Competitive Auction Markets in British Columbia

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0 QUALIFICATIONS OF AUTHORS

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I am the Holbrook Working Professor of Economics at Stanford University, Research Associate at the National Bureau of Economic Research, and Principal of Market Design Inc. I am an expert on auctions, microeconomic theory, and industrial organization. In 2004-2005, I am also a Fellow at the Center for Advanced Study in the Behavioral Sciences at Stanford University. I previously was the Castle Krob Career Development Associate Professor of Economics at the Massachusetts Institute of Technology, and I was a Sloan Foundation Research Fellow and a National Fellow at the Hoover Institution at Stanford University. I have received continuous funding from the National Science Foundation since 1996. My curriculum vitae, which includes a list of my publications and other experience, is attached as Exhibit A.

I have written two scholarly articles on the subject of U.S. Forest Service timber auctions. I have also published advances in statistical methods for analyzing data from auctions. In a series of theoretical articles, I have explored the topics of collusion, price-fixing, and market dominance.

Since December 2001, I have advised the British Columbia Ministry of Forests on the design of market reforms.

I have published numerous articles in scholarly journals, including American Economic Review, Econometrica, Review of Economic Studies, Journal of Political Economy, Quarterly Journal of Economics, and the RAND Journal of Economics. I am a Fellow of the Econometric Society. I currently serve as associate editor of Quarterly Journal of Economics and the American Economic Review, and in the past I have served as foreign editor for Review of Economic Studies, co-editor of the Journal of Economics and Management Strategy, and associate editor for the RAND Journal of Economics.

Peter Cramton

I am Professor of Economics at the University of Maryland and Chairman of Market Design Inc. I am an expert on auctions, bargaining, and market exchange. Much of my recent work has applied this expertise to market design in many industries. I previously was an Associate Professor at Yale University and a National Fellow at the Hoover Institution at Stanford University. My curriculum vitae, which includes a list of my publications and other experience, is attached as Exhibit A.

I have advised many governments in the design and implementation of auctions, and have also advised firms that bid in high-stakes auctions. My auction practice is worldwide, including recent engagements in the United States, France, Belgium, Germany, the Netherlands, Italy, the United Kingdom, Switzerland, Canada, Australia, Austria, India, Singapore, Mexico, and Taiwan.

I have advised the U.S. Department of Justice and the U.S. Federal Communications Commission on collusion in auctions. Designing competitive auction markets has been a focus of this work.

Since December 2001, I have advised the British Columbia Ministry of Forests on the design of its market reforms.

I have published numerous articles in scholarly journals, including American Economic Review, Econometrica, Review of Economic Studies, Journal of Economic Literature, European Economic Review, International Economic Review, Journal of Regulatory Economics, Journal of Law and Economics, Journal of Labor Economics, Journal of Economics and Management Strategy, Games and Economic Behavior, and Journal of Law, Economics and Organization.

1 INTRODUCTION

We have advised the British Columbia Ministry of Forests from December 2001 to date. Our advice focused on the design of a more transparent and market-oriented environment for selling rights to harvest timber. Since 2001, the regulatory environment has been simplified and streamlined to enhance competition. Key policy changes were implemented as part of the *Forestry Revitalization Plan* and the associated legislative and regulatory changes which came into effect during 2003.[1] In this paper, for simplicity we focus our attention on the period beginning November 5, 2003, when all of the regulatory changes were operational. We note, however, that many of the most important changes were in place prior to November 5.

After November 5, 2003, BC timber sales:

- Are managed by B.C. Timber Sales (BCTS), a division of the Ministry of Forests with a mandate for commercial timber sales. Revenue maximization and competitiveness of the markets are explicit objectives.
- Are awarded using a first-price, sealed-bid auction, on a price-only basis.
- Are open to all bidders (including U.S. bidders).[2]
- Are open and transparent. Detailed information packages are provided by the Ministry. In addition, interested bidders may visit the license area and conduct their own timber cruises or other assessments. The auction rules are known and enforced.

In addition, changes have been made that further increase the size and transparency of the log markets into which the auctioned timber is sold:

- The province has established a monthly log price reporting system for the Interior similar to that provided for the Vancouver log market on the Coast.
- The take-back of tenure and the associated increase of timber sold at auction and by other market loggers (e.g. First Nations, woodlots) has increased the volume of logs that are traded on the log market.

The behavior of tenure-holders has also been deregulated:

[1] These measures include: *Forestry Revitalization Act*; *Forest Revitalization Act (No.2), 2003*; *Forest (Revitalization) Amendment Act, 2003*; *Forest (Revitalization) Amendment Act (No.2), 2003*; *Forest Statutes Amendment Act, 2003*; and the *Advertising, Deposit and Disposition Regulation*. See the following website for regulations: http://www.for.gov.bc.ca/tasb/legsregs/forest/faregs/adder/adder.htm

[2] A small number of auction sales after November 5, 2003 still have restrictions on which bidders may participate, as a legacy from the prior small business program. To keep the discussion simple and transparent, in this report, we exclude those sales from our analysis, and we instead focus on the sales without restrictions on participation.

- Mill closures are not penalized, and employment and capacity are determined by market forces.
- There are no minimum cut, processing or appurtenancy regulations in place.
- Tenures may be transferred, except if they raise antitrust concerns by increasing concentration too much, or if the tenure-holder is delinquent in payments to the Crown.

We conclude that during the time period on which we focus (November 5, 2003 to March 31, 2004), BCTS timber auctions were competitive, and that the prices paid by winning bidders at BCTS timber auctions for the exercise of timber harvest rights acquired in these sales represented market prices for those rights. We outline our reasoning in the following subsections.

In our subsequent analysis, we focus on two particular sets of tracts that were auctioned by BCTS during the time period November 5, 2003 to March 31, 2004. The first set consists of 142 tracts from the Interior, and will be referred to as the "142 Interior tracts" in the body of this paper. These tracts satisfy the following criteria: (i) harvesting rights were sold via BCTS auctions between November 5, 2003 and March 31, 2004, (ii) the auctions had no restrictions on participation, and (iii) full appraisal data is available for the tracts. It should be noted that 20 additional tracts met criteria (i) and (ii) but had incomplete data as of this writing and were thus excluded.

The second set consists of 34 tracts from the Coast that also satisfy criteria (i)-(iii) above. These tracts will be referred to as the "34 Coast tracts" in the body of the paper.

We will generally refer to tracts that satisfy criteria (i)-(ii) as "unrestricted auctions" or "unrestricted sales."

2 THE PERFORMANCE OF THE AUCTION MARKET

We evaluate the BCTS auctions along several dimensions. First, we evaluate the rules and procedures used to select timber for auction and conduct the auctions. Second, we evaluate the outcomes of the auctions, including the degree of participation and the auction prices paid on BCTS sales.

