# THE EFFECT OF FOREST TENURE ON ENVIRONMENTAL QUALITY IN BRITISH COLUMBIA

**Daowei Zhang**
School of Forestry, Auburn University
Auburn, Alabama

**Abstract**

Canada's forest tenure system is a policy tool with important economic and social implications. Governments in Canada, as landlords of more than 90 percent of the forest lands, have attempted to reform the tenure system in recent decades by increasing the security of forest tenure. Previous research shows that providing more secure tenure will bring significantly more investment and better forest practices. Two questions that have not been addressed are the transaction costs of different tenure arrangements and the effect of tenure on environmental quality.

This paper presents empirical evidence on the relationship between forest tenure and environmental quality. Data on tenure holders' compliance to British Columbia's Coastal Fisheries Forestry Guidelines, tenure, the characteristics of the logging sites, and others are collected from some 97 tracts of forest lands which were logged between 1988 and 1992. Regression analysis shows that, everything else being equal, logging activities on sites under Tree Farm Licenses have less environmental impacts than under Forest Licenses. These results suggest that changing Forest Licenses to Tree farm Licenses will have a positive impact on environmental quality.

Key words: property rights, forest tenure reform, policy, environmental quality, economic incentives.

## I. Introduction

Canada's natural resource policy and economic development differ from other western countries in their characteristic of overwhelming public ownership of resources that are utilized by private enterprises (Pearse 1990). The link between publicly owned resources and the privately owned enterprises is called tenure, which consist of a wide variety of usufructuary rights provided to the private users. These rights, in the forms of leases, licenses, or permits are the primary means of reconciling the interests of the private users with those of public landlords. They are instrumental to Canadian economic development and have had profound impacts on the economic efficiency and social welfare of Canada's natural resource sectors.

Several countries, including the newly independent countries of the former Soviet Union, Malaysia, China, Tasmania, and Kenya, have tried to imitate Canada's tenure system in the management of state-owned forests in recent years (Pearse 1993). Canadian-style forest tenure has also been suggested as an alternative to current methods used in managing publicly-owned forests in the U.S. (Resler 1984; Leman 1984). Moreover, policy related to forest tenure has been strongly recommended to the governments in tropical countries to combat destructive deforestation (Hyde, Mendelson and Sedjo 1991; Hyde and Newman 1991; Gray 1992).

On the other hand, several major timber-producing provinces in Canada have tried to rationalize their tenure systems and eliminate serious anomalies and inconsistencies resulted from years of piecemeal development. Attempts have been made to redesign the tenure systems so that they could achieve broad public objectives. Many recent changes and proposed changes are adopted from the Pearse Royal Commission Report on Forest Resources (Pearse 1976). Such planning has been mainly intuitive, and met serious challenges during the process of implementation. Three questions have often been brought out in public debate. They are:

- What will the impacts of alternative tenure arrangements be on land value, investment in silviculture, and forest practices?
- What will their impacts be on non-timber resource use, such as recreation, fish and wildlife, water quality, and aesthetics?
- What will the costs be to implement and maintain alternative tenure arrangements?

This paper focuses on the effect of tenure on non-timber resource uses or environmental quality. In particular, it addresses the environmental impacts of two most important tenure arrangements, Tree Farm Licenses and Forest Licenses in British Columbia. The next section reviews literature related to forest tenure and debates on the impacts of forest tenure on the environment. Section III provides data. Section IV presents the results. The final section discusses the policy implication of this study.

## II. Literature Review

British Columbia has various forest tenure arrangements. The most important ones are Tree Farm Licenses and Forest Licenses, which accounted for 53.5 and 16.4 percent, and aggregately 70 percent of actual timber harvested in 1992 (Ministry of Forests 1993). Forest Licenses convey a right to harvest a specified volume of timber each year within a broad administrative area. The specific tracts to be harvested are identified from time to time, but the licensee does not have an exclusive right to a defined area for the term of the license. Forest Licenses have shorter terms than Tree Farm Licenses. Nevertheless, both are renewable on an evergreen basis: that is, the licensee has a right to

call for a new license to replace his existing license when its term is only partly expired (Pearse 1976).

