University of Alberta

Preferences of Industry and Government Stakeholders for Characteristics of Forest Tenures in Canada – An Application of Best-worst Scaling Methods

by

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A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science

in

Agricultural and Resource Economics

Department of Rural Economy

Edmonton, Alberta

Spring, 2008

Library and
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395, rue Wellington
Ottawa ON K1A 0N4
Canada

Your file Votre référence
ISBN: 978-0-494-45849-5
Our file Notre référence
ISBN: 978-0-494-45849-5

Abstract

This research examines preferences of forest industry and provincial government stakeholders for the current tenure systems and the impacts of possible changes in tenure characteristics on three social objectives toward Sustainable Forest Management (SFM) - competitiveness, environmental integrity and community stability. The Best-worst Scaling Method (BWS) is applied. Results indicate that most respondents are satisfied with the current tenure systems. In general, industry and government respondents have similar perceptions of the impacts of tenure characteristics changes on competitiveness and community stability, while they have different concerns of changing tenure characteristics with respect to environmental integrity. Similar findings are found between provinces. In addition, stumpage fees and operational requirements are perceived to be more important than other characteristics for pursuing the social objectives.

Acknowledgements

I want to extend my gratitude to my advisors: Dr. Peter Boxall and Dr. Marty Luckert. Their tremendous insights, guidance and encouragement lead me through numerous rough times in my research. Their various comments helped me to greatly enhance the quality of this thesis.

I would like to thank the financial support from the SFM project of forest tenure policies. I also want to express my special thanks to my colleague, Chris Arnot, for his generosity and friendship. In addition, I want to thank Christopher Kruger and Randy Lucas, who helped me on revising the thesis.

Also, I thank the defense committee members, Dr. Glen Armstrong and Dr. Naomi Krogman. Your comments and suggestions were much appreciated.

Finally, I would like to thank my family for the many ways they helped me along the way. Thank you Mom and Dad for your love and support. I want to especially thank you Mom for your great help on taking care of my kids. I would like to express my highly gratitude to my husband. Your encouragement and help were along with my whole life. I love you. I also want to thank my two little kids, Ian and Kayla, who bring me happiness.

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Chapter 1

Introduction

In Canada, nearly 94 percent of forestland is publicly owned (National Forest Strategy, 2003). Because almost all Canadian forestland is under public ownership, the government plays a key role in developing policies to properly preserve, use, allocate and manage these lands. Conversely, private industries in the forest sector are mainly concerned with harvesting and processing timber to effectively pursue their profit maximizing objectives. It is difficult to avoid conflicts between the government and the private sector because of their oftentimes-opposing objectives. To narrow the gap between government and industry, and to build a harmonious relationship between the private benefits of industries and social welfare, governments make forest tenure policies that regulate the rights and obligations of private industries harvesting timber on Crown lands.

The existing forest tenure systems in Canada have been adapted over time to meet changing social expectations, but it is still arguable whether they adequately satisfy the standards of modern sustainable forest management (Luckert, 1997; Zhang, 1996; Pearse, 2001). One big challenge governments face is in making changes that will be desirable for both the private and public sectors.

Most of the previous studies analyzing forest tenure policies focused on selected tenure characteristics. The study by Luckert (1991a) on stumpage and cost drivers, or another by Luckert (1990) on investment and security, as well as Bouthillier et al. (1994) on harvesting constraints are all examples of studies done that only treat select characteristics of tenures. In fact, very few studies analyze existing tenures comprehensively by comparing the policies from different provinces. Only Haley and Luckert (1990) and Ross et al. (1995) collected provincial laws and regulations associated with forest tenures to assess and compare the main tenure characteristics for each province, such as duration, stumpage fees, and operational requirements.

The above statements create the main motivation for this thesis – to evaluate the effectiveness of existing tenure systems and to explore potential ways to change current tenures to be more effective instruments guiding the forest industry toward Sustainable Forest Management (SFM).

1.1 Research Objectives

This research contributes to the literature on forest tenure policy analysis. By examining industry and government perceptions of current forest tenure systems and preferences in changes of tenures, this provides information that could potentially allow SFM to be achieved more completely.

Through investigating public preferences, the research attempts to answer two questions: First, whether the current forest tenure systems are effective in improving the development of forest management towards SFM? Second, what could potentially be done to make the current tenure systems more effective in achieving the SFM criteria?

The specific objectives of this research are:

1) Design and administer a survey to collect data from two stakeholder groups – forest industries and government representatives;

2) Apply economic models to estimate the impacts of perceptions associated with changing the current tenure policies on maintaining or enhancing competitiveness, environmental integrity and community stability;

3) Provide suggestions to policy makers to shift forest managements toward SFM objectives.

1.2 Research Approach

In the context of this thesis, the term "public" refers to the forest stakeholders, to whom the tenure systems apply, including forest industries, the government and forest

communities. While evaluations from all three-stakeholder groups are very important, only two stakeholder groups are considered in this present research. The first, forest industries, or tenure holders, are users of the forest resources. Tenure policies regulate their rights and obligations on the forestland and thus directly affect their benefits and costs. The second group is the government who is the policy maker and monitor. Their point of view can reflect if the tenures are administratively viable, and if the tenure policies meet the needs of both industry and society at large.

A survey was designed and administered to members of these two stakeholder groups across Canada. Industry decision makers and government policy makers were the main respondents. Questionnaires were designed to investigate stakeholders' perceived impacts of tenure characteristics on 1) industry competitiveness; 2) environmental integrity (which involves sustainable development of multiple forest resources); and 3) community stability. A somewhat new economic method – best-worst scaling method (BWS) is applied to analyze these impacts.

1.3 Thesis Structure

The following chapters provide the background, methods, results, and discussion and conclusion. Chapter 2 provides an overview of the current state of forest management in Canada, as well as a discussion of basic tenure policy for each province. A summary of the literature on existing tenure systems is also included in this chapter. In addition, the chapter provides an overview of methods used to evaluate tenure characteristics. Chapter 3 describes the methods used in this study to measure tenure characteristics. This includes the survey design, data collection, econometric modeling and estimation. This section provides a detailed description of the Best-Worst Scaling method, which is based on Random Utility Theory (RUT). The analysis in this thesis is the first time that this method has been applied to analyze forest tenure policies. Chapter 4 documents the characteristics of the sample, including descriptive statistics and the results of the empirical models. Basic survey results are also described in the context of the study objectives. Chapter 5 discusses the results of the research and what these findings would imply for reforming current tenure policies. Also, this chapter outlines the contributions

and limitations of this study. Finally, it concludes with recommendations about future research in this field.

Chapter 2

Backgrounds and Literature Review

This chapter begins with a general description of forest policy situation in Canada. This includes a review of the basic framework of tenure policy for each province. As part of this general description, a review of previous studies discussing the potential importance of selected tenure characteristics is also provided. In addition, this chapter includes a general review of the methods that previous researchers have adopted to analyze relevant tenure issues. Finally, this chapter introduces the methods adopted in this study, which are based on those used in previous studies.

2.1 Canada Forests and Tenures

Canada's total land area is 909.4 million hectares (ha), of which there is 402 million ha of forest and other wooded land. Public ownership of forestlands is the dominant characteristic – 94% forests is publicly owned and the remaining 6% is privately owned (National Resource Canada, 2005 - 2006). However, private companies are largely responsible for harvesting and managing these public lands through agreements known as forest tenures.

Canada's forests and the industries they support, play important roles in the Canadian economy employing approximately 391,100 people directly and 555,000 people indirectly. Over 300 communities are economically dependent on the forest sector. Furthermore, Canada is the largest exporter of forest products in the world, accounting for about 16% of world trade (National Resource Canada, 2005 - 2006).

In addition to their contribution to national and international economies, Canada's forests are increasingly recognized for their importance beyond production of commercial timber products. About two-thirds of Canada's estimated 140,000 species of plants, animals and micro-organisms live in the forest. Moreover, the forest-related tourism industry is worth several billion dollars annually (National Resource Canada, 2005 - 2006). Canada's forests also play an important role in global carbon cycles and are

significant for global warming policy because forest biomass, soils and products store large amounts of carbon (Luckert and Salkie, 1998).

Given the ownership pattern of forest resources and the importance of forests for the economy and the environment in Canada, it is essential that an effective policy system be constructed to manage forest resources and relevant regional economies. Tenures, which provide rights and obligations to private users, become a bridge linking publicly owned resources and private users (Zhang, 1996). Provincial governments, as a representative of the public, control, regulate and monitor private industrial use of forest resources through tenure systems.

Forest tenures in Canada, can be categorized into three types: large, medium, and small tenures (Haley and Luckert, 1990; Ross, et al., 1995; Luckert and Salkie, 1998). Integrated, pulp-producing companies generally hold large tenures. These tenures are agreements based on specific areas, and are renewable and long-term (e.g. 25 years). Companies are permitted to harvest an annual allowable cut (AAC) within a defined area of sufficient size to supply a wood processing facility. Tenure holders must follow prescribed standards for harvesting, reforestation, and maintaining non-timber forest values and are therefore responsible for most aspects of forest management.

Smaller, non-integrated logging and/or sawmill firms usually hold medium tenures. These tenures are generally shorter in duration (e.g. 10 or 15 years) with options for renewal (or replacement). Different than the area-based, large tenures, medium tenures are volume-based agreements which provide rights to harvest a specific volume of timber that may be cut in various places within a forest spatial unit. The holders of medium-sized tenures have fewer management responsibilities than those who hold large tenures. Governments generally calculate the AAC for these tenures. As with large tenures, most medium tenures are still required to construct and operate a wood processing facility, and all medium tenure holders must follow regulations on harvesting, reforestation, and the maintenance of non-timber values.

Small tenures allocate rights to harvest miscellaneous types of timber for various purposes. Examples of this type of harvesting can include Christmas tree production, maple syrup collection or fuel wood production. Small firms or private individuals hold these tenures, typically over periods of less than five years. Generally, they are not renewable but may be applied for repeatedly. The management responsibilities are generally retained by provincial forest services. This type of tenures is not necessarily linked to the ownership or operation of a wood processing facility.

In addition to the above characteristics, all tenure holders must pay certain fees to harvest. Traditionally a stumpage fee system is an important method to collect some of the returns of harvesting to the government. Stumpage fees refer to a price per cubic meter that is levied on all timber cut by the tenure holder (Luckert and Salkie, 1998). Provincial governments have adopted a vast variety of stumpage systems (Luckert and Bernard, 1993).

2.2 Characteristics of Forest Tenure Systems

Tenures greatly influence the use and maintenance of publicly owned forest resources. If governments perceive that the current tenures cannot satisfy social needs, they may seek to change the structure of the tenures. Tenures restrict and affect the behavior of forestry industries. These restrictions serve to attenuate property rights in that these rights become weaker. Attenuated rights lead to owners not investing appropriately in improving or maintaining benefit streams flowing from their property. Thus, more attenuated tenures affect their competitiveness. Moreover, changes in investment and production influence the fate of environmental resources that rely on forests and their condition. Furthermore, communities in which forests play important roles in providing employment and income can be affected. Thus governments are concerned about the stability of communities associated with forest industries.

This section provides a review of previous studies on the issue of how tenures and changes to tenures affect the forest industry, the environment and the communities involved. In summarizing what has been done, this section will point out analytical gaps

that this present study will attempt to fill. The review will be developed by discussing five important tenure characteristics, which were used to describe forest tenures above and have been discussed frequently by researchers. These characteristics are: 1) the duration of tenures; 2) stumpage payments required; 3) operational requirements; 4) flexibility of the companies to manage within harvest level; and 5) the requirement for wood processing capital equipments such as plants and mills.

