The Effect of Some British Columbia Forest Tenures on the Distribution of Economic Rents and the Allocation of Resources

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1 Introduction

One of the great triumphs of economic theory is the general equilibrium proof whereby market forces under conditions of perfect competition are shown to allocate resources which result in an organization such that no change can be made without making one or more people worse off. However, despite the persuasiveness of these results, deviations from perfectly competitive conditions and the absence of ethical considerations in market determined income distributions have led governments to frequently intervene in market processes.

Forests are often considered to have two general properties which make them particularly vulnerable to market failures. First, because of the many interrelated products and services that forests provide, externalities may pose serious problems. The commercial use of one forest product can have great external effects on other forest products and thus lead to the misallocation of resources. Second, forests often make up a substantial portion of local and regional economies and thus have a great potential to affect income distributions. Thus, governments are frequently hesitant to rely on markets to determine distributions.

Because of the potential for market failures in the commercial use of forests, governments across Canada exercise substantial control over private forestry firms. In order to regulate the use of forests, provincial governments have devised many ways to restrict the behavior of forestry firms as they pursue profits. For the most part, provincial governments have maintained ownership of forested lands and allowed private firms only limited usufructuary rights to harvest timber. In a few instances, governments have chosen to grant private ownership rights to firms, but have nonetheless instituted policies which regulate the behavior of firms.

The different degrees of government regulation of forestry firms are represented by different kinds of forest tenures. Forest tenures specify the conditions which tenure holders must follow in order to enjoy benefits derived from forests. Forest tenures may have few restrictions, such as payments of property taxes for private lands, or, in the case of government owned land, there may be numerous complex requirements including payment of stumpage fees and royalties, adherence to harvesting guidelines, and requirements for forest management.

This paper will investigate how forest tenures, by regulating the behavior of forestry firms, affect the distribution of economic rents and the allocation of resources. First, the underlying theory will be described. Next, a methodology is presented for obtaining empirical measurements of the affects of tenure restrictions on rent distributions and resource allocations. Finally, the methodology is applied in a case study conducted among selected tenure types in British Columbia.

2 Tenures as Distributors of Economic Rents and Allocators of Resources

Governments are frequently concerned with collecting economic rent from the harvesting of public forests because of the great impact that rent collection has on income distributions and resource allocations. Governments have many ways to collect economic rent from timber harvesters. The most obvious means is with stumpage fees or taxes. If full rent is captured with fixed charges, such as area based stumpage fees, fixed annual rents, or productivity taxes, then resource allocations are not affected and rent collection serves to redistribute wealth from the tenure holder to the Crown.[1] However, if governments collect too little rent, or seek to collect more rent than is available, then resource allocations may be affected. If too little timber rent is collected with stumpage fees, the depressed value of logs, as inputs to downstream manufacturing, alter market determined production decisions. For example, sawmillers faced with deflated log prices have less incentive to invest in wood saving sawmilling equipment. Furthermore, stumpage fees which collect too little

1 . See, for example, Nautiyal and Love (1971) and Pearse (1976) which follow the concept that the collecting of economic rent will not interfere with market determined resource allocations.

timber rent alter silvicultural investment decisions as costs of planting or tending trees are compared with the low costs of buying timber from the government. If governments attempt to collect more revenues than there is rent, firms are denied a normal level of profit. In such cases, allocations are affected as forest companies take their capital to new endeavors.

Governments are faced with many complications in calculating how much rent is available to collect. Evidence of some of these difficulties abounded in British Columbia's stumpage system which, prior to 1987, was based on a residual conversion return method of appraisal. In this method, prices of downstream products, such as logs, are used as a basis from which costs of harvesting and transportation are subtracted. The dependency of harvesting and transportation costs on the site specific characteristics of forest stands created enormous complications in calculating stumpages.

However, there exists another whole class of considerations which affects the amount of economic rent available for governments to collect which the conversion return method does not and cannot consider. Any tenure requirement which alters the voluntary behavior of forestry firms in their attempts to maximize profits, also absorbs some economic rent. For example, a forestry firm which is required to abide by strict harvesting guidelines incurs increased costs and cannot afford to pay as much in stumpage fees. Therefore, requirements which restrict a tenure holder's behavior are similar to requirements to pay stumpage fees in that they both influence whether full economic rent is being collected. That is, both types of restrictions affect the distribution of income between the Crown and the tenure holder.

Even though all requirements affect rents, there is an important difference between requirements which restrict voluntary behavior and requirements which mandate the payment of fees. As discussed above, it is possible for fees to only affect income distributions if fixed charges are used to collect exactly the available amount of economic rent. However, all requirements which restrict the behavior of forestry firms affect income distributions and resource allocations even if the amount of economic rent available is precisely consumed by tenure restrictions.

Governments are well aware that requirements alter a firm's behavior, and thus resource allocations, for the designed intent of tenure regulations is usually to modify practices of forestry firms. Governments often institute requirements in order to control externalities or manipulate resource allocations so that desirable income distributions may be promoted.

The efficacy of these policies depends on whether the benefits of controlling resource allocations and income distributions exceed the costs of intervention. In cases where benefits exceed costs, the government is collecting "social rents". In determining whether social rents exist, the benefits derived from restricting firms are often dependent upon diverse political objectives. Thus, much of the benefits side is beyond the scope of an economic investigation. However, the costs of tenure restrictions may be assessed by constrained tenure holders whose primary concern is generating profits.[2,3]

The costs to tenure holders of those requirements which mandate payments to the Crown are easy to determine by adding up stumpage fees, taxes, and other charges paid to the government. However, since all other restrictions may also reduce the benefits of tenure holders, how much timber rent are tenure restrictions absorbing in order to facilitate altered resource allocations and income distributions? The answer to this question is important because restrictions which govern the behavior of forestry firms result in forgone revenue for governments. If it were possible to estimate how much each tenure restriction was costing the private sector, then it would be possible to develop some idea of what government policies are costing in terms of foregone revenues. With this information, governments would be better able to determine whether they do indeed receive social rents by receiving benefits which exceed the costs of regulating the behavior of forestry firms.

