FOREST TENURES AND LAND VALUE IN BRITISH COLUMBIA

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ABSTRACT

Forest tenures are a set of complicated institutions that have played a significant role in the forest sector's evolution in British Columbia. This paper analyzes the effect of forest tenure on land value. Various forms of tenure are briefly reviewed and a theoretical model of forest land value is developed. Data on forest tenure, forest cover, natural attributes of land, and others are used to test the proposition that variations in land value are related to forest tenure. The results show that government restrictions on tenures significantly decrease land value and that per hectare value of forest land under Timber License is only about 23-34 percent of fee-simple land.

Keywords: Forest tenure, hedonic study, land value, policy, property rights.

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INTRODUCTION

Forest tenures conveying property rights to forest resources on Crown lands to private firms is a conspicuous phenomenon in Canada. The forest tenure system is the principal instrument for allocating the country's public timber to private industry and has played a major role in its forest policy since the early European settlement. As the result of evolution over a century, various and often complicated forest tenures exist. Different tenures carry in differing degrees of property, and these differences affect all aspects of forestry (Pearse, 1988).

The theory of different tenures and their characteristics on economic efficiency and social welfare is clear (Pearse, 1976, 1988). Empirical studies for agriculture (e.g., Feder *et*

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al., 1988; Anderson & Lueck,1992) and forestry (e.g. Luckert, 1988; Zhang & Pearse, 1994) are limited and do not address the effect of these institutional instruments on land value. This study examines the effect of forest tenures on land value in British Columbia (BC). As a by-product, this paper also addresses the determinants of forest land value and the role of allowable cut effect in large and integrated firms' decision on purchasing forest lands in the province (Pearse, 1965; Schweitzer, Sassaman & Schallau, 1972).

The determinants of land value have been examined for real estate (e.g., Vrooman, 1978; Coulson & Robins, 1987) and agriculture (e.g., Hushak & Sadr, 1979; Palmquist & Danielson, 1989). With the exception of Armstrong (1975) and Washburn (1990), few studies are found for forest lands. Furthermore, the literature apparently contains no research on the effect of institutional instruments on land values in any of these sectors.

The next section of this paper reviews briefly the four most important types of tenure in British Columbia with special emphasis on the characteristics of property rights. Section III presents an empirical study, including discussion on the theoretical framework of land value and methodology, data, and empirical results. Section IV concludes the findings of this paper and some suggestions for future work.

A BRIEF REVIEW OF FOREST TENURES IN BRITISH COLUMBIA

Private Forest Lands

The origins of private forest lands in BC can be traced back for more than 100 years. Before 1906, the Crown granted extensive areas of forest lands to private users as fee-simple lands. Private lands are the most complete form of right over forest lands conveyed to private parties. The right is comprehensive, including both land and timber. It is exclusive, freely transferable, flexible, secure, and perpetual (Scott, 1991; Pearse, 1992). Furthermore, private land holders reap all of the economic benefits after paying for property tax, and bear all of the management and development costs.

Few regulations apply to private forest lands. As a general rule, private forest owners may harvest their timber and manage their lands as they wish. They may classify their lands as either managed or unmanaged forest lands. The owners of managed forest lands make a work plan and a commitment to practise sustainable forestry in return for preferential property tax treatment. They also have to reserve their lands for forestry use only and face complicated process and payback of tax if they want to change the lands to unmanaged. The owners of unmanaged forest lands enjoy fewer restrictions. Most industrial private forest lands in BC are private forest lands within Tree Farm Licenses (see below), which are usually classified as managed forest lands as well (Townshend, 1993). Unlike the owners of other private forest lands, the owners of these managed forest lands within Tree Farm Licenses have to report harvesting and silvicultural activities to the BC Ministry of Forests, although they do not need cutting permits to harvest their forests and reforestation costs are strictly borne by themselves.

Tree Farm Licenses

Tree Farm License is a relatively long-term and large-scale tenure, serving large industrial enterprises that are often required, as a condition of the license, to operate a timber processing facility in BC. Five characteristics of Tree Farm Licenses are important. First, the holders have rights to the timber on the land only. Their rights are therefore less comprehensive than those of private forest owners. Second, Tree Farm Licenses have a limited term of 25 years, with provisions for "evergreen" replacement.[1] Third, Tree Farm Licenses may include private forest lands and Timber Licenses (called "Schedule A" Lands), in combination with Crown lands ("Schedule B" Lands). Fourth and most important, the forests and lands under Tree Farm Licenses have to be managed under approved management plans by the Ministry of Forests and all timber harvests are subject to cutting permits. Lastly, the holders pay stumpage

[1] "Evergreen" replacement means that, after 10 years of the license term have expired, the holder may call for a new 25-year license to replace the original one and the government is obligated to offer a replacement license with only minor modifications of the terms and conditions.

at an appraised rate for timber harvested and land rental for standing timber on "B" lands, and they must carry out silviculture and road building (until 1987 some of the costs were reimbursed by the government).

