Indiana's Stumpage Markets – Potential Impacts of Increased Sales from State Forestland

(A discussion paper)

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Many factors should be considered in the determination of harvest levels on timberland managed by government agencies. Most important is the relationship of the agency's harvesting program to its overall goals. Because agency timber is sold into local and regional stumpage markets, these decisions should also consider possible impacts on stumpage markets that would affect private timberland owners. Advocates of no or limited harvesting on government timberland have argued that such a policy would increase stumpage prices for private owners, providing an incentive for them to improve the management of their lands. By-in-large this discussion has taken place with regard to the Western United States where the government's ownership is as high as 75 percent of total forestland, Table 1.[1] The comparable figure for Indiana is 17 percent. The percentage owned by all Indiana state agencies is 7.2 percent. These percentages are for all forest land, even those lands not available or suitable for timber production, such as nature preserve and state parks.

Stumpage markets in the short-run are defined on the supply side not by the area of forest land, but by the volume of timber offered for sale by owners, and the derived demand for stumpage based on the markets for logs and the products derived from logs.

[1] See for example, Gorte, Ross W. 2004. Below-Cost timber Sales: An Overview. CRS Report for Congress, Congressional Research Service, The Library of Congress, Washington, DC

Table 1. Forest land area in the United States by ownership and region, 1997, thousands of acres.[2]

Region	All Ownerships	Total Public	Percent Public	State	Percent State	Non-Industrial Private	Percent Non-Industrial Private
Northeast	84,758	14,788	17.4	10,021	11.8	58,908	69.5
North Central[3]	84,121	26,019	30.9	19,923	23.7	54,321	64.6
Indiana	4,464	764	17.1	321	7.2	3,682	82.5
South	87,911	12,765	14.5	2,818	3.2	60,758	69.1
South Central	124,374	12,576	10.1	5,150	4.1	89,462	71.9
Rocky Mountain	137,271	102,417	74.6	5,922	4.3	31,941	23.3
Pacific Coast	217,428	143,688	66.1	28,966	13.3	61,110	28.1
United State	740,620	313,791	42.4	59,996	8.1	359,716	48.6

In the long-run, however, timber supply is of course determined by timber inventories, or growing stock, the term used by the U.S. Forest Service. The volume of timber actually marketed in a given year is reflected in harvest levels.

Harvest levels from growing stock on public "timberland" other than National Forests was the highest in the North Central Region, Table 2, because of the large state and county timberland holdings and harvest levels in Michigan, Minnesota, and Wisconsin. Timberland is defined by the U. S. Forest Service as forest land that is producing or capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation.

[2] Smith, et. al. (2002) Table 2, hectares converted to acres by multiplying hectares by 2.45

[3] Includes Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin

Table 2. Annual removals of growing stock on timberland by ownership and region, 1996, thousands of cubic meters[4]

Region	All Ownerships	Non USFS Public	Percent Non-USFS Public	Non-Industrial Public	Percent Non-Industrial Public
Northeast	36,074	1,669	4.6	26,011	72.1
North Central	42,385	8,555	20.2	27,443	64.7
South	126,197	4,320	3.4	83,831	66.4
Indiana	na	na	na	na	na
South Central	162,032	3,211	2.0	104,812	64.7
Rocky Mountain	15,055	1,450	9.6	5,271	35.0
Pacific Coast	71,643	7,561	10.6	21,877	30.5
United State	453,387	26,766	5.9	269,244	59.4

The affect on market price of an increase in stumpage offered for sale depends on market structure, the shape of the supply and demand curves for stumpage, and the resulting price elasticity of supply. This elasticity is defined in the Appendix.

Market Structure

It is generally assumed that timber owners sell into a highly competitive market, however, the level of competition is highly variable. Buyers' interest in a given offering depends on the volume, species, product mix (sawlog, veneer log, pulpwood, firewood), quality, and the accessibility and location of the timber relative to buyers' log markets. There are a large number of potential timber sellers in any given year.

Statewide there were an estimated 151,300 private owners of forestland in Indiana in 1994, a 228 percent increase from 1976 (Birch, 1996). Because the parcelization of forestland has apparently continued since 1996, the number of owners is now higher.

Roundwood processing has almost doubled over the last thirty-four years, Figure 1, (Piva and Gallion, 2003), increasing from 197 MMBF Doyle in 1966 to 387 MMBF in

[4] Smith, et. al. (2002), Table 35.