2.1 The Rules and Procedures for the BCTS Auctions Enhance Competition

The BCTS auctions are conducted using rules and procedures that are standard for public and private sellers of standing timber. In particular, the following procedures are used:

- For the tract for which timber harvest rights are to be auctioned, a preliminary appraisal is prepared and made public in advance of the auction.[3]
- The auction is advertised in local newspapers and on a website.
- Potential bidders are offered an opportunity to inspect the tract.
- Sealed bids, expressed in a price per unit of volume (non-negative "bonus bids," which are added to the upset price to obtain a per-unit "total bid"), are solicited with a specified due date.

[3] The precise time periods for advertising and advertisements vary with sale size, as specified in the Advertising, Deposits, Disposition, and Extensions Regulation (posted at http://www.for.gov.bc.ca/tasb/legsregs/forest/faregs/adder/adder.htm). For example, the largest sales require advertising at least once every two weeks for eight weeks.

- An "upset price" is publicly announced.
    - Bids below the upset price are rejected, and the tract is not sold if there are no bids above the upset price.
    - The upset price is determined as a percentage of the predicted winning bid for the tract, using a regression-based statistical model (MPS) based on past auction prices.
- Bids are publicly opened, and the highest bidder is awarded the harvest rights for the tract.
- Bidders typically have between 1 and 3 years to harvest the timber, with an average of about 1 ½ years.
- As timber is harvested, the volume is measured and the winning bidder pays the amount of its bid (upset price plus bonus bid) for each unit of volume harvested (except for dead and dry timber, which is billed at $.25 per cubic meter).
- Regulations and procedures are in place to deter collusion.

All of these procedures are "best practice" in the timber industry and in auction markets more generally, and qualitatively similar procedures are in place in a wide range of public and private auction settings. The procedure for determining the upset price is similar to the procedure used in much of the U.S. Forest Service. The use of sealed bidding is also standard practice (for example, it is used for natural resource auctions and procurement by governments and private firms around the world, including in the United States). Economic theory and our experience in designing and implementing auctions indicate that this practice is revenue-maximizing. Similarly, the use of "scale sales," whereby bidders pay the amount of their bid on each unit actually harvested, is also standard practice, as it reduces the volume-based risk borne by bidders and thus increases the prices that bidders are willing to pay.[4]

The BCTS has several procedures in place to prevent collusion. First, collusion is illegal, and bidders who engage in collusion are at risk for both civil and criminal penalties, punishable by fines up to $500,000 as well as jail time for those involved in collusion. In addition, the Ministry has a "whistleblower" policy, whereby the first person to report collusive activity is immune from prosecution. This type of policy is also referred to as a "leniency" policy. The U.S. Department of Justice argues that leniency policies are extremely effective when criminal penalties are available, particularly the threat of jail time, as is the case here.[5] The policy induces a "race" among employees of colluding firms to be the first to report illegal activity in order to avoid jail time; anticipating this, firms are reluctant to collude.

[4] Historically, scale sales have been a commonly-used method for auctioning timber in state and federal auctions in the western United States. The alternative to a "scale sale" is a "lump sum sale," whereby the bidder pays a fixed amount for harvesting rights on a tract, irrespective of the volume that is actually harvested. The disadvantage of the lump sum format is that bidders face uncertainty about the volume of timber that they will actually extract from the tract, and so to account for this uncertainty, the bidders factor a "risk premium" into their bids (Athey and Levin, 2001, p. 381). Note that BCTS auctions require a single bonus bid for all sawlogs, and so the problem of "skewed bidding" does not arise. Thus, the BCTS procedure is broadly consistent with, for example, the recommendations of the United States General Accounting Office (1983), which argued for the elimination of species-specific bids in United States Forest Service scale sales.

[5] See, e.g., Hammond (2004), a speech by Scott Hammond of the U.S. Department of Justice outlining the important elements of a leniency program.

Thus, BCTS has implemented "best practices" in terms of the legal policies surrounding collusion, policies that have proven quite effective in other markets.[6]

Second, the BCTS has a training program for all personnel involved in administering BCTS auctions that is designed to help detect and deter collusion. The content of the training program is consistent with "best practices" in government procurement and natural resource auctions, as well as with advice we provided to BCTS.

The BCTS procedure for setting the upset price is also consistent with "best practice." Setting the upset involves complex tradeoffs to best meet three objectives: (1) to guarantee substantial revenue in auctions where competition is weak but the upset is met without creating too much inefficiency due to unsold stands, (2) to limit the incentive for—and the impact of—collusive bidding, and (3) to provide useful information to bidders. In our opinion, the approach used by BCTS of setting the upset at 70 percent of predicted value is consistent with revenue maximization. Such an upset strikes the right balance between the benefits of enhanced revenues and the costs of unsold timber stands.

Thus, we believe that the design of the BCTS auctions is fundamentally sound. The auctions are consistent with best practices elsewhere, for settings in which the seller's goal is to maximize revenues.

2.2 The Level of Participation is Sufficiently High to Enhance Competition

Economic theory provides a simple framework for analyzing the participation of bidders at sealed bid auctions.[7] First, bidders become aware of the auctions. Second, bidders must decide whether to evaluate a tract and prepare a bid. Bidders will weigh these costs against the profits they expect from entering the auction.[8] At the time they make their entry decisions, as well as when they bid, bidders face uncertainty about the number and identities of opposing bidders who also enter the auction, and this uncertainty enters their calculations about the profitability of entry as well as their decisions about how aggressively to bid. In particular, what matters to bidders is the probability distribution over potential competition—that is, bidders consider the possibility that many opponents will bid as well as the possibility that only a few will bid. The *risk* of greater participation induces bidders to place bids closer to their true values in *all* sales even though the *actual* number of participants may in *some* sales be smaller than expected (of course, in other sales, the actual number is larger than expected). Thus, even in an auction where only one or two bidders actually submit bids, bidders typically are not aware of this in advance, and so they still bid closer to their willingness to pay than if they had known with certainty that only a few bidders would arrive.

The relationship between the expected number of bidders and the expected profitability from bidding in an auction depends on a number of factors, including the dispersion of costs and values among bidders as well as the extent to which these costs and values are private information to the bidders. Historical data from U.S. Forest Service timber auctions in the 1980s have found participation of an average of 3 to

[6] Examples are given in Hammond (2004).

[7] See, e.g., Levin and Smith (1994).

[8] An interesting theoretical result is that if bidders are on average symmetric, in an "independent private values" model of bidders' information, bidders make socially efficient entry decisions. That is, bidders decide to bear the cost of entering the auction exactly when their expected contribution to social surplus (in terms of lower harvesting cost or greater value for the timber) is greater than the entry cost, and so the entry decisions maximize social surplus, given the simultaneous-move structure of the game. This result follows as a direct consequence of the Revenue Equivalence Theorem from auction theory, together with the well-known result that a second-price auction yields efficient allocation by giving each bidder his contribution to social surplus.

4 bidders to be typical,[9] although the number varies across the different geographical areas. Although we have not performed a detailed study of this issue in the U.S. Forest Service, on its face the data suggests that in these areas, an average of 3 to 4 bidders at timber auctions creates enough competition that expected profits in the auction are as low as the (fairly small) entry costs.