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2 . The costs of restricting firms follows the concepts of Coase (1960) who discusses "the reciprocal nature of externalities".

3 . There are also costs of intervention borne by governments as they administer tenures. However, these governmental transactions costs are beyond the scope of this study.

3 Methodology

3.1 Background

Tenures contain a variety of restrictions which regulate the behavior of forestry firms. Any one restriction of a tenure may vary across a wide spectrum of alternatives. For example, in the case of transferability, at one end of the spectrum a tenure may be freely transferable to any party under any conditions while, at the other end, a transferal in any form may be forbidden. Between the two extremes, different degrees of transferability may be permitted. The closer a tenure holder is to the most restrictive end of the spectrum, the more costly is the restriction. In order to analyze the distribution of rents and the allocation of resources determined by tenure restrictions, it would be useful to know where a tenure holder lies on any given restriction spectrum in terms of how costly the restriction is to the tenure holder.

3.2 Procedures

In order to obtain estimates of the costs of tenure restrictions to tenure holders, it was necessary to conduct interviews. The interview procedures employed were as follows:

1. The tenure holder was given a number of randomly shuffled cards. Each card had printed on it a hypothetical change in policy in the form of an individual change of a tenure restriction. The group of cards contained two possible changes for each spectrum being measured; one which proposed an increase in government control, and one which proposed a decrease in government control. For example, one card would propose free transferability of tenures, while another would propose no transfers of tenures be allowed.
2. The tenure holder was asked to sort the cards into three piles according to how the proposed change would affect the potential benefits a tenure holder may derive from a tenure: 1) a pile that would increase, 2) a pile that would decrease, and 3) a pile that would have no effect on their potential benefits.
3. The tenure holder was asked to order the cards: 1) in the pile of changes which decreased benefits from most harmful to least harmful, and 2) in the pile of changes which increased benefits from most beneficial to least beneficial. This provided ordinal rankings of the hypothetical policy changes.
4. The tenure holder was asked to assign to each of the policy cards ratings of how harmful or beneficial the hypothetical policy change would be. Ratings were assigned by laying the cards down on a scale ranging from -10 to 10, where -10 was most harmful, 10 was most beneficial and 0 was a point of reference where there was no effect. The tenure holders were given a scale with equal appearing intervals between the rating numbers and asked to pay specific attention to these intervals when assigning ratings.[4] The end result was a ratio scale with cardinal ratings.

Figure 1 illustrates how the collected data may be turned into useful information. To begin, the hypothetical policy change of each restriction printed on the cards defines the end-points of the spectrum. For example, Figure 1 shows that transferability spectrum endpoints are defined by proposed policy changes of eliminating tenure transfer restrictions and the elimination of tenure transfers. Restrictions were included in the survey if it was thought that they could possibly affect the benefits of tenure holders. The magnitudes of the changes were chosen so that endpoints of spectra were as far apart as possible, while considering the plausibility of the changes.

The rating that the tenure holder gives to each change represents the distance from the position of the tenure holder, X, on the spectrum to the end-points of the spectrum in terms of benefits received from reduced restrictions and costs borne from increased restrictions. For example, Figure 1 shows that if free transferability of tenures is given a rating of +3 and the elimination of transfers is given a rating of -5, the position of the tenure holder on the spectrum would be 3 points away from free transferability and 5 points

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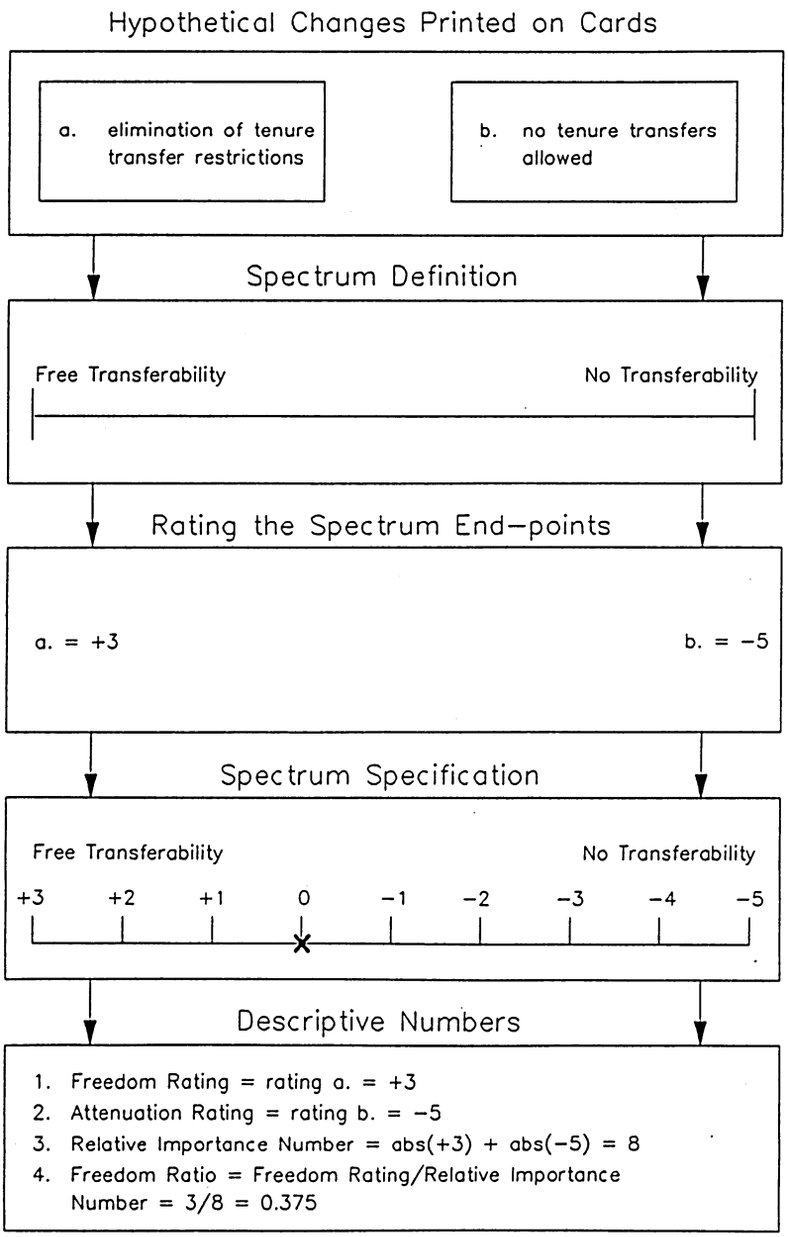
4 . Thurstone and Chave (1929) pioneered the process of using equal appearing intervals to obtain proportional ratings.