2000. The average annual increase was 5.6 MMBF. The number of primary wood-using mills in Indiana, however, has decreased by fifty-four percent, from 444 in 1961 to 206 in 2000, Figure 2. This is due primarily to the restructuring of the hardwood sawmill industry required to offset increased labor and log costs. Economies of scale have driven the average output per mill from 380 MBF per annum in 1966 to 1,879 MBF in 2000.

Most primary mills buy logs delivered by logging contractors and brokers. In addition to these mills there are a large number of brokers who buy stumpage from landowners, and other brokers who buy logs that are merchandised to regional mills, off-shore exporters, and mills in other regions of the United States. Thus, there are at least 400 buying units that provide the market for stumpage.

Sellers of small quantities and/or poor quality timber frequently have to negotiate with any buyer willing to deal with them, a classic ologopsonistic market structure in which the seller is a price taker. In such cases timber is frequently sold "on-the-shares" whereby the seller shares market risk with the buyer, usually a logger. The proceeds received by the logger from log sales are split with the seller based on a fixed percentage split. As the volume of timber, average tree size, and timber quality increase, the number of potential buyers increases. Larger blocks of high quality timber may have twenty or more buyers interested in bidding on the timber in sealed bid sales facilitated by a private consulting forester.[5] This indicates that the demand for such timber is much higher than for low quality and/or small sales, representative of a competitive market structure in which the market price (winning bidder) is based on the unique needs of the buyer at that point in time.

[5] Hubbard and Abt (1989) found that the advantage to landowner in the southeast of market information and technical assistance increased as market value increased

Supply and Demand Curves

The demand curve for stumpage is derived from the demand for logs, which in turn is derived from the demand for pulpwood, lumber and veneer, which after other processing stages is derived from the demand for final industrial and consumer products. With a few vary rare exceptions,[6] the demand curves at each of these stages is negatively sloped. This means that for a specified market and time period an increase in the market price will reduce the amount buyers are willing to purchase. Market price is determined by the interaction of supply and demand conditions, shown graphically by the intersection of the market supply and demand curve. Gregory (1987) describes the typical log supply curve as sinusoidal, initially increasing at a decreasing rate, then increasing at an increasing rate. This is because as price increases the buyers can reach out to tracts of timber further from the buyers' mills. The same logic would apply in terms of timber quality, that is, as price increases owners of high quality timber are more willing to sell.

The supply curve for stumpage would not be a smooth curve unless the market is defined to include a very large geographic area. This is because quantity increases by the addition of tracts of timber of highly variable sizes. Nevertheless, the critical relationships can be described using smooth continuous curves.

Supply and Demand Curves for Logs

The readily available market information is for Indiana's log markets. Price data is available from the annual *Indiana Forest Products Price Report and Trend Analysis* (Hoover and Preston, 2004), and quantity of logs purchased by mills is available from

[6] Some luxury goods have positively sloped demand curves. Burl and highly figured veneer may fall into this category.

Indiana Timber Industry—An Assessment of Timber Product Output and Use, 2000 (Piva and Gallion, 2003).

Log purchase data by species and product class was used to divide the total log market into high quality and average quality segments. All veneer log purchases and a percentage of sawlog purchases were assigned to the high quality segment. The sawlog percentage varied from 30 to 60 percent depending on species. The equilibrium market quantity in 2000 was estimated to be 190 MMBF for high quality timber. The equilibrium market quantity for average quality timber in 2000 was 200 MMBF, the difference between 390[7] and 190 MMBF. The equilibrium market prices used were the weighted average delivered log prices for the high quality and average quality log mixes for 2000 (Hoover and Preston, 2004). These were $620 per MBF and $425 per MBF for high and average quality respectively.

These equilibrium prices and quantities identify one point on both the supply and demand curves for the two market segments. The second points needed to define the straight line curves were identified by making assumptions regarding the intercepts for the two curves. The second point on the supply curves was identified by assuming that no logs would be delivered to mills unless the log price at least covered logging and transportation cost, estimated to be approximately $145 and $140 per MBF for high and low quality segments respectively (Hoover and Preston, 2004). The second point on the demand curves was identified by assuming that if the log price was zero mills would produce at total capacity, assumed to be 400 MMBF (2.1 times the equilibrium quantity) for the high quality market segment and 450 MMBF (2.25 times equilibrium quantity) for

[7] The 89.1 mil cubic feet of industrial roundwood receipts, Piva and Gallion (2003), Table 2, was converted to 387 MMBF Doyle scale and rounded to 390 MMBF.

the low quality segment. This assumes that mills are currently operating with a single shift, but in the short-run could add at least a second longer shift.