Tree Farm Licenses combine Crown forest lands with private lands and Timber Licenses held by the licensee to form large and geographically defined sustained yield units, with the Crown land often being the dominant in the three.[1] All categories of land are subject to the same silvicultural regulations. Other private lands, not included in Tree Farm Licenses, are subject to different rules.

Both forms of tenure are subject to similar timber harvesting and silvicultural regulations. In September 1987 these regulations were changed in important respects, making all licensees and owners responsible for ensuring reforestation by natural or artificial means after logging, for road-building, and for bearing the cost of these requirements. Listed below are their characteristics most relevant in determining the economic security they afford their holders.

| Form of Tenure | Term | Renewability | Rights conveyed | Governmental charges |
|---|---|---|---|---|
| Forest Licenses | 15 years | replaceable every 5 years | allowable annual harvest | stumpage on timber harvested |
| Crown land in Tree Farm Licenses | 25 years | replaceable every 10 years | allowable annual harvest for a defined area | stumpage on timber harvested |

Obviously, the main difference in Tree Farm Licenses and Forest Licenses are duration and the base of harvesting rights (area-based vs. volume-based). Holders of Tree Farm Licenses and Forest Licenses thus have different incentives. Tenure holders, like other investors, respond to expectations about future returns. The expectations of tenure holders are affected by the nature of their property rights over the forest. For example, if their rights extend for a long time into the future, like the infinite term associated with freehold ownership, they can expect to capture all the benefits of investment in increased forest growth. Conversely, if their rights are of short duration, they cannot. Forest tenure can blunt incentives to invest and practice in other ways, as well. Volume-based licenses do not convey exclusive rights to a defined area of forest even for their term, so licensees cannot benefit from enhanced growth on any particular tract. Other licenses provide that licensees must pay for timber they harvest, including enhanced production, thus reducing their expected benefits from silviculture.

It was based on this logic that the provincial government of British Columbia proposed to reform its tenure system in 1987 by increasing the size of Tree Farm Licenses at the expenses of Forest Licenses (Ministry of Forestry 1987). However, opponents of the reform demanded empirical evidence and effectively blocked the proposal from being implemented.

In response to the call for more information, Zhang (1994,1996) and Zhang and Pearse (1995, 1996) provided empirical studies on the relationships among forms of tenure, land value, investment, and forest practice in British Columbia. They compared the four most important types of tenure: Forest Licenses, Timber Licenses, Tree Farm Licenses, and private lands, which aggregately

[1] Timber License is an area-based tenure under which its tenure holder is given a non-renewable right to harvest mature timber within a specified period. If a Timber License is within a Tree Farm License, it will be converted to Crown Lands within the Tree Farm License.

accounted for 85 percent of actual timber harvested in 1992 (Ministry of Forests 1993). The findings related to Tree farm Licenses and Forest Licenses are summarized as follows.

*Tenure and silvicultural investment*. Investors spend about $660 per hectare in Tree farm Licenses and $536 in Forest Licenses, after controlling for other factors that influence the potential investors behavior in particular circumstances – the natural fertility of the land, its distance from market centers, the value of the species to be grown, and so on. In other worlds, everything else being equal, the holders of Tree Farm Licenses invest 24 percent more than the holders of Forest Licenses. These findings are consistent with the presumption that firms will invest more in long-term forest production under more secure forms of tenure. Moreover, the degree of the measured difference is striking – had the 1987 tenure reform plan which would triple the size of Tree Farm Licenses at the expense of Forest Licenses been carried out, the province would have received an additional $950 million per year in silvicultural investment.

