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Observations on the new stumpage Market Pricing System in British Columbia

By

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ABSTRACT: The Province of British Columbia (BC) is moving to let market forces set the price of stumpage. The BC Market Pricing System (MPS) has two parts: the competitive sale of stumpage and using market evidence to set stumpage price for tenure holders. Sale records of 1001 stumpage auctions since January 2002 are examined. Bidders have been pushing the price up. A lot of money has been left on the table and number of bidders/sale has decreased slightly. The market evidence method in use is unbiased in relation to actual bids, but actual bids have smaller variance than predictions.

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Introduction

British Columbia (BC) has a lot of wood, with its' land area larger than Washington, Oregon and California combined and much of it forested in a wide range of climatic types. Right now several concurrent events are taking place in BC's forestry sector. The BC Ministry of Forests is taking back approximately 20% of the annual allowable cut (ACC) from long term lease holders. The 20% is being divided between BC Timber Sales (10%), First Nation groups (8%) and communities (2%). The major purpose of this "take back" is to create both competitive timber and log markets, at least partially in response to criticism raised in the softwood lumber dispute. At the same time, a pine beetle epidemic of historical proportions is killing pine trees throughout the province. Some estimates have as much as 5 years worth of BC's 64 million m^3 allowable annual cut (AAC) being currently effected (i.e. 320 million m^3 - the entire US annual harvest is about 447 million m^3 (Smith and others, 2003)), and with 2005 being another mild winter the beetles are expected to continue spreading.

The Provincial government is engaged in a fundamental reform of forest policy. They are moving to letting market forces guide the development of the forest sector (Howard, 2005). The purpose of this paper is to examine the timber Market Pricing System (MPS) being implemented in BC. Other significant forest policy reforms are that tenures can now be bought and sold, remove lower bounds on harvest levels (they still have the upper bound that they cannot exceed the ACC averaged over a 5 year period), tenure and lease holders no longer have to process their own logs and logs may be actively marketed.

Starting on February 29, 2004 stumpage prices in the BC Coast region have been determined using the new "Market Pricing System". This system is being phased in across the whole Province over the next couple of years. BC Ministry of Forests (MOF) created BC Timber Sales (BCTS) as an independent organization to develop Crown timber for auction, to sell timber and to capture as much of the value of BC's timber asset for the public as possible (Revenue Branch, 2004).

The old timber pricing system was not popular on either side of the US/Canadian border. Crown timber price was set by a "Comparative Value Pricing" (CVP) approach to estimating the derived residual value of timber. The CVP system was implemented in BC to "solve" the trade dispute in 1987. Stumpage was raised, but nothing was solved (Howard, 2005). The major deficiency with this system was the estimate of target stumpage rates and the adjustment of individual unit stumpage rates to achieve the target. Target prices were derived from a composite of Statistics Canada lumber and chip indexes. A specific harvest unit stumpage rate was adjusted to maintain the average. An additional difficulty was the estimated market value of products. Values were updated quarterly using product prices reported by Statistics Canada. This resulted in at least a 3 month lag between product market and stumpage fees. The CVP system all too often resulted in stumpage fees that were not appropriate to current product markets. Industry did not like this system. They wanted a pricing system that would not only yield a reasonable return to the Province but also reflect industry's ability to pay (COFI, 1999). This system is being phased out by MPS.

The office of BC Timber Sales (BCTS) largely absorbed of what was formerly called the Small Business Forest Enterprises Program (SBFEP), which provided approximately 13% of the Provinces AAC to small private operators in a competitive bidding process. Part of BCTS's mandate is to expand and remove constraints on the competitive stumpage market, to increase the total amount of timber offered in competitive bidding (when completely implemented

approximately 33% of the AAC), to replace the CVP system with a market pricing system and ultimately to increase net return to the Province (BCTS, 2002).

The new Market Pricing System

"The central concept of the Market Pricing System (MPS) is that auctions of standing timber establish the market value of the timber, and those market values can then be used to determine the stumpage price for timber harvested under long-term tenures" (Revenue Branch, 2004). When completely implemented, 23% of the AAC will be sold by a bidding process through BCTS, 8% will be sold be by First Nation groups, 2% will be sold by communities. Long-term tenures holders will harvest 67% of the AAC, which will be priced (and billed) using market evidence gathered from stumpage auctions.

Competitive Timber Bidding Process

BCTS conducts competitive timber sales from crown lands. Sales are put up for bid in a manner similar to private timber sales in the United States. BCTS Foresters select an area for harvest, gather information, and publicly publish the stand, contract and sales information. Sales are by sealed bids. Bids are opened publicly, with at least two witnesses in local business area offices throughout the Province. Sales are awarded to the highest qualified bidder. Qualified bidders are those who are registered with the Province and provide an appropriate deposit at time of bid opening.