These assumptions yielded the following equations for demand and supply curves,

High quality market segment:

$$Pdh = 1180 - 2.95\ Qdh$$

$$Psh = 145 + 2.53\ Qdh$$

where,

Pdh and Qdh are the demand price and quantity in the high quality log market

Psh and Qsh are the supply price and quantity in the high quality log market

Average quality market segment:

$$Pdl = 765 - 1.7\ Qdl$$

$$Psl = 140 + 1.43\ Qsl$$

where,

Pdl and Qdl are the demand price and quantity in the average quality log market

Psl and Qsl are the supply price and quantity in the average quality log market

These curves are shown in Figures 4 and 5 for the two market segments

The resulting price elasticities of supply and demand at equilibrium are indicative of responsive (elastic) markets, Table 3. This means that if prices change by 1 percent supply would increase by more than 1 percent, and demand would decrease by more than 1 percent.

Table 3. Price elasticities of supply and demand for the log market at equilibrium for the two market segments.

	High Quality	Average Quality
Demand	1.1	1.2
Supply	1.3	1.5

For example, in the case of the average quality segment a 1 percent increase in price, $4.25 per MBF, would increase supply by 3 MMBF. Or, reversing causality, a 1 percent increase in supply, 2 MMBF, would lower the price by 0.7 percent, $3.00 per MBF.

Supply and Demand Curves for Stumpage

The log market is responsive (elastic) because in the short-run loggers and log brokers supply mills with logs that are already in process from timber already under contract. The stumpage market is less elastic because stumpage is contracted in advance of log production. The time between closing on a stumpage sale and the start of logging can a year or more. The average quality segment of the stumpage market would be more responsive than the high quality. Mills in need of high quality logs of the prime species are more likely to contract ahead to take advantage of good timber as it becomes available. Loggers focusing on average quality timber are less able financially to contract ahead and more likely to contract just in time to move to the next job.

The data available makes it difficult to derive stumpage demand and supply curves. This requires resorting to the simplifying assumption that both curves are shifted downward by the cost of logging and hauling, $145 per MBF for high quality segment, and $140 per MBF for the average quality segment. The resulting equations are,

High quality market segment:

Pdh = 1035 -2.95 Qdh

Psh = 2.53 Qdh

Average quality market segment:

Pdl = 625 -1.7 Qdl

Psl = 1.43 Qsl

These curves are shown in Figures 4 and 5.

As expected the stumpage market is less responsive than the log market, Table 4. Demand for stumpage is inelastic, while supply is unitary elastic, always the case at equilibrium when the supply curve is forced through the origin. For example, a 1 percent increase in price will increase supply by 1 percent, and a 1 percent increase in the quantity supplied will reduce the price by 1 percent. On the demand side, a 1 percent increase in price will reduce demand by 0.8 percent.

Table 4. Price elasticities of supply and demand for the stumpage market at equilibrium for the two market segments.

	High Quality	**Average Quality**
Demand	0.85	0.82
Supply	1.0	1.0

Estimated Impact of Increased Harvest on State Forests

The current harvest level from state forest lands is approximately 3.4 MMBF per year. Since many of the harvests are improvement cuts it's assumed that 60 percent, 2.0 MMBF, enters the average quality market segment, and 40 percent, 1.4 MMBF enters the high quality market. These volumes represent seven tenths of one percent of the high quality market and one percent of the average quality market.

The strategic plan calls for an increase to a total level of 10 to 17 MMBF per year. This is an increase of 256 percent to 436 percent from the current 3.4 MMBF. The increase would not occur within one year since it would be necessary to build up the staff

needed to prepare and administer the increased number of timber sales. However, the analysis starts by assuming that the change does occur within one year.

Short-Run Price Impact for Instantaneous Increase in Harvest Volume

Assuming all other conditions remain the same, the short-run impact on price at the harvest level of 10 MMBF would be a 1.4 percent decrease, $8.60 per MBF, in the equilibrium price in the high quality market; and a 2.0 percent decrease, $8.40 per MBF, in the equilibrium price in the average quality market segment. These changes are based on the equilibrium prices of $620 per MBF for the high quality segment, and $425 per MBF for the average quality segment. At the 17 MMBF level the price reductions would be 2.9 percent, $17.75 per MBF, in the high quality market, and 4.1 percent, $17.30 per MBF, in the average quality market.