Now consider how these factors relate to BCTS timber auctions in the time period under consideration. Since in BC, the Ministry widely advertises BCTS auctions, it is inexpensive for participants to maintain awareness of auction opportunities. Furthermore, BCTS provides extensive information, including cruise data, about sales, hence the cost of preparing a bid is fairly low. Thus, we expect entry to occur up to the point where expected profits from entering the auction are equal to these entry costs.

The bidding data in BCTS sales from November 5, 2003 through March 31, 2004 had substantial participation, and the bidding patterns are consistent with the hypothesis that bidders are not aware of the precise number of opponents when they prepare their bids, but rather bidders consider the expected competition.[10] Specifically, the BCTS auctions attracted more than four bidders per auction, on average: on the coast, the average number of bidders was 5.7, with a median number equal to 5, while on the interior, the average number of bidders was 3.78, with a median of 3,[11] similar to the numbers reported above for U.S. Forest Service auctions.

Note that most of the bidders in the auctions during this time period were *not* the major timber companies or tenure-holders, but rather most bidders were logging firms.[12] This reflects an industry structure characterized by a lack of vertical integration. In the case of vertical integration, a single firm carries out multiple steps of a production process, in this case both logging and milling. In contrast, in British Columbia, typically firms with manufacturing capability have only limited logging capability, and they use contractors to do the logging. For example, most long-term tenure holders use independent logging contractors to harvest timber from their tenures. Contracting is used almost exclusively in the Interior, while on the Coast at least 50% of logging work is done by contractors.[13] In general, the use of contractors allows firms to operate more efficiently and to specialize in their "primary business." The logging firms, in turn, specialize as well, keeping costs low and staying fully employed by contracting with multiple manufacturing firms. These firms also develop knowledge and expertise at evaluating tracts and estimating the costs of harvesting timber.

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[9] There are few statistics available about other timber auction markets. The U.S. Forest Service is one of the world's largest auctioneers of timber. Although the U.S. Forest Service does not publish these summary statistics, the authors calculated that in Region 6 (Oregon and Washington) during the 1980s, there were approximately 750 sealed bid auctions that attracted an average of 3.5 bidders and a median of 3 bidders. In Region 1 (Idaho and Montana) during the 1980s, there were approximately 1420 sealed bid auctions that attracted an average of 3 bidders and a median of 2. See http://www.econ.yale.edu/~pah29/timber/timber.htm for data.

[10] For example, even for the small fraction of tracts for which only one bid was received, the average bonus bid is significantly greater than zero, where zero would be the optimal bonus bid for a bidder that knew it had no competition. This highlights an important advantage of sealed bidding: firms always face some uncertainty about who else has submitted bids.

[11] We consider the sample of 142 tracts on the Interior that were sold using unrestricted auctions between November 5, 2003 and March 31, 2004. Unfortunately, as of this writing the number of bidders was not entered in the information system for twelve of the tracts. Thus, the summary statistics include the 130 tracts for which data is available. Similarly, for the coast, the number of bidders is missing for one tract.

[12] About two-thirds of the 34 Coast tracts were won by log brokers or market loggers, while about four-fifths of the 142 Interior tracts were won by log brokers or market loggers.

[13] See the November 22, 2004 BC Questionnaire Response at Pages BC-VI-22 to BC-VI-24.

Thus, it appears that the efficient industry structure has specialized logging firms and manufacturing firms. The logging firms place bids in BCTS auctions, and they sell the timber directly to mills, through log markets, or some combination thereof. Mills occasionally participate in auctions directly, but this participation is the exception rather than the rule.

The BCTS auctions during this time period restricted bidders to hold no more than three BCTS timber licenses simultaneously. This restriction was introduced in the small-business timber auction program that was a precursor to BCTS, as a way to prevent speculation and promote a competitive market structure. In our opinion, this restriction should have little impact on bid prices. To understand why, first note that only about 10% of BCTS registrants were subject to the limit during the time period. In addition, if a mill is unable to bid on a tract due to the restriction, the market loggers participating in the BCTS auctions will still take into account the mill's valuation for the logs, since the loggers anticipate being able to sell the harvested logs directly to the mill or through the log market (where log market prices will reflect the valuations of all local mills). Thus, a mill's valuation for the logs is still reflected in the auction prices, even if it does not bid directly. Indeed, in the efficient industry structure, this may be the standard practice. For this reason, the restrictions on participation should not have a significant effect in practice.

Next, we review the auction prices. The patterns of bidding appear competitive. On the 142 tracts from the Interior, the volume-weighted average of bonus bids, normalized as a percentage of the upset price, is equal to 47.5%. This implies that the average total bid (bonus bid plus upset) is slightly greater than the statistical prediction of the MPS equation that forms the basis of the upset price.[14] In addition, over 75% of the tracts had bids greater than 10% above the upset price, and 99% of tracts had bids greater than the upset price. This indicates that the market is competitive enough that the upset price rarely binds. In addition, the MPS equation used for setting the upset price is fairly accurate, in that it very rarely led to upset prices that were so high that no bidders valued the tract at the upset prices. The patterns are qualitatively similar on the Coast, with somewhat higher bonus bids: the volume-weighted average of bonus bids as a percentage of the upset is equal to 66.8%.

3 PRICES PAID IN BCTS AUCTIONS ARE A COMPETITIVELY DETERMINED MEASURE OF THE MARKET VALUE OF THE TIMBER HARVESTING RIGHTS SOLD

It is relatively common to use pricing data from competitive transactions as a benchmark for non-market transactions in the same market. This procedure is commonly used to determine transfer pricing within large organizations. For example, General Motors, as well as other companies, set prices for internal transactions using prices from transactions in local markets, in a process known as tapered integration. Indeed, the most common way for determining prices not set directly through auctions or other competitive mechanisms is to determine the price from comparable market sales. This is the approach proposed for the British Columbia timber industry.

One example of using an auction for a portion of goods or services to create a benchmark price for a non-auctioned portion is seen in electricity restructuring in the United States. For example, in Texas, the former utilities are required to auction off 15 percent of their generating capacity. The auction prices are then used to determine the value of the remaining 85 percent of capacity, which is then used to calculate stranded costs.

In many markets that involve substantial capital investment, the vast majority of transactions are long term; firms enter into forward contracts to ensure a return on their capital investments. In such markets, only a small fraction of transactions occur in the spot market. Despite this structure, spot market

[14] If the average total bid was equal to the prediction of the MPS equation, then the bonus bid would be equal to 3/7 of the upset, or 43%.

prices are valid indicators of the present market price for the good. Depending on the resolution of market uncertainties, spot market prices may be higher or lower than prices in long term contracts. However, those spot market prices provide current information on the supply and demand of marginal participants at that point in time. Wholesale electricity markets around the world provide an important example of this phenomenon. These markets are characterized by large capital investment and reliance on long-term contracts. Typically, only 5 percent to 20 percent of the energy volume is traded in the daily spot market. The remaining 80 percent to 95 percent is traded in long-term contracts. Yet, the spot price remains the price that clears the market by equating supply with demand at a given point in time.