Each sale notice clearly states an upset rate (reserve price), which is the starting point for bidding. A bid (in $\$/m^3$) is the amount above the reserve price, called the bonus rate. The bidder with the highest bonus rate is awarded the sale contract.

The upset rate is derived using a market evidence approach. Developed with data from past competitive sales, two regression equations are used to estimate the "preliminary estimated winning bid" (PEWB) (see Table 1). The PEWB is then adjusted for specified operational costs which the equations do not account for: skyline logging, inland water transportation, single tree selection with a helicopter and other specific operating situations listed in Amendment No. 4 of the Coast Appraisal Manual (Revenue, 2005a). The upset rate is 70% of the estimated winning bid, or 0.25 $C\$/m^3$ which ever is larger. Though the 70% is somewhat subjective, the purpose is to allow for error in the estimate and for downward variation in market price.

Stumpage price (upset rate plus bonus bid) is what the winning bidder pays on every merchantable m^3 harvested or left on site. Merchantable specifications are defined by the MOF (Revenue Branch, 2005b). To place a rational bid, the bidder needs to estimate the stumpage price as a composite of all MOF defined merchantable species and grades.

Timber Pricing Under Long Term Tenure Agreements

When the Market Pricing System is fully implemented, long term tenure holders will control approximately 67% of the AAC in British Columbia. This timber is priced in exactly the same way that the estimated winning bid is calculated for the competitive market except no 70% factor and deductions are made for tenure obligations. Minimum price still must be greater than 0.25 $C\$/m^3$. If the stumpage rate is too high, they do not have to harvest. Tenure obligation adjustments include cost for forest planning, road development and maintenance, silviculture investments, administrative overhead and a return to forest management. These adjustments represent reasonable payment for forest management, which would have been incurred by MOF if they were managing the land.

Table 1: Market pricing system equation used for estimating the "winning bid" for coastal stands with greater than 2,500 m^3. (Revenue Branch, 2005 and 2004). The Dependent variable is an estimated winning bid in C$/$m^3$. The equations are updated yearly using new data and removing the oldest data.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	-22.14037	5.944577	-3.724466	0.0002
Cruise Grade	3.460424	1.651467	2.095363	0.0372
2nd Growth HemBal %	-19.00256	4.44079	-4.279094	0.0000
3-month Average Log Selling price	0.784393	0.061253	12.80572	0.0000
LN(Old Growth HemBal % +0.01)	-2.879611	0.605312	-4.757236	0.0000
Slope	-0.166169	0.052742	-3.150589	0.0018
Helicopter Logging %	-40.09100	3.506940	-11.4319	0.0000
LN(Volume per Hectare/1000)	11.94704	1.82794	6.535793	0.0000
LN(Number of Bidders) (Eq below)	10.06841	1.477136	6.816169	0.0000
Haul distance	-0.034161	0.020904	-1.634167	0.1036
Barge Distance	-0.011281	0.002742	-4.114145	0.0001
Adjusted R^2	0.757806	Mean dependent var		44.3930
S.E. of Regression	0.747587	S.D. dependent var		22.8377
SSR	31200.86	Akaike info criterion		7.76136
Log likelihood	-951.4085	F-Statistic		74.1555
Durbin-Watson Stat	1.608942	Prob(F-Statistic)		0.00000

Market pricing system equation for estimating the number of bidders. Number of bidders is needed to estimate "winning bid" using equation above.

Variable	Coefficient	Std.Error	t-Statistic	Prob.
Constant	0.241721	0.657234	0.367785	0.7134
Location	-0.006391	0.0027	-2.367201	0.0187
2nd Growth Hembal %	2.145033	0.815768	2.629465	0.0091
LN(Volume/1000)	0.834071	0.204916	4.07031	0.0001
Cable Yarding %	-1.588758	0.354653	-4.479757	0.0001
2nd Growth Fir %	2.889571	0.549288	5.26058	0.0000
Predicted Bid (Table 1)	0.097253	0.00868	11.20385	0.0000
Adjusted R^2	0.521536	Mean dependent var		5.93145
S.E. of Regression	2.374162	S.D. dependent var		3.43230
SSR	1358.431	Akaike info criterion		4.59499
Log likelihood	-562.7782	F-Statistic		45.8726
Durbin-Watson Stat	2.244846	Prob(F-Statistic)		0.00000

British Columbia Stumpage Market Observations

The bidding process appears to be competitive. Figure 1 shows winning bids for stumpage over the last 2¼ years, including SBFEP sales and BCTS sales in the Coastal Region after March 2004. There is a significant trend of increasing stumpage prices over this time span. The distribution of number of bidders is displayed in Figure 2. One of auction theory's basic outcomes is that more bidders result in higher prices (Engelbrecht-Wiggans, 1980). On average there are 4 bids/sale. Some people may worry about sales with only one or two bidders since

more competition increases stumpage price. However, zero or one bid results are to be expected (i.e. a distribution such as displayed in figure 2 is expected). That use of a reservation price will eliminate buyers was shown by Carter and Newman (1998), and sales with no bidders are a logical result. Use of a reservation price also increases the expected stumpage price (Carter and Newman, 1998). Figure 3 displays a distribution of the difference between the estimated winning bid and the actual winning bid. There is no significant difference between estimated and actual winning bid before or after March 2004, even though the average winner underbid the estimated winning bid by an average of $10.65/m3. The equations listed in Table 1 are unbiased in estimating winning bid. It is possible in light of accuracy of results, that the 70% upset rate estimate may be influencing bidder behavior.