Figure 1: The Measurement of Tenure Restriction Spectra



away from no transfers allowed. The rating of +3 is the freedom rating and indicates how beneficial the elimination of a restriction would be. In this way, freedom ratings estimate how much current tenure transfer restrictions are costing a tenure holder. The rating of -5 is the attenuation rating and indicates how much worse off the tenure holder could be if no tenure transfers were allowed.

The potential importance of a restriction in affecting the benefits of a tenure holder may also be derived from these ratings. Continuing the above example, the entire spectrum has been awarded 8 rating points. That is, this restriction spectrum has been awarded a relative importance number of 8 out of a possible maximum of 20.[5] This number may be compared to the relative importance numbers of other characteristics to see which characteristics have the greatest potential to affect benefits of tenure holders.

Additionally, the position of the tenure holder between the end-points of the spectrum may be expressed by dividing the freedom rating by the relative importance number. Continuing the above example, this tenure holder would have a tenure transfer freedom ratio of 3/8. That is, for the spectrum defined by the printed cards, the tenure holder is 3/8 of the distance from the least restrictive end, moving towards the most restrictive end.

4 A British Columbia Case Study

4.1 The Sample

Holders of three British Columbian tenure types were interviewed: Tree Farm Licences, Taxation Tree Farms, and Timber Lands. A brief description of each of these tenure types follows.[6]

Timber Lands are properties which the Crown has given or sold to the private sector. These lands have relatively few restrictions; although taxes payable to the Crown and log export restrictions may greatly affect benefits of Timber Land holders.

Taxation Tree Farms are private lands which are being managed according to plans approved by government. The tenure holder is required to follow: Ministry of Forests and Lands guidelines for protecting environmentally sensitive areas; utilization requirements; and stipulations which require the forest be protected from fire, insects and disease. Plans of tenure holders must include the calculation of an allowable annual cut which may be increased if investments in forest management can be shown to increase future yields. In return for giving up some autonomy of operations, holders of Taxation Tree Farms receive tax concessions.

Tree Farm Licences give tenure holders exclusive rights to an allowable annual cut of public timber within the area of the tenure holder's licence. Licences are granted for 25 years and may be replaced with a new licence every 10 years for an additional 25 years. Tree Farm Licences are granted to holders who, among other things, intend to operate a timber processing plant. Licensees are required to submit plans which follow Ministry of Forests and Lands: environmental protection guidelines; harvesting utilization requirements; and regulations governing the protection of forests from fire, insects and disease. Following harvesting, reforestation is undertaken by the Licensee who is reimbursed for expenditures on Crown Lands with credits which may be deducted from stumpage fees. If the Licensee can convince the Ministry of Forests and Lands that increased yields will result from management expenditures, then the allowable annual cut may be increased.

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5 . A maximum of 20 comes from the absolute value of the sum of the two maximum possible ratings of +10 and -10.

6 . As of January 1, 1987, new legislation was put into effect which changed the taxation policy for private lands. Furthermore, on September 15, 1987, the British Columbia Ministry of Forests and Lands announced "New Directions for Forest Policy in British Columbia". These new policies included many changes of restrictions for Tree Farm Licences. The following description reflects the tenures as they were at the time that interviews were administered before specific procedures for the tax legislation had been worked out and before the "New Directions" had been announced. The final section will discuss the importance of this study to the new policies.

Tree Farm Licences are made up of Schedule B lands, and any combination of Schedule A Timber Licence lands, and private lands, some of which are held as Taxation Tree Farms.[7] Schedule B lands are Crown lands for which tenure holders pay stumpage and annual rents. Schedule A Timber Licence lands are historic cutting rights, (known as Old Temporary Tenures), which have lower harvesting fees, in the form of statutory royalties, and lower annual rents than Schedule B lands. In return for lower stumpage fees, tenure holders must provide road access to the timber and reforest without reimbursement. The amalgamation of these different types of holdings are managed as one Tree Farm Licence under a single management plan.

Interviews were administered between January and April, 1987. At the end of 1985, there were 30 Tree Farm licences, 52 Taxation Tree Farms, and hundreds of Timber Land holdings in the province of British Columbia. However, not all of these tenures were held by separate firms. Twenty firms held the 30 Tree Farm Licences; thirty-six firms held the 52 Taxation Tree Farms; and the hundreds of Timber Lands were held by 57 firms or individuals.