Although markets where only a fraction of trade takes place in the spot market are common, they typically function best when trading is not subject to many restrictions. Thus, it is useful that the BC reforms have broadened participation in log markets and made these markets more transparent.

3.1 BCTS Auction Prices as a Broader Indicator of Market Value

Given that auction prices reflect market prices for the particular harvesting rights being auctioned, the next question to consider is whether these prices can also be used to estimate the market value of timber harvested under long-term tenures. There are several matters to consider.

3.1.1 Volume and Number of BCTS Auctions

The 142 Interior tracts include a net cruise volume of 3.2 million cubic meters of timber, while the 34 Coast tracts include a net cruise volume of 800,000 cubic meters. Total winning bids for the Interior tracts were $124.4 million, while on the Coast total winning bids were $35.7 million. Thus, these markets incorporate a significant volume of economic activity during the relevant time period.

If (as we will argue below) BCTS auctions for timber harvest rights consist of timber that is representative of tracts harvested under long-term tenures, the stumpage paid for timber harvested[15] in the unrestricted BCTS sales can be used to estimate the market price of the timber harvested from the long-term tenures. In particular, the average (appropriately weighted by volume[16]) of the auction prices from the unrestricted BCTS sales should be equal to the average price that would be paid if all of the timber harvested under long-term tenures had been sold at auction. Because BCTS auctions and harvests of long-term tenure are drawn from the same geographic locations, involving the same market participants, logging costs, processing facilities, market conditions, and so on, and because BCTS tracts are representative of tracts harvested under long-term tenures, it is possible to simply compare the average prices from the two sets of tracts.

What is necessary to implement this procedure? To make such a comparison requires sufficient BCTS sales to calculate a representative average of BCTS stumpage paid by species. As an illustration, on the 142 Interior tracts, the average price per cubic meter for green, coniferous sawlogs is approximately $38, while the standard deviation is approximately $11. Given a population of tracts with a mean value of $38 and a standard deviation of values equal to $11, elementary statistics tells us that the average of 142 random draws from this population has standard deviation of $.92. Thus, if the exercise of

[15] In Section 3.1.3 below, we will discuss the distinction between average auction prices (weighted by cruise volumes) and stumpage paid for harvesting rights in BCTS sales, which weights auction prices using harvest volumes and also includes stumpage for grades 3, 4, 5, 6 and y (referred to as dead and dry timber) weighted by harvest volumes. The qualitative arguments in this section are not sensitive to how we resolve ambiguities arising due to the distinction, and so for simplicity we use (unweighted) auction prices for sawlogs in our illustration.

[16] See footnote 15 and Section 3.1.3 for a discussion of weighting and the inclusion of dead and dry timber. The dead and dry timber price can be thought of as a fixed component that enters into the overall auction price, and so we will sometimes speak of auction prices without specifically referring to dead and dry timber.

drawing 142 tracts from the population was repeated many times, 95% of the time the sample mean will lie between $36.16 and $39.84. Thus, when appropriately weighted as described in Section 3.1.3 below, price data from 142 representative tracts can be used to generate an estimate of the average value of the timber harvested from the long-term tenures.[17]

In practice, due to normal variation that arises in moderately sized samples, there are some minor differences in observable characteristics (such as appraised logging costs or species composition) between the tracts harvested under long-term tenures and the characteristics of tracts where harvesting rights are sold at BCTS auctions. To adjust for those differences,[18] the same regression model (MPS) used in setting auction upset prices can be applied. The MPS is designed to analyze the effects of observable characteristics of tracts on auction prices. This model is used to predict average (volume-weighted) prices as a function of tract characteristics for both the BCTS tracts[19] and the long-term tenure tracts. The difference between the two averages yields a prediction of the quality adjustment, that is, the amount that the average prices would differ across the two sets of tracts if all harvesting rights had been sold using auctions.

Note that the MPS statistical model is well suited for understanding the effects on price of the types of variation in tract characteristics that naturally occurs *within* tracts in the sample. For example, within BCTS sales, some tracts are large and some small, and so it is possible to predict the effect of sale size on price. In contrast, the MPS model would *not* be very useful for adjusting for the type of variation that does *not* occur within the sample; for example, a model estimated solely using data from the Coast would not necessarily do very well at predicting differences in auction prices between the Coast and the Interior. Similarly, quality adjustments based on the MPS model would not necessarily give a very accurate prediction of differences in auction prices between BC and tracts in a different country.

In summary, given a set of tracts sold using BCTS auctions that are very similar to tracts harvested under long-term tenures, the stumpage paid in the unrestricted BCTS sales can reasonably be used to estimate the current market values of the timber harvested from the long-term tenures. A statistical model can be used to adjust for any observable differences in tract characteristics. This is appropriate because the BCTS tracts are similar to the tracts harvested under long-term tenures in terms of location, market environment, and tract characteristics. In contrast, any attempt to use prices from other markets would rely on many more assumptions: such a model would need to predict the effects of differences in the number and type of mills, local labor supply conditions, climate, insect infestations, and so on. Since geographical variation in quantities like the number and type of local mills does not happen randomly, but rather is systematically related to observable and unobservable characteristics of each geographical location, it is especially difficult to draw inferences about the causal effects of variation in these factors on prices. Attempts to draw such inferences and then extrapolate to new environments are typically very sensitive to a number of specific modeling assumptions.

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[17] With thousands of tracts harvested under long-term tenures, the standard deviation of the average value sold under long-term tenures is negligible compared to that of the auctioned sales.

[18] To avoid any possible confusion, we emphasize that adjusting for differences in observable tract characteristics such as logging costs (a "quality" adjustment) is a distinct concern from the issue of accounting for dead and dry wood using harvest volumes. The latter issue is taken up in Section 3.1.3.

[19] Even though actual prices are available for the BCTS auctions, the quality adjustment does not directly make use of them. The quality adjustment uses the MPS for both sets of tracts (BCTS and long-term tenures) in order to generate a measure that depends solely on tract characteristics. The coefficients of the MPS are estimated using past auction data rather than contemporaneous data, which is reasonable given that the coefficients are fairly stable over time, and given that the same model is applied to both sets of tracts.

3.1.1.1 Volume for Measuring Market Value versus Volume for Implementing Auction-based Pricing

Having argued that the BCTS auctions provide sufficient data to measure market value, we pause to compare our analysis of this question to a related question we considered in the past. In particular, MDI has also advised the BC Ministry about the implementation of an auction-based pricing system for setting stumpage on the tracts harvested under long-term tenures. In our analysis we addressed the question of how much auction volume is required to accurately estimate the regression equations used in setting these rates. This question is closely related to, but distinct from, the issue considered above of using stumpage paid for timber sold in BCTS sales to estimate the current value of timber harvested from the long-term tenures.