In contrast to private forest lands and Timber Licenses, transfers of Tree Farm License require the consent of the Minister of Forests. Furthermore, the transactions should include part or all of the appurtenant manufacturing facilities (Haley & Leitch, 1992; Schwindt, 1992), and the Crown will retract 5 percent of the allowable annual cut (AAC) attributable to "B" lands. In short, the transaction costs for Tree Farm Licenses are significantly higher than are those for private lands and Timber Licenses.

The holders are also required to make 50 percent of the harvests from "B" lands available for harvesting by independent contractors. Government cut controls dictate that the licensees must harvest within 50 percent of AAC annually and within 10 percent over a 5-year period. Up to 5 percent of the AAC of a Tree Farm License may be taken without compensation during the 25-year term.[2] These restrictions, added to legislated changes to Tree Farm Licenses, have weakened the security of this tenure (Luckert, 1991).

Timber Licenses

Timber Licenses came into existence with the conversion of Old Temporary Tenures since 1978 (Pearse, 1992). In this form of tenure, the Crown owns the land and timber and the licensees are given a non-renewable right to harvest the mature timber within a specified period. The right is not comprehensive and has finite duration. Nevertheless, it is exclusive, and transferable under the condition that the holders pay 5 percent of the market value of the timber standing in the area of the license. Since 1987, the holders of Timber Licenses pay an annual rental and, at their choice, either a fixed royalty or a variable stumpage on timber harvested. If the royalty is chosen, the holders must bear the

[2] There is some uncertainty over the maximum amount which may be deducted without compensation. According to some interpretations, Section 53 of the Forest Act allows for 5 percent deletion for highways, pipelines and similar rights of way and an additional 5 percent for other purposes (Schwindt, 1992, p. 76).

costs of all works, notably reforestation and road-building required under the Forest Act and other related regulations. As Pearse (1992) notes, "with few exceptions, Timber License holders chose the royalty option." Therefore, it is safe to say that the Timber License holders are responsible for the reforestation costs.

Timber Licenses exist both within and outside Tree Farm Licenses. All Timber Licenses contained in Tree Farm Licenses are subject to the Tree Farm License agreement and its management and working plans, and once harvested, they are rescheduled as "B" lands. Timber Licenses outside Tree Farm Licenses are subject to an approved operating plan and cutting permits and they simply revert to the Crown once harvested. These regulations make Timber Licenses be less flexible and less secure than private forest lands, and probably Tree Farm Licenses. Moreover, because Timber Licenses outside Tree Farm Licenses will revert to the Crown once harvested, the rights associated with these Timber Licenses are weaker to their holders than that with Tree Farm Licenses in terms of equity in future crops (Zhang, 1994).

Forest Licenses

Forest Licenses are the most important type of tenure in British Columbia, accounting for 54 percent of timber harvests in 1992 (Ministry of Forests, 1993). Forest Licenses are volume-based agreements that grant licensees a "quota" or right to cut a specified volume of timber per year within a broad administrative area.[3] The Crown designates the spe-

[3] Traditionally area-based tenures refer to the rights to timber in a given geographical area, and volume-based tenures refer to the rights to certain volume of timber irrespective of location. The area-based tenures in BC (Tree Farm License and Timber License) are consistent with the above definition: they all have a specified geographic area with in which harvest and silvicultural activities are confined.

In contrast, the volume-based tenures have slightly changed their meanings in BC. There is no specific geographical area for volume-based tenures (Forest License and Major Timber Sale License). However, there are broad areas (Timber Supply Areas) that define the operational boundary for these licenses. Therefore licensees' actual harvest areas (and subsequent silvicultural activities) are changed over time although licensees usually have enough timber to log for 3–5 years once they set up a log camp. Because the licensees are responsible for their actual harvest area until they have, after 15–20 years, completed their silvicultural responsibilities, the volume-based tenure also fits the traditional definition of area-based tenures: which have well-defined locations in this period.

cific location of operations from time to time. As in the case of Tree Farm Licenses, Forest License holders have rights to the timber only. The licenses are issued for 15 years and most of them are renewable or replaceable on an "evergreen" basis. They are transferable, subject to Ministerial consent and a take-back of 5 percent of AAC. Harvesting and other management activities under Forest Licenses are subject to cutting permits and approved management plans. The licensees pay stumpage and rental based on the authorized allowable cut, practise silviculture at their own expense to ensure successful regeneration within a specified period, and are subject to cut controls similar to Tree Farm Licenses.

The obligation of licensees to provide independent contractors with the opportunity to cut a portion of the authorized harvest has been applied to Forest Licenses since 1987 (Pearse, 1992). In addition, up to 5 percent of AAC can be withdrawn from Forest Licenses without compensation during the 15-year term. All Forest Licenses bear a lesser degree of security than Tree Farm Licenses since their holders perceive that they are unlikely to return to the same area in which they invest in silviculture, and therefore cannot recoup the benefits (Zhang & Pearse, 1994).