*Tenure and Forest Practices*. Differences in certain indicators of forest management performance, or output, were further examined among the same types of tenure. Although the results are not always statistically significant, forest practices in Tree Farm Licenses are generally better that Forest Licenses.

These results clearly demonstrate that private producers are demanding a more complete form of property rights.[2] They invest more and perform better silviculture as the security of the tenure increase. However, it may not be in the best interest of the public to provide such rights for two reasons. First, the costs of establishing and maintaining the property rights may be too high (Coase 1960; Scott 1983, 1991). Second, more complete property rights to timber may have adverse effects on the use of non-timber resources or environmental goods, most of which are not priced in markets (Scott 1991). However, there is no empirical study on these subjects. Lack of such information hinders further debate on the development of property rights policy in Canada.

## III. **Approaches and Data**

Many services provided by forest resources are not often exchanged through market channels. Such services include various types of outdoor recreation, fish and wildlife habitat, flood control, water quality, soil stabilization, aesthetic values, and climate modification. Since the government retains its rights over these resources, any negative impacts on them when a firm exercises its rights over timber will be a part of the total costs incurred by the government.

Given the inherent difficulty associated to measure all non-timber services, this study chooses to measure the effect of tenure on water quality, soil stabilization, and fish habitat protection. These are some of the most important services provided by forests, and often the most controversial ones in British Columbia.

In 1988, the provincial government of British Columbia issued a Coastal Fisheries Forestry Guidelines to guide road building and logging activities on the Coast.[3] The government and the forest

[2] The enthusiasm of private firms in changing Forest Licenses to Tree Farm Licenses is also demonstrated by some 120 letters-of intent received from tenure holders within one year after the government proposed to do so in 1987 (Ministry of Forests 1989).

[3] The guidelines have three general categories (planning and administration, roads and bridges, stream and

industry all agreed that following the guidelines would protect water quality and fish habitats and prevent soil erosion. Field inspections support this claim (Tripp 1994).[4] However, following the guidelines is voluntary in most cases.

Between 1992 and 1994, the government hired an independent firm to audit individual firms' compliance with the guidelines for cut blocks that were harvested on the Coast between 1988 and 1992. The audit covered Vancouver Islands, Queen Charlotte Island, and six other forest districts (Sunshine Coast, Chilliwack, Squamish, Mid Coast of the Vancouver Forest Region, and North Coast and Kalum of the Prince Rupert Forest Region) on the Coast. One hundred and twenty-six (126) cut blocks were audited, 97 of which were under Tree Farm Licenses (all Crown lands) and Forest Licenses. The relative scales (percentage) of compliance to the detailed guidelines in planning, road building and harvesting practices, were compared among firms, forest districts, terrain, cut block size, and the date of logging. The sampling intensity is 4.5 percent. The audits reported that terrain and forest districts affect logging performance (Tripp 1994). The audit report did not reveal if, and, to what extent, property rights were a factor that influences the firms' compliance.[5]

Since following the guidelines is not mandatory and the licensees have no proprietary claims for water and fishery resources, many believe that they will not adequately protect them. Therefore, firms will not consider the impacts of their activities on streams, water, and fisheries, and their road building and logging performance will be poor.

On the other hand, the previous studies indicate that firms will outperform the minimum standards of regulations, whether mandatory or not, if they have incentives to do so. In this case, firms that have long-term and area-based tenures such as private lands, and to a lesser extent, Tree Farm Licenses, may choose to build better logging roads and bridges than others who do not expect to use them for a long time. They also care about soil erosion and loss of land productivity, and

---

streamside treatment) and 25 specific prescriptions for practicing logging near streams. Without going into much technical details, it is sufficient to mention them here.

The planning and administration category includes streams mapped and classified at appropriate scale, all Class I-III reaches identified, prescriptions proper for class I-III reaches, all mod/high risk Class IV reaches identified, prescriptions proper for mod/high risk Class IV reaches.