The problem of estimating market value involves calculating average prices over many tracts. The auction-based pricing system we examined has an additional goal: the prices should be accurate not just on average, but also the difference between prices tenure-holders expect to pay on different tracts should reflect differences in the economic values of the individual tracts, in order to avoid any distortions in the tract selection process. Accurately predicting differences among individual tracts requires a statistical model with additional precision. For this reason, we believe that although auctioning a larger volume of tracts would not affect the average stumpage fees collected, a larger volume of tracts auctioned through BCTS would have an additional benefit of improving the fit of the regression equation and thereby inducing more efficient tract selection by long-term tenure-holders. This additional benefit is unrelated to the question of whether the stumpage paid on the unrestricted auctions can be used to estimate, again on average, the value of timber harvested from the long term tenures.

3.1.2 Representativeness of BCTS Auctions

Table 1 illustrates information about harvests from three categories of tracts. The first category includes the 142 Interior tracts. The second category includes the harvests from tracts whose harvesting rights were sold through auctions prior to or during this time period (including unrestricted auctions, but also including auctions where participation was limited to small mills or loggers). The third category includes all other Crown harvest during this time period (that is, harvests from long-term tenures).

We are interested in estimating the market value of timber harvested between November 5, 2003 and March 31, 2004, and priced using methods other than unrestricted auctions. Thus, for the "All Auctions" and the "other Crown" categories, we include data about all timber harvested during the relevant time period. We can compare this timber to timber *sold* through auctions during the relevant time period. Because grade data is not available on the appraisal, but instead is recorded at the time of timber harvest, we use data about the aggregate harvest to date from the 142 tracts.[20]

Inspection of Table 1 indicates that the species composition and the quality composition of the 142 Interior tracts is very similar to the species and quality composition of timber harvested from tracts in the "All Auctions" category, as well as of timber harvested from other types of Crown tenures, which are primarily the long-term tenures. For example, the leading species, Douglas Fir, Lodgepole Pine, and Spruce, comprise 10.8%, 60.4%, and 16.8% of the timber harvested from the 142 tracts, respectively, and 8.7%, 56.2%, and 21.3% of the "other Crown" harvest. Among the other, less valuable grades, the 142 tracts have a higher fraction of dead and dry sawlogs (19.5% Grade 3) versus the other, less valuable grades 4-6 (10.6% Grades 4-6). In contrast, the "other Crown" harvest of Coniferous timber has 11.5% Grade 3 and and 9.2% Grades 4-6.

[20] Below, in Section 3.1.3, we discuss this issue further.

We also observe that there is a slightly smaller fraction of Coniferous green sawlogs in the unrestricted auctions: 69.3% versus 76.8% in the other Crown harvest. Note, however, that this difference can be accounted for by comparing stumpage paid on harvest for the BCTS sales with the stumpage paid on harvest for the long term tenures, as described in Section 3.1.3.

Finally, a closer look at the data underlying Table 1 indicates that there is a large amount of overlap in the distributions of tract characteristics among the different groups. For example, there is a wide range of species composition within the 142 Interior tracts: the percentage of Douglas Fir ranges from zero to 79%, the percentage of Lodgepole Pine ranges from zero to 99.7%, and the percentage of Spruce ranges from .2% to 68%. Similarly, the fraction of green sawlogs in the 142 Interior tracts ranges from 8% to 95%. More generally, for each tract harvested under long-term tenures, there are similar tracts sold at unrestricted BCTS auctions.

Given the information presented in Table 1, we expect that the average value of harvesting rights for timber sold in unrestricted BCTS sales should be similar to the value of timber harvested under long-term tenures. Thus, any "quality adjustments" as described above will likely be relatively small in magnitude, and well within the range of variation that can be accurately predicted using the MPS equation.

Table 2 presents the analogous information for the 34 Coast tracts. The findings are qualitatively similar.

We reiterate that the applicability of the statistical model which adjusts for differences in tract characteristics hinges on the fact that a wide variety of factors (notably location, and thus local market conditions) are similar across the different sale procedures. It would be much more difficult to use a statistical model to adjust for those types of factors.

To further emphasize this point, Tables 3 and 4 illustrate the geographic dispersion of the unrestricted BCTS auctions on the Interior and Coast, respectively. Clearly, the 142 Interior tracts and 34 Coast tracts are representative of the non-auctioned timber in terms of geographic location.[21]

3.1.3 Using Harvest Prices or Bid Prices to Estimate the Value of Current Timber Harvests

A complexity arises in evaluating data from "scaled" timber auctions. In BCTS timber auctions, similar to many U.S. Forest Service timber auctions, the successful bidder is awarded a Timber Sale License (TSL) which conveys harvesting rights to the sawlog timber at the winning bid (upset plus bonus bid) price as well as rights to timber of grades 3, 4, 5, 6 and y (referred to as "dead and dry timber") at a pre-set rate (currently $.25 per cubic meter). As discussed above, the auctions establish a competitively determined market price for TSLs. However, as timber is harvested, it is scaled, and bidders' payments depend on the actual volume harvested. In particular, the *ex ante* expected payment by the bidders is equal to the product of the total stumpage rate bid for sawlogs and the cruise volume for sawlogs, *plus* the product of the pre-set stumpage rate for dead and dry timber and the expected volume for dead and dry timber.

However, because there is no cruise volume available for dead and dry timber, it is difficult for an analyst to quantify the bidders' expectations about dead and dry timber using only appraisal data. One approach to approximating the expected value that bidders anticipated (at the time of auction) to pay for harvesting rights on the tract is to weight the auction bids for sawlogs and the dead and dry timber rate using the actual harvest volumes that are later realized. This approach incorporates the fact that bidders take into account their expected payment for all harvesting rights on the tract (including dead and dry

[21] One minor exception is that no harvest has yet been reported from unrestricted auctions in the North Coast district, which comprises 1.7% of the Coast "other Crown" volume.

timber) when they place their bids. The value calculated using this approach is what we have referred to in the paper as the price paid for stumpage by winning bidders.

Timber harvested under long-term tenures is charged the stumpage rate then in effect for green sawlogs, and the same $.25 per cubic meter for dead and dry timber. Like auction bidders, long-term tenure-holders consider the overall stumpage they expect to pay for *both* sawlogs and dead and dry timber when they evaluate tracts for harvest.

In summary, the presence of dead and dry timber in the BCTS TSLs and in the cutting permits under long-term tenures means that care must be taken when utilizing the auction data to estimate the value of current timber harvests. We have described one approach to accounting for dead and dry timber, using harvest data from the auctioned tracts.

3.2 Long-Term Tenures do not Undermine Competitiveness of Auction Markets

The analysis above shows that the BCTS auction markets are well-designed and function well. In this subsection, we discuss the issue of how the presence of long-term tenures and the stumpage prices paid on long-term tenures affects the prices in auction markets, in the case where auction markets are used for volumes in the range of 5-15% of the total volume sold by the BC Crown. For the purposes of this discussion, we will consider the hypothetical case where administered stumpage prices paid on long-term tenures are below average auction prices, adjusted by any potential differences arising due to tenure obligations.