Summary

Table 1 summarizes the rights conferred by the four types of tenure. Collectively these tenures occupy a wide range within the spectrum of "property." They are similar in exclusiveness, but vary considerably in the characteristics of comprehensiveness, duration, security, transferability and benefit conferred.[4] These are the key characteristics, and the rest of this study investigates their effects on land value.

It is also evident that most characteristics of Timber Licenses are less diluted than or at least equivalent to those of Forest Licenses (if not Tree Farm Licenses). Forest Licenses lay further away from a complete property than Timber Licenses. Therefore, the conclusion of the following empirical study, which does not include Forest Licenses directly, carries to Forest Licenses as well.

[4] Forest License is exclusive in terms of harvesting rights, but not exclusive over time.

TABLE 1. CHARACTERISTICS OF MAJOR FOREST TENURES

	PRIVATE LANDS	TREE FARM LICENSE	TIMBER LICENSE	FOREST LICENSE
Comprehensiveness				
Land and Timber	Yes	No	No	No
Timber only	No	Yes	Yes	Yes
Exclusiveness	Yes	Yes	Yes	Yes
Duration				
Term	Perpetuity	25 years	Until timber removed	15 years
Replacement	Perpetuity	Evergreen	No	Evergreen
Security				
Deletion Conditions	No	Yes	No	Yes
Area or Volume Based	Area	Area	Area	Volume
General Security	Yes	Less secure	Yes	Less secure
Transferability				
Free Transferable	Yes with consent	Permitted	Yes	Permitted with consent
Takeback when Transfer	No	Yes	Yes	Yes
Benefit Conferred				
Property Tax	Yes	No	No	No
Crown Charge: Stumpage	No	On "B" lands	No	Yes
Crown Charge: Royalty	No	On Timber Licenses	Yes	No
Crown Charge: Rental	No	Yes	Yes	Yes
Obligation: Reforestation	Yes	Yes	Yes	Yes
Restriction: Cut Control	No	Yes	No	Yes
Restriction: Log Export	Some	Yes	Yes	Yes
Restriction: Contract Clause	No	Yes	No	Yes

EMPIRICAL STUDY

Private forest lands and Timber Licenses are frequently traded in BC. Enough observations are available to estimate a hedonic price model that captures the effect of forest tenure on land value. The rest of this paper presents and interprets the effect of these tenures on land value. Transactions of Tree Farm License are extremely thin and the geographical area of Forest Licenses cannot be defined with precision. No reliable market value of the lands can be ascertained and both are not considered in this empirical study.

Theoretical Framework and Methodology

Capital theory postulates that the value of a tract of forest land, or any other capital asset, is the present value of the future net revenues that the asset is expected to produce. This present value can be viewed as the demand price of the assets: the maximum price that a buyer is willing to pay for the rights to the asset's expected income. It can also be viewed as the supply price of the asset: the minimum amount that a seller is willing to accept to relinquish the rights to the income. In this context, the present value of the expected net revenues is the asset's market equilibrium price (Washburn, 1990). Based on this, a theoretical framework of forest land value and tenure can be constructed.

The expected future net revenue of a tract of forest land is affected by (1) its forest-cover characteristics such as species, timber volume and size of trees; (2) its natural attributes such as size, soil quality, topography that determines the natural productivity of land; (3) its location and distance to market; and (4) the nature of the property rights. With respect to the last of these, it is hypothesized that, *ceteris paribus,* the per hectare land value is affected by tenures that differ in comprehensiveness, duration, security and transferability (Zhang, 1994).

However, the regulatory environment, such as a sustained yield policy, can modify property rights and property values. In particular, the allowable cut effect can affect the forest land value (Pearse, 1965). Under this regulatory environment, potential buyers can afford to pay a higher price for a tract of forest land if they can add it to an existing sustained-yield forest because this will enable them to increase the regulated harvests on their other lands. This implies that private lands added to a Tree Farm License as "Schedule A" lands are worth more than private lands alone because of their impact on AAC from "Schedule B" lands. This can be expressed as a hedonic equation:[5]

[5] Taxation affects land value as well. One way to capture the effect of taxation is to treat it as an independent variable and put it in the right-hand-side of equation (1). Since taxation represents a characteristic of tenure (economic benefit conferred to the holder), it can also be explicitly ignored (and its effect will be caught in the tenure variable). The second method is used in this paper for simplicity.

$$P = P(C_l, C_f, L, T, ACE) \quad (1)$$

where

P = per hectare market value of a tract of forest land,

C_l = natural attributes of land (site index, size, etc.),

C_f = forest characteristics (volume, species composition, etc.),

L = location,

T = tenure type,

ACE = allowable cut effect.

Since specification of the functional form of a hedonic equation is usually arbitrary, the maximum likelihood method can be used to find the functional formulation. The regression results of equation (1) will reveal the contributions to forest land value of the characteristics of the land, forest, and tenure type.