If the increase to the 10 MMBF harvest level occurred over a three year period, 2.2 MMBF per year , the price decreases the first year would be $2.87 per MBF and $2.80 per MBF for the high quality and average quality segments. Similarly, at the 17 MMBF level, the price decreases would be $5.87 per MBF, and $5.74 per MBF, for the high and average quality segments, respectively.

Long-Run Price Impact of Increase in Harvest Volume

As shown by Figure 1, the volume of logs processed by mills in Indiana has increased in response to increased growing stock volumes, and the associated increase in the volume sold by timber owners. The increase in sales volume from state forests would thus be absorbed by an industry that has a long history of increased efficiency and total output. The impact would be different for a declining industry that had less capacity to absorb the increased volume. If the owners of mills whose drain area includes state forest

land believe that the increased harvest levels will continue for the next 15 to 20 years, they will have an incentive to improve the efficiency of their mills, allowing them to increase output. It's also possible that the increase in volume would be sufficient to bring additional mills on line. However, this is less likely because by-and-large new mills are in the 8 to 10 MMBF capacity range. In some areas, however, average or below size mills operate as contract mills to concentration yards.

Overall, however, it is reasonable to assume that demand will increase, shifting the demand curve to the right. The supply curve would also increase in proportion to the increase in the volume sold. If demand for logs is increased in the long run by the amount of the increased sales volume, the equilibrium market price for the high quality market segment would increase $5 per MBF from $620 to $625. The increase for the average market segment would be $6 per MBF from $425 to $431 per MBF. The commensurate increases in stumpage prices would be $8 per MBF from $472 to $480 for the high quality segment, and $6 per MBF from $282 to $288 for the average quality segment.

Conclusions

The proposed increase in the volume of timber sold from state forests can be expected to somewhat depress the market price of stumpage in the short-run. The decrease depends on local market conditions. The estimates discussed above are based on the total market in Indiana. They do not represent local market conditions. The impact will be greater on the value of average to low quality timber, and less for high quality timber. Given the assumptions made in this analysis the percentage reduction in price is proportional to the percentage increase in volume.

In the long-run, 3 to 5 years in this analysis, increased demand and supply will more than offset the short-run decrease in price for high quality timber, and just offset the decrease in the case of average quality timber. The long-run equilibrium stumpage price would increase by $8 per MBF for high quality timber, and by $6 per MBF for average quality timber.

The volume of logs processed by Indiana's primary hardwood industry has been expanding at an average annual rate of 5.6 MMBF Doyle. A 6.6 MMBF increase from the current 3.4 MMBF to 10 MMBF would be absorbed in a little over one year based on the past rate of expansion. An increase to a total of 17 MMBF would be absorbed in 2.5 years.

Literature Cited

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Piva, Ronald J. and Joey Gallion. 2003. *Indiana Timber Industry – An Assessment of Timber Product Output and Use, 2000*. USDA Forest Service, Resource Bulletin NC-216.

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Figure 1. Industrial roundwood receipts by Indiana mills, Doyle log scale (Piva and Gallion, 2003)