In short, if private and public owners of timber announce a total quantity Q to be sold in a particular year, there is a unique price at which the demand for the timber is equal to the supply, call this the "market price." At any lower price, there is "excess demand," in that buyers wish to purchase more than Q units. The market price is the price that will result at auctions for private timber, as well as at auctions for public timber, even if prices for a subset of the total quantity are set using an administered system at a level below the market price. Even if a large majority of the volume is sold using such an administered system, auction prices will adjust to be equal to the market price. If auction prices were lower, more buyers would enter the auctions and bid up the price, since at any lower price, more than Q units are demanded—in other words, some potential bidders would value the timber more than the auction prices.

The argument for why the stumpage prices paid on long-term tenures do not influence market prices for the remainder of the market is made clearly in Nordhaus (2004) and Kalt and Reishus (2004). The volume available from long-term tenures is limited by restrictions such as the Allowable Annual Cut (AAC).[22] During the period of review the harvest from long term tenures represented only 69% of the total demand for timber (as measured by the private and public timber harvest). Thus, the timber from the long-term tenures is not "marginal." Given that there is insufficient volume in long-term tenures to serve all buyers at the stumpage rate during the POR, the "residual demand" must be served through the private market and through auctions. If the stumpage rate was below the average auction price, then the level of the stumpage rate is irrelevant to the market price. The stumpage rate could fall in half, or all the way to

[22] The total Allowable Annual Cut AAC) from the public forest is apportioned among different types of tenures, including long-term replaceable tenures generally held by major forest companies, auctioned tenures and a variety of other minor tenure forms such as woodlots. During the POR long term tenures comprised about 85% of total provincial AAC. This does not take into account the contribution from private timberland. Note that the rules for AAC allow for some flexibility in reallocating the harvest across years in response to market conditions; as a result, some firms may not choose to harvest as much as they are permitted to in a downturn, qualitatively similar to a private landowner. For simplicity of exposition, we focus on the case of homogeneous stands and relatively stable market conditions, whereby firms tend to smooth their harvests over time with only minor variations around the AAC.

zero; still, the long-term tenure holders would remain unchanged at the constrained level, and the "residual demand" remaining would be unchanged. Since the market price in the private market and in auctions equates supply and this residual demand, the market price would also remain unchanged.[23]

Furthermore, if all of the public timber were sold at auction rather than some through long-term tenures, with the total quantity sold by the crown held fixed, the auction price would remain exactly the same: just as before, the auction price would be the price at which market demand for timber is equal to the total quantity sold in the public and private sector. (Of course, if the administered stumpage prices were below the auction prices, the switch to 100% auctions would result in higher average prices paid by tenure-holders, despite the fact that the auction prices would be unchanged.)

Although it may seem counterintuitive that the stumpage rates on long-term tenures do not affect auction prices, similar phenomena arise in other contexts too. Consider an analogy to electricity markets. Nuclear generators are typically regulated, and they have much lower marginal costs of producing electricity than other sources. Yet, when an auction is used to price electricity, market prices still emerge, without regard to the bids of regulated nuclear plants. In most cases the nuclear plants cannot serve the full market, and so the auction prices for electricity are determined by the costs (and thus the bids) of the "marginal" electrical generators, not the nuclear plants. Shutting down the nuclear plants would, of course, increase the price of electricity, because their supply would be replaced by that of higher-cost generators; but as long as the plants keep operating, it follows that within a wide band, changing the bids of the nuclear plants would have no effect on the market price. Instead, as is standard in economic models of supply and demand, the market price is determined as the lowest price that induces the marginal electrical generators to serve the residual demand. This argument does not change even if the marginal generators serve only a small fraction of the market.

It is, however, important that enough volume is auctioned so that a sufficient number of potential auction participants find it worthwhile to stay "active" in the market. Above, we showed that the BCTS auctions during the relevant time period had levels of participation that are high enough to meet this requirement.

4 CONCLUSIONS

We have reviewed the rules and procedures for BCTS auctions, as well as auction outcomes, for the unrestricted BCTS sales from November 5, 2003 through March 31, 2004. We believe that the prices paid for stumpage by winning bidders at BCTS auctions represent market prices, determined through competitive behavior by buyers of harvesting rights for standing timber. The BCTS auction markets are transparent, open, and free of restrictions and regulations that might hamper the effectiveness of the markets. The rules and procedures follow industry "best practice." A relatively small volume is required to be auctioned at BCTS auctions in order to establish a valid basis for comparisons with timber harvested under other tenures. Standard economic logic implies that the stumpage fees paid by auction winners should, on average, be equal to the market price at which the total timber sold by public and private sellers is equal to the demand for timber. It is important that BCTS sells enough timber at auctions in order to (a) generate competitive and active participation by potential bidders, and (b) to sell by auction a representative sample of timber sold under long-term tenures. The size of the BCTS program is sufficient for the purpose of estimating the average market price of all harvests from long-term tenures.

[23] See Kalt and Reishus (2004) for a more detailed and nuanced discussion of the arguments supporting the conclusion that below-market stumpage rates do not affect prices in the non-administered sector.

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Table 1: Interior Crown Volume, Value and Average Rate Billed

		Volume (m3)						Value (C$)			Average Rate (C$/m3)		
	Grade	**142 Tracts***	**%**	**All Auctions****	**%**	**Other Crown*****	**%**	**142 Tracts***	**All Auctions****	**Other Crown*****	**142 Tracts***	**Section 20****	**Other Crown*****
Coniferous	3	389,366	19.5%	329,436	15.2%	3,085,429	11.5%	97,342	82,361	771,330	0.25	0.25	0.25
	4	121,306	6.1%	139,943	6.4%	1,586,442	5.9%	30,328	34,987	396,618	0.25	0.25	0.25
	5	69,706	3.5%	61,062	2.8%	551,319	2.1%	17,427	15,266	137,830	0.25	0.25	0.25
	6	19,090	1.0%	20,459	0.9%	318,231	1.2%	4,773	5,115	79,559	0.25	0.25	0.25
	Green Sawlogs	1,383,797	69.3%	1,471,762	67.7%	20,633,421	76.8%	51,926,214	53,822,219	341,358,896	37.52	36.57	16.54
Coniferous Total		1,983,266	99.3%	2,022,662	93.0%	26,174,843	97.5%	52,076,084	53,959,948	342,744,233	26.26	26.68	13.09
Deciduous	3	63	0.0%	225	0.0%	1,099	0.0%	16	56	275	0.25	0.25	0.25
	4	2,369	0.1%	16,675	0.8%	118,383	0.4%	592	4,169	29,596	0.25	0.25	0.25
	5	31	0.0%	74	0.0%	1,258	0.0%	8	19	314	0.25	0.25	0.25
	6	307	0.0%	2,191	0.1%	8,746	0.0%	77	548	2,186	0.25	0.25	0.25
	Green Sawlogs	10,817	0.5%	132,226	6.1%	555,000	2.1%	5,408	252,372	276,794	0.50	1.91	0.50
Deciduous Total		13,586	0.7%	151,393	7.0%	684,485	2.5%	6,101	257,164	309,166	0.45	1.70	0.45
Grand Total		1,996,852	100.0%	2,174,055	100.0%	26,859,328	100.0%	52,082,185	54,217,112	343,053,399	26.08	24.94	12.77