It should be noted that the concept of land value used in this study is not the same as that used by forest land appraisers in BC. The latter is in fact a "bare land value", i.e., the value of land after mature timber is removed. It is conventional for a forest property appraiser to estimate the value of a forest property by assessing the value of mature forest first and then, according to the timber growing capacity of the land, assessing its "residual land value" or so-called "land value." In contrast, the land value used in this paper corresponds to the economic definition of an asset's value, i.e., the discounted future net income of land. For example, if a land tenure has only a duration of 20 years, its holder may only appreciate the income derived from the land in this 20-year period. Other things being equal, this is likely to be less than the value under a tenure with a 100-year term. In this simple case, the difference in land value can be attributed to one of the characteristics of the tenures, namely, duration.

Data

Cross-sectional data have been collected on transactions of private forest lands and Timber Licenses for the period from 1987 to 1992 to demonstrate the effect of forest tenures on land value. This six-year period is long enough to cover a

whole business cycle, thereby controlling for major changes in macroeconomic conditions. The starting year, 1987, has been chosen because major changes in BC forest legislation took place in January of that year. The study area includes the BC Coast (Vancouver forest region) and the Southern Interior (Kamloops and Nelson forest regions), which together account for some 54 percent of the timber harvested in 1991–1992 and at least half of the productive forest lands in the province. Managed and unmanaged forest lands are treated as two separate tenures.[6]

The data used in this study came from various sources. Information on private forest lands has been mainly provided by the BC Assessment Authority (BCAA), which assesses all private forest lands in the province and records the transactions that involve them. There were 1084 private forest lands province-wide that changed hands during the study period. Excluding all properties that apparently do not have values (i.e., the values are attached to something else or have yet to be determined and recorded) and all properties outside the study area resulted in 247 transactions that were usable for this study.

Since the data from BCAA do not include information on the forest inventory, species composition and potential products of each property, a mail-out survey was conducted to recover it. Among the 247 properties that were surveyed, respondents from some 115 properties provided data, but only 82 of these responses (45 from the managed forest lands and 37 from the unmanaged forest lands) are useful. The rest are excluded from the study because the owner unable or unwilling to reveal all the information that is needed for this study. None of these 82 properties have

[6] If the lands are outside Tree Farm Licenses, BC legislation allows re-classification of these two categories from one to another provided that the holders pay certain tax differences. For example, if holders of managed forest lands find that their lands would be more valuable if classified as unmanaged, they can have them reclassified upon payment of the accumulated tax savings they have enjoyed by having classified the lands as managed forest lands since 1987. Therefore, the difference between managed forest lands outside of Tree Farm Licenses and unmanaged forest lands is limited to taxation difference, commitment for sustainable forestry practice and burden to go through the re-classification process. However, most managed forest lands used in this study are within Tree Farm Licenses. Consequently unmanaged and managed forest lands are treated as two different types of tenure.

buildings. This circumstance simplifies data analysis, and helps avoid error due to the difficulty of estimating the value of the buildings.

Data for Timber Licenses have been provided by the Ministry of Forests, licensees and independent appraisers. There were some 170 Timber Licenses traded between 1987 and 1992 in the study area, but full sets of information are available only for twenty-four (24) of them due to the confidentiality considerations of most Timber License holders. Since Timber License transactions are not always arms-length sales, appraised values were used as market values. This usage is appropriate since the BC Forest Act (Section 50.4) specifically requires that an independent current appraisal be conducted when a Timber License changes hands. Some of these Timber Licenses are in proximity to Tree Farm Licenses and have the potential to be converted into "Schedule B" lands after expiring.

Table 2 describes the variables used in this study. Price per hectare is the dependent variable. While the mean price per hectare for all observations is $3115.80 (real price as of December 1992), it differs significantly among tenures (Table 3). However, any conclusions regarding the effect of tenure on land value can only be firmly drawn after a full analysis of the determinants of land value, since other factors differ among tenures as well. To facilitate presentation, the variables used are categorized into five groups: tenure, forest cover, natural attributes of the lands, location and others, and allowable cut effect.

Tenure

The three types of tenures considered in this study are converted into two dummy variables (*PFLu* and *PFLm*) for analysis. *PFLu* takes the value of unity if the property is classified as unmanaged forest land, and the value of zero otherwise. Similarly, *PFLm* takes the value of unity if the property is classified as managed forest land, and the value of zero otherwise. Timber Licenses are treated as the base type; therefore, the dummy variables for managed and unmanaged forest lands are of primary interest in this study. The variables for both managed and unmanaged forest lands are expected to have significant positive signs since the characteristics of private lands favour the owners