Looking a little deeper into the MPS equations listed in table 1 results in some interesting observations. The first equation in table 1 has standard deviation on the estimated winning bid of C$22.84 /$m^3$. Given this, we would expect the highest bid to be above the 70% reservation criterion about 72% of the time and no one would bid about 28% of the time (i.e. actual winning bid is below 70% error allowance. This was calculated using a Z statistic and assuming bids have a distribution). The results using the after March 2004 population of 497 BCTS sales have no bids 13% of the time. In other words, the winning bids have a smaller standard deviation than the estimated winning bid using the MPS equation in table 1. Look at figure 3 again, the distribution is skewed by the reserve price and the right side of the distribution drops quickly. The equations in table 1 are unbiased, but with more error in estimation than the winning bidders.

Along another line, consider the interesting picture of monthly averages for the log market, stumpage price, upset rate and bonus bid displayed in Figure 4. As should be, a perfect relationship ($R^2 = 1$) exists for stumpage price as a function of upset rate and bonus bid, but when taken one at a time, there are no significant correlations between stumpage price and log market or upset rate or bonus bid. Looking a little deeper there is a statistically significant (alpha =0.05) correlation (-.74) between Log Market Price and Upset rate, but the correlation is negative. There is also a correlation (.38) between Log Market Price and bonus bid, also significant at the alpha = 0.05 level.

Further analysis of this data set reveals that stumpage price is not significantly related to upset rate and log market price, which is not surprising given that they are negatively correlated and neither is correlated with stumpage. On the other hand when Stumpage is related to bonus bid and log market price a fairly strong statistical relation exists.

The implication of this discussion (concerning figure 5) is that timber bidders in BC are logical. They estimate the value of the sale using, among other things, information concerning the Log Market. Then they subtract off the upset rate to derive their bid. The upset rate is a hurdle, either they can or cannot exceed it. Since the upset rate has no correlation with stumpage price, the bonus bid won't either, but they do add up to the stumpage price.

Stumpage versus Number of Bidders

The hope of every timber buyer is to outbid opponents by 1¢/m^3 yet still make a profit. A buyer never wants to "leave money on the table", bidding significantly more than the next highest bid. The average stumpage auction "winner" in BC during the first 3 months of 2005 paid on average C$100,000 more than the next highest bidder. That is a lot of money to leave on the table. There is only one thing more upsetting than leaving money on the table, and that is bidding more money than the timber is worth. Bidding on timber is a tricky way to make a living. Both experience and analysis are necessary to be a successful timber buyer. The question a buyer must

answer for each sale is what bid will defeat the competition with a minimum margin and still be below the estimated value in use of the timber? So far in 2005 BC timber buyers have left more than C$10.9 million on the table. Money left-on-the-table in relation to the number of bidders is shown in figure 5. There is no relation between overbid and how many bidders are participating. One bidder sales, though clustered below C$200,000, are still overbidding the upset rate. This indicates that a single bidder did not know who or how many they were competing against. Perhaps, more interesting is the distribution of overbids displayed in figure 6. When looking at the actual bid amount (figure 6a) people appear to be bidding their privately estimated valuation. When looking at the "total amount" (figure 6b) you can see that bid are closer together as total value gets larger. Comparing figure 6a and b, as stakes get higher bidders seem to be more cautious and probably experienced bidders make up a higher percentage. Nevertheless, some bids are high and chances are that some are higher than the sale is worth. This is the "winners curse", because of error in valuation some bidders will always be on the right hand side of the distribution and bid too much. It is expected that some of these will go out of business and for the number of bidders to decline in a new competitive market. A statically significant decrease in numbers of bidders per sale has been observed over the past two years. This is not to be taken as proof of people going out of business., however, leaving money on the table and the shake out of bidders is evidence of a competitive market.

The rules of BCTS timber auctions are clearly spelled out. It is a "first price auction", participants submit sealed bids. The highest bid wins (Klarreich, 2003). Collusion is strictly forbidden (Howard, 2005) and information on who, or how many, are bidding is protected until after bid opening (Kennah, 2005). Since a bidder doesn't know how much the other bidders value the timber, or the error of their measurements, it is difficult to guess rival strategies. Information about what rival bidders have done in the past and who might be in the game is valuable. To provide market information and aid the bidders, BCTS publishes sale bid results on their website giving information on who bid what. This potentially useful information still requires analysis, and bidders still do not know who is participating, until after the fact. Rules for BCTS auctions agree with the theory of auctions with uncertain number of bidders when the seller's objective is to maximize expected utility. It is in the seller's advantage not to reveal the number of bidders, on the other hand, it is in the buyer's advantage to know how many bidders are participating (Levin and Ozdenoren, 2004).