The roads and bridges category includes present road status agrees current use, streams not encroached upon, road failures, sidecasting in scream absent, number of culverts adequate, all culverts functioning, number of waterbars adequate, all waterbars functioning, ditch effective, road surface free of erosion, road material appropriate, bridge locations appropriate, bridge clearance appropriate.

The stream and streamside treatment category includes leave strip width in field agrees with plan, leave strip length in field agrees with plan, falling direction appropriate, yarding appropriate, cleanup appropriate, blow down less than District sample average, natural drainage patterns maintained, site specific prescriptions compiled with.

The overall compliance rate to the guidelines in a cut block is measured by a simple average of the compliance to each specification. For example, if a firm complied in 20 out of the 25 prescriptions in a cut block, its compliance rate is 80 percent (Tripp 1994).

[4] Therefore, the compliance rate to the guidelines will serve as a surrogate parameter of enviromental quality (in terms of protecting fisheries and water resources and of preventing soil erosion).

[5] No cut blocks logged since 1992 under revised fisheries Forestry Guidelines or the new Forest Practice Code are included in the audit. The findings therefore do not reflect logging practiced after 1992.

therefore their logging practices will comply with or even outperform the requirements of the guidelines.

Moreover, a firm's compliance with the guidelines relates to its expectation on the benefits and costs, and may relate to its reputation. Natural factors, such as terrain, logging tract size, distance to stream water, and location may affect the compliance as well. Therefore, I hypothesize:[6]

$$Y = f(T, S, L, R, C)$$

Where Y is the scale (percentage) of a logging site that complies with the Coastal Fisheries Forestry Guidelines, T is terrain, S is the size of the cut block, L is location, R is the type of tenure, C is the reputation of the firm.

Data for this study is from Tripp (1994, 1995) and Tripp, Nixon and Dunlop (1992). The effect of tenure would be captured by a dummy variable, TFL, which takes the value of one when the logging sites are in Tree farm Licenses, and zero otherwise. The coefficient of this variable measures the effect of Tree Farm Licenses as comparing to Forest Licenses. This variable is the primary interest of this paper. It is expected to have a significant positive sign since Tree Farm Licenses are area-based and have longer duration, which may provide incentive for their holders to prepare a better plan, logging more carefully, and avoid environmental damage to streams.

The average terrain of the log sites is included as a variable (SLOPE). It is expected to have a significant negative sign since the larger the slope, the more difficult to log on the sites and thus more difficult to avoid environmental damages (Tripp 1994). The size of the cut block in hectares is represented in a variable, SIZE, and is expected to have a negative sign. This is because that logging in a large area is more easily to cause environmental problems.

Since location is a significant factor in Tripp (1994), the geographical areas included in this study were converted into seven dummy variables. VANCOUVER takes the value of one is the logging sites are on Vancouver Island and zero otherwise. CHARLOTTE takes the value of one if the logging sites are on Queen Charlotte Island and zero otherwise. Similarly, SUNSHINE, MIDCOAST, NORTH_COAST, takes the value of one if the logging sites are in Sunshine Coast, Mid Coast, and North Coast districts, respectively, and zero otherwise. Chilliwack and Squamish forest districts are combined into one variable, CHIL_SQUA, which takes the value of one if the logging sites are in either districts and zero otherwise.[7] Kalum district is the base for comparison. The coefficients of these location variables measure the variation of compliance rates as compared to Kalum districts.

Finally, a dummy variable (HOLDER) was used as approximate of the reputation of individual firms and their expectations on the benefits and costs of complying with the voluntary

---

[6] Although compliance with the guideline is voluntary, the monitoring and inspection frequency would be important in explaining compliance rates. Since there is only one inspection since the guidelines were issued, control for the monitoring and inspection frequency is not possible.