TABLE 2. VARIABLE DEFINITIONS, SOURCES AND STATISTICS

VARIABLE	MEAN VALUE	STD. DEVIATION	DEFINITION	SOURCES
PRICE	3115.80	4980.20	Real price of land per hectare as of December 1992 ($)	BC Assessment Authority (BCAA)
PFLm	0.35	0.48	Dummy: managed forest land (1 if managed forest land, 0 otherwise)	BCAA, Tenure holders
PFLu	0.42	0.50	Dummy: (1 if unmanaged forest land, 0 otherwise)	BCAA, Tenure holders
VOLUME	205.05	188.19	Estimated timber inventory (m^3)	BCAA, Appraisers
D_FIR	28.72	29.24	Percent of Douglas fir	Appraisers, Tenure holders
HB	33.68	24.82	Percent of hemlock and balsam	Appraisers, Tenure holders
CEDAR	16.80	19.45	Percent of cedar	Appraisers, Tenure holders
PRODUCT1	10.09	20.13	Percent of products as peeler and pole	Appraisers, Tenure holders
PRODUCT2	55.85	30.08	Percent of products as sawlog	Appraisers, Tenure holders
SIZE	111.23	254.29	Tract size (hectare)	BCAA, Appraisers
COAST	0.42	0.50	Dummy: location (1 if Interior, 0 otherwise)	BCAA, Appraisers
ACCESS1	0.53	0.50	Dummy: distance from a mill (1 if between 32-64 km, 0 otherwise)	BCAA, Appraisers
ACCESS2	0.25	0.44	Dummy: distance from a mill (1 if greater than 64 km, 0 otherwise)	BCAA, Appraisers
TOPO1	0.43	0.50	Dummy: average slope (1 if less than 40 degrees, 0 otherwise)	BCAA, Appraisers
TOPO2	0.42	0.50	Dummy: average slope (1 if between 40-60 degrees, 0 otherwise)	BCAA, Appraisers
S_G	28.04	27.26	Percent of good soil quality	BCAA, Appraisers
S_M	45.42	31.87	Percent of medium soil quality	BCAA, Appraisers
S_P	12.26	20.28	Percent of poor soil quality	BCAA, Appraisers
DATE	45.16	21.25	Number of months from transactiondate to January 1987	BCAA
CPI	0.93	0.07	Consumer Price Index (December, 1992=1)	Statistics Canada
INT	0.09	0.02	Risk-free interest rate (3-month Canadian Treasury Bill rate)	Statistics Canada
PRODUCER	0.42	0.50	Dummy: purchaser (1 if large forest firm, 0 otherwise)	Ministry of Forests

TABLE 3. SOME STATISTICS ON UNMANAGED AND MANAGED FOREST LANDS, TIMBER LICENSES

VARIABLE	UNMANAGED FOREST LANDS		MANAGED FOREST LANDS		TIMBER LICENSES	
	Mean Value	Std. Dev.	Mean Value	Std. Dev.	Mean Value	Std. Dev.
PRICE	3768.00	4398.30	3406.30	6193.30	1565.30	2493.00
VOLUME	127.75	111.43	199.58	202.77	334.46	190.92
D_FIR	40.46	34.04	28.97	25.13	10.17	17.34
HB	16.87	20.52 3	9.49	25.18	48.71	13.58
CEDAR	13.92	22.94	12.28	15.17	29.75	15.32
PRODUCT1	17.57	29.33	4.11	8.41	9.75	14.41
PRODUCT2	43.11	34.98	59.56	29.75	67.37	14.25
SIZE	85.53	204.60	68.55	125.79	230.87	424.08
COAST	0.32	0.47	0.44	0.50	0.54	0.51
ACCESS1	0.57	0.50	0.53	0.50	0.46	0.51
ACCESS2	0.22	0.42	0.39	0.49	0.08	0.28
TOPO1	0.51	0.51	0.52	0.51	0.13	0.33
TOPO2	0.41	0.50	0.39	0.49	0.50	0.51
S_G	34.18	31.74	20.38	19.28	32.92	30.07
S_M	44.57	35.70	51.76	29.65	34.83	27.63
S_P	11.30	23.75	12.02	16.92	14.21	21.04
DATE	43.97	18.69	51.20	19.37	35.67	15.67
PRODUCER	0.11	0.31	0.76	0.43	0.29	0.46
Observations	37		45		24	

more than do those of Timber Licenses favour the holders. The coefficients for *PFLu* and *PFLm* are hypothesized to be equal, a rejection of which means the restrictions on managed forest lands cost more than the benefits.

Forest Cover

The average volume of timber per hectare on each property is included as a variable (*VOLUME*), and it is expected to have a positive sign. Four species (Douglas fir, hemlock and balsam, cedar) are singled out in this study in order to measure the effect of species composition on land price. These species account for more than 70 percent of the timber harvested in the province (Ministry of Forests 1993). To simplify the analysis, hemlock and balsam is treated as a single species because both have about the same price and end-use for a particular grade, and, in fact, the Minis-

try of Forests treats them as a single species in its stumpage appraisal. This reduces the analysis to three species variables *D_FIR*, *HB* and *CEDAR* which measures the percent of Douglas fir, hemlock and balsam, and cedar, respectively, on each property. The coefficients of these variables indicate the effect of these species on the land price per hectare, compared with the remaining species (a mixture of spruce, pine and hardwood species). The signs of these variables are expected to be related to timber prices by species.