BCTS data on stumpage price versus the number of bidders is displayed in figure 7. The linear trend line included in the figure is not intended to predict or even explain stumpage rate. The purpose is to show that bidders, as expected, push up the price. The slope of the line is significant ($\alpha = 0.01$). When the data is sorted by the 12 business areas in BC (figure 8), the slope of the line varies, but is still significant for each business area. A summary of results for the twelve BCTS business areas are listed in Table 2. The Strait of Georgia is the most competitive business area. They have the most bidders per sale, they pay the most for stumpage and access is not a major issue. Remote Skeena is probably the least competitive area. They have the fewest bidders per sale, access is usually a problem, they pay the lowest stumpage but they still pay a good bonus. Prince George has the largest volume put up for bid. They have less than average bidders per sale but they still pay higher than average stumpage. In conclusion, though the Province is large and diverse the timber markets in BC have characteristics of a competitive market.

Long Term Tenure Prices

Stumpage harvested under long term tenure agreements is priced in the same way that the expected winning bid is priced, using equations in table 1. If we assume the reallocation of the Provinces land base is balanced in line with the MPS equations (big assumption) and that the winning stumpage bid distribution summarized in figure 3 is applicable, then for about 33% of the tenure holder's harvests stumpage price will be ± C$5 of what the winning bid would have been, about 51% of the time the tenure holders will be complaining about paying too much and around 19% of the time they will be feel like they are getting a good deal. It appears that tenure holders could be paying more than the market value on approximately 2/3 of the harvests (in figure 3, approximately 2/3 of the winning bids are below the estimated winning bid.) However, the equations are adjusted annually, and the above portions will change. The question about the reallocation of the land base is a big one. If the land base is not allocated in line with MPS equations then the market equity of stumpage prices cannot be predicted.

Table 2: BC Timber Sales Business Office Averages since March 1, 2004. Sorted by number of bids per sale when greater than 0.

Business Area	Vol (m^3)	Upset ($/$m^3$)	Bonus ($/$m^3$)	Bids ≥ 0 Tendered	Bids ≠ 0 Tendered	Ratio of Stumpage to upset	# of Sales
Strait of Georgia	22024	30.75	20.89	4.5	5.4	168%	59
Seaward-Tlasta	32352	33.96	14.83	4.8	4.8	144%	8
Chinook	23032	22.14	13.56	4.4	4.4	161%	21
Kamloops	18076	34.77	10.66	4.0	4.5	130%	78
Okanagan-Columbia	23203	31.42	16.27	4.1	4.2	152%	28
Peace-Liard	18052	22.70	5.92	3.8	3.9	126%	35
Babine	15329	31.53	8.57	2.8	3.6	127%	42
Cariboo-Chilcotin	22890	30.66	7.88	2.9	3.5	126%	50
Kootenay	22073	29.34	11.15	3.2	3.4	138%	37
Prince George	34418	36.32	8.46	2.9	3.3	123%	54
Stuart-Nechako	32460	33.20	5.03	2.2	2.3	115%	48
Skeena	18667	13.82	6.41	1.8	2.7	146%	37
BC Average	23931	29.20	10.50	3.2	3.7	136%	497

The MPS equations are an estimate (with error) of the market price. It is totally appropriate to use them as a bench mark for upset rate, but as a pricing mechanism one must be wary of the belief that prices will average out. Depending on the land allocation, and unquantified sources of error, it is likely that the equation average will be biased in relation to actual bids. Updating the equations each year does counter this. New sales from the past year will be added and old sales dropped. The biases referred to above can be thought of as an expression of sample error. Each year is a sample. Over several years, the Central Limit Theorem will hold and estimates are expected to average out.

Summary

The B.C. Provincial government has implemented a fundamental change in forest policy, including a competitive market for timber, logs and market pricing for long term tenure holders. Competitive bidding is setting the market value for stumpage. When applying the MPS system to

long term tenure holders, equations based on market evidence will set the price. In the long run, tenure holders will be paying more than the market rate at least ½ the time and paying less ½ the time. In the short run, biases either above or below market price, will occur for long term tenure holders.