Interviews were conducted with questions referring to a specific tenure holding. Only one interview per tenure type was administered to a given tenure holder because of the excessive time requirements and tediousness that tenure holders possessing several holdings of one tenure type would have experienced. Interviews were granted by 19 of the 20 firms that held Tree Farm Licences. Of the 36 firms that held Taxation Tree Farms, several were within, and surveyed with, Tree Farm Licences. Furthermore, several Taxation Tree Farm holders have their lands managed by the same consulting firm. This left 23 companies, including consultants, which managed Taxation Tree Farms outside of Tree Farm Licences. Interviews were granted by 22 of these companies. Of the 57 firms holding Crown Grants, 20 were interviewed.[8,9]

When interviewing tenure holders, the interviewer sought the person who was most familiar with the costs of tenure restrictions. In the case of large corporations, this person was most often the Chief Forester or Vice President of Planning and Operations. In the case of smaller firms, the owners themselves were interviewed.

4.2 Results

4.2.1 Interpreting the Results

There are two primary problems that were anticipated when the methodology was designed which should be considered when interpreting the following results. First, it was expected that the interdependencies between restrictions would make it difficult to isolate costly or beneficial effects of individual changes of restrictions. For example, it was thought that it would not be easy to conceptualize changes in allotment type in isolation of other restrictions. For this reason, tenure holders were instructed during the interviews to assume that all restrictions, other than the change printed on the card, are held constant. Despite these explicit instructions, the results obtained for highly interdependent restrictions should be interpreted with caution.

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7 . Taxation Tree Farms and other private lands that lie within Tree Farm Licences are managed under the Tree Farm Licence management plan. Therefore, they were surveyed with Tree Farm Licences and in this study are referred to as private lands within Tree Farm Licences.

8 . Because several firms manage more than one tenure type, several tenure holders were the subject of more than one interview. A total of 43 firms were interviewed.

9 . Because such a large proportion of the tenure holders were sampled, a common practice would be to adjust statistical results to reflect the increased representation of the population. Specifically, the variance of the sample mean could be reduced by a factor of (N-n)/(N-1), where n is the number of observations drawn from a population of N individuals (see, for example, Wonnacott and Wonnacott, 1977). Although using such a factor could greatly reduce mean variances of descriptive numbers, this factor will not be used so that the results presented are conservative. Conservatism is warranted because of the new approach used to measure tenure restrictions in this study.

The second problem anticipated was that there would be differences in the abilities of tenure holders to take account of both micro and macro effects in their rating of the policy changes. For example, freeing log exports would allow tenure holders micro benefits of access to higher log prices for exports. However, the change would also have macro effects which influence the whole economy. Domestic log prices would increase, thereby increasing costs for tenure holders with mills that are supplied with logs from the Vancouver log market.[10] However, most policy changes proposed would not likely have large macro effects on the economy, so it was thought that the differences in the abilities of tenure holders to assess macro effects would not play a large role in affecting their ratings.

In interpreting the following results, it should also be remembered that these ratings do not necessarily represent actual dollar costs. Some of the smaller tenure holders interviewed had objectives other than the maximization of profits. Thus, the ratings of these tenure holders sometimes reflected personal perceptions of what they deemed to be socially desirable. The fact that the characteristic ratings include these perceptions provides for a more accurate analysis of the true costs of restrictions to tenure holders. The large companies were found to respond with ratings which more directly reflected actual dollar costs.[11]

Finally, it should be noted that results between tenure types are not directly comparable. Whereas an average rating of +5 by Taxation Tree Farm holders could represent a cost of $100 per hectare, the same rating may represent a much higher or lower cost to holders of Tree Farm Licences or Timber Land.[12]

Tables 1-3 show, respectively, mean values of the descriptive numbers for Timber Lands, Taxation Tree Farms, and Tree Farm Licences. Restriction spectra have been ordered from largest to smallest mean values of freedom ratings.

Table 1: Mean Values of Timber Land Descriptive Numbers

Restriction Spectrum	Freedom Rating Means	Attenuation Rating Means	Relative Importance Means[1]	Freedom Ratio Means[1,2]
1. Property Taxes	5.75+	-6.83-	12.88+	$0.47_{(19)}$**
2. Environmental Protection Guidelines	1.58+	-2.39-	3.96+	$0.36_{(20)}$**
3. Forest Protection Stipulations	1.16+	-2.00-	3.26+	$0.28_{(19)}$*
4. Log Export Controls	0.75	-1.33-	4.88+	$0.40_{(9)}$

1. Relative importance number and freedom ratio means are the average of individual tenure holder's numbers. As such, they are not equivalent to values calculated from mean values of freedom and attenuation ratings.
2. Subscripted numbers in parentheses indicate the sample size out of a total of 20 interviewees.

\+ Policy changes with mean ratings significantly greater than zero at the 5% level of significance.

\- Policy changes with mean ratings significantly less than zero at the 5% level of significance.

* Mean ratio expected to be 0.50, H_0: $u_{EC}=0.50$.

** Mean ratio expected to be 0.50 and the sample mean supports the null hypothesis at the 5% level of significance.

10. In the case of freeing log exports, tenure holders seemed to take account of the resulting increases in log prices as is evidenced by the relatively low freedom rating assigned to the elimination of log export restrictions by Tree Farm Licence holders (Table 3).

11. It is not surprising that small tenure holders were found to have multiple objectives while larger corporations were found to better fit the assumption of profit maximization. Forest economists have had problems applying economic theory, based on this assumption, to the behavior of small non-industrial private holders.

12. Comparing ratings between tenure types would be similar to comparing a Japanese yen with a Canadian dollar. In order to make comparisons, ratings from each tenure type would have to be pegged to a common value. This was not done in this study because it was thought that translating ratings into common dollar values would imply a degree of precision in the results which the author does not believe exists.