Three forest products peeler (and pole), sawlog and pulpwood are considered in this study. Two potential product variables (*PRODUCT1* and *PRODUCT2*) measure, respectively, the percent of timber inventory that is for the purpose of producing peeler (and pole), and the percent of timber volume that is for producing sawlogs. The coefficients of these variables indicate the effect of the average tree size or potential timber products on the land value, compared to pulpwood. Both variables are expected to have positive signs.

Natural Attributes

The size of each property in hectares is included as a variable (*SIZE*). The price per hectare should vary inversely with the size of the tract because the market for large tracts of private forest lands is thinner. In other words, few buyers are willing to pay the costs of subdividing the lands. Furthermore, harvest costs vary inversely with the per hectare inventory, although perhaps weakly. Total timber volumes being equal, the value per hectare is inverse to the size of the parcel.

The distance to market is measured as the approximate distance from the property to the closest mill or log dump. Following the practice of BCAA, three categories of distance are used. Two dummy variables (*ACCESS1* and *ACCESS2*) are assigned the value of unity if the property is less than 32 kilometres away and between 32–64 kilometres away from the closest mill or log dump, respectively, and zero otherwise. The coefficients for these variables reveal the effect of these distances on land value, compared to the property that is greater than 64 kilometres away from the closest mill or log dump. Positive signs for these vari-

ables are expected, with *ACCESS1* greater than *ACCESS2*. Similarly, three categories of topography are incorporated in the property assessment. Two dummy variables (*TOPO1* and *TOPO2*) are assigned the value of one if the tract is flat (with an average slope of less than 40 degrees) and steep (with an average slope of between 40–65 degrees), respectively, and zero otherwise. The coefficients of these variables reveal the effect of flat and steep topography on the per hectare value of a property, compared with very steep topography (with an average slope of greater than 65 degrees).

Four categories of soil quality (good, medium, poor, inoperable and non-productive) measure the natural productivity of the land. Three variables are used to take into account the effect of soil quality on the price of land. *S_G* is a variable that measures the percentage of good soil quality included in a property; *S_M* is a variable that measures the percent of medium soil quality; *S_P* is a variable that measures the percent of the poor soil quality. The coefficients of these variables indicate the effect of good, medium and poor soil quality lands on land price compared with the effect of inoperable and non-productive lands. All of the soil quality variables should have positive signs, with *S_G* greater than *S_M*, and *S_M* greater than *S_P*.

Location and Others

A dummy variable (*COAST*) is assigned to a value of unity for each property in the Coast; all other properties are assigned zero. *COAST* is a location and ecological variable, and is expected to have a positive sign since the Coast is closer to population centres and to markets for forest lands.

A date variable (*DATE*) is included to capture the time trend of land price. The monthly Canadian Consumer Producer Index is included as a variable (*CPI*) to test the effectiveness of forest land as a price hedge during inflation. A variable of risk-free interest rates (*INT*), which takes the value of the 3-month Canadian treasury bill rate, is added to catch the financing cost of purchasing forest lands.

Allowable Cut Effect

Since the influence of the allowable cut effect on land value is not directly measurable, an instrumental variable has to be used. A dummy variable (*PRODUCER*) accounts for the

effect of each producer's characteristics, including the allowable cut effect. It takes the value of unity if the purchaser of a property is a large integrated forest products firm and zero otherwise. The criterion used here to distinguish large firms from others is the holding of committed cutting rights in the province. The top 20 companies, which collectively hold more than 74 percent of the committed annual allowable cut, are designated as large firms.[7] A significant positive sign indicates that these companies are willing to pay a higher price to hold more forest lands and timber. The explanation for this result could be the allowable cut effect (Pearse, 1965) or economies of scale.

EMPIRICAL RESULTS

The functional form of the hedonic equation is selected empirically by applying the Box-Cox techniques to the most common functional forms (linear-linear, linear-log, log-linear, and log-log). The log-log form proved to be preferable.[8] The regression results are given in Table 4.

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[7] These companies are: Macmillan Bloedel, Fletcher Challenge, Canfor, West Fraser/Enso, Weldwood, Doman, Slocan, Westar, Canadian Pacific, Weyerhaeuser, Tolko Industries, Lakeland, Crestbrook, Repap, Ainsworth, Louisiana Pacific, Carrier Lumber, Pope and Talbot, and Lignum.

[8] Two methods are used here to choose the function forms. Both lead to the same conclusion. The first is maximum likelihood method. Spitzer (1982) and Judge *et al.* (1988) show that maximizing the Box-Cox likelihood function is equivalent to minimizing the residual sum of squares for the regression where the dependent variable is divided by its geometric mean prior to transformation. This method is used in Palmquist and Danielson (1989) and Washburn (1990). I divided each dependent variable by its geometric mean and estimated the four functions. The residual sum of squares is 3333 for linear-linear; 216 for linear log; 2400 for log-linear and 181 for the log-log model. Thus the log-log function form which has the smallest residual sum of squares is preferable.