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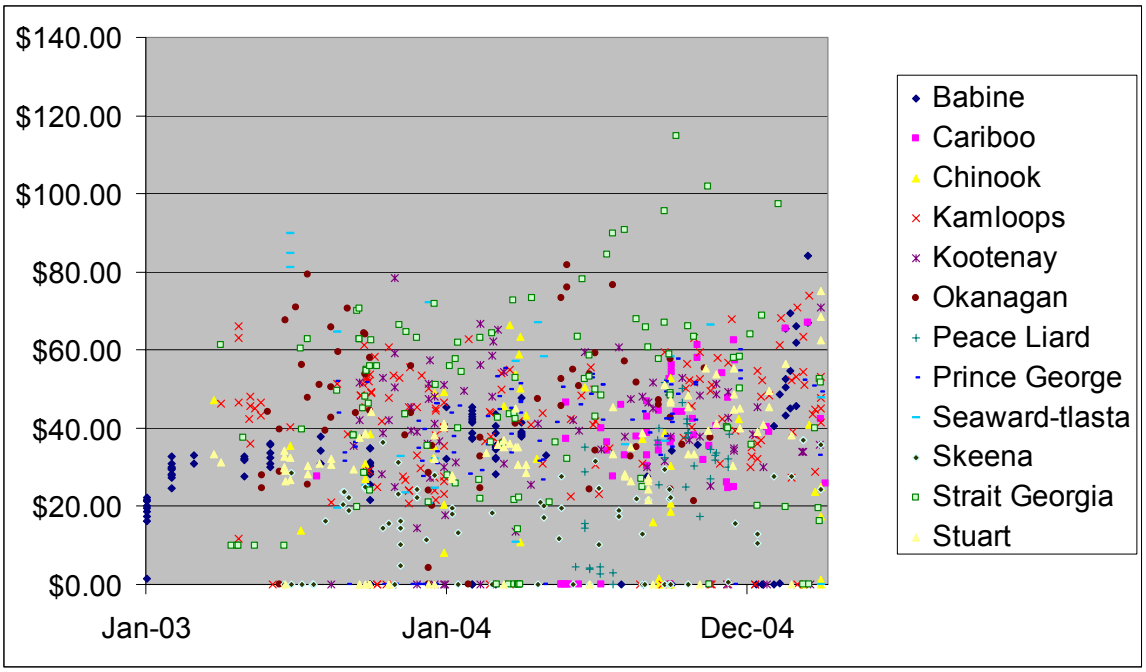

Figure 1: Winning stumpage prices (upset + bonus) for the Small Business Forestry Enterprise Program before March 1, 2004 and BC Timber Sales after, broken down by business area.

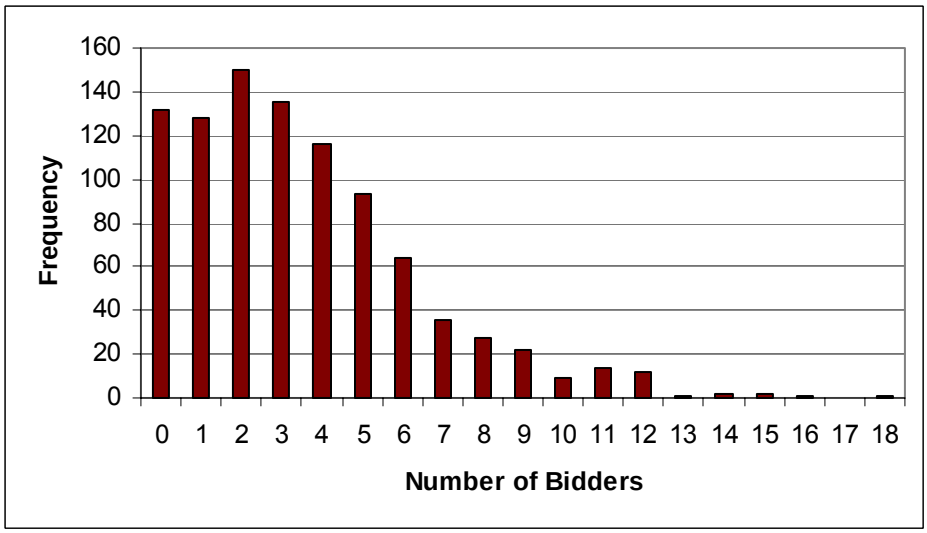

Figure 2: Distribution of the number of bidders for 945 sales since January 2003. There is an average of 3.5 bidders per sale. If the 131 zero bids are removed the average is 4.0 bidders per sale. The equation in table 1 reports an average of 5.9 bidders.