[7] These two districts are located closely. More importantly, no Tree Farm Licenses sites are audited in Chilliwack district. Combining both districts thus avoid the correlation problems might otherwise exist in the regression.

guidelines.[8] It takes the value of one if the tenure holders are among the top 10 firms which collectively hold 60% of the Annual Allowable Cut in British Columbia, and zero otherwise. Most of these large firms appear in the media frequently and are supposed to have a good reputation. The coefficients of this variable measure the effect of these large firms, as compared to the other firms.

Table 1 provides some statistics for the compliance rate under both Tree Farm Licenses and Forest Licenses. While the overall compliance rate is 68.6 percent, the compliance rate under Tree farm Licenses differs significantly from that under Forest Licenses. However, any conclusions regarding the effect of tenure on environmental quality can only be firmly drawn after full analysis that includes all factors, since other factors differ among tenures as well.

## IV. Results

The functional form of the equation was selected empirically by applying the Box-Cox techniques to the most common functional forms (linear, semi-log, inverse semi-log, and log-linear). Since 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 (Spitzer 1982; Judge et al. 1988), minimization of the residual sum of squares is widely used in selecting functional forms (e.g., Palmquist and Danielson 1989; Washburn 1990; Zhang 1996). This method was applied in this study as well. Given the residual sums of squares are 4.1429 for linear, 4.8359 for semi-log, and 4.0807 for inverse semi-log, and 4.7907 for log-linear, the inverse semi-log form were chosen in this study.

The results of the inverse semi-log equation are presented in Table 2. None of variable included is highly correlated to other variables. Neither serial correlation nor heteroskedasticity is found in the model. Of the 11 variables estimated, 8 are significant at the 20 percent level or better. Most of their signs and values appear reasonable. The relative low $R^2$, however, shows much variations remains unexplained. This could be because the model overlooks other variables.

The coefficient for the tenure is positive and significant at the 20 percent level. This indicates that , after allowing other influences, Tree Farm License is a better form of tenure in terms of maintaining high environmental quality in logging sites. Everything else equal, the compliance rate under Tree Farm Licenses is about 5 percent higher than that under Forest Licenses.

Other significant factors include terrain, location, and tenure holders. The coefficient for SLOPE confirms that terrain affects negatively the compliance to the Coast Fisheries Forestry Guidelines, and logging on high slope sites often cause environmental problems (Tripp 1994, 1995). The positive and significant coefficients for three location variables indicate that the compliance rates of logging sites on Vancouver Island, Queen Charlotte Island, and Chilliwack, Squamish, and Sunshine Coast districts are higher than Kalum district. The coefficient for HOLDER indicates that large timber-holding firms have a worse record than other firms in terms of compliance to the

---

[8] Licensees' decisions about whether to comply with the voluntary guidelines undoubtedly involving balancing of expected costs and benefits over a period of time, possibly including expectations about the likelihood of acquiring other timber plots in the future. Such decision variable is unfortunately not observable. Therefore, I intend to use this instrumental variable as a proxy.

Coastal Fisheries Forestry Guidelines.

## V. Conclusions and Discussion

This study provides empirical evidence on the relationship between forms of tenure and compliance to the Coast Fisheries Forestry Guidelines which protect resources that are not directly covered by the tenure arrangements. The conventional wisdom that property rights to one resource (timber) have no relation or negative relation to protection of other non-market environmental resources proves to be wrong. On the contrary, it is found that more complete property rights to timber have positive relation to protection of other resources.

The results could be attributed to two factors. First, different forms of tenure, although designed primarily for timber production, may provide different incentive to their holders. Longer duration and area-based Tree Farm Licenses may make their holders bear some of the consequences of their current logging actions. They are more likely to come back to the same sites, to reuse the roads and bridges, or to harvest the second growth. Therefore, they have some incentive to plan more thoroughly, build better roads and bridges, and conduct timber harvesting with better care than they would otherwise. Second, the timber harvesting sites on Crown lands may be close to the private lands within the same Tree Farm License. These again provide incentive to build better road and bridges, and take care of stream near the logging sites.