The second method is comparison of R^2. Goldberger (1968) promotes this method. Since the four R^2's of functions which have different dependent variables are not directly comparable, comparable measures have to be proceeded. A log-linear equation exemplifies this method. First, compute the $\hat{Y}_i$'s , the calculated values from log-linear function; take their anti-logs, $\hat{Y}_i^* = \text{antilog}\,\hat{Y}_i$. These are obviously estimates of the absolutes rather than logarithmic values. Second, compute the R^2 between Y_i and $\hat{Y}_i^*$. This is comparable to R^2's of linear-linear and linear-log functions, which are the R^2 between $\hat{Y}_i$ and Y_i. The same logic applies to log-log function. I computed the estimated R^2's for log-linear and log-log functions as 0.2437 and 0.5463. Comparing them with the R^2's for log-linear and linear-log functions (0.2614 and 0.4806), it is evident that log-log function is the best.

Therefore the log-log function has been chosen. Notice also the constant price elasticity property of the log-log function.

TABLE 4. EMPIRICAL RESULTS OF LOG-LOG EQUATION FOR FOREST LAND VALUES

VARIABLE	(1)		(2)	
	Coefficient	t-ratio	Coefficient	t-ratio
TENURE				
PFLu	1.4874	2.7550 **	1.6447	2.9926 **
PFLm	1.0746	1.8599 *	0.9111	1.5190
FOREST COVER				
VOLUME	0.0011	1.9900 **	0.0009	1.8122 **
D_FIR	–0.0641	–0.9410	–0.0478	–0.6947
HB	–0.0066	–0.0814	–0.0140	–0.1732
CEDAR	–0.0459	–0.6686	–0.0491	–0.7191
PRODUCT1	0.0579	0.3243	0.0040	0.0225
PRODUCT2	0.1181	0.1235	0.0244	0.0956
NATURAL ATTRIBUTE				
SIZE	–0.0905	–0.6121	–0.0557	–0.3732
ACCESS1	0.7915	1.8082 *	0.8996	2.0250 **
ACCESS2	–0.3656	–0.7411	–0.3175	–0.6450
TOPO1	0.0625	0.1155	0.1595	0.2938
TOPO2	–0.0960	–0.1995	–0.1083	–0.2260
S_G	0.0543	0.7577	0.0298	0.4060
S_M	0.1999	2.4334 **	0.1955	2.3898 **
S_P	0.1511	2.9194 **	0.1583	2.4448 **
LOCATION AND OTHERS				
COAST	0.4065	1.0075	0.1992	0.4639
DATE	–1.2009	–2.1528 *	–1.3602	–2.4017 **
CPI	12.8220	1.8044 *	13.2590	1.8732 *
INT	0.8263	0.7517	1.1991	1.0932
INTERCEPT	14.0100	2.9194 **	14.9740	3.1017 **
PRODUCER			0.6727	1.3580
R^2	0.4408		0.4528	
R^2 -adjusted	0.3093		0.3161	
Number of observations	106		106	

** Significant at the 5 percent level.
* Significant at the 10 percent level.

Column one of Table 4 is the result of a regression without the variable of *PRODUCER*. Most of the results for the explanatory variable are reasonable. Out of twenty (20)parameters estimated, seventeen (17) of them have the expected signs. Of those that have counterintuitive signs, none is statistically significant from zero. Among the parameters with the expected sign, nine (9) are significant at a 90 percent confidence level or higher. The following part of this section describes some parameters in detail.

Tenure

The coefficients for unmanaged and managed forest lands indicate that tenure is a significant factor in determining the land price. These parameters are significantly different from zero at the 90 percent confidence level. The regression results imply that the value of a Timber License, expressed respectively as a percentage of the average value of managed and unmanaged private forest lands, is 22.6 percent and 34.1 percent. This means that, while all observations have a mean value of $3115.80 per hectare, Timber Licenses have the value of only $704.04–$1063.84 per hectare.

One may argue that these results are surprising given that, everything else being equal, the difference in land price between private forest lands and Timber Licenses is the residual value after harvesting mature timber. However, on closer examination, the results appear reasonable. First, private forest land owners own other things such as minerals and can use the land for non-timber purposes. In particular, unmanaged forest lands may be more valuable because they can be used for agricultural, recreational and other uses. Managed forest lands may be more valuable since the owners enjoy the benefits of the allowable cut effect (see below). Second, most Timber Licenses studied here will not expire before 2015. This means that some returns from harvesting the mature timber will not be captured immediately.

The test for identity of the coefficients for *PFLu* and *PFLm* indicates that they are not identical at the 20 percent level (with T-ratio of 0.9034 and 84 degrees of freedom). However, when the *PRODUCER* is added into the equation (column two of Table 4), their identity is rejected at the 20 per-

cent level (with T-ratio of 1.4317). This may be because *PFLu* is picking some effects that were not included in the model, such as potential for development and non-timber uses, or because the restrictions on managed forest lands cost more than the benefits, noted earlier.