Table 2: Mean Values of Taxation Tree Farm Descriptive Numbers

Restriction Spectrum		Freedom Rating Means	Attenuation Rating Means	Relative Importance Means	Freedom Ratio Means[1,2]
1.	Property Taxes	7.47+	-8.02-	15.49+	$0.45_{(22)}$**
2.	Log Export Controls	4.09+	-4.09-	8.41+	$0.52_{(18)}$
3.	Penalties for Cutting Under the AAC	3.44+	-3.17-	6.61+	$0.48_{(13)}$**
4.	Penalties for Cutting Over the AAC	2.03+	-1.86-	5.26+	$0.47_{(22)}$**
5.	Non-Voluntary Planning Costs	2.06+	-1.81-	3.92+	$0.55_{(16)}$**
6.	Sustained Yield Cut Controls	1.75+	------[3]	3.66+	$1.00_{(10)}$[4]
7.	Harvesting Utilization Requirements	0.93	-2.51-	4.47+	$0.34_{(10)}$**
8.	Environmental Protection Guidelines	0.89	-3.09-	4.30+	$0.19_{(14)}$*
9.	Forest Protection Stipulations	0.07	-2.52-	3.01+	$0.14_{(12)}$*
10.	Annual Allowable Cuts	0.02	-6.57-	8.54+	$0.15_{(15)}$
11.	Reforestation Requirements	-1.24	-1.51-	3.47+	$0.13_{(8)}$*
12.	ACE[5] Provisions	------[6]	-3.50-	3.50+	$0.00_{(15)}$[7]

1. Relative importance number and freedom ratio means are the average of individual tenure holder's numbers. As such, they are not equivalent to values calculated from mean values of freedom and attenuation ratings.
2. Subscripted numbers in parentheses indicate the sample size out of a total of 22 interviewees.
3. No attenuation ratings were collected for this restriction.
4. Freedom ratio of 1.00 occurs because no attenuation ratings were collected for this restriction.
5. The Allowable Cut Effect (ACE) provisions allow holders to increase their current cuts in return for investments in forest management which can be shown to increase future yields.
6. No freedom ratings were collected for this restriction.
7. Freedom ratio of 0.00 occurs because no freedom ratings were collected for this restriction.

\+ Policy changes with mean ratings significantly greater than zero at the 5% level of significance.

\- Policy changes with mean ratings significantly less than zero at the 5% level of significance.

* Mean ratio expected to be 0.50, H_0: $u_{EC}=0.50$.

** Mean ratio expected to be 0.50 and the sample mean supports the null hypothesis at the 5% level of significance.

Table 3: Mean Values of Tree Farm Licence Descriptive Numbers

Restriction Spectrum		Freedom Rating Means	Attenuation Rating Means	Relative Importance Means	Freedom Ratio Means[1,2]
1.	Certainty of Replacement Opportunity	6.75+	-6.72-	13.47+	$0.49_{(19)}$**
2.	Stumpage Fees	6.29+	-6.93-	13.22+	$0.46_{(18)}$**
3.	Road Building Reimbursements	6.00+	-4.66-	10.66+	$0.65_{(19)}$
4.	Tenure Terms	5.95+	-3.83-	9.90+	$0.57_{(17)}$**
5.	Management Expenditure Reimbursements	5.83+	-5.23-	11.33+	$0.47_{(18)}$
6.	Period Before Section 88[3] Reimbursements	5.51+	-2.17-	8.67+	$0.55_{(16)}$
7.	Penalties for Under Cutting the AAC	3.20+	-2.21-	5.67+	$0.57_{(16)}$**
8.	Harvesting Utilization Requirements	3.05+	-5.00-	8.05+	$0.34_{(18)}$*
9.	Accumulated Section 88[3] Credits	2.39+	-4.38-	7.88+	$0.46_{(11)}$*
10.	Sustained Yield	2.36+	------[4]	3.47+	$1.00_{(11)}$[5]
11.	Penalties for Over Cutting the AAC	2.24+	-2.47-	4.71+	$0.45_{(15)}$**
12.	Environmental Protection Guidelines	2.00+	-3.50-	5.76+	$0.31_{(17)}$**
13.	Property Taxes on Private Lands Within Tree Farm Licences	1.92+	-2.32-	4.24+	$0.45_{(9)}$**
14.	Schedule A Royalty Charges	1.61+	-2.17-	3.78+	$0.40_{(7)}$**
15.	Log Export Controls	1.36+	-1.18	3.30+	$0.60_{(10)}$
16.	Tenure Transferability	1.32+	-4.00-	5.80+	$0.25_{(15)}$
17.	Non-Voluntary Planning Costs	1.28+	-1.68-	3.88+	$0.37_{(13)}$**
18.	Forest Protection Stipulations	0.82	-1.25-	3.07+	$0.40_{(12)}$**
19.	Annual Allowable Cuts	0.73	-7.54-	11.17+	$0.36_{(11)}$
20.	Reforestation Requirements	0.54	-2.75-	4.09+	$0.15_{(14)}$*
21.	Processing Stipulations	-0.16	------[4]	1.21+	$1.00_{(1)}$[5]
22.	Allotment Type	-----[6]	-4.66-	5.71+	$0.00_{(15)}$[7]
23.	ACE[8] Provisions	-----[6]	-3.97-	3.97+	$0.00_{(14)}$[7]
24.	Adding Royalty Fees to Private Lands Within Tree Farm Licences	-----[6]	-1.08	2.34+	$0.00_{(11)}$[7]
25.	Adding Property Taxes to Timber Licences Within Tree Farm Licences	-----[6]	-1.04-	1.04+	$0.00_{(5)}$[7]

1. Relative importance number and freedom ratio means are the average of individual tenure holder's numbers. As such, they are not equivalent to values calculated from mean values of freedom and attenuation ratings.
2. Subscripted numbers in parentheses indicate the sample size out of a total of 19 interviewees.
3. Section 88 of the British Columbia Forests Act allows approved expenditures on forest management to be subtracted from stumpage fees.
4. No attenuation ratings were collected for this restriction.

5. Freedom ratio of 1.00 occurs because no attenuation ratings were collected for this restriction.
6. No freedom ratings were collected for this restriction.
7. Freedom ratio of 0.00 occurs because no freedom ratings were collected for this restriction.
8. The Allowable Cut Effect (ACE) provisions allow holders to increase their current cuts in return for investments in forest management which can be shown to increase future yields.