2.2.1 Duration of Tenure

Duration refers to the length of time a tenure agreement is in force. Haley and Luckert (1990) asserted that restrictions on the duration of tenures have important implications for the way in which the forest resources are managed. The restrictions may affect tenure holders' investment behavior when their returns to investment are not ensured within the duration of the tenure. Haley and Luckert said, "the duration of a tenure and its effect on tenure holders depends, not only on its initial term, but on whether the tenure may be renewed and under what conditions". Haley and Luckert go on to explain that a renewable tenure with complete certainty can reduce tenure holders' uncertainty and therefore motivate them to further investment. Furthermore, stable investment behavior of tenure holders under long-term duration would promote and increase their competitiveness. Despite the advantages of longer tenures to industry, however, such arrangements may leave governments with less flexibility to meet changing social needs and preferences (Pearse, 1976). Duration, therefore, can act like a double-edged sword.

A number of empirical studies investigated the influence of duration on some aspects of industry competitiveness. Zhang and Pearse (1994), Zhang (1996) and Zhang and Pearse (1997) verified that long-term and renewable tenures have a positive effect on investments in silviculture, compliance with environmental regulations, and reforestation practices. Luckert (1988) and Luckert and Haley (1990) also concluded that more security of tenure (including duration) creates greater incentives for industries to invest in silviculture. However, one limitation of these empirical studies is that they did not isolate impacts of duration from other tenure characteristics. Rather, they tested impacts of duration and a number of other tenure characteristics that accompany long tenures.

In sum, previous studies have established a conceptual link between duration and some aspects of industry competitiveness (i.e. investments and reforestation) and other social interests. Also, they have hypothesized a relationship, investigated empirical relationships between complete tenures (not just duration) and some aspects of competitiveness and some environmental regulations. But no more empirical links have been created between duration and competitiveness, environmental development and community stability, which are the key factors for achieving the SFM criteria.

2.2.2 Stumpage Fee Payments

Stumpage fees are the amounts that private firms are required to pay to provincial governments in return for harvesting timber on crown land. In addition to be a source of government revenue, collecting stumpage payments is one way to restrict private harvesting behavior and maintain environmental resources. Although stumpage fees may account for a relatively small percentage of the total costs of forest harvesting to firms, both Luckert and Bernard (1993) and Grafton et al (1998) explain that the importance of stumpage fees cannot be overemphasized. As they summarize first, the level of stumpage fees plays a vital role on firms' strategies regarding timber harvesting, processing, and production, thereby influencing their competitiveness. Second, stumpage fees also affect the competitiveness of industries through international trade relations. For example, stumpage prices charged domestically may lead to trade barriers in softwood lumber, which restrict lumber trade between the United States and Canada. Both of these impacts on industry have the potential to influence the stability of communities. Finally, stumpage fees are an important determinant in influencing environmental objectives. Not only are they important indicators of returns to timber management, they also provide signals in deciding between timber and non-timber uses.

Designing an appropriate stumpage fee system is difficult, due to their complexity as described by Luckert and Bernard (1993). Therefore, Canadian provincial governments have adopted several stumpage collection systems, including competitive bidding,

appraisals, comparisons to known prices, negotiated or administratively set and administratively set target levels.

Given the importance and complexity of stumpage systems, several researchers have explored how to change them. Nautiyal (1988) pointed out that the stumpage value should be based on "economic rent". Economic rent is a residual value equal to the price of an end forest product subtracting all costs of producing this product. Luckert (1991a) suggested that collecting stumpage fees through negotiation may be superior to appraisals. Grafton et al. (1998) suggested that changes to the stumpage system should reflect the multiple objectives of forest policy and that the new stumpage system should try to capture only economic rent, while considering the impacts on the industry. Luckert and Bernard (1993) recommended a hybrid system, which combines strengths of the various existing stumpage systems. In addition, he suggested that alternative systems should also account for the differences between stock rents and land productivity rents and consider issues associated with non-timber rents produced by forests.

Beyond the above literature, which discusses potential strengths and weaknesses of stumpage systems, there has been no empirical research, to our knowledge, exploring whether stakeholders (industry and government) are satisfied with current stumpages and how they perceive about the potential impacts of changing stumpage collection on promoting industry competitiveness, environmental objectives, or community sustainability.

2.2.3 Flexibility within operational requirements

Tenures contain numerous operational requirements such as utilization standards for wood harvesting, and requirements concerning environmental protection, reforestation and other forestry operations. Highly prescribed requirements do not allow the industry much flexibility to carry out forestry operations compared to less prescribed requirements, under which the industry owns much flexibility to undertake forestry operations along with its expectations of available benefits. But highly prescribed requirements may push industries to participate in maintaining social benefits.

Operational requirements have different impacts on the environment and the forest industry. On one hand, they improve the protection of environmental resources; on the other hand, they create more costs for the forest industries. The magnitude of these costs vary with the operational requirements in question and the market and the financial conditions that the industries face (Ellefson et al., 1985; Lickwar et al., 1992)

Considering present operational requirements, Pearse (2001) addressed three failures. First, the operational requirements are almost entirely commands and controls issued by governments. There are no incentives provided that reward desired behavior, resulting in costly dependence on enforcement. Second, considering economic implications, Pearse pointed out that the current operational requirements are over-restricted so that they prevent tenure holders from responding flexibly to forest conditions and market circumstances. Third, it was noted that requirements only focus on demanding operators to do things in certain ways rather than to achieve specific results. These failures have a major impact on the forest firms' financial performance because it increases their costs.

How should desirable operational requirements be designed? Whether there should be more or less operational requirements have been argued by environmental advocates and private industries. A key reason for such arguments is that the environmental advocates and private industries have different objectives. Environmental advocates are concerned with the costs imposed on society by environmental damage caused by forest operations. However, instead of considering social costs, private forestry industries only focus on their own operational costs (Hoberg, 2002). Therefore, an important issue faced by policy makers is, how to create a harmonious working relationship between the private industries and the public interest. This leads to considering how to provide appropriate flexibility within operational requirements to private industries as well as protect the public's interests (Haley and Luckert, 1990).

Some researchers suggested that appropriate levels of monitoring and enforcement are necessary for the smooth implementation of any operational requirements, although it imposes a high cost on both the public and the private firms (Haley and Luckert, 1990;

ARSSC Report, 2001). Pearse (2001) pointed out that the alternatives should be results-based regulation, specifying the results, rather than processes and procedures, to be achieved and penalties for failure to achieve them.

Overall, previous studies conceptually discussed failures of current operational requirements, with respect to forestry industry competitiveness and public interests, and addressed potential ways to change them. However, no empirical studies have been done to explore the relationships between the flexibility of operational requirements and industry competitiveness, environmental interests or community stability.

2.2.4 Flexibility of harvest levels

The flexibility of harvest levels refers to the degree that private firms are allowed to deviate from projected annual allowable harvest levels or AACs. In Canada, tenure holders are required to follow some designated allowable annual cuts, but are allowed some flexibility in cutting levels over time. In other words, a certain degree of flexibility is granted to the tenure holders to harvest annually above or below the AAC, provided the total volume harvested over a specific time (e.g. a five-year period) is within a fixed percentage of the AAC. Over harvesting may result in a reduction of the authorized volume for next period and payment of a penalty; under harvesting may result in payment of an "underutilization" charge by the holder (Ross et al., 1995).

The original objective of AACs was to sustain flows of timber and promote community stability through projected constant operation of harvesting and milling operations. However, the concept of sustained yield has been criticized in that it may actually create instability. One aspect of this instability is that the less flexibility there is in AACs, the less market responsiveness firms are allowed because constraints cause firms to produce less in good market conditions and produce more in poor market conditions than they would in the absence of AACs (Dowdle, 1984). Also, sustained yield may cause instability in community economies because it merely emphasizes sustaining flows of timber by replacing jobs with machines while ignoring sustaining stable job opportunities for communities (Pearse, 1976; Stier and Bengston, 1992). In

addition, sustained yield may fail to consider aspects beyond timber production such as environmental services (Luckert, 1997).

Given the potential impacts of harvest control policies (or AAC), governments allow some measure of flexibility of harvest levels over time. A core issue faced by policy makers is exactly how flexible the harvest levels should be. If there is little flexibility, tenure holders may incur substantial costs due to institutional constraints, thus reducing the returns to forest production (Alavalapati and Luckert, 1997; Pearse, 2001). On the other hand, if there is a relatively large amount of flexibility in the harvest level, tenure holders are more likely to harvest large quantities of timber in the early periods of their tenures. This may not be socially desirable and possibly adversely affect community stability (Alavalapati and Luckert, 1997).

Overall, previous studies conceptually discussed the impacts of the flexibility of AACs on industry competitiveness, environmental development and community stability. But there is little empirical analysis of these impacts. Therefore, this thesis conducts an empirical analysis connecting the flexibility of harvest levels to the three objectives.

2.2.5 Wood processing requirements

In Canada most private firms, especially those with large tenures, are required to own or operate a processing facility before they are granted to access to Crown timber resources (Haley and Luckert, 1990). The original objective of this policy was to encourage the development of forest industries, especially their investments in the manufacturing of forest products. However, today there may be too much manufacturing capacity and too little timber available for allocation (Pearse, 2001). Given this situation, it is questionable that governments should still require tenure holders to maintain a mill and process all wood that they harvested or rather just process some proportion of the wood they harvested.

Several researchers have pointed out the problems caused by the wood processing requirements (Luckert, 1997; Pearse, 2001). First, it may force firms to add value to

forest products where comparative advantage does not dictate. Second, it forces firms to be vertically integrated and thus causes the markets for logs to be thin. Finally, tenure holders may not have access to log market to sell species, which they cannot process. Therefore, Luckert (1997; p213) suggested, "allowing firms access to Crown timber without requiring further processing could alleviate these problems and provide incentives to produce a broader array of forest products and services".

The above studies, while providing conceptual discussions on how the development and competitiveness of forest industry are influenced by wood processing requirements, they did not conduct empirical analysis. Moreover, neither conceptual nor empirical research has linked the wood processing requirements to the environment and community issues, which are also important components of social welfare. Therefore, empirical study is needed to investigate how processing restrictions impact competitiveness, maintaining community stability and improving environmental integrity.

2.2.6 Methods Applied to Analyzing Tenure Policies

Section 2.2.1 - 2.2.5 provided an overview of five key tenure characteristics and their potential impacts on industry competitiveness, environmental integrity and community stability. Table 2.1 lists whether the previous studies established both conceptual and empirical links between tenure characteristics and social objectives. It shows that most studies discussed conceptual links, but only a few established empirical links, including Luckert and Haley, 1990; Zhang and Pearse, 1994; Zhang, 1996; Zhang and Pearse, 1997. This can be explained by the fact that there is a wide range of existing tenure types relative to the limited number of tenure holders. Because of this limitation, most studies focused on the hypothesized influences of tenure characteristics on social objectives, without supporting empirical studies. This thesis is an effort to fill the gap by verifying these perceptions through an empirical study.

As for the specific analytical approaches applied in previous studies, there are two types of analysis - comparative analysis and stated preference (SP) methods. Comparative analysis, such as the studies by Haley and Luckert (1990), Zhang and Pearse (1994),

Zhang (1996) and Zhang and Pearse (1997), etc., compared main tenure types by different characteristics.