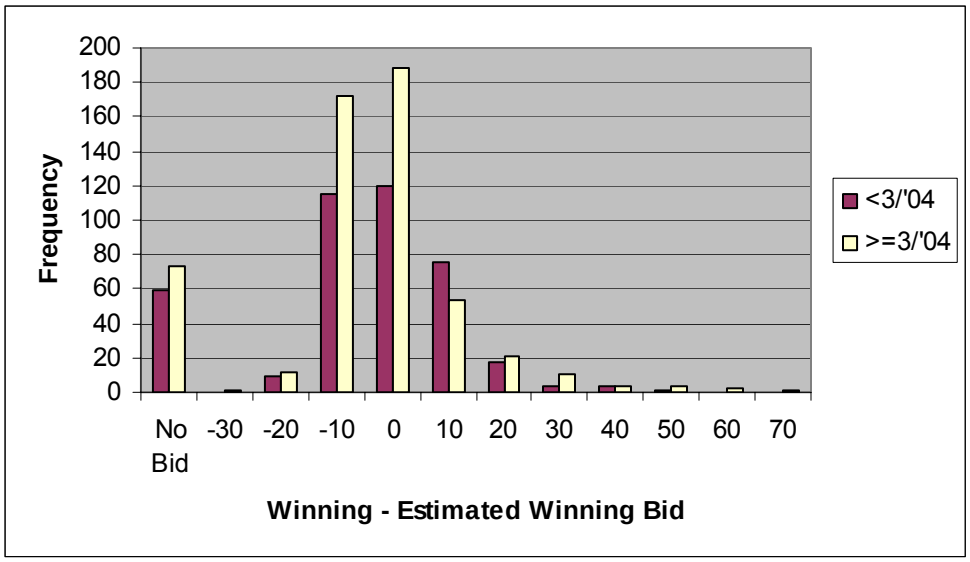

Figure 3: Distribution of the difference between the actual winning bid and the estimated winning bid. A negative means that the bidder under bid the estimate. A positive means that the bidder over bid. The mean of the before March '04 distribution is 0.1 (SDEV = 10.3) and the after March '04 is -.6 (SDEV = 12.0). The category labels are the mid point of a 10 C$/$m^3$ range (i.e. 0 is for the range -5.00 to 4.99).

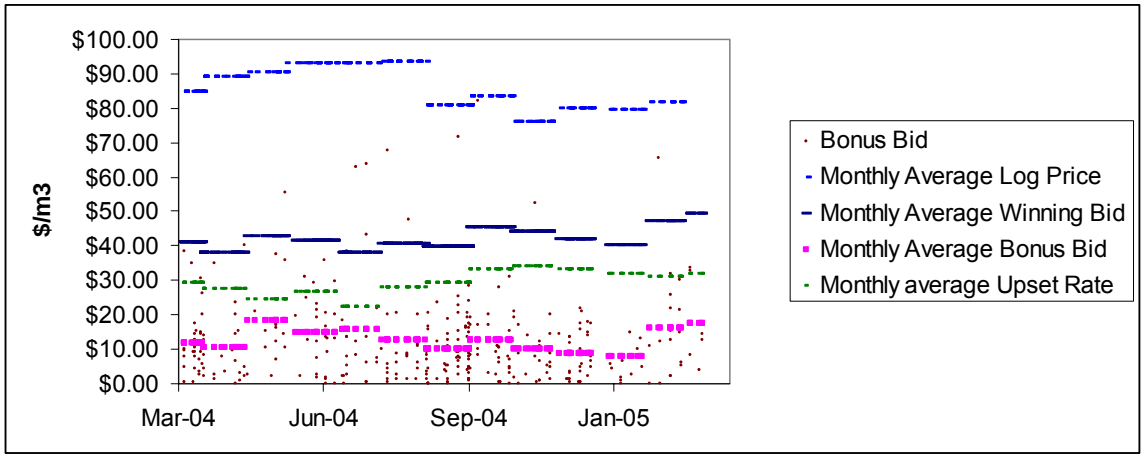

Figure 4: Monthly averages of the final product market for coastal logs compared to the stumpage market and the MPS bidding components. The monthly average winning bid is the same as monthly average stumpage market.

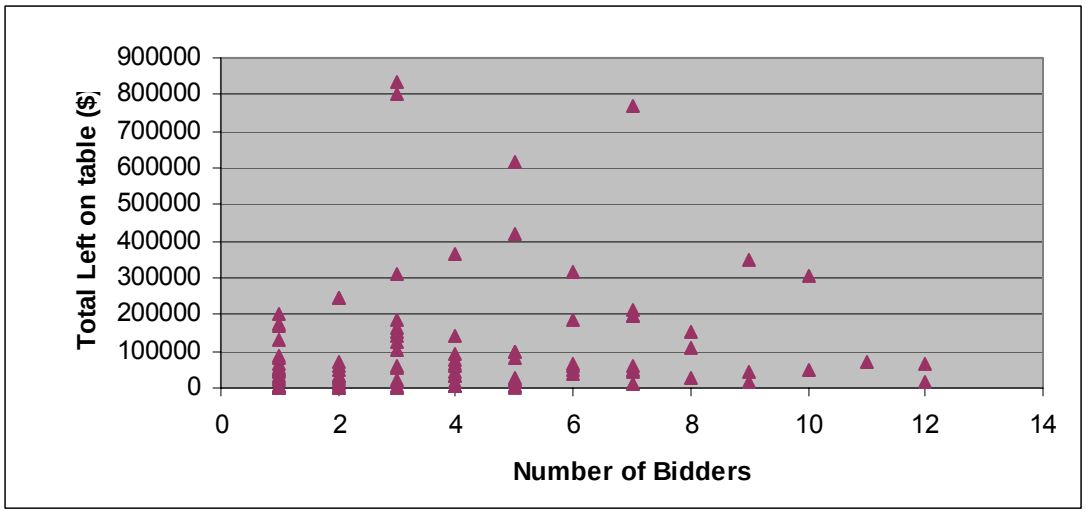

Figure 5: Money left on the table in the first three months of 2005 in British Columbia.