\+ Policy changes with mean ratings significantly greater than zero at the 5% level of significance.

\- Policy changes with mean ratings significantly less than zero at the 5% level of significance.

* Mean ratio expected to be 0.50, H_0: $u_{EC}=0.50$.

** Mean ratio expected to be 0.50 and the sample mean supports the null hypothesis at the 5% level of significance.

4.2.2 Freedom Ratings

Freedom ratings are an indication of how much current tenure restrictions are costing tenure holders. They are a measure of the potential benefits a tenure holder may receive by moving to the most unrestricted endpoint of a spectrum. By seeing how beneficial removing the restrictions are perceived to be, it becomes evident how costly they are to tenure holders.

It was expected that the ratings which tenure holders assigned to relaxing tenure requirements would be positive. Although most freedom ratings were positive, a few tenure holders thought reducing restrictions would have an adverse effect on the potential benefits they could receive from their tenures. There were several reasons cited by tenure holders for negative freedom ratings.

First, some tenure holders felt that eliminating restrictions might disrupt some competitive advantage that they currently possess. For example, tenure holders who voluntarily follow harvesting guidelines might not like stipulations for others to be lessened because of the comparative advantage competitors might gain. A few smaller tenure holders liked to be restricted because of the benefits they perceived from being regulated by government. These tenure holders believed that the government knew best and that the restrictions that the government imposed upon them would enable them to maximize their personal benefits. Lastly, some tenure holders believed that restrictions placed on them created a better society. Being part of society, they as individuals personally benefited from the restrictions placed on them. Despite these attitudes, a vast majority of tenure holders, responded to freeing restrictions with positive ratings.

If tenure restrictions are costly to tenure holders and thereby absorbing significant amounts of timber rent, we would expect mean values of freedom ratings for each restriction spectrum, u_{FRr},[13] to be significantly greater than zero. To test this hypothesis, statistical tests were conducted:

$H_0: u_{FRr}=0$ $\quad H_1: u_{FRr}>0$ $\quad a=5\%$.

Freedom ratings identified with superscripted plus signs in Tables 1-3 indicate restriction spectra with changes which were rated significantly greater than zero at the 5% level of significance. All observations of freedom ratings, both positive and negative, were used in the tests.

In Table 1, all mean values of freedom ratings for Timber Land holders are shown to be significantly greater than zero except for the elimination of log export restrictions. Although holders of coastal Timber Lands generally saw the elimination of export restrictions as beneficial, holders in the Interior with no exportable logs rated the change negative. Interior Timber Land holders, with none of their potential wealth at stake, generally wanted to see wood processing jobs kept in Canada.

A priori, it was expected that property taxes would be the most costly restriction for holders of Timber Land. Table 1 shows this to be the case with the highest mean ratings in support of eliminating property taxes. Environmental and forest protection requirements, although significantly costly, were rated far lower.

In Table 2, six of eleven mean values of freedom ratings for Taxation Tree Farm holders are shown to be significantly greater than zero. It was expected that property taxes would be the most costly restriction, as was the case for holders of Timber Land. Table 2 shows this to be the case with the highest mean ratings in support of eliminating property taxes. Taxation Tree Farm holders also rated log export restrictions as heavily attenuating their benefits. Furthermore, they rated eliminating non-voluntary planning costs and several changes describing different cut control reductions as beneficial.

Those restrictions which, when eliminated, were not significant to holders of Taxation Tree Farms included harvesting utilization requirements, environmental protection guidelines, forest protection requirements, and reforestation requirements. Many Taxation Tree Farm holders indicated that these requirements were not affecting them. That is, they were doing more than the requirements stipulated voluntarily, so eliminating the requirements would not affect their benefits. Other Taxation Tree Farm holders thought eliminating these requirements would harm society in general and thereby harm them.

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13. Where r is the rth restriction, r=1-4 for Timber Lands, r=1-11 for Taxation Tree Farms, and r=1-21 for Tree Farm Licences.

Proposed changes which greatly increased annual allowable cuts of tenure holders were also insignificant in affecting benefits of tenure holders. Several Taxation Tree Farm holders saw this change as being harmful causing an average rating that was not significantly greater than zero. This result was not surprising because large increases in the allowable annual cut in isolation of other changes in restrictions is not necessarily an overall reduction of restrictions. If tenure holders were penalized for under-cutting an allowable annual cut which would liquidate their stands faster than they desired, then their operations would be adversely affected by the increased cut. That is, tenure holders are restricted by the fact that an allowable annual cut, with a required minimum, still exists.

In Table 3, seventeen of twenty-one mean values of freedom ratings for holders of Tree Farm Licences are shown to be significantly greater than zero. Tree Farm Licence holders, on average, rated an assured opportunity to replace their licence as even more beneficial than elimination of stumpage fees. Furthermore, holders rated perpetual tenure terms, complete reimbursement of a variety of costs and several changes describing different cut control reductions as significantly increasing their benefits.

As was the case with holders of Taxation Tree Farms, large increases in the allowable annual cut were insignificant because several Tree Farm Licence holders thought the change to be harmful. Many tenure holders indicated that if their allowable annual cut was increased, they would be forced to face under-cutting penalties, or the possibility of running out of wood in the future. The elimination of protection, reforestation, and processing requirements for Tree Farm Licence holders was also insignificant. Tenure holders in the interior, for the most part, indicated that eliminating protection requirements was not beneficial because the Crown is responsible for all protection activities. Coastal tenure holders, in general, indicated minor protection responsibilities which were not onerous. Lack of concern about the elimination of reforestation requirements was probably due to almost complete reimbursement for this management activity. Eliminating processing requirements was probably insignificant because the costs of these requirements to tenure holders were sunk. Tenure holders indicated that stipulations which required the initial construction of a plant did not require the continuation of processing operations.