Stated preference methods, which elicit people's preferences for goods or services based on their intentions expressed in hypothetical market situations (Louviere, et al, 2000) were applied to analysis of forest resource management and relevant policies, i.e. Luckert (1990), Garrod and Willis (1997), Schaberg et al. (1999) and Klosowski et al. (2001). These studies mainly used rating and ranking approaches. The rating approach requires respondents to rate on an integer scale (e.g. ranging from 1 to 10) each alternative separately. Alternatives can consist of combinations of various levels of attributes of subjects investigated. Ratings provide cardinal measurements of respondents' preferences and give numerical information (Gustafsson, 1999). This method displays accurate information about the degree of importance of an alternative to a respondent. Usually, few respondents refuse to rate alternatives. The ranking approach asks respondents to order several alternatives from most to least preferred. Different from the rating method, ranking provides ordinal measurement of respondents' preferences. This method is easy for respondents since an order of preference is less difficult than stating a degree of preference (Gustafsson, 1999).

Schaberg et al. (1999) used the rating method to evaluate preferences for attributes of national forest management plans. The experimental design was based on priority levels (low, medium, and high) for the attributes: forest recreation, hunting and fishing, timber harvesting, water quality, and native ecosystems. The study found that the ideal management plan would place high emphasis on ecosystem restoration and water quality protection, low emphasis on timber harvesting, and moderate emphasis on recreational opportunities.

Table 2.1 Previous Studies on Tenure Characteristics with Respect to the Social Objectives

Tenure Characteristics	Potential Impacts On					
	Industry Competitiveness		Environmental Integrity		Community Stability	
	Conceptual Link	Empirical Link	Conceptual Link	Empirical Link	Conceptual Link	Empirical Link
Duration	**Yes** Pearse (1976); Haley and Luckert (1990)	**Some aspects:** Tenures with longer duration promote more investment. Luckert and Haley (1990), Zhang and Pearse (1994), Zhang (1996) Zhang and Pearse (1997)	**Yes** Pearse (1976)	**Some aspects:** Tenures with longer duration have positive effects on compliance with some environmental regulations. Luckert and Haley (1990), Zhang and Pearse (1994), Zhang (1996) Zhang and Pearse (1997)	**Yes** Pearse (1976)	**No**
Stumpage Payments	**Yes** Luckert (1991), Luckert and Bernard (1993) Grafton et al (1998)	**No**	**Yes** Luckert and Bernard (1993) Grafton et al (1998)	**No**	**Yes** Luckert and Bernard (1993) Grafton et al (1998)	**No**
Operational Requirements	**Yes** Haley and Luckert (1990) Pearse (2001) Hoberg (2002)	**No**	**Yes** Haley and Luckert (1990) Pearse (2001) Hoberg (2002)	**No**	**Yes** Haley and Luckert (1990) Pearse (2001) Hoberg (2002)	**No**
Flexibility of Harvest Levels	**Yes** Dowdle (1984) Alavalapati and Luckert (1997) Pearse (2001)	**No**	**Yes** Pearse (1976) Stier and Bengston (1992) Alavalapati and Luckert (1997) Pearse (2001)	**No**	**Yes** Luckert (1997) Alavalapati and Luckert (1997) Pearse (2001)	**No**
Wood Processing	**Yes** Luckert (1997) Pearse (2001)	**No**	**No**	**No**	**No**	**No**

Klosowski et al. (2001) applied the rating method to evaluate the effect of economic incentives on the probability of non-industrial private forest (NIPF) landowner's participation in coordinated management programs. A status quo (do nothing) and 16 alternative coordinated management plans were presented to respondents. Each alternative included 5 attributes: timber harvest areas, recreation access, magnitude of incentive, duration of commitment and penalty. Results indicated that the economic incentives, such as property tax reductions, are not likely to increase the probability substantially that coordinated management programs will be undertaken.

Garrod and Willis (1997) used a ranking study to estimate the benefits of enhancing forest biodiversity. Generic standards of increases in forest biodiversity were used (no increase, low-medium increase, medium-high increase, high increase). Alternatives were constructed using the area of forest managed according to each of three biodiversity standards. The results show that respondents were not willing to pay higher taxes for the greatest level of forest biodiversity restoration.

Luckert (1990) analyzed the impacts of changes in forest tenure policies on tenure holders' perceived tenure security through a case study on British Columbia forest tenures. Ranking and rating techniques were applied to collect the data for tenure holder's perceptions of tenure security. Three types of tenures in BC (Timber Lands, Taxation Tree Farms, and Tree Farm Licenses) were investigated. Results indicated that tenure holders perceive Tree Farm Licenses and Timber Lands as insecure and Taxation Tree Farms as secure.

One problem with rating and ranking techniques is that they may cause fatigue issues. Respondents may take the "middle ranking" approach when they face too many rating scales or complex ranking choice sets (Ben-Akiva et al., 1991). This could result in the solicitation of random ratings or rankings, which violates random utility theory that underpins the theoretical constructs of these methods (Chapman and Staelin, 1982). The best-worst scaling method, as a new stated preference approach applied by this thesis, minimizes this problem. The best-worst tasks provide more information than a "pick one"

task by forcing respondents to consider the extremes of the utility space, minimizing the chances of middle rating or ranking (Flynn et al., 2007).

2.2.7 Method Applied in This Research

The Best-worst Scaling Method (BWS) is applied in this thesis. This approach was developed by Louviere and his colleagues (Finn and Louviere, 1992; Louviere et al., 1995). So far, no literature has been found that applies this approach to forest tenure policy studies. A key advantage of applying this approach in this research is that it can help us assess the importance of each characteristic and its different levels to performance regarding each specific SFM objective.

BWS presents only one profile to respondents at one time and asks them to choose "one best" and "one least" object from a list or profile of provided items. In the empirical case in this present research, this profile will involve a set of tenure attributes at specified levels. This approach provides an ordinal ranking of attribute levels in each profile and sufficient information to develop interval scales of individual levels (Finn and Louviere, 1992). In the case of this research, each profile (or scenario) will be a combination of different levels of the five tenure attributes described above. Respondents were required to choose one best and one worst attribute level (i.e. less, current or more) in the context of each SFM objective. Thus, we can obtain information about the ranking of attributes as well as the scales of levels of each attribute. In other words, we can discern which tenure characteristic is the most preferred and which one is the least, and at the same time we can obtain information on the preferred degree of change of that attribute.

In a summary, BWS has four main advantages over traditional stated preference rating and ranking methods (Cohen, 2003). First, BWS can reduce tasks faced by respondents since it provides only one profile to respondents at one time. This is easier than traditional stated preference tasks, such as choice experiments in which respondents are required to compare two or more profiles at one time. Second, a well-designed BWS task requires respondents to make trade-offs among attribute levels. It does not permit respondents to like or dislike all items. The task forces the relative importance of the

items in the profile from the respondents. Thus, order effects can be controlled. Third, the BWS also can avoid scale bias because it prevents respondents from being a constant high/low rater or a one who consistently rates items in the middle of the scale (i.e. a "middle-of-the-roader"). Finally, this approach allows both intra- and inter- attribute comparisons by measuring them on a common interval scale. The next chapter describes the methodological approach employed in this study in detail.

2.3 Summary

This chapter provided a general background of Canada's forests and a basic framework of current forest tenure types. It also provided a review of previous studies on forest tenure polices and summarized the key issues of tenures. In addition, this chapter reviewed the approaches applied by previous researchers and introduced the method that this present research employed.

This thesis will contribute to literature in three ways. First, it will investigate what we think are the five key tenure attributes mentioned above instead of only focusing on one or two of them. Thus, it will provide a more comprehensive empirical evaluation of tenure systems regarding the specific social objectives. Second, the thesis will analyze the impacts of changing tenure policies on not only forest industry competitiveness but also on environmental integrity and community stability which are important social components of tenure policy. Finally, a new approach, the best-worst scaling method, will be applied to analyze tenure attributes. This method overcomes some of the methodological issues inherent in the earlier work on forest policy. This approach will provide comparisons between not only tenure attributes but also specific levels of each attribute.

Chapter 3

Methods

This chapter begins with a brief description of Random Utility Theory (RUT), which is the theoretical basis for using the Best-worst Scaling method (BWS). Then the discussion will focus on introducing the BWS methodology in detail. Following this, the techniques used in this study to collect the preference data will be described. This includes the survey design and procurement of data. Finally, this chapter describes the procedures used for model estimation.

3.1 Basic Theory - Random Utility Theory Framework

RUT is the basic theoretical framework that underpins attribute-based preference methods (Grafton et al., 2004). This framework, pioneered by McFadden (1974) and Manski (1977), is based on the economic principle of utility maximization. RUT assumes that the probability that an individual chooses a good from a set of goods is dependent on the utility of the good relative to the utility of other goods. That is, an individual q will choose alternative i over alternative j if and only if $U_{iq} > U_{jq}$ ($i \neq j \in A$), where A is the set of alternatives (or choice set) faced by q. The utility of the good i can be represented as:

$$U_{iq} = V_{iq} + \varepsilon_{iq} \qquad (3.1)$$

where V_{iq} is an observable (deterministic) component, including a vector of alternative specific attributes and individual characteristics, and ε_{iq} is an unobservable (stochastic) component which is assumed to follow some random distribution function. Hence, the probability of choosing alternative i instead of j is equal to the probability that the deterministic utility (V) plus the random utility (ε) for i is greater than for j (based on Ben-Akiva and Lerman, 1985).

$$P(i|i, j \in A) = P(V_{iq} + \varepsilon_{iq}) > P(V_{jq} + \varepsilon_{jq}) \qquad (3.2)$$

If the error terms are assumed to be independently and identically Gumbel distributed (Ben-Akiva and Lerman, 1985), the probability of choosing i can be expressed in a logistic form as:

$$\Pr ob(i|A) = \frac{e^{V_i}}{\sum_{j \in A} e^{V_j}} \qquad (3.3)$$

where V is the conditional indirect utility function for each alternative. The choice set of alternatives, A, contains n alternatives. Each alternative is a combination of levels or values of a set of attributes. Then each alternative in A can be expressed by a combination of levels of k attributes denoted by the vector $X=(x_1, x_2, \ldots, x_k)$. Hence, the utility function of each alternative has the following form:

$$V_i = \beta_0 + \sum_{n=1}^{k} \beta_i X_i + \varepsilon_k = \mu \beta' X_i \qquad (3.4)$$

where, β_i is the weight or importance of attribute k in the utility provided by alternative i; μ is a scale factor that is inversely related to the variance of the error component (Ben-Akiva and Lerman, 1985). Therefore, (3.3) can be expressed as:

$$prob(i|A) = \frac{e^{\mu X \beta_i}}{\sum_{j \in A} e^{\mu X_j \beta}} \qquad (3.5)$$

This equation (3.5) yields the conditional (Multinomial) logit model (Ben-Akiva and Lerman, 1985; McFadden, 1986; Grafton et al., 2004), which models an individual's probability of choosing alternatives from a set of available alternatives. Given this expression for the probability of choosing an alternative, maximum likelihood methods can be used to estimate parameters or taste weights (also called part worths) associated with the attributes of the choice alternatives in the conditional indirect utility function (Ben-Akiva and Lerman, 1985; Louviere, Hensher, and Swait, 2000).