The results of this study suggest that providing a secure right to timber is complementary to providing a right to some important environmental resources, namely, soil stabilization, water quality and fish habitat protection. Future tenure reforms should strengthen the property rights to timber. Thus, The proposal of changing Forest Licenses to Tree Farm Licenses has its merits not only in encouraging more silvicultural investment and better forest practice, but in protecting environmental quality as well.

The results of this study provide economic justification and evidence for tenure reforms in British Columbia and other Canadian provinces. More important, the study could be used in the forest tenure policy in developing countries because too often they have adopted forest practices simply because it was a policy being followed in more developed countries. Developed countries (including the United States) with primarily only private and public forest lands, could use the results to evaluate the potential of alternative, intermediate forms of tenure. Moreover, the study could be useful in other resource areas such as fisheries and wildlife management, water quality management, and erosion control, and in the design of land use regulations, easements, and charges in forestry and other resource areas.

## Literature Cited


Gray, John. 1992. Pricing and Economic Incentives for Sustainable Management of Tropical Forests in West and Central Africa. Paper Presented in International Conference on Forestry and the Environment: Economic Perspectives. Banff, Canada. March 9-12.

Hyde, William F. and David H. Newman. 1991. Forest Economics in Brief-with Summary Observations for Policy Analysis. Report to the World Bank.

Hyde, William F., Robert Mendelson, and Roger Sedjo. 1991. The Applied Economics of Tropical Deforestation. Discussion Paper. Virginia Polytechnic Institute and State University. Blacksburg, VA.

Judge, George G. R. Carter Hill, William E. Griffiths, Helmut Lutkepohl, and Tsoung-Chao Lee. 1988. *Introduction to the Theory and Practice of Econometrics* (second ed.). New York, NY: John Wiley & Sons.

Leman, Christopher K. 1984. The Revolution of Saints: The Ideology of Privatization and Its Consequences for the Public Lands. Pp. 76-83 in Adrian E. Gamache (ed.) Selling the Federal Forests. University of Washington College of Forest Resources. Seattle, WA.

Ministry of Forests. 1989. Facts on Forest Tenure. Victoria, British Columbia.

Ministry of Forests. 1993. Annual Report of 1991-1992. Victoria, British Columbia.

Palmquist, Raymond B., and Leon E. Danielson. 1989. A Hedonic Study of the effects of Erosion Control and Drainage on Farmland Values. American Journal of Agricultural Economics 71 (February): 55-62.

Pearse, Peter H. 1976. Timber Rights and Forest Policy in British Columbia. Report of the Royal Commission on Forest Resources of British Columbia. 2 vols. Victoria, British Columbia: Queen's Printer.

Pearse, Peter H. 1990. Forest Tenure Policy in Canada: The Interface of Private and Public Interests. Paper Prepared for the IUFRO XIXth Word Congress. Montreal, Canada.

Pearse, Peter H. 1993. Forest Tenure, Management Incentives and the Search for Sustainable Development Policies. Pp: 77-96 in W.L. Adamowicz, W. White and W.E. Phillips (eds.) Forestry and the Environment: Economic Perspective. CAB International. UK.

Resler, Rexford A. 1984. The Future of Federal Forest Lands: Why the Public Will Retain Ownership of the Federal Forest and Range Lands. Pp. 47-62 in Adrian E. Gamache (ed.) Selling the Federal Forests. University of Washington College of Forest Resources. Seattle, WA.

Scott, Anthony. 1983. Property Rights and Property Wrongs. *Canadian Journal of Economics* 16 (4): 555-73.

Scott, Anthony. 1990. The Market for Characteristics of Property Rights. Discussion Paper.

Department of Economics, University of British Columbia. Vancouver, Canada.

Scott, Anthony. 1991. Individual Right to Use the Forest. Discussion Papers. Department of Economics, University of British Columbia. Vancouver, Canada.

Spitzer, John J. 1982. A Primer on Box-Cox Estimation. *Review of Economics and Statistics* 64: 307-13.

