect of truck cost per hour was assessed (Figure 3).

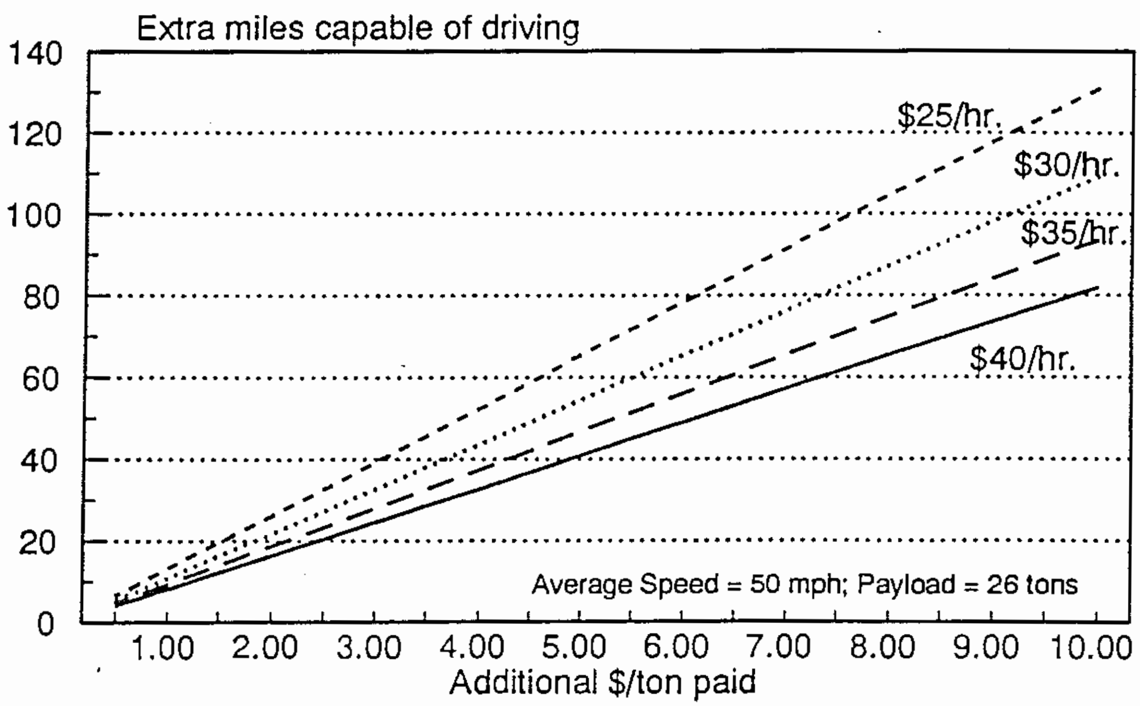



Figure 3. The effect of truck cost per hour on the number of extra miles driven, according to specific price differences between mills.

As truck cost per hour decreased, the cost per ton-mile also decreased and the truck could travel further distances at a given price difference. Truck cost per hour also had a greater effect on the haul cost than did payload or speed, simply due to the nature of the variable cost per ton-mile equation (Sundberg and Silversides 1988).

Realistic truck costs per hour using the machine rate ranged from $30 to $40 depending on the fixed, operating, and labor costs that were used. Before-tax cash flow costs were slightly less than machine rate costs and ranged around $30 to $35 per hour. An even lower range of costs was included in the analysis to account for used equipment which would entail a much lower fixed cost and hence a lower truck cost per hour.

As payload was increased, the distances that could be hauled also increased. Payload had a lesser effect on costs per ton-mile than truck cost per hour, however, simply because the return trip to the woods was empty. This nonproductive return trip essentially reduced the impact of payload by half.

As average truck speed increased, the cost per ton-mile gradually decreased so that additional miles could be travelled at any given price difference. The primary factor affecting average roundtrip speed was the type of road class driven. When more time is spent on second and third class roads the average speed will naturally decrease and cause costs per ton-mile to increase.

One important advantage of the model was that it calculated a unique cost per ton-mile based on the actual extra miles driven. Theoretically, this should be much more accurate for marginal decisions than using a rule-of-thumb haul cost (such as the $0.07 per ton-mile often used) that are often applied in the field. Rule-of-thumb costs may be fairly accurate considering travel time in the woods and on gravel roads, but they are usually too high for measuring differences in mileage between mills. These costs are too high because the load must be hauled from the woods and usually on gravel regardless of the mill destination. The actual differences in miles are therefore usually incurred on paved roads which provide less wear on the truck, have greater rates of speed, and thus have lower costs per ton-mile.

## CONCLUSIONS

Since harvesting costs remain essentially the same whether a tree-length load of logs is driven to a sawmill or to a pulping facility, transportation cost is the most important variable for in-woods merchandising of sawlogs and pulpwood. Transportation costs for tractor trailers are primarily determined by truck costs per hour, payload, average speed, and distance. Distance between mills is the most important factor assessed when making the break-even decision between alternative mills simply because additional costs are incurred with each additional mile travelled. The remaining variables all have individual effects on the cost per ton-mile of hauling individual loads. Hauling costs per ton-mile can be decreased by increasing the payload, increasing the speed, and by decreasing the operating cost per hour of the truck.

Based on average truck costs of $40 per hour, a roundtrip speed of 50 mph, and an average payload of 26 tons, a truck should be able to travel 24-32 miles further based on the $3-$4 per ton average price difference found in Mississippi. Since these costs, speeds, payloads, and price differences can easily change, each load should be individually evaluated for its merchandising and transportation options.

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