In most SP studies, using this model involves developing arguments of the utility function as attributes of hypothetical choice alternatives used in surveys administered to the individuals of interest. The most popular form of SP task in which this is performed involves choice experiments or choice modeling in which respondents are asked to choose among the different hypothetical scenarios that consist of different levels of attributes. However, in the present research a slightly different approach is employed called BWS in which respondents are asked to make two extreme choices – one best and one worst from one given scenario. The BWS models the probability of choosing a best-worst pair, which has the largest utility difference, from a given scenario. This approach is explained in detail below.

3.2 Best-Worst Scaling Method

3.2.1 Basic Theory of BWS

In this study the BWS approach involved respondents being asked to choose "one best" and "one worst" attribute level from each scenario. The choice sets (or scenarios) can be designed using experimental procedures. Typically an orthogonal main-effects fractional factorial experiment (Finn and Louviere, 1992; Louviere et al., 1995) or a balanced incomplete block design (BIBDs) are employed by practitioners. The specific techniques of the two design methods will be described in section 3.4.

BWS requires respondents to provide a joint choice of the "best" and the "worst" attractive feature for a given scenario of attribute levels presented to them. This joint choice reflects the largest utility difference on an underlying utility scale for each scenario of attribute levels (Finn and Louviere, 1992). Thus, BWS sometimes is called the "Maximum Difference Conjoint Model" (Haider and Rasid, 1998) or " Maximum Difference Scaling" (Cohen, 2003). The difference between the two attribute levels can be expressed as:

$$D_{ij} = \delta_{ij} + \varepsilon_{ij} \qquad (3.6)$$

where D_{ij} is the true but unobservable difference between attribute levels *i* and *j*; δ_{ij} is an observable component and represents the utility scale difference between levels *i* and *j* of the two different attributes; and ε_{ij} is a random component associated with the difference. The probability of choosing the best-worst pair of attribute levels *ij* in a choice set A is:

$$P(ij|A) = \Pr[(\delta_{ij} + \varepsilon_{ij}) \geq Max(\delta_{kl} + \varepsilon_{kl}), \forall kl \neq ij \in A \quad (3.7)$$

where $\delta_{ij} + \varepsilon_{ij}$ is the difference between *i* and *j* on the underlying scale, plus an associated random disturbance term; Max ($\delta_{kl} + \varepsilon_{kl}$) denotes the largest of all other differences in the set A (Finn and Louviere, 1992).

To model the BW pairs, one first considers how many unique best-worst pairs are available to be chosen in each scenario (Flynn, et al. 2007). Specifically, by pairing attribute i with each of the remaining K-1 attributes (K here refers to the number of attributes in one scenario) in a scenario, then pairing attribute j with each of the remaining K-2 attributes, etc., we can get all possible (B, W) pairs in the scenario. Then, the order is reversed for these pairs to get all possible (W, B) pairs. Consequently, the number of pairs of choices in a given scenario is $2\sum_{j=1}^{K-1} j = \frac{2(K-1)K}{2} = K(K-1)$.

3.2.2 Modeling the Choice Data and Estimations

The best-worst data can be modeled in three ways: 1) using a paired model (or frequency model); 2) using a marginal model; and 3) using a choice model (Marley and Louviere, 2005; Flynn et al., 2007). We do not consider the marginal model here because our data contains large numbers of observations associated with the total number of attribute levels and thus can lead to large standard errors in estimated utility parameters (Flynn et al., 2007). The other two methods, however, are applied in this research. We compare the results from the two models. Detailed descriptions of the two methods are provided below.

1) The Frequency Model Approach: The frequency model is a sample level analysis, which can be estimated using weighted least squares (WLS) (Flynn et al., 2007). This model considers impacts of both attributes and their levels. The number of observations is equal to the number of unique BW pairs (P) that can be estimated given the attribute scenarios provided to the respondents. P, in a main effects design, can be calculated as follows:

$$P = 2\sum_{i=1}^{K-1}\left[L_i \sum_{K=i+1}^{K} L_k \right]$$ where K is the number of attributes.

Each one of these P pairs will have been available to be chosen at least once. The dependent variable in this model is the frequency of each individual BW pair being selected by the respondents. The independent variables include a constant and effects coded variables representing the impacts of each of the attributes (impact weights) as well as their levels (level scale values) employed in the study. Specifically, the impact weight for attribute k takes a value of 1 when it is picked as the best in all pairs and -1 when it is picked as worst in all pairs. Of the K attributes, one is omitted to avoid a saturated model. Therefore, there are K-1 attributes included in the model estimation (Flynn, et al., 2007). For the levels of attribute k effects coding is used. Since three levels of each attribute (0, 1, 2) are used in this research, two variables (β_{i1} and β_{i2}, i=1, ..., 5, indicating attributes) can be constructed. Level 0 is treated as the base level. β_{i1} and β_{i2} can be coded as 1, 0, or –1 depending on the level of attribute in the design as Table 3.1 shows.

Table 3.1 Effect Coding Format for Attribute i

	β_{i1}	β_{i2}
Level 0	-1	-1
Level 1	1	0
Level 2	0	1

Thus, the impacts of attribute i on a respondent's utility can be assessed by levels: the marginal utility of level 1 is β_{i1}, level 2 is β_{i2}, and level 0 is $-(\beta_{i1}+\beta_{i2})$. In other words, the coefficient of level 0 is -1 times the sum of the other two level estimates (Boxall and Macnab, 2000; Hensher, et al., 2005). Subsequently, the final equation to be estimated is:

$$\ln(f+\theta) = \alpha + \sum_{k=2}^{5} \beta_k att_k + \sum_{k=1}^{5}\left(\sum_{l=1}^{2} \beta_{kl} att_k L_l\right) \qquad (3.8)$$

where, f is the frequency that a best-worst pair is picked across all scenarios and across all respondents, adjusted to eliminate zero frequencies by adding θ, the reciprocal of the sample size (suggested by Goodman, 1968) to enable natural logarithms to be taken (Louviere, et al., 1995); *k and l* represent attributes and levels respectively; *att* denotes the attributes coded as above (*att*1 is omitted); and the effect-coded level scale values are expressed by L. Appendix B provides a sample of data set using the frequency model.

2) The Choice Model Approach: The choice model involves a conditional logit model of selecting BW pairs at the respondent level. In this analytical framework one choice set (or one scenario) includes all of the five attributes. The number of observations is equal to the number of all valid choice sets from which the best choice is selected plus the number of all valid choice sets from which the worst choice is selected. Since each valid choice set must have a best choice and a worst choice, the number of observations is twice of the total number of BW pairs collected from the respondents. The dependent variable reflects the best or worst choice from given choice sets. For each choice set, the dependent variable is coded by four zeros and a one for the attribute that is selected as either the best or the worst choice. The independent variables are the effect-coded values of two levels of each attribute, one level being the base (same as those in the frequency model). As in the frequency model, the value of the base level is also equal to -1 times the sum of the other two level estimates. If the dependent variable is a worst choice, all of the independent variables are coded in negative values (see Appendix C). Continuing with (3.6), if we assume that the error term follows a Gumbel distribution, the choice model can be written as (Finn and Louviere, 1992; Louviere et al., 1995):

$$P_{ij} = \frac{e^{\delta_{ij}}}{\sum_{k,l \in C} e^{\delta_{kl}}} \qquad (3.9)$$

where, P*ij* is the probability of choosing the best-worst pair *ij*. δ_{ij} is an observable component and represents the utility scale difference between levels *i* and *j* of the two different attributes.

3.3 Survey Design

The survey was to collect the BW data by employing a web-based design. Respondents were contacted by telephone and asked if they were interested and willing to participate in the survey. After receiving their consent, we sent them an email providing the link to the survey website and an ID code accessing the survey. If requested, the respondents could also be mailed a hardcopy of the survey.

The survey included two sections. Section 1 was designed for the best-worst analysis. Section 2 asked respondents to answer rating scale questions about their perceptions of forest tenures. The data of this section was collected for separate analysis and will not be discussed in details in this thesis. Only some of the rating data will be used to support the results from econometrical models.

The objective of the best-worst section was to investigate the respondents' preferences on how changes in current tenure characteristics may, or may not be important in influencing some important social objectives from forests, enhancing industry competitiveness, preserving the environmental integrity of forests, and promoting the stability of communities associated with forests. The respondents were provided with a set of tenure scenarios that differed on a number of tenure characteristics. For each scenario the respondent was required to make best-worst choices for attributes in each given scenario.

Detailed descriptions of the social objectives were provided in the survey. Specifically, competitiveness referred to the ability of Canadian forest companies to compete in global markets. Increased competitiveness would lead to an expanding forestry sector, thereby leading to the creation of more jobs and/or capital investments. Environmental integrity of forests was considered a broad concept that included multiple

factors associated with forest resources. Maintaining and/or increasing environmental integrity would support enhanced biodiversity, wildlife populations, and forest recreation. Moreover, increasing the integrity of the forest environment may help sustain the benefits associated with harvesting non-timber forest products (e.g. berries, mushrooms, etc.). Promoting or maintaining community stability was defined such that forest associated communities would be vibrant places where current residents were willing to stay and to which newcomers were attracted. Such communities are sufficiently robust that they are able to weather economic downturns and continue to prosper. Continuous and long-term jobs and income would stay within the local economy. Each of these objectives was considered, in turn, as being influenced by selected tenure characteristics.

Each best-worst scenario consisted of five tenure attribute levels relating to one of the three social objectives. The five attributes were: the duration of the tenure, the amount of stumpage fees, flexibility of operational requirements, flexibility of harvest levels, and wood processing requirements. Each attribute could hold one of three possible levels – keep current status, increase current levels or decrease current levels (see Table 3.2). For example, duration had three levels: reduce current tenure duration by 10 years, maintain the current duration, and increase current duration by 10 years. Each scenario presented a tenure profile where the specific levels of attributes constitute the profile. An example of the profile is shown in Figure 3.1. Respondents were asked to choose one best and one worst tenure attribute from the list of five attributes provided in the tenure scenario.

Table 3.2 Current Tenure Characteristics with Different Levels

Tenure attributes	Alternative levels
Duration of tenure	(1) Current duration of tenure is reduced by 10 years (2) Current duration of tenure is maintained (3) Current duration of tenure is increased by 10 years
Stumpage fee payments ($/volume harvested)	(1) Stumpage fees are reduced to half of current levels (2) Stumpage fees remain at current levels (3) Stumpage fees are increased to twice current levels
Flexibility within operational requirements	(1) Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives. (2) Operational requirements for tenure holders remain as currently prescribed. (3) Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.
Flexibility of harvest levels	(1) The amount of flexibility that tenure holders are allowed around their AAC is half current levels. (2) The amount of flexibility that tenure holders are allowed around their AAC remains at the current level. (3) The amount of flexibility that tenure holders are allowed around their AAC is twice current levels.
Wood processing requirements	(1) None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder. (2) Some proportion of the wood (i.e. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder. (3) All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.

In the industry and the government survey samples, the same design technique - orthogonal, main-effects fractional factorial design was applied to best-worst questionnaires (Louviere et al., 1995). Since the design included five attributes and three levels of each attribute, a total of $3^5 = 243$ scenarios could be presented to the respondents. However, to minimize the number of scenarios that respondents evaluate, all

higher order interactions were assumed to be insignificant (Louviere, Hensher and Swait, 2000). Finally, an orthogonal main-effects design, processed by SPSS software, generated 27 scenarios. Furthermore, in order to reduce the tasks taken by each respondent, the 27 scenarios were blocked into 3 versions and each version had a total of 9 scenarios. Thus, each respondent only faced one version (9 scenarios). With the assistance of random sampling procedures the 9 scenarios were distributed into three sections – competitiveness, environmental integrity of forests, and community stability, and each section consisted of three scenarios with the criteria that each level of each attribute was included in each section and appeared once and only once.