Tripp, Don, A. Nixon, and R. Dunlop. 1992. The Application and Effectiveness of the Coastal Fisheries Guidelines in Selected Cut Blocks on Vancouver Island. Prepared for Ministry of Environment, Lands and Parks. Nanaimo, British Columbia: Tripp Biological Consultant Ltd.

Tripp, Don. 1994. The Use and Effectiveness of the Coastal Fisheries Guidelines in Selected Forest Districts of Coastal British Columbia. Prepared for the Ministry of Forests. Nanaimo, British Columbia: Tripp Biological Consultant Ltd.

Tripp, Don. 1995. The Use and Effectiveness of the Coastal Fisheries Forestry Guidelines in the Chilliwack and Mid-coast Forest Districts of Coastal British Columbia. Prepared for the Ministry of Forests. Nanaimo, British Columbia: Tripp Biological Consultant Ltd.

Washburn, Court L. 1990. The Determinants of Forests Value in the U.S. South. Unpublished Ph.D. Thesis, Yale University. New Haven, CT.

Zhang, Daowei. 1994. Implications of Tenure for Forest Land Value and Management in British Columbia. Ph.D. Dissertation. University of British Columbia. Vancouver, Canada.

Zhang, Daowei. 1996. Forest Tenure and Land Value in British Columbia. *Journal of Forest Economics* 2(1): 7-30.

Zhang, Daowei and Peter H. Pearse. 1994. The Effect of Forest Tenure on Forest Practices in British Columbia. Working Paper 206, Forest Economics and Policy Research Unit, University of British Columbia.

Zhang, Daowei and Peter H. Pearse. 1996. Differences in Silvicultural Investment under Various Types of Forest Tenure in British Columbia. *Forest Science* 42 (4): 1-8.

Table 1. Some statistics of Tree farm Licenses and Forest Licenses

| Variable | Tree farm Licenses | | Forest Licenses | |
|---|---|---|---|---|
| | Mean | Standard deviation | Mean | Standard deviation |
| Compliance Rate | 72.42 | 13.61 | 65.60 | 17.77 |
| SLOPE | 25.79 | 17.43 | 40.84 | 19.11 |
| SIZE | 80.49 | 54.33 | 53.28 | 43.31 |
| VANCOUVER | 0.21 | 0.41 | 0.15 | 0.36 |
| CHARLOTTE | 0.43 | 0.50 | 0.13 | 0.34 |
| CHIL_SQUA | 0.05 | 0.22 | 0.29 | 0.46 |
| SUNSHINE | 0.10 | 0.30 | 0.13 | 0.34 |
| MIDCOAST | 0.02 | 0.15 | 0.15 | 0.36 |
| NORTH_COAST | 0.02 | 0.15 | 0.07 | 0.26 |
| HOLDER | 0.88 | 0.33 | 0.58 | 0.50 |
| Observation | 42 | | 55 | |

Table 2. The results of a inverse semi-log equation

| Variable | Efficient | t-ratio |
|---|---|---|
| TFL | 4.8524 | 1.322* |
| SLOPE | -4.0268 | 2.574*** |
| SIZE | -1.1974 | -0.575 |
| VANCOUVER | 8.8220 | 1.523* |
| CHARLOTTE | 16.7620 | 3.053*** |
| CHIL_SQUA | 9.9339 | 1.687** |
| SUNSHINE | 12.4840 | 1.801** |
| MIDCOAST | 7.5912 | 1.109 |
| NORTH_COAST | -6.6656 | -0.832 |
| HOLDER | -7.3973 | -1.977*** |
| Constant | 80.4310 | 7.745*** |
| $R^2$ | 0.3016 | |
| $R^2$ - adjusted | 0.2203 | |
| D.W. | 1.9303 | |
| Observation | 97 | |

*** Significant at the 5 percent level.

** Significant at the 10 percent level.

* Significant at the 20 percent level.