		Volume (m3)						Value (C$)			Average Rate (C$/m3)		
	Grade	**142 Tracts***	**%**	**All Auctions****	**%**	**Other Crown*****	**%**	**142 Tracts***	**All Auctions****	**Other Crown*****	**142 Tracts***	**Section 20****	**Other Crown*****
Coniferous	Balsam	97,418	4.9%	144,184	6.6%	1,689,432	6.3%	1,937,395	3,231,702	21,657,934	19.89	22.41	12.82
	Red Cedar	51,644	2.6%	48,239	2.2%	495,950	1.8%	1,438,692	1,546,799	5,839,220	27.86	32.07	11.77
	Cypress	0	0.0%	0	0.0%	73	0.0%	0	0	18		0.70	0.25
	Douglas Fir	215,868	10.8%	142,185	6.5%	2,344,187	8.7%	8,078,934	5,734,793	32,305,760	37.43	40.33	13.78
	Hemlock	53,833	2.7%	49,288	2.3%	512,378	1.9%	1,131,110	995,030	2,979,216	21.01	20.19	5.81
	Larch	21,291	1.1%	15,709	0.7%	264,038	1.0%	732,808	548,656	2,686,529	34.42	34.93	10.17
	Lodgepole Pine	1,205,597	60.4%	1,196,890	55.1%	15,084,819	56.2%	27,625,258	28,152,731	184,971,141	22.91	23.52	12.26
	Other	-	0.0%	-	0.0%	0	0.0%	-	0	1			26.59
	Spruce	335,901	16.8%	423,990	19.5%	5,732,317	21.3%	11,078,690	13,702,690	91,913,641	32.98	32.32	16.03
	Yew	-	0.0%		0.0%	1	0.0%	-		0			0.25
	Whitebark Pine	3	0.0%	1	0.0%	607	0.0%	108	33	3,427	35.93	39.95	5.64
	White Pine	1,128	0.1%	1,996	0.1%	43,151	0.2%	30,730	43,559	333,730	27.25	21.82	7.73
	Yellow Pine	583	0.0%	180	0.0%	7,890	0.0%	22,359	3,953	53,616	38.36	22.01	6.80
Coniferous Total		1,983,266	99.3%	2,022,662	93.0%	26,174,843	97.5%	52,076,084	53,959,948	342,744,233	26.26	26.68	13.09
Deciduous	Alder	2	0.0%		0.0%	0	0.0%	1		0			0.16
	Aspen	7,279	0.4%	130,845	6.0%	529,298	2.0%	3,270	226,557	237,758	0.45	1.73	0.45
	Birch	5,058	0.3%	5,956	0.3%	17,829	0.1%	2,246	10,872	7,174	0.44	1.83	0.40
	Cottonwood	1,247	0.1%	14,591	0.7%	137,358	0.5%	585	19,735	64,233	0.47	1.35	0.47
Deciduous Total		13,586	0.7%	151,393	7.0%	684,485	2.5%	6,101	257,164	309,166	0.45	1.70	0.45
Grand Total		1,996,852	100.0%	2,174,055	100.0%	26,859,328	100.0%	52,082,185	54,217,112	343,053,399	26.08	24.94	12.77

* Interior unrestricted auction sales with full appraisal data awarded Nov. 5, 2003 through March 31, 2004: Harvest reported is November 1, 2003 through January 31, 2005.
** All BCTS Section 20 Sales: Volume Billed November 1, 2003 through March 31, 2004
*** All other Crown harvest: Volume Billed November 1, 2003 through March 31, 2004
Excludes waste, reject and special forest products.

Table 2: Coast Crown Volume, Value and Average Rate Billed

		Volume (m3)						Value (C$)			Average Rate (C$/m3)		
Species Type	Grade	34 Tracts*	%	All Auctions**	%	Other Crown***	%	34 Tracts*	All Auctions**	Other Crown***	34 Tracts*	All Auctions**	Other Crown***
Coniferous	B	976	0.2%	65	0.0%	9,333	0.1%	41,300	3,163	156,860	42.31	48.43	16.81
	C	11,346	2.4%	3,731	1.2%	74,232	1.1%	514,281	216,384	1,068,484	45.33	58.00	14.39
	D	5,811	1.2%	1,697	0.5%	199,238	3.0%	264,569	74,751	5,057,582	45.53	44.06	25.38
	E	55	0.0%	35	0.0%	2,785	0.0%	3,876	1,268	40,621	69.97	36.44	14.58
	F	7,588	1.6%	1,506	0.5%	200,026	3.0%	348,868	59,027	4,138,317	45.97	39.19	20.69
	G	103	0.0%	201	0.1%	7,443	0.1%	6,967	6,158	109,980	67.96	30.57	14.78
	H	85,773	18.4%	45,918	14.2%	1,699,872	25.9%	4,059,202	2,234,633	34,518,167	47.32	48.67	20.31
	I	44,678	9.6%	36,510	11.3%	894,225	13.6%	2,094,248	1,832,584	17,410,131	46.87	50.19	19.47
	J	201,598	43.3%	155,283	48.0%	1,736,189	26.5%	9,717,014	7,733,662	28,915,229	48.20	49.80	16.65
	K	3,301	0.7%	1,987	0.6%	103,244	1.6%	189,587	95,424	2,774,757	57.43	48.03	26.88
	L	7,543	1.6%	4,725	1.5%	167,731	2.6%	439,097	225,054	3,836,453	58.21	47.63	22.87
	M	5,048	1.1%	4,566	1.4%	135,450	2.1%	266,902	213,938	3,079,498	52.87	46.86	22.74
	U	53,341	11.4%	40,269	12.4%	653,757	10.0%	2,418,306	1,835,578	12,204,742	45.34	45.58	18.67
	X	18,985	4.1%	10,704	3.3%	365,280	5.6%	754,433	445,847	7,194,507	39.74	41.65	19.70
	Y	18,386	3.9%	12,391	3.8%	260,132	4.0%	6,192	3,122	65,126	0.34	0.25	0.25
Coniferous Total		464,532	99.7%	319,588	98.8%	6,508,938	99.2%	21,124,843	14,980,592	120,570,452	45.48	46.87	18.52
Deciduous	U	1,405	0.3%	3,779	1.2%	47,934	0.7%	1,405	3,779	31,237	1.00	1.00	0.65
	Y	107	0.0%	179	0.1%	1,485	0.0%	27	45	373	0.25	0.25	0.25
Deciduous Total		1,512	0.3%	3,957	1.2%	49,419	0.8%	1,432	3,824	31,610	0.95	0.97	0.64
Grand Total		466,045	100.0%	323,545	100.0%	6,558,357	100.0%	21,126,275	14,984,415	120,602,063	45.33	46.31	18.39