3.4 Sample Recruitment

Respondents were recruited from two stakeholder groups: forest industry and provincial government[1]. The objective of this sampling strategy was to compare the perspectives of tenure systems across these groups representing different benefits. The survey started in March 2006 and ended in May 2007.

The recruited forest industry respondents included employees from major tenure holding companies in all Canadian provinces except for Prince Edward Island. A "major tenure holder" was defined as those companies holding volume-based tenures larger than 40,000 m^3 and area-based tenures. The managers or other leaders in the companies were the main respondents. On the first page of the survey (see Appendix A), the respondents were asked what position they held in the company.

In the industry survey some firms hold tenures in more than one province and some hold multiple tenures within a province. For the former, the survey was conducted for each province in which they held tenures. For the latter, we attempted to recruit respondents for each of the tenures in the province, although it was difficult since the firms were often managed be the same people.

[1] There was also a community group recruited, but it is not part of this study.

Initially, a total of 233 companies were identified as the sample for this survey. Of these, 50 could not be reached, 3 were closing or had recently closed down their operations, and 16 were owned by other companies or were not actively harvesting or managing their woodlands. This left a sample of 164 companies. Of these 164 companies, 142 agreed to complete the survey.

In order to obtain a sufficient sample size for statistical purposes, respondents were recruited from each company. As a result, a total of 166 surveys were sent to the 142 companies who agreed to participate in the survey. Of this total, 123 surveys were completed and 43 were either incomplete or not started. In addition, four surveys were completed and returned at the June 2006 Sustainable Forest Management Network Conference. Therefore, a total 127 surveys comprise the sample of industry stakeholders.

The government survey was completed by respondents from provincial governments. Officers who engaged in forestry resource management were the main respondents. Similar to the industry survey, the respondents were asked about the position they held in the government at the beginning of the survey. By the end of the survey, we received a total of 40 completed government surveys. Of these, 36 surveys were fully completed and were valid for analysis. Due to the small sample size, the government data was pooled with the industry data in the estimations.

The final sample of survey respondents contained information from representatives from nine different provinces in Canada. Table 3.3 provides summary statistics about the location of respondents from industry and government. In the industry sample, respondents were most numerous from Alberta, British Colombia, Quebec and Ontario. In the government sample, respondents were mainly from Alberta, British Colombia, Newfoundland, Quebec and Ontario.

Table 3.3 Origin of Respondents (Industry and Government)

Province	Industry		Government		Total number of respondents
	Number of respondents	Proportion of sample participating, % (n=127)	Number of respondents	Proportion of sample participating, % (n=36)	
Alberta	47	37.0	6	16.7	53
British Columbia	22	17.3	4	11.1	26
Quebec	22	17.3	7	19.4	29
Ontario	12	9.4	7	19.4	19
Manitoba	8	6.3	2	5.6	10
New Brunswick	6	4.7	2	5.6	8
Saskatchewan	5	3.9	2	5.6	7
Nova Scotia	4	3.1	1	2.8	5
Newfoundland	1	0.8	5	13.9	6
Total	127	100	36	100	163

Table 3.4 shows the tenure types associated with the sample of industry respondents. A total of 11 types of tenure holders comprised the sample - about 88% of these were individuals associated with large and long-term tenure holders. The remaining 12% percent were medium tenure holders (i.e. Alberta Quota and Ontario Forest Resource Licence (FRL)).

Table 3.4 Tenure Type of Industries Investigated

Tenure	Number of individuals from industry
Alberta and Saskatchewan Forest Management Agreement (FMA)	38
Alberta Timber Quota (Quota)	14
British Columbia Forest Licence (FL)	14
British Columbia Tree Farm Licence (TFL)	8
Manitoba Forest Management Licence Agreement (FMLA)	8
Nova Scotia Long-Term License and Management Agreement (LMA)	4
Newfoundland Long Term Timber Licence (LTTL)	1
New Brunswick Crown Timber Licence (CTL)	6
Ontario Sustainable Forest Licence (SFL)	11
Ontario Forest Resource Licence (FRL)	1
Quebec Contract d'Approvisionnement et d'Manénagement Forestier (CAAF)	22
Total	127

Three versions of best-worst scenarios were distributed to the respondents. Each version contained 9 scenarios focusing on three social objectives: competitiveness, environmental integrity and community stability as described in the previous chapter. Table 3.5 shows the number of respondents in both industry and government groups answering the different versions of BW scenarios. The sample size of each version was distributed evenly within the sample.

Table 3.5 Version Statistics (Number of Respondents)

Version	Industry	Government	Total
1	40	14	54
2	41	10	51
3	46	12	58

3.5 Model Estimation

Two types of models were estimated with the best-worst data: the frequency model and the choice model. Both methods were applied to estimate the impacts of tenure characteristics on three different social objectives: competitiveness, environmental integrity and community stability. Therefore, three frequency models were estimated using WLS methods and three choice models estimated by maximum likelihood techniques. In addition, since the choice models analyzed individual level data, interactions between attribute information and respondent specific information (such as provincial and government dummy variables) were added to the estimations and thus five more models (one with government interactions and another four with provincial interactions) for each social objective were estimated.

In the frequency models, the attributes and levels were effects coded as section 3.2.2 described. The attribute "duration" was omitted to avoid a saturated model. Each attribute had three levels represented as 0, 1, and 2. Recall that level 0 of each attribute served as the base level. The values of the base levels were the negative sum of the estimated coefficients of the other two levels (see 3.2.2).

In the choice models, only levels of attributes were included in the estimations. The levels were also effects coded, and level 0 of each attribute served as the base level. The significance of the base level was estimated by using the WALD command in LIMDEP.

3.6 Summary

This chapter provided a description of the methods that were applied to this research. It began with an introduction of random utility theory that provided the theoretical underpinnings of the BWS method. Following this section, a detailed description of BWS method was provided, including basic theory, discussions of its advantages, and data modeling and estimations. Subsequently, the design of the survey used in this study was described, including the technical aspects of the best-worst experiments. This was followed by a discussion of data collection. The last section discussed model estimations / procedures using two different methods. The next chapter will report the findings of the two types of models.

Figure 3.1 An Example of the Best-worst Scenario (Industry and Government Survey)

Suppose that the province introduces a form of tenure with the following characteristics. Which characteristic, in your opinion, is the **best** for maintaining or enhancing competitiveness, and which one is the **worst**? (Please check one answer in **each** column)

Best characteristic (Please check only one)	Tenure Characteristics	**Worst** characteristic (Please check only one)
☐	The current duration of tenure is maintained.	☐
☐	Stumpage fees are increased to twice current levels	☐
☐	Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	☐
☐	The amount of flexibility that tenure holders are allowed around their AAC remains at the current level.	☐
☐	Some proportion of the wood (i.e. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	☐

Overall, how would you rate this tenure in terms of maintaining or enhancing competitiveness?

Highly desirable	Somewhat desirable	Neutral	Somewhat undesirable	Highly undesirable
1☐	2☐	3☐	4☐	5☐

Chapter 4

Results

4.1 Introduction

This chapter provides characteristics of the results in the sample, describes and discusses the results from the best-worst model estimations and relates these results to statistical and qualitative observations on respondents' attitudes to tenure characteristics. Section 4.2 provides descriptive statistics of respondents' information; section 4.3 shows and discusses the results from the empirical models; section 4.4 reports respondents' general attitudes to current tenure characteristics and possible changes, which support the results from the empirical models to some extent; section 4.5 summarizes the above results and provides ranks of the importance of tenure characteristics.

4.2 Descriptive Statistics of Respondents' Information

At the beginning of the survey, respondents were asked to provide information on their position in their company. Table 4.1 summarizes these results. In the industry sample 45.7 % of the respondents worked in a regional office, which involves primarily operational planning. 34.6% of respondents worked in company headquarters that is primarily involved in central planning. About 18.9% of respondents were employed in other positions. One individual's position was not reported. In the government sample, 41.7% of the respondents worked in planning function in forestry departmental headquarters, and 27.8% worked with operational planning in regional offices. The remaining respondents (13.9%) were employed in other functions. Six respondents' positions were not available.

Table 4.1 Respondents' Positions in Industry or Government

Position	Number of Respondent (Industry)	Proportion of sample participated (%)
Central planning	44	34.6
Operational planning	58	45.7
Others	24	18.9
Total	126	99.2

Position	Number of Respondent (Government)	Proportion of sample participated (%)
Central planning	15	41.7
Operational planning	10	27.8
Others	5	13.9
Total	30	83.4

4.3 Results of the Best-worst Models

4.3.1 The Frequency Model Results

The frequency models were estimated based on combined industry and government responses. Parameters estimated from the frequency models are shown in Table 4.2. The adjusted R^2 for the competitiveness model is 0.38, the environmental integrity model is 0.12 and the community stability model is 0.24. All impacts of the general tenure attribute variables were not statistically significant with the exception of wood processing in the environmental integrity model, which was significant at the 95% level. However, a number of tenure attribute levels were significant. A positive parameter value indicates that the respondents believe the level would positively support the social objectives. The bigger the magnitude of the level, the greater is the level of support. Conversely, a negative value means that they perceive that the level would negatively affect the social objectives. Recall (section 3.2.2) that the value of the base level (the current level) of each attribute is minus one times the sum of the other two levels rather than the one estimated from the model.

Results from the competitiveness model indicate that respondents have significant preferences for changes in tenure characteristics. They believe that maintaining the

Table 4.2 Frequency Models (Paired WLS Methods) (Industry and Government)[2]

	Competitiveness	Environmental Integrity	Community Stability
	n = 132	n = 138	n = 132
	Coefficients	Coefficients	Coefficients
CONSTANT	-2.4943***	-2.4768***	-2.9896***
Attribute Impacts			
Duration	-	-	
Stumpage	-0.7142	-1.0336	0.4860
Operation Req.	0.1075	-0.2098	0.1709
Harvesting Levels	-0.2709	-0.3837	0.3236
Wood Processing	-0.5295	-1.1468**	0.0014
Level Scale Values[3]			
Duration			
DUR 0 = Current duration of tenure is reduced by 10 years	-3.0252 ***	-2.4753***	-1.7134**
DUR 1 = Current duration of tenure is maintained	1.9433***	0.8676	0.2700
DUR 2 = Current duration of tenure is increased by 10 years	1.0819 *	1.6077**	1.4434**
Stumpage			
STUMP 0 = Stumpage fees are reduced to half of current levels	2.1701***	1.6851**	1.7281**
STUMP 1 = Stumpage fees remain at current levels	0.9102	-0.1967	1.3810**
STUMP 2 = Stumpage fees are increased to twice current levels	-3.0804***	-1.4884**	-3.1091***
Operational Req.			
OPER 0 = Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	2.3120***	-1.1355	0.8862
OPER 1 = Operational requirements for tenure holders remain as currently prescribed.	0.0428	0.8185	0.3801
OPER 2 = Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.	-2.3548***	0.3170	-1.2663*

[2] The asterisks in the figures denote the levels of significance: *** indicates that the level is significant at 99% confidence level; ** indicates that the level is significant at 95% confidence level; * indicates that the level is significant at 90% confidence level.