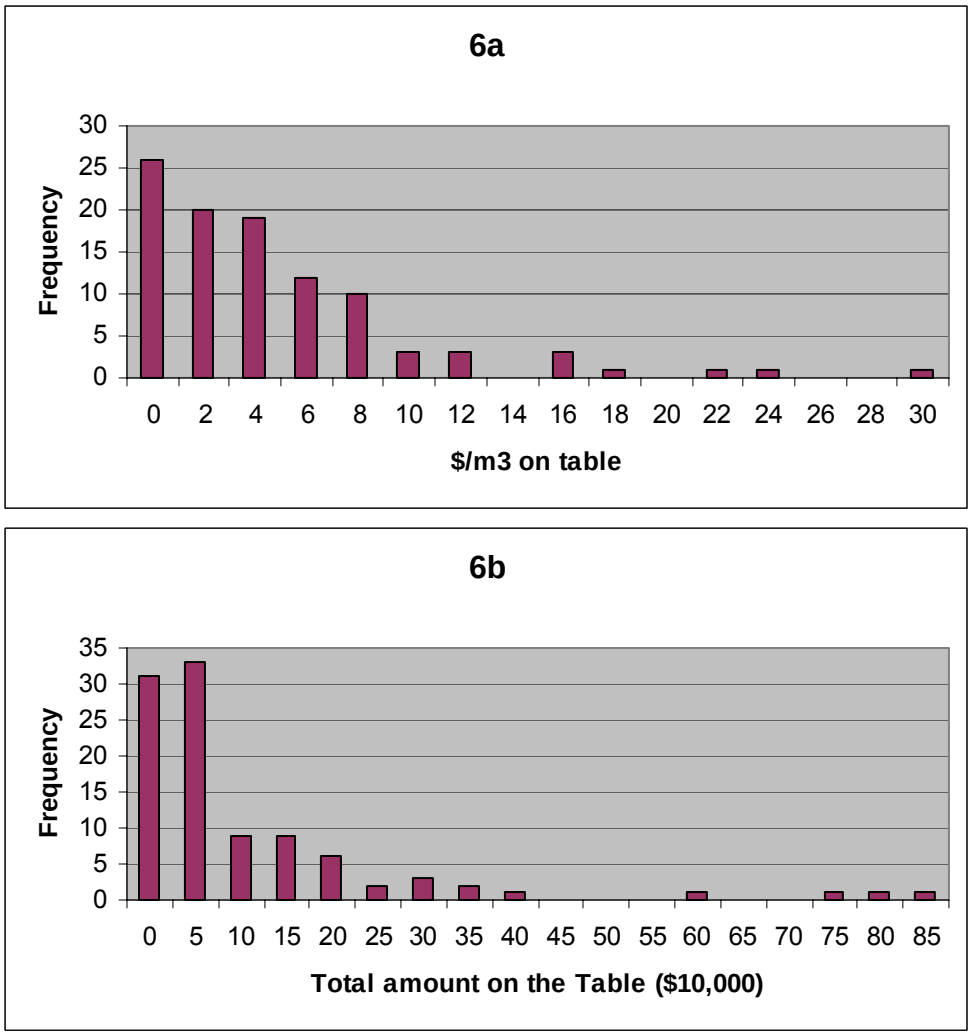

Figure 6: Distribution of (winning bid – next highest bid). a: is the amount of over bid in $/m3. The "0" category is from 0 to 1, while each other category is $2 wide. (i.e. "2" is from 1.01 to 3.). b: is the total amount of overbid in C$ (bid x estimated volume). The "0" category is from 0 to $25,000, while each other category is C$50,000 wide. (i.e. the second category C$50,000 goes from 25,000.01 to 75,000)