4.2.3 Attenuation Ratings

Attenuation ratings are an indication of how costly a further increase in restrictions would be to tenure holders. They are a measure of the potential costs to tenure holders of moving to the most restrictive points of the spectra.

The ratings assigned by tenure holders to attenuations were expected to be negative. Although most attenuation ratings were negative, a few tenure holders thought increasing restrictions would increase the potential benefits of their tenures. The reasons tenure holders may consider restrictions to be beneficial were discussed in Section 4.2.2.

If increasing restrictions increases costs to tenure holders, then one would expect mean values of attenuation ratings for each restriction spectrum, u_{ARr}[14], to be significantly less than zero. To test this hypothesis, statistical tests were conducted:

$H_0: u_{ARr}=0$ $H_1: u_{ARr}<0$ $a=5\%$.

Attenuation ratings with superscripted minus signs in Tables 1-3 indicate restriction spectra with changes which were rated significantly less than zero at the 5 percent level. All observations of attenuation ratings, both positive and negative, were used in the tests.

In Tables 1 and 2, all Timber Land and Taxation Tree Farm attenuation rating means are shown to be significantly less than zero. In Table 3, twenty-one of twenty-three attenuation rating means for Tree Farm Licence holders are significantly less than zero. Those which were insignificant were generally of little concern to Tree Farm Licence holders.

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14. Where r is the rth restriction, r=1-4 for Timber Lands, r=1-5, 11-12 for Taxation Tree Farms, and r=1-9, 11-20, 22-25 for Tree Farm Licences.

As was the case with the freedom ratings of Timber Lands and Taxation Tree Farms, expectations were that increasing property taxes would be most costly to these tenure holders. Tables 1 and 2 show this to be the case. For holders of Timber Land all other hypothetical increases in restrictions received ratings with much lower mean values. Other changes in Taxation Tree Farm arrangements which rated highly included reductions in the allowable annual cuts and elimination of log exports.

In Table 3, Tree Farm Licence holders are shown to have rated a reduction in allowable annual cuts as being most harmful with increasing stumpage fees following. Next most harmful was increasing the probability of having no opportunity to replace their tenure.

4.2.4 Relative Importance Numbers

By combining freedom and attenuation ratings, it becomes evident how important a given spectrum of a restriction is relative to other restriction spectra. The relative importance of a given spectrum is the total number of rating points assigned to the spectrum from one end to the other (see Figure 1). By adding the absolute value of freedom ratings (which represent the distance of the tenure holder from the least restrictive end of the spectrum) with the absolute value of attenuation ratings (which represent the distance of the tenure holder from the most restrictive end of the spectrum) a number is derived which measures the relative importance of each entire spectrum in its potential to affect the benefits of tenure holders.

In calculating relative importance numbers, the prevalent situation involved adding a positive freedom rating with the absolute value of a negative attenuation rating. However, when one or the other or both ratings had unexpected signs or were zero, different procedures were followed:

1. If both the freedom and the attenuation ratings of a spectrum were positive, the relative importance of the spectrum was taken to be the larger of the two numbers.
2. If both the freedom and the attenuation ratings were negative, the relative importance of the spectrum was taken to be the largest absolute value rating.
3. If the freedom rating was negative and the attenuation rating positive, the relative importance of the spectrum was taken to be the sum of the absolute values.
4. If one or the other of the ratings was zero, the relative importance number was taken to be the absolute value of the non-zero rating.
5. If both of the ratings were zero, the relative importance number was taken to be zero.

In sections 4.2.2 and 4.2.3, it was shown how increases and decreases of restrictions significantly affected benefits of tenure holders. Tests of significance were repeated for the mean value of relative importance numbers of each restriction, u_{RIr}[15], to determine the overall relative importance of restrictions in their ability to affect the benefits of tenure holders:

$H_0: u_{RIr}=0$ $\quad$ $H_1: u_{RIrX}>1$ $\quad$ $a=5\%$.

In Tables 1-3, all restriction spectra for all types of holdings are significantly greater than zero. That is, survey results indicate that every restriction spectrum has the potential to absorb rents.

Following results of sections 4.2.2 and 4.2.3, it was expected that the property tax spectrum would have the most potential for affecting the benefits of Timber Land and Taxation Tree Farm holders. Tables 1 and 2 show this to be the case. Log exports also rated highly for both types of tenure. Taxation Tree Farm holders indicated that altering cuts and cut penalties also had a high potential effect. Holders of Tree Farm Licences rated the certainty of having the opportunity to replace their tenure as having the greatest potential to affect their benefits. Stumpage fees, and management expenditure reimbursements also rated highly.

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15 . Where r is the rth restriction, r=1-4 for Timber Lands, r=1-12 for Taxation Tree Farms, and r=1-25 for Tree Farm Licences.

4.2.5 Freedom Ratios

Having looked at the magnitude of the effects of different restrictions on rents, we now turn to identifying where a tenure holder lies along a restriction spectrum. That is, given the spectrum defined, how far is a tenure holder from the most and least restrictive ends?

Freedom ratios estimate the position of a tenure holder on a restriction spectrum from the perspective of the least restrictive end of the spectrum (see Figure 1). The position of the tenure holder is expressed in terms of that proportion of all possible attenuation costs that is borne by the tenure holder.

Calculating these ratios generally involved dividing a zero or positive freedom rating by a positive relative importance number of the restriction, thereby creating a zero or positive freedom ratio. In Tables 1-3, mean values for such freedom ratios are presented.[16] The closer the mean values are to 1.00, the closer tenure holders are to bearing all possible costs of restrictions.