[3] Level 0 of each attribute is treated as the base level and its value is minus one times the sum of the parameters on level 1 and level 2. Chapter 3 provided detailed descriptions of the coding parameter.

Harvesting Levels			
HARVEST 0 = The amount of flexibility that tenure holders are allowed around their AAC is half current levels.	-1.9750***	0.9637	-1.0278
HARVEST 1 = The amount of flexibility that tenure holders are allowed around their AAC remains at the current level.	1.7358***	0.1635	0.9381
HARVEST 2 = The amount of flexibility that tenure holders are allowed around their AAC is twice current levels.	0.2392	-1.1272*	0.0897
Wood Processing			
PROC 0 = None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	1.3802**	1.2462*	-2.5510***
PROC 1 = Some proportion of the wood (i.e. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	0.0284	-0.2497	1.4566**
PROC 2 = All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	-1.4086**	-0.9965	1.0944
Adjusted R2	0.38	0.12	0.24

current level of duration is important to promote competitiveness, but that reducing duration would have significant negative effects. They strongly believe that reducing stumpage fees would improve competitiveness and that increasing stumpage fees would be a negative factor. Respondents prefer more specificity in operational requirements and reject less flexibility. As for the flexibility of harvest levels, respondents prefer retaining the current flexibility and disagree with reducing it. In addition, respondents feel that having no wood processing requirements would improve competitiveness, while increasing the required proportion of wood processed would not support competitiveness.

Looking across all attributes in the competitiveness model, it is evident that maintaining the current levels of tenure attributes is generally neither a good nor a bad option. The exceptions are with respect to duration and flexibility of harvest levels, where the current levels are thought to be positive factors in promoting competitiveness. However, there were fairly strong preferences expressed for proposed changes. For all tenure attributes in the competitiveness model, results indicated that respondents did not prefer levels that represent attenuations of their current property rights. Moreover, for almost all attributes, respondents preferred changes which decreased attenuation. The exception is the flexibility of harvest levels where increasing flexibility was not preferred to the current level of flexibility. This finding will be discussed further using the choice models where differences in preferences between government and industry respondents are presented.

In the environmental integrity model, the results suggest that respondents strongly support increasing levels of tenure duration and that they would not support reductions in duration. They also believe that reducing stumpage fees would be good for maintaining environmental integrity while increasing stumpage fees would not. All three levels of the specificity of operational requirements were not significant in this model, indicating that respondents may not be sure about the impacts of this attribute on environmental integrity. Respondents are also not clear if reducing or retaining the current levels of harvesting flexibility would affect environmental integrity significantly. However, they do believe that increasing the flexibility of harvest levels would not be a good way of

achieving this objective. For wood processing requirements, respondents prefer having no restrictions on wood processing rather than keeping some proportion or adding full restrictions on wood processing.

The pattern of preferences that emerges from the environmental integrity model suggests that respondents were in some cases unclear of the link between tenure attribute levels and this social objective. There is weak evidence for a negative effect of wood processing requirements on environmental integrity as suggested by the statistically significant negative parameter on this attribute. Furthermore, the parameters on the levels of this attribute identify that the least attenuated level (none of the wood harvested must be processed by the tenure holder) is weakly preferred. Perhaps this points to the fact that wood processing plants generate pollution (e.g. pulp mills) and that having wood processed outside the tenure boundaries would promote environmental integrity within the tenure area.

The strongest preferences for environmental integrity appear to be over levels of duration and stumpage fees. Explaining the pattern of preferences and their link to environmental integrity is difficult in this pooled government and industry sample. It does appear, however, that these results are similar to those for the competitiveness model in that further attenuation of these tenure attributes would not be welcomed, while reductions in attenuations would be beneficial.

In the community stability model the results indicate that respondents believe that increasing rather than reducing duration would support community stability. They also suggest that reducing stumpage fees would promote community stability. Respondents believe that reducing the flexibility of operational requirements would negatively affect community stability. However, they appear to hold no significant preferences for levels of the flexibility of harvests. Respondents strongly believe that an absence of wood processing requirements would adversely effect community stability.

The strongest preferences regarding community stability emerge connected to tenure attribute levels associated with duration, stumpage fees and wood processing. In the case of duration and stumpage fees, the model parameters are similar to those from the competitiveness model, suggesting that what is good for the industry may be good for community stability. However, the story is somewhat different for wood processing. For this attribute, eliminating wood processing requirements, while perceived as being positive for competitiveness, is perceived as being detrimental to community stability. In this case, respondents seem to believe that potential loss of jobs created by reducing processing requirements are more important to community stability than the positive competitiveness effect created by this change.

Looking across objectives, it is evident that the elimination of wood processing requirements represents the only change where there is a significant tradeoff identified between objectives. That is, the signs associated with all other significant results are consistent across objectives. For example, increasing duration and decreasing stumpage fees are seen as being positive for all objectives, while decreasing duration and increasing stumpage fees are seen as being negative for all objectives. This phenomenon suggests that in most cases, policy changes that are thought by the respondents to be beneficial would promote all three SFM objectives.

4.3.2 Choice Models with Government Interactions

The frequency models provide a global view of preferences over the industry and government respondents. Unfortunately, one cannot tease out differences between these two stakeholder groups using that econometric framework. As mentioned above, the choice model econometric approach does allow this, however. Accordingly, the data were reorganized into the BW choice format and multinomial logit models were estimated using these data. Since the choice models estimated on this pooled choice data provide the same results as the frequency model, those results are not reported (Appendix D provides these specific results). However, this section provides estimates of parameters including interactions between a dummy variable representing government respondents and attribute levels. This allows comparisons between the two stakeholder groups.

Table 4.3 displays parameter estimates associated with tenure attribute levels for industry respondents and also parameters for the interactions with government dummy variables. Industry preferences are represented by the "base" parameters, while government preferences can be calculated by summing the relevant coefficients from the base industry responses and government interaction terms. For example, for DUR 0 within the competitiveness model, the base coefficient is -1.6293, while its interaction with government (GOV DUR0) has a coefficient of 0.7809; so the government response coefficient is –0.8484 (DUR 0 + GOV DUR0 = -1.6293 + 0.7809). The pseudo R^2 for the competitiveness model is 0.25, the environmental integrity model is 0.10 and the community stability model is 0.24.

Based on the parameters in Table 4.3, figures 4.1–4.3 were constructed to display comparisons between industry and government respondent preferences for each social objective by different tenure attributes. Note that according to the attributes designed (Table 3.1), the three levels of each attribute are respectively indexed as less, current and more. In addition, the asterisks in the figures denote the statistical significance of levels.

Table 4.3 The Choice Models with Government Interactions

	Competitiveness	Environmental Integrity	Community Stability
	n = 940	n =886	n =900
	Coefficient	Coefficient	Coefficient
Duration			
DUR 0 = Current duration of tenure is reduced by 10 years	-1.6293***	-1.4180***	-1.6521***
DUR 1 = Current duration of tenure is maintained	1.0198***	0.4919***	0.5548***
DUR 2 = Current duration of tenure is increased by 10 years	0.6095***	0.9261***	1.0972***
Stumpage			
STUMP 0 = Stumpage fees are reduced to half of current levels	2.5467***	1.5762***	1.8923***
STUMP 1 = Stumpage fees remain at current levels	0.0826	0.0150	0.0771
STUMP 2 = Stumpage fees are increased to twice current levels	-2.6293***	-1.5912***	-1.9694***
Operational Req.			
OPER 0 = Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	2.4518***	1.5467***	1.5660***
OPER 1 = Operational requirements for tenure holders remain as currently prescribed.	-0.1665	-0.1105	-0.0914
OPER 2 = Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.	-2.2853***	-1.4363***	-1.4745***
Harvesting Levels			
HARVEST 0 = The amount of flexibility that tenure holders are allowed around their AAC is half current levels.	-1.4367***	-0.3690**	-0.9110***
HARVEST 1 = The amount of flexibility that tenure holders are allowed around their AAC remains at the current level.	0.0829	0.2463	0.1324
HARVEST 2 = The amount of flexibility that tenure holders are allowed around their AAC is twice current levels.	1.3538***	0.1227	0.7786***
Wood Processing			
PROC 0 = None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	0.6183***	0.2852*	-2.0576***
PROC 1 = Some proportion of the wood (i.e. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	0.3036*	0.1833	1.3433***
PROC 2 = All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	-0.9219***	-0.4684***	0.7143***
Gov. Interactions			
GOV DUR 0	0.7809**	0.9163***	0.4303
GOV DUR 1	-0.1505	-0.3053	-0.0719
GOV DUR 2	-0.6305**	-0.6109**	-0.3584
GOV STUMP 0	-2.0294***	-1.9098***	-1.1113***
GOV STUMP 1	0.5738*	0.1025	0.4803
GOV STUMP 2	1.4556***	1.8073***	0.6310*
GOV OPER 0	-1.3136***	-3.1852***	-1.7371***
GOV OPER 1	0.4330	1.0148***	0.6333**

GOV OPER 2	0.8806***	2.1704***	1.1038***
GOV HARVEST 0	0.7617**	0.8866***	0.8594***
GOV HARVEST 1	0.5486*	0.0543	-0.0369
GOV HARVEST 2	-1.3103***	-0.9410***	-0.8224**
GOV PROC 0	0.2173	-0.0897	0.2203
GOV PROC 1	0.1364	0.1500	-0.7120**
GOV PROC 2	-0.3537	-0.0604	0.4917
LL at convergence	-1,117.0	-1,208.9	-1,079.7
pseudo-R2	0.250	0.100	0.235