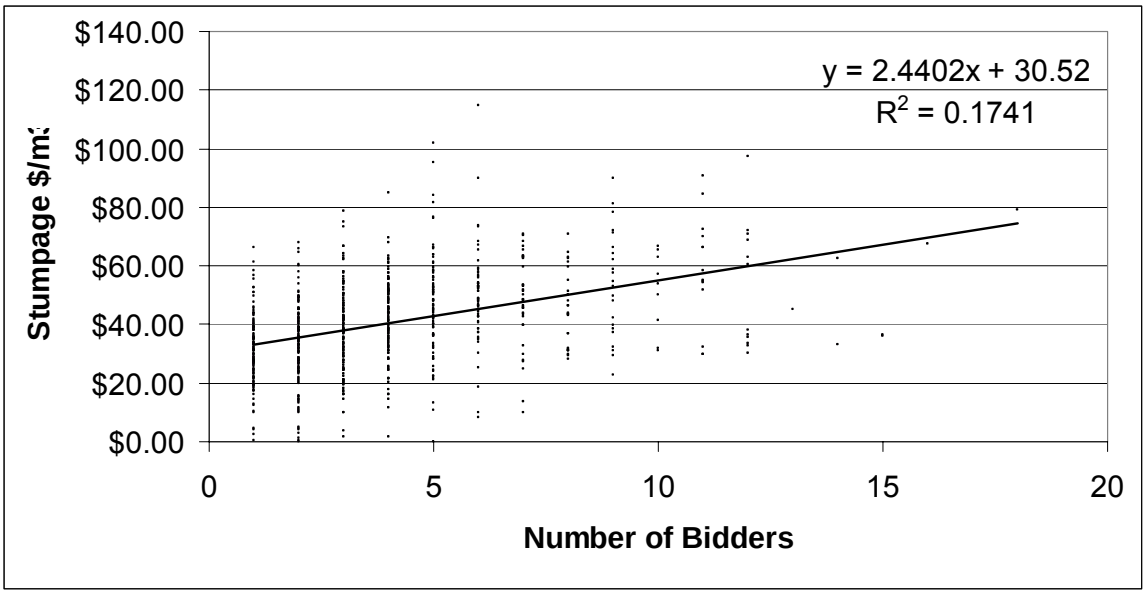

Figure 7: BC Timber Sales winning stumpage rate versus the number of bidders. Trend line does not include no-bid sales.

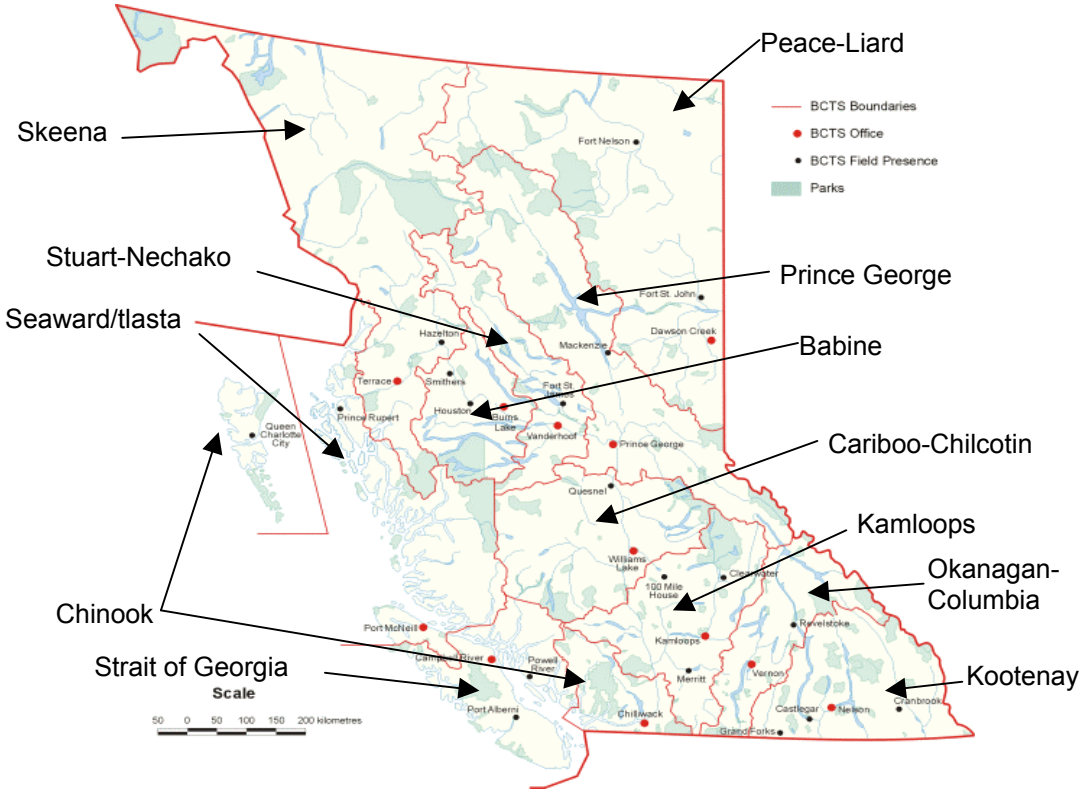

Figure 8: British Columbia Timber Sales Business Areas. Red dots are business offices and black dots are field offices. BC is a little larger in land area than Washington, Oregon and California combined.