While interviewing tenure holders, many hypothetical policy changes were worded in such a way that freedom ratios of 0.50 were expected. For example, hypothetical changes of doubling and eliminating stumpage fees would be expected to have equal absolute values, but with opposite signs, creating a freedom ratio of 0.50. Hypothesis tests were conducted to test whether expectations of the population mean for each restriction, u_{Er}[17], were supported by sample results:

$H_0: u_{Er}=0.5$ $H_1: u_{Er}=0.5$ $a=5\%$.

Asterisks in Tables 1-3 indicate restriction spectra for which freedom ratios of 0.50 were expected. Double asterisks indicate restriction spectra for which the null hypothesis was accepted.

For holders of Timber Land, 2 of 3 freedom ratios that were expected to be 0.50 were not significantly different from 0.50. For Taxation Tree Farm holders, 5 of 8 anticipated 0.50 freedom ratio means were not significantly different from 0.50, while 10 of 12 expected 0.50 ratio means were not significantly different from 0.50 for Tree Farm Licence holders.

All mean values of freedom ratios that were significantly different from 0.50 had lower values. A probable reason for these results is risk aversion of tenure holders. Tenure holders may rate a loss of $100,000 a -5 while rating a gain of $100,000 only +3. Thus, risk averse tenure holders would have attenuation ratings higher than freedom ratings causing freedom ratios to be less than 0.50.

Two interrelated reasons are commonly cited for firms being risk averse (see, for example, Sugden and Williams, 1978). First, if a firm risks large changes in wealth, it is likely to be risk averse. Second, if different risks are interrelated, causing large amounts of wealth to be at risk, then a company will likely be risk averse.[18] In interviewing holders of tenures, risks of changes in restrictions were found to be highly interrelated. That is, tenure holders often indicated that although the actual attenuating change proposed would not be too harmful, they feared that such a change might open the door for a stream of restrictive changes. Thus the elimination of a restriction would be rated 0 because of its insignificance to the tenure holder, yet the holder would rate increasing the restriction a -1 or -2 because of the far reaching implications the change could have. Such ratings created freedom ratios of 0.00 which pulled down mean values.

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16 . Freedom ratios which had negative freedom ratings or relative importance numbers made up of two positive, two negative, or two zero ratings were not included in calculating mean values because they would have distorted hypotheses tests which follow.

17 . Where r is the rth restriction, r=1-3 for Timber Lands, r=1, 3-5, 7-9, 11 for Taxation Tree Farms, and r=1-2, 7-9, 11-14, 17-18, 20 for Tree Farm Licences.

18 . Both of these factors cause firms to be risk averse because the utility per dollar of income to a firm losing large amounts of wealth is thought to be greater than the utility to a firm losing small amounts.

5. Summary and Conclusions

Forest tenures contain many restrictions which regulate the behavior of private forestry firms in their pursuit of profits. In regulating behavior, tenures influence the benefits that forestry firms may derive. Because tenure restrictions affect the benefits of tenure holders, they influence how much economic rent governments can collect without causing firms to leave for better returns elsewhere.

Governments may collect rent in the form of revenues through stumpage fees, royalties, or taxes, or they may collect "social rents" by restricting the behavior of forestry firms in order to internalize externalities and/or control income distributions. This study has developed a methodology which may be used to determine the costs of altering resource allocations and income distributions.

The methodology is applied in a case study of selected tenure types in British Columbia. Results show that all restrictions may be important in influencing rent distributions and resource allocations. Furthermore, results indicate that in some cases, restrictions which require monetary payments are less costly than restrictions which regulate tenure holders' behavior.

The role of tenure restrictions in affecting the benefits of tenure holders has important implications for tenure policy. Governments need to be aware of how much tenure restrictions are costing tenure holders for several reasons. First, the costs of attenuating benefits of tenure holders should be studied so that these costs may be better allocated amongst different tenure restrictions which provide social benefits. In this way social rents would be maximized. Second, costs of tenure restrictions determine how much economic rent is available for governments to collect in the form of stumpages, royalties, and taxes. Two recent issues illustrate the importance of this concept.

The existence of many rent absorbing characteristics drives home a point argued by lawyers for Canadian softwood lumber producers in the recent countervailing duty case.[19] That is, stumpages paid under different tenure systems are not directly comparable. There are too many differences in restrictions placed on forestry firms under different administrative systems to determine through regional comparisons whether a stumpage system is collecting full economic rent.

This concept also has implications for the related issue of "New Directions in Forest Policy for British Columbia" (British Columbia Ministry of Forests and Lands, 1987) which has resulted in the elimination of the export tariff. Recent changes have greatly increased restrictions on tenure holders. The new policy, among other things, increased stumpages and royalties, eliminated reimbursements for most forest management and road building expenditures, and reduced allowable annual cuts by 5%. Given the great increase in costs of restrictions borne by forestry firms, the government should carefully monitor investments by tenure holders because the new policies may greatly affect the amount of capital that stays in the forest industry. Unless all tenure holders were benefiting from a substantial portion of economic rent before the policy changes, it is probable that investing to replace depreciated capital will decrease.

This study has only begun to assess how tenures as instruments of forest policy affect the economic behaviour of forestry firms. Given the important implications of tenure policy, there is a surprising lack of theoretical and empirical research. Further exploration is necessary to evaluate how alternative tenure policies may, or may not, further social objectives.

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19 . In 1986, a group of American lumber producers, the "Coalition for Fair Lumber Imports", submitted a petition to the U.S. Department of Commerce claiming Canadian timber was subsidized (U.S. Department of Commerce 1986a). The preliminary determination of the International Trade Administration placed a 15% interim tariff on softwood lumber pending final determination (U.S. Department of Commerce, 1986b). The petition was withdrawn when an agreement called the "Memorandum of Understanding" was reached just before the final determination was due. (U.S. Trade Representative, 1986) The Memorandum allows the government of Canada to collect a 15% tariff on softwood lumber being exported to the U.S. and also contains a clause which would allow the tariff to be replaced by increased stumpage charges.

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