Government respondents' implied coefficients

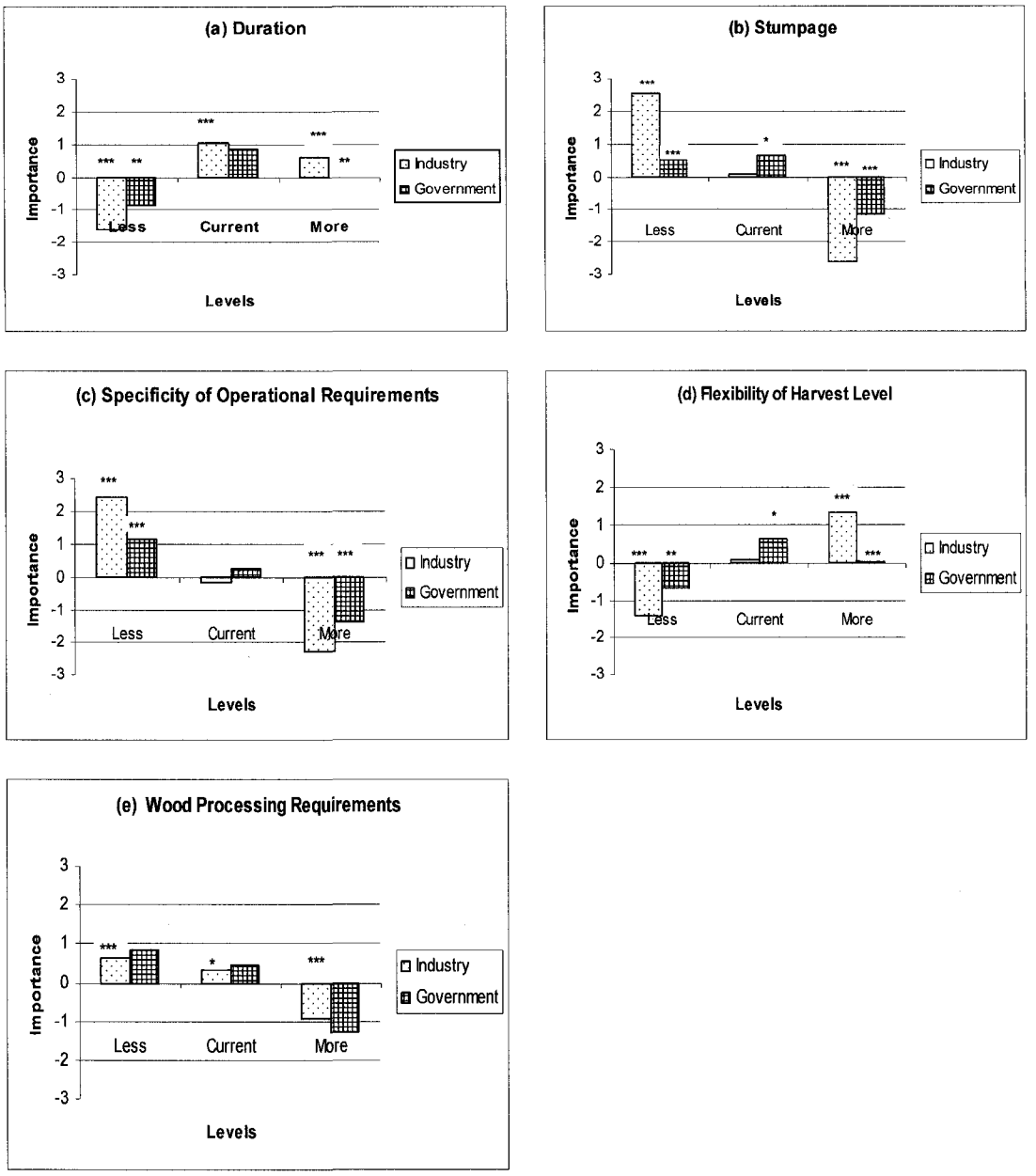
	Competitiveness	Environmental Integrity	Community Stability
Duration			
DUR 0 = Current duration of tenure is reduced by 10 years	-0.8484	-0.5017	-1.2218
DUR 1 = Current duration of tenure is maintained	0.8693	0.1866	0.4830
DUR 2 = Current duration of tenure is increased by 10 years	-0.0210	0.3152	0.7388
Stumpage			
STUMP 0 = Stumpage fees are reduced to half of current levels	0.5173	-0.3336	0.7810
STUMP 1 = Stumpage fees remain at current levels	0.6564	0.1175	0.5574
STUMP 2 = Stumpage fees are increased to twice current levels	-1.1738	0.2161	-1.3384
Operational Req.			
OPER 0 = Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	1.1382	-1.6385	-0.1711
OPER 1 = Operational requirements for tenure holders remain as currently prescribed.	0.2665	0.9044	0.5419
OPER 2 = Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.	-1.4047	0.7341	-0.3707
Harvesting Levels			
HARVEST 0 = The amount of flexibility that tenure holders are allowed around their AAC is half current levels.	-0.6750	0.5176	-0.0516
HARVEST 1 = The amount of flexibility that tenure holders are allowed around their AAC remains at the current level.	0.6315	0.3006	0.0955
HARVEST 2 = The amount of flexibility that tenure holders are allowed around their AAC is twice current levels.	0.0435	-0.8182	-0.0439
Wood Processing			
PROC 0 = None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	0.8356	0.1955	-1.8373
PROC 1 = Some proportion of the wood (i.e. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	0.4400	0.3333	0.6314
PROC 2 = All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	-1.2756	-0.5288	1.2060

Figure 4.1 shows comparisons between industry and government respondents' preferences for levels of tenure characteristics with respect to competitiveness. Both industry and government respondents have similar preferences for levels of many of the tenure attributes. Where they differ is in the strength of preferences, with government respondents generally exhibiting preferences of smaller magnitudes for changes to tenure characteristics than their industry counterparts.

Overall, regarding competitiveness, there appears to be agreement that decreasing attenuation[4] of rights would increase competitiveness, while increasing attenuation of rights would decrease competitiveness. For most tenure characteristics, there appears to be more support for changes that would decrease attenuation rather than maintain the current levels of the attributes examined. The one exception is duration where industry and government respondents appear satisfied with the current level.

[4] Note that attenuation can be related to both rights and obligations. Attenuation of rights would decrease competitiveness, but attenuation of obligations would have positive impact on competitiveness. In this thesis, attenuation is only related to rights.

Figure 4.1 Histogram of tenure preference parameters from the choice models for the competitiveness social objective for Industry and Government respondents.[5]



[5] The asterisks in the figures denote the levels of significance: *** indicates that the level is significant at 99% confidence level; ** indicates that the level is significant at 95% confidence level; * indicates that the level is significant at 90% confidence level.

Figure 4.2 displays the comparisons between industry and government respondents' perceptions associated with environmental integrity. Both industry and government respondents consistently agree that longer duration would improve environmental integrity, and that less duration would have negative effects on this objective. Both respondent groups also provided positive preferences for current levels of duration, indicating that they were satisfied with the current duration.

There are significant differences between industry and government in preferences for changes in stumpage fees, however. Industry respondents perceive lower stumpage fees to maintain environmental integrity while higher stumpage fees would have negative effects. This is consistent with the finding from the frequency model. However, government respondents support higher stumpage fees but reject lower stumpage fees for promoting environmental integrity. Our questions do not provide us with insights into why industry and government differ on their perceptions of impacts of stumpage fees on environmental integrity. However, it could be that government respondents perceived that higher charges on harvesting could deter industries from over-harvesting, resulting in a more sustained and balanced ecosystem. Conversely, perhaps industry respondents believe that lower stumpage fees would reduce industry's costs and increase their capability to carry out external activities relevant to environmental protection.

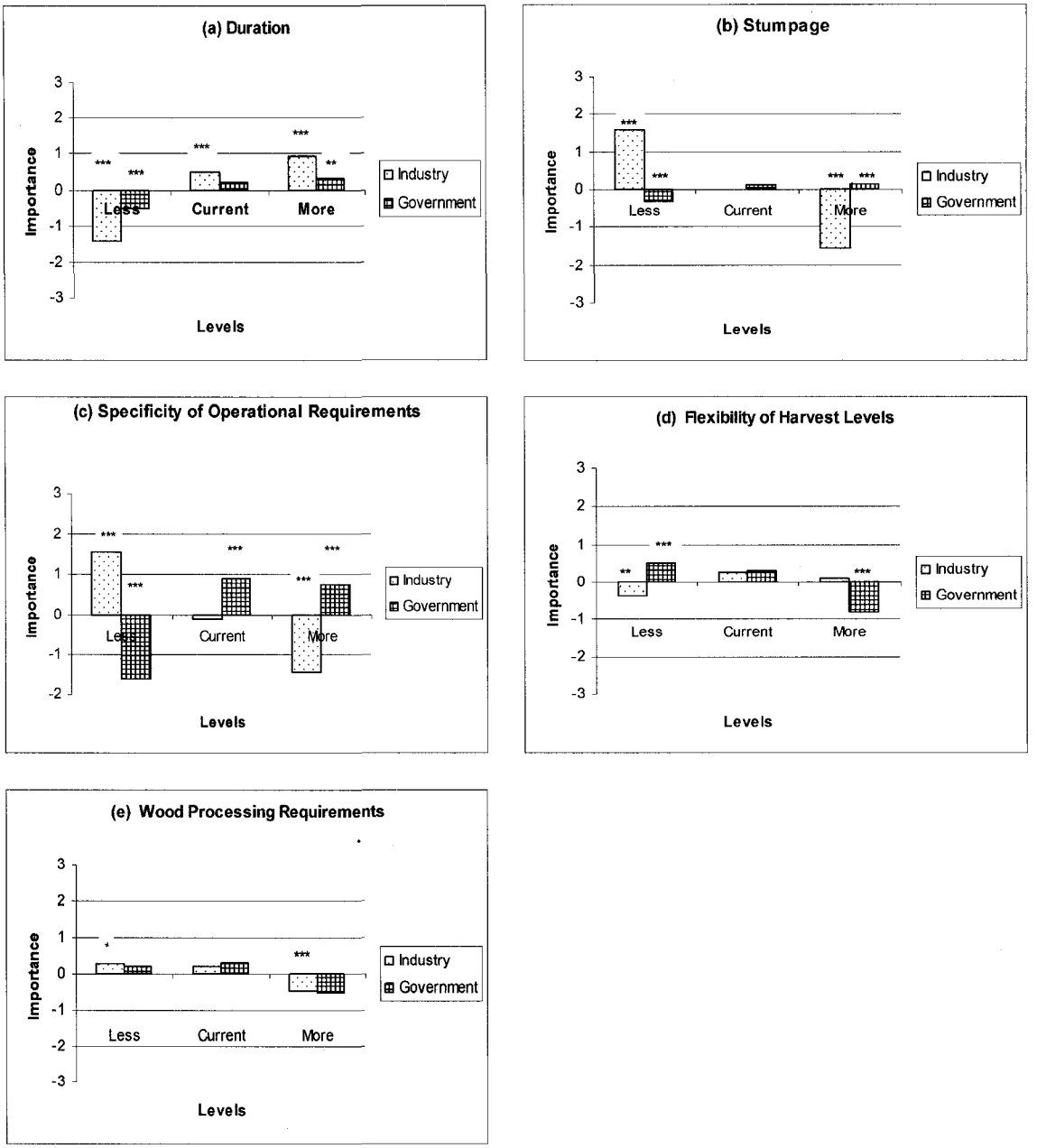
Industry and government respondents also have different preferences for changing the specificity of operational requirements. Industry respondents believe that less specificity of operational requirements would improve environmental integrity and that more specificity of operational requirements would have negative effects on pursuing this objective. On the other hand, government respondents prefer more specificity and dislike less specificity. More specificity of operational requirements, as government respondents probably perceived, imposes more restrictions on industries' operations. This might reduce resource damages caused by forest operations, and it pushes industries to participate in maintaining social benefits and

environmental protection. For the current level of the specificity of operational requirements, industry respondents do not have a statistically significant perception. However, government respondents appeared satisfied with the current prescribed requirements and provided significant positive preferences.

Industry and government respondents also have different preferences regarding environmental integrity and the flexibility of harvest levels, although preferences do not appear to be as strong as for tenure duration, stumpage fees, and the specificity of operational requirements. Government respondents indicate that reducing flexibility would maintain environmental integrity and that increasing it would have negative impacts. In contrast, industry believes that less flexibility would harm environmental integrity. Both respondents have no significant perceptions of the current flexibility of harvest levels.

Regarding wood processing restrictions, results suggest that preferences are not strong as there are few parameters that are statistically significant. However, the general pattern is that industry and government are in agreement that greater attenuation of tenure is bad for environmental integrity, while less is good.

Figure 4.2 Histogram of tenure preference parameters from the choice models for the environmental integrity social objective for Industry and Government respondents.[6]



[6] The asterisks in the figures denote the levels of significance: *** indicates that the level is significant at 99% confidence level; ** indicates that the level is significant at 95% confidence level; * indicates that the level is significant at 90% confidence level.