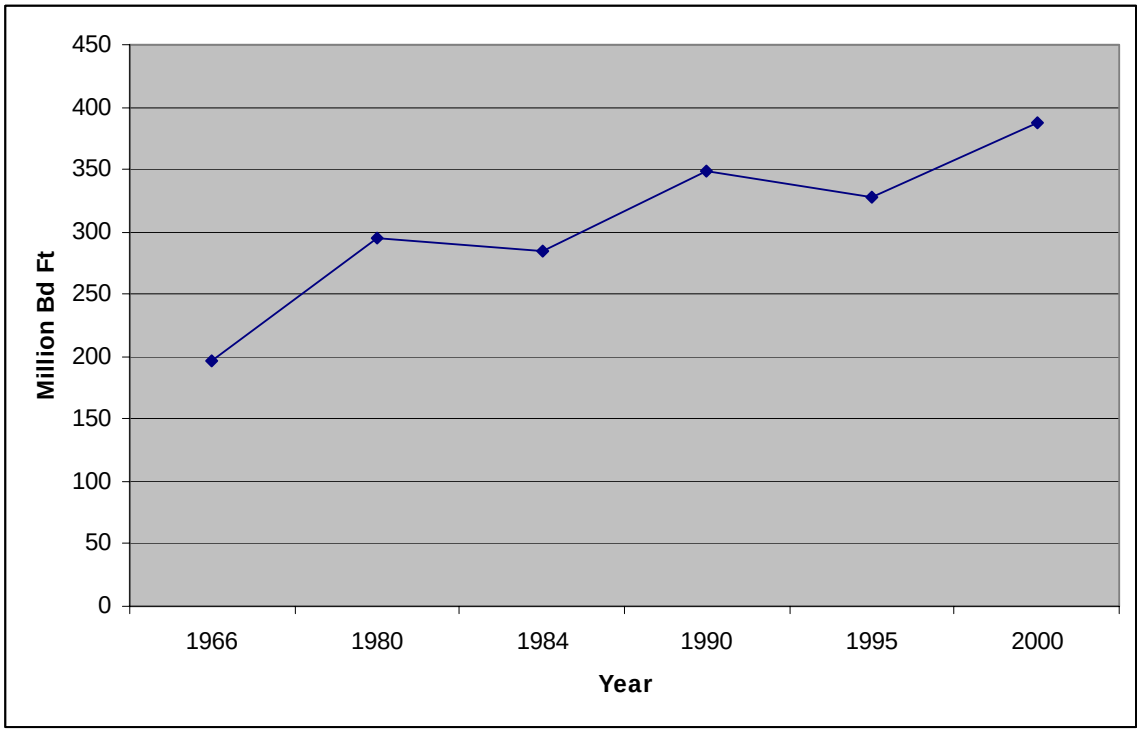


Figure 2. Number of active primary wood-using mills (Riva and Gallion, 2003)

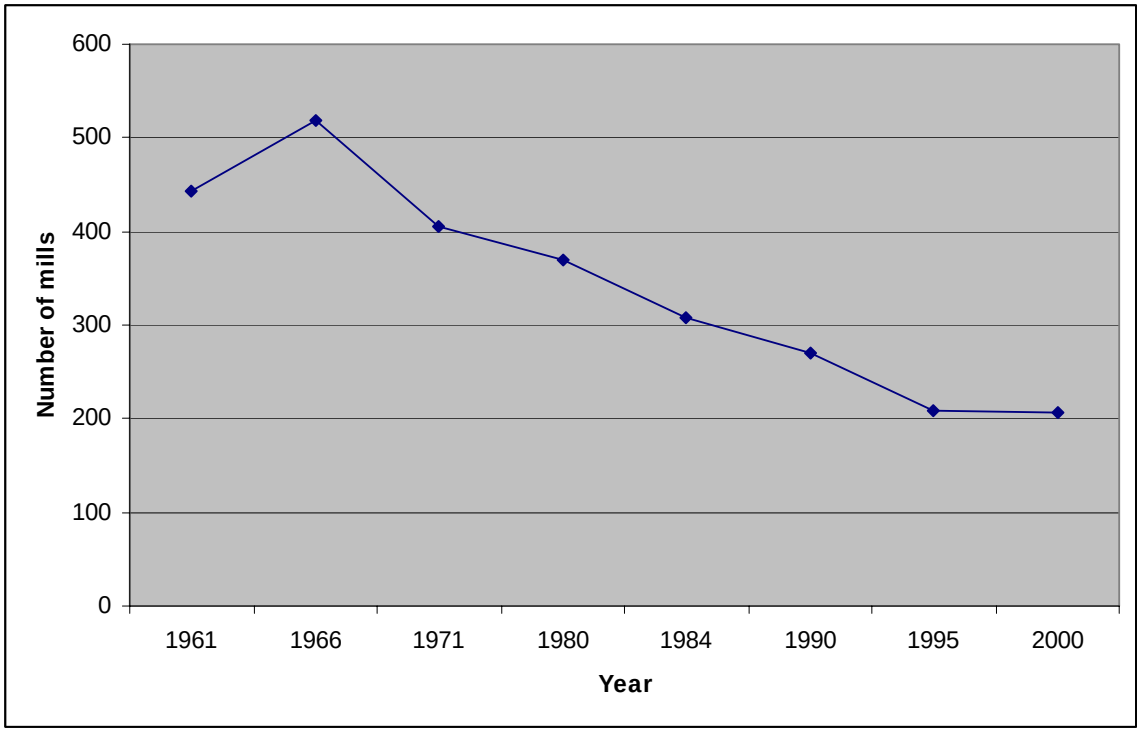


Figure 3. Output per mill, MBF.