		Volume (m3)						Value (C$)			Average Rate (C$/m3)		
Species Type	Species	34 Tracts*	%	All Auctions**	%	Other Crown***	%	34 Tracts*	All Auctions**	Other Crown***	34 Tracts*	All Auctions**	Other Crown***
Coniferous	Balsam	28,579	6.1%	27,200	8.4%	861,884	13.1%	856,702	748,743	17,350,265	29.98	27.53	20.13
	Red Cedar	110,920	23.8%	58,345	18.0%	1,884,570	28.7%	5,796,947	3,058,857	41,663,147	52.26	52.43	22.11
	Cypress	10,650	2.3%	5,907	1.8%	251,451	3.8%	457,786	342,301	4,876,367	42.98	57.94	19.39
	Douglas Fir	186,429	40.0%	174,024	53.8%	1,125,363	17.2%	8,715,548	8,884,790	16,105,828	46.75	51.06	14.31
	Hemlock	122,644	26.3%	44,535	13.8%	2,251,445	34.3%	5,023,153	1,663,657	38,967,379	40.96	37.36	17.31
	Lodgepole Pine	490	0.1%	723	0.2%	3,367	0.1%	23,410	40,840	45,862	47.80	56.53	13.62
	Spruce	4,591	1.0%	8,529	2.6%	122,857	1.9%	240,060	228,230	1,418,388	52.29	26.76	11.54
	Yew	0	0.0%		0.0%	27	0.0%	0		7	0.25		0.25
	Whitebark Pine		0.0%		0.0%	1	0.0%			0			0.25
	White Pine	228	0.0%	314	0.1%	7,971	0.1%	11,237	13,028	143,209	49.19	41.47	17.97
	Yellow Pine		0.0%	11	0.0%	1	0.0%		146	0		13.69	0.25
Coniferous Total		464,532	99.7%	319,588	98.8%	6,508,938	99.2%	21,124,843	14,980,592	120,570,452	45.48	46.87	18.52
Deciduous	Alder	1,111	0.2%	2,729	0.8%	45,522	0.7%	1,054	2,636	28,169	0.95	0.97	0.62
	Arbutus		0.0%		0.0%	1	0.0%			1			1.00
	Aspen		0.0%		0.0% -	45	0.0%			- 45			1.00
	Birch	82	0.0%	1	0.0%	72	0.0%	74	0	49	0.91	0.26	0.68
	Cottonwood	91	0.0%	482	0.1%	1,618	0.0%	91	471	1,361	1.00	0.98	0.84
	Maple	228	0.0%	746	0.2%	2,252	0.0%	213	716	2,076	0.93	0.96	0.92
Deciduous Total		1,512	0.3%	3,957	1.2%	49,419	0.8%	1,432	3,824	31,610	0.95	0.97	0.64
Grand Total		466,045	100.0%	323,545	100.0%	6,558,357	100.0%	21,126,275	14,984,415	120,602,063	45.33	46.31	18.39

* Coast unrestricted auction sales with full appraisal data awarded Nov. 5, 2003 through March 31, 2004: Harvest reported is November 1, 2003 through January 31, 2005.
** All BCTS Section 20 Sales: Volume Billed November 1, 2003 through March 31, 2004
*** All other Crown harvest: Volume Billed November 1, 2003 through March 31, 2004
Excludes waste, reject and special forest products.

Table 3: Interior Crown Volume Billed by District

Region	District	142 Tracts*	%	All Auctions**	%	Other Crown***	%
Northern Interior	Fort Nelson		0.0%	11,069	0.5%	39,833	0.1%
	Fort St. James	133,207	6.7%	177,309	8.2%	1,159,610	4.3%
	Kalum	57,801	2.9%	37,999	1.7%	155,906	0.6%
	MacKenzie	79,874	4.0%	23,272	1.1%	1,575,796	5.9%
	Nadina	77,427	3.9%	226,064	10.4%	2,027,334	7.5%
	Peace	52,934	2.7%	321,078	14.8%	1,830,746	6.8%
	Prince George	392,083	19.6%	122,773	5.6%	3,388,255	12.6%
	Skeena Stikine	9,724	0.5%	55,791	2.6%	308,274	1.1%
	Vanderhoof	128,927	6.5%	215,256	9.9%	2,329,062	8.7%
Northern Interior Total		931,977	46.7%	1,190,611	54.8%	12,814,816	47.7%
Southern Interior	100 Mile House	9,652	0.5%	49,498	2.3%	1,128,845	4.2%
	Arrow Boundary	37,231	1.9%	42,836	2.0%	1,229,980	4.6%
	Cascades	60,549	3.0%	62,628	2.9%	1,179,439	4.4%
	Central Cariboo	97,628	4.9%	52,527	2.4%	1,557,774	5.8%
	Chilcotin	11,545	0.6%	19,318	0.9%	282,300	1.1%
	Columbia	6,445	0.3%	50,602	2.3%	390,406	1.5%
	Headwaters	25,423	1.3%	52,414	2.4%	788,132	2.9%
	Kamloops	299,895	15.0%	211,848	9.7%	1,411,438	5.3%
	Kootenay Lake	26,265	1.3%	24,845	1.1%	318,776	1.2%
	Okanagan Shuswap	244,675	12.3%	123,058	5.7%	2,071,321	7.7%
	Quesnel	114,100	5.7%	233,959	10.8%	2,948,095	11.0%
	Rocky Mountain	131,465	6.6%	59,911	2.8%	738,005	2.7%
Southern Interior Total		1,064,874	53.3%	983,444	45.2%	14,044,512	52.3%
Interior		1,996,852	100.0%	2,174,055	100.0%	26,859,328	100.0%

* Interior unrestricted auction sales with full appraisal data awarded Nov. 5, 2003 through March 31, 2004: Harvest reported is November 1, 2003 through January 31, 2005.
** All BCTS Section 20 Sales: Volume Billed November 1, 2003 through March 31, 2004
*** All other Crown harvest: Volume Billed November 1, 2003 through March 31, 2004
Excludes waste, reject and special forest products.

Table 4: Coast Crown Volume Billed by District

District	34 Tracts*	%	All Auctions**	%	Other Crown***	%
Campbell River	153,000	32.8%	78,177	24.2%	1,257,638	19.2%
Chilliwack	123,533	26.5%	27,657	8.5%	292,280	4.5%
North Coast		0.0%	15,825	4.9%	109,634	1.7%
North Island - Central Coast	85,604	18.4%	40,605	12.6%	1,234,127	18.8%
Queen Charlotte Islands	13,272	2.8%	8,065	2.5%	347,249	5.3%
South Island	60,987	13.1%	124,133	38.4%	2,561,061	39.1%
Squamish	14,290	3.1%	27,248	8.4%	92,294	1.4%
Sunshine Coast	15,358	3.3%	1,836	0.6%	664,074	10.1%
Coast	466,045	100.0%	323,545	100.0%	6,558,357	100.0%

* Coast unrestricted auction sales with full appraisal data awarded Nov. 5, 2003 through March 31, 2004: Harvest reported is November 1, 2003 through January 31, 2005.
** All BCTS Section 20 Sales: Volume Billed November 1, 2003 through March 31, 2004
*** All other crown harvest: Volume Billed November 1, 2003 through March 31, 2004
Excludes waste, reject and special forest products.

EXHIBIT A: Curriculum Vita for Susan Athey and Peter Cramton