Forest Cover

The value of forest land is strongly related to its forest inventory. The elasticity of the price per hectare of forest land with respect to average per-hectare volume is 0.0011. In other words, for a 1 percent increases (decreases) in average volume per hectare, the value of forest land per hectare increases (decreases) 0.0011 percent. This means that a 2.05 cubic metre increase in timber volume (1 percent of the mean timber volume) would result in a land value increase of $3.43 (0.0011 percent of the mean land value per hectare).[9] No significant difference among the species and potential products is found, but the product variables do have the expected signs.

Natural Attributes

Soil quality is found to be significantly related to the land value. The significant positive coefficients of medium and poor soil quality indicate that the value of forest land tends to increase as the percent of medium and poor soil quality on the property increases. The variable for good soil quality has a positive sign, but it is not significantly different from zero. The coefficients for the land size variable are not significantly different from zero.

The variable that measures the 0–32 km category of distance to mill is significantly different from zero, but the 32–64 category km is not significantly different from the greater than 64 km category. No significant relationship is found between land value and topographical variables.

Location and Other Variables

The coefficient for *COAST* indicates that land value is positively related to location, but the per hectare value of forest lands on the Coast is not significantly different from

[9] This result is surprising given that the average stumpage was 7–10 dollars per cubic meter during the study period. One possible explanation is that some immature trees were reported by some owners.

that of the Southern interior once all other factors have been accounted for. The coefficient for the transaction date indicates that the land value is negatively related to transaction dates, and therefore the forest land price is declining over the study period. This trend is perhaps related to the 1990-1992 recession. *CPI* is significantly different from zero, but *INT* is not. These results imply that forest land is a good price hedge during inflation, and that interest rate does not affect the value of forest land very much. The latter may be due to too little movement of interest rates in the study period.

Allowable Cut Effect

The results in column two of Table 4 reflect the addition of the variable of *PRODUCER*. This addition has little statistical relation to any of the variables other than PFLm. The t-ratio for *PFLm* is reduced and the variable becomes insignificant at the 10 percent level with this addition. This outcome indicates that there is some collinearity between *PFLm* and *PRODUCER*. In fact, 34 out of the 45 managed forest lands are held by the large firms. These results confirm the hypothesis of Pearse (1965) in combination with the tenure of managed forest lands, the allowable cut effect affects forest land value in BC. Large forest products firms do consider the allowable cut effect when they purchasing forest lands, especially when the lands can be added to Tree Farm Licenses.

CONCLUSIONS

In British Columbia a peculiar mixture of forest tenure systems has evolved over the last century. The tenures differ from each other in terms of their characteristics, namely, comprehensiveness, duration, security, transferability and others. These tenures affect the market value of forest lands. In particular, the estimate of this paper shows that the per hectare value of Timber License is only about 23–34 percent of that of private forest lands. This finding complements to these of Zhang and Binkley (1995), who found that forest lands under Tree Farm Licenses and Forest Licenses have low marginal values. More importantly, these findings could be applied to the values of lands under other tenures. For example, the characteristics of Forest Licenses

are not as complete as those of Timber Licenses. Therefore, lands under Forest Licenses must have a lower value than private forest lands as well.

The high land value of private forest lands comes as no surprise, since in almost every aspect, private forest land as a tenure favours the holder. Furthermore, the owners of unmanaged forest lands, by avoiding the commitment to sustainable forestry practice, could put a high value on their lands for recreational, fishery, hunting and other uses. The owners of managed forest lands, on the other hand, could enjoy the benefit of the allowable cut effect if they hold their land in conjunction with Tree Farm License "Schedule B" lands.

Property institutions do make a difference for land value, and since most forest lands in other parts of the province are also under various types of tenure, it is likely that the implication of this study would carry to them as well. But simply knowing that some tenures such as Timber License reduce the market value of forest land does not necessarily imply that these tenures should be abolished or changed. Other considerations such as transaction costs and public acceptability must be taken into consideration as well. This analysis, however, indicates that the rewards of pursuing these objectives to the 95 percent forest land owners of the province, the BC government, is significant.

This study raises an important question about whether the value foregone in various restrictive tenurial arrangements represents a fair trade for what the public receives. Research on the public benefits of these restrictions on tenures will be fruitful. Moreover, much work could be done to provide a better understanding of forest tenure and land value. Some of the weaknesses of this study may provide an agenda for further work. First, the data could be improved. Some of the empirical results do not fully comply with prediction, and an increase in the sample size and data quality is needed to improve them. Second, while most characteristics of Timber License are less attenuated than those of Forest License, there is one exception: Timber License only confers rights to the mature timber and Forest License confers rights forever. Therefore the inference with regard to the value of Forest License drawn from the empirical study should be treated with caution and be sup-

ported by further empirical study. Finally, this investigation can be expanded to other jurisdictions.

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