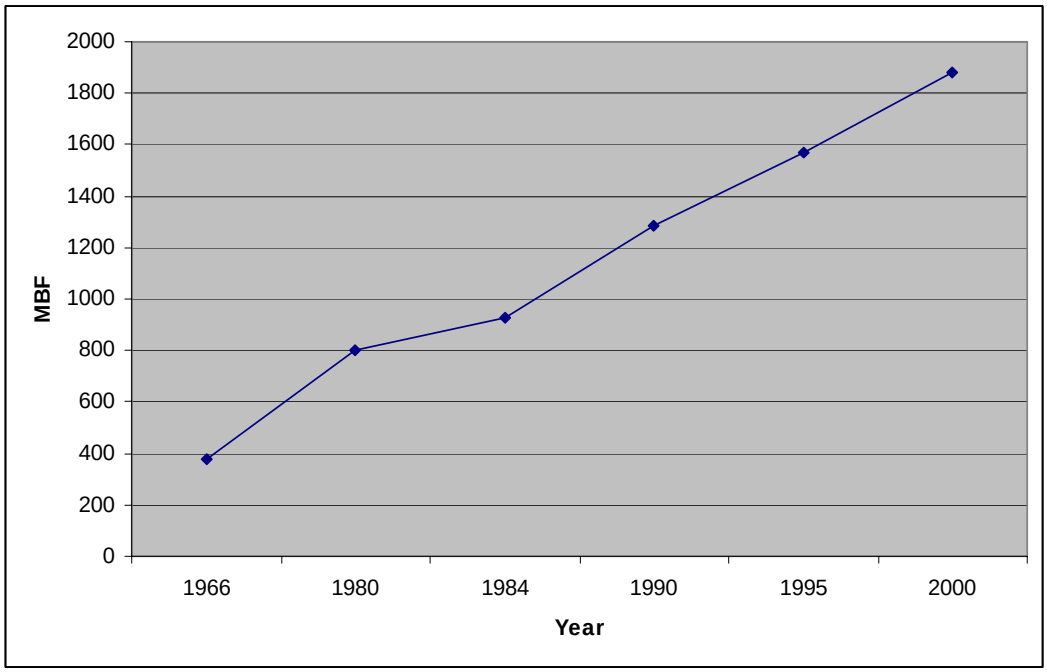


Figure 4. Likely demand and supply curves for high quality logs and stumpage..

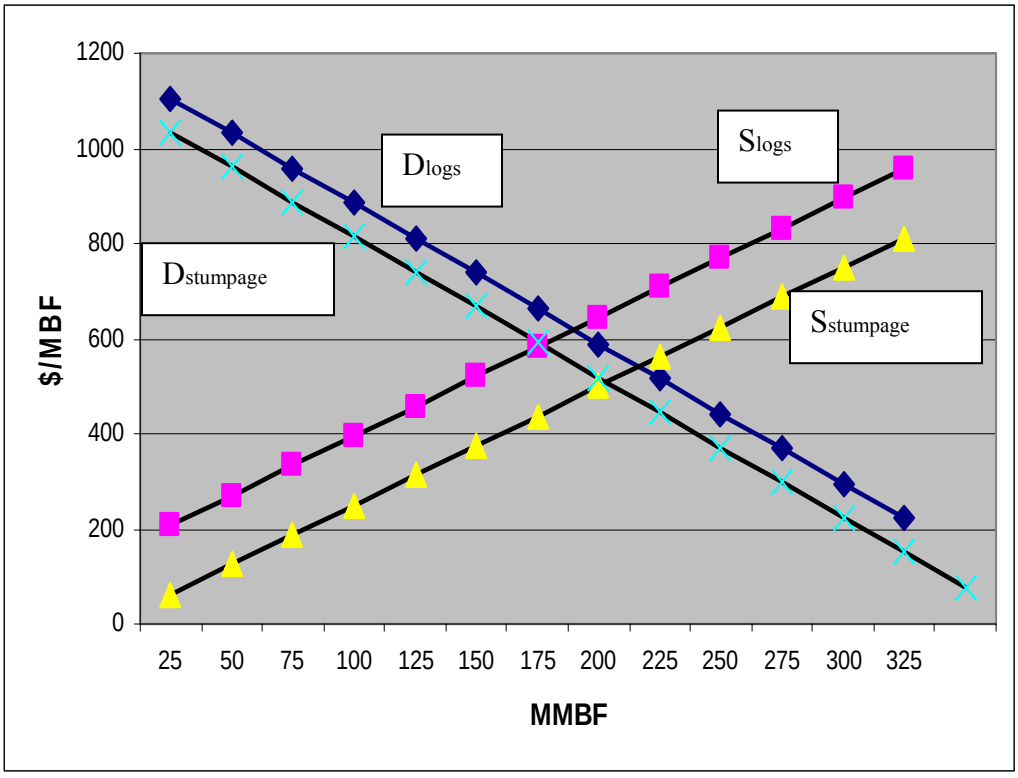
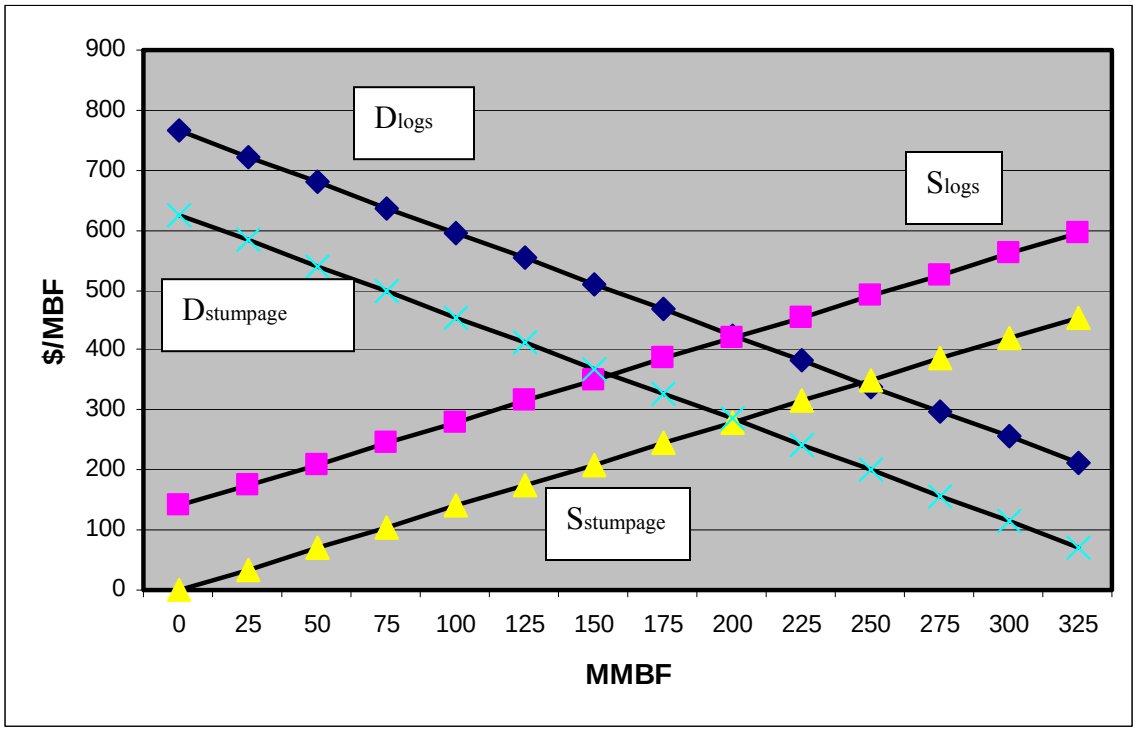


Figure 5. Likely demand and supply curves for average quality logs and stumpage.



APPENDIX

Elasticity

Elasticity is a pure number representing the relative change in a response variable to a change in a casual variable. The concept is widely used in economics to summarize the expected response of a change in prices, or other economic factor. In this case we're interested in the response of stumpage price to an increase in supply. Elasticity at a given point on a supply or demand curve is defined as,

$$\varepsilon = \frac{\%\ \text{Change in Quantity}}{\%\ \text{Change in Price}}$$

$$= \frac{(\text{Change in Quantity}) / \text{Quantity}}{(\text{Change in Price}) / \text{Price}}$$