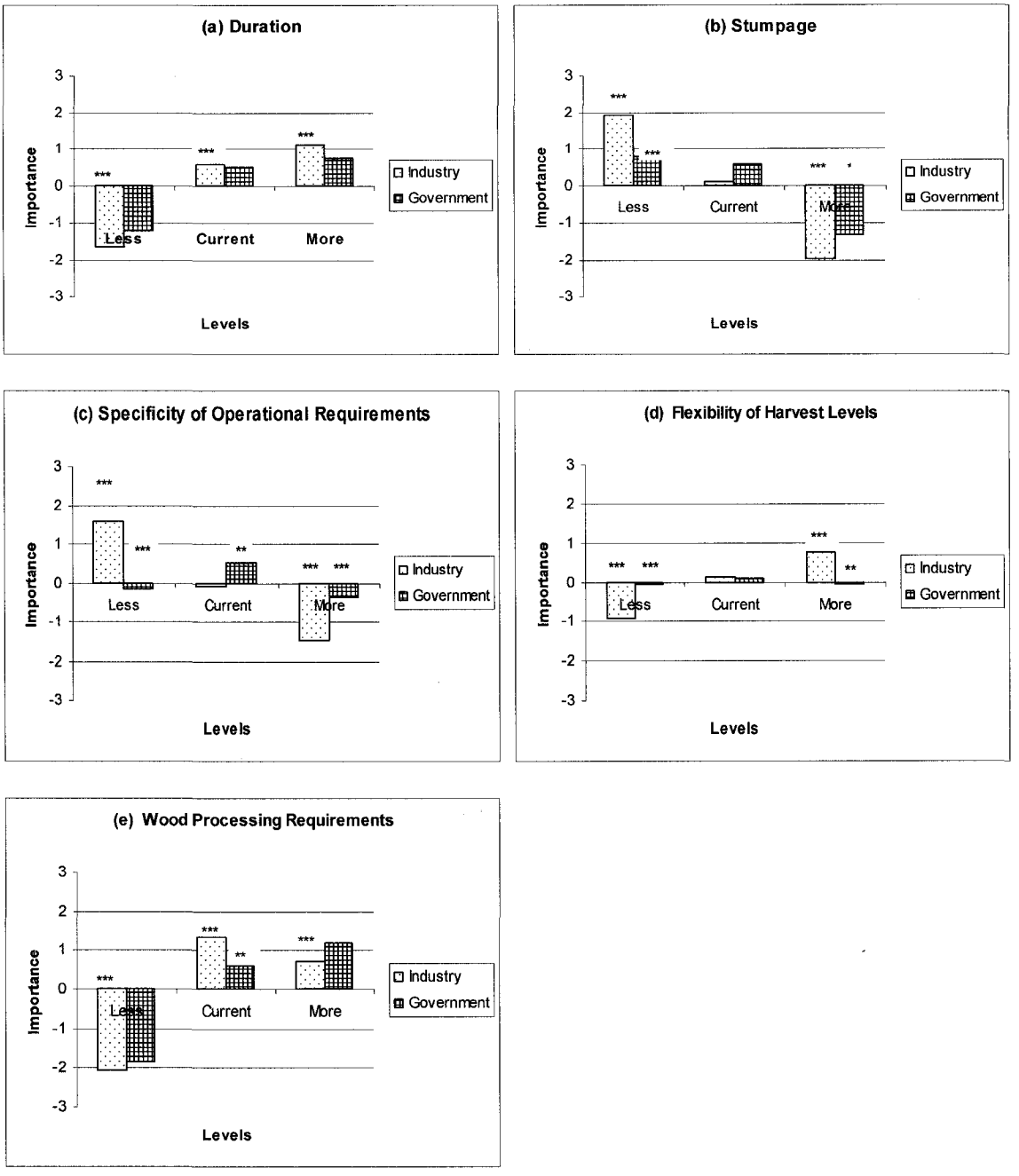
Figure 4.3 provides industry and government respondents' perceptions of the impacts of the tenure characteristics on community stability. Both industry and government respondents seem to agree that longer duration would support community stability and that shorter duration would have negative effects. They also provide positive evaluations of the current duration levels. Although industry and government results seem to be similar, only the industry results are statistically significant.

Both respondent groups also have similar perceptions for levels of stumpage fees. As was the case for the combined sample, they believe that lower stumpage fees would help to sustain community stability, while higher fees would be not.

However, the two groups have different opinions on reducing the specificity of operational requirements. Industry respondents indicate that less specificity would support communities whereas government respondents dislike reductions in specificity, perhaps because they believe that the current requirements already provide stable communities. Both respondent groups, however, agree that increasing the specificity of operational requirements would negatively affect community stability.

Regarding the flexibility of harvest levels, industry responses suggest that increasing harvest flexibility would promote stable communities and that reducing this flexibility would not. These perceptions may be supported by the belief that tenure holders with increased harvest flexibility would expand production and increase employment levels, which is an important factor for sustaining stable community. The values of the three levels of this attribute provided by the government respondents were close to zero, implying that unlike industry, government respondents may not think that the flexibility of harvest levels has significant impacts on community stability.

Figure 4.3 Histogram of tenure preference parameters from the choice models for the community stability social objective for Industry and Government respondents.[7]



[7] The asterisks in the figures denote the levels of significance: *** indicates that the level is significant at 99% confidence level; ** indicates that the level is significant at 95% confidence level; * indicates that the level is significant at 90% confidence level.

Concerning wood processing requirements, there were no significant differences between industry and government preferences. Both groups appear to agree with retaining some proportion of wood processing requirements for community stability objectives, and disagree with less wood processing requirements. These preferences could be driven by the belief that such requirements can sustain some level of employment for the community. However, there is also support for the current level of these requirements from both industry and government respondents.

In summary, results with respect to competitiveness from the choice model analysis are almost consistent with those from the frequency model. The exception is that industry respondents prefer increasing the flexibility of harvest levels rather than current flexibility of harvest levels, which is agreed by all respondents in the frequency model. With respect to environmental integrity, most results from the choice model are different from those from the frequency model due to the different perceptions between industry and government respondents. The only consistent results between the two models is that all respondents agree that increasing duration would be good, while reducing duration would have negative effects.

As for community stability, results from the choice model indicate that industry respondents have perceptions of duration and wood processing requirements that are consistent with those from the frequency model, while government respondents have no significant perceptions. Results associated with stumpage fees from the two models are consistent. A significant difference between the two models is that the perceptions of the specificity of operational requirements and the flexibility of harvest levels are insignificant in the frequency models but industry and government respondents expressed clear and different perceptions on them in the choice models.

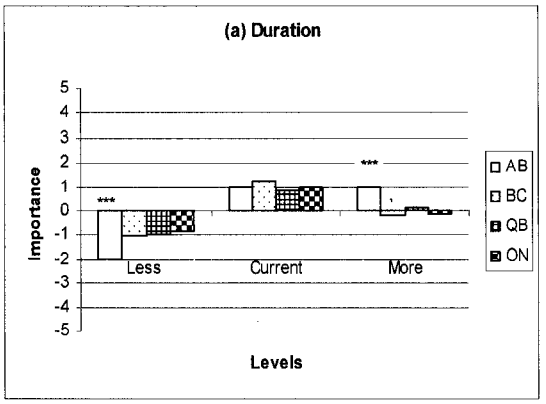
4.3.3 The Choice Models with Provincial Interactions

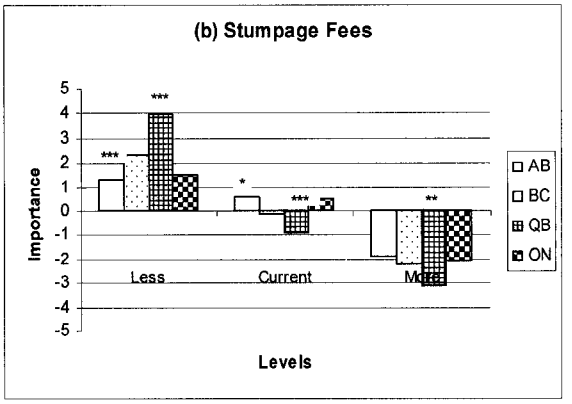
To investigate differences across provinces, dummy variables for four provinces, Alberta (AB), British Columbia (BC), Quebec (QB) and Ontario (ON) were added to the choice models through interactions with tenure attribute levels. Other provinces were not considered because of their low response rates. Note that these choice models with province interactions were estimated independently. The government interactions were not included in these models. Appendix E provides results of these estimations.

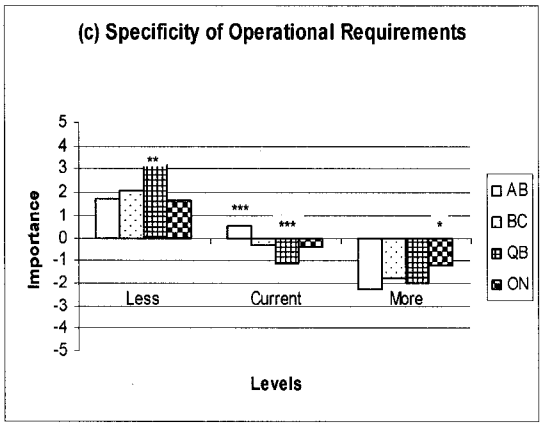
Based on Appendix E, Figures 4.4–4.6 were developed to display comparisons between provinces associated with each social objective by different tenure characteristics (or attributes). Similar to the government interaction models discussed above, the three levels of each attribute are respectively indexed as less, current and more.

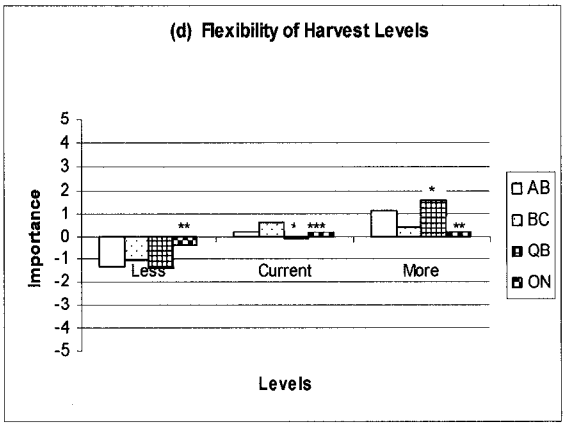
Figure 4.4 indicates that considering promoting competitiveness, respondents across provinces do not have statistical significant differences in their preferences regarding the current level of tenure characteristics except that those from Quebec have significant negative preferences for the current level of stumpage fees, operational requirements and flexibility of harvest levels. With respect to the changes of tenure characteristics, respondents across provinces have no significant different perceptions. Respondents from all provinces examined appear to agree that attenuating any tenure characteristics would negatively affect competitiveness while having less restrictions would promote competitiveness.

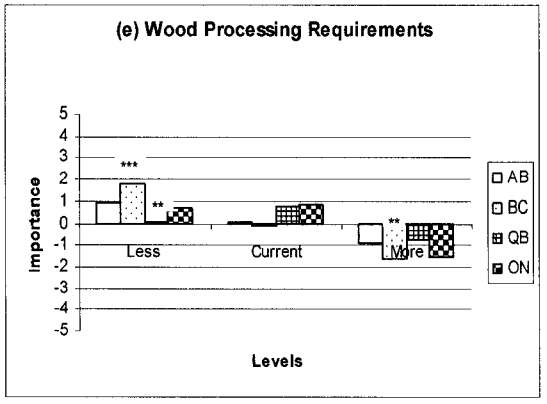
Figure 4.4 Histogram of tenure preference parameters from the choice models for the competitiveness social objective for respondents across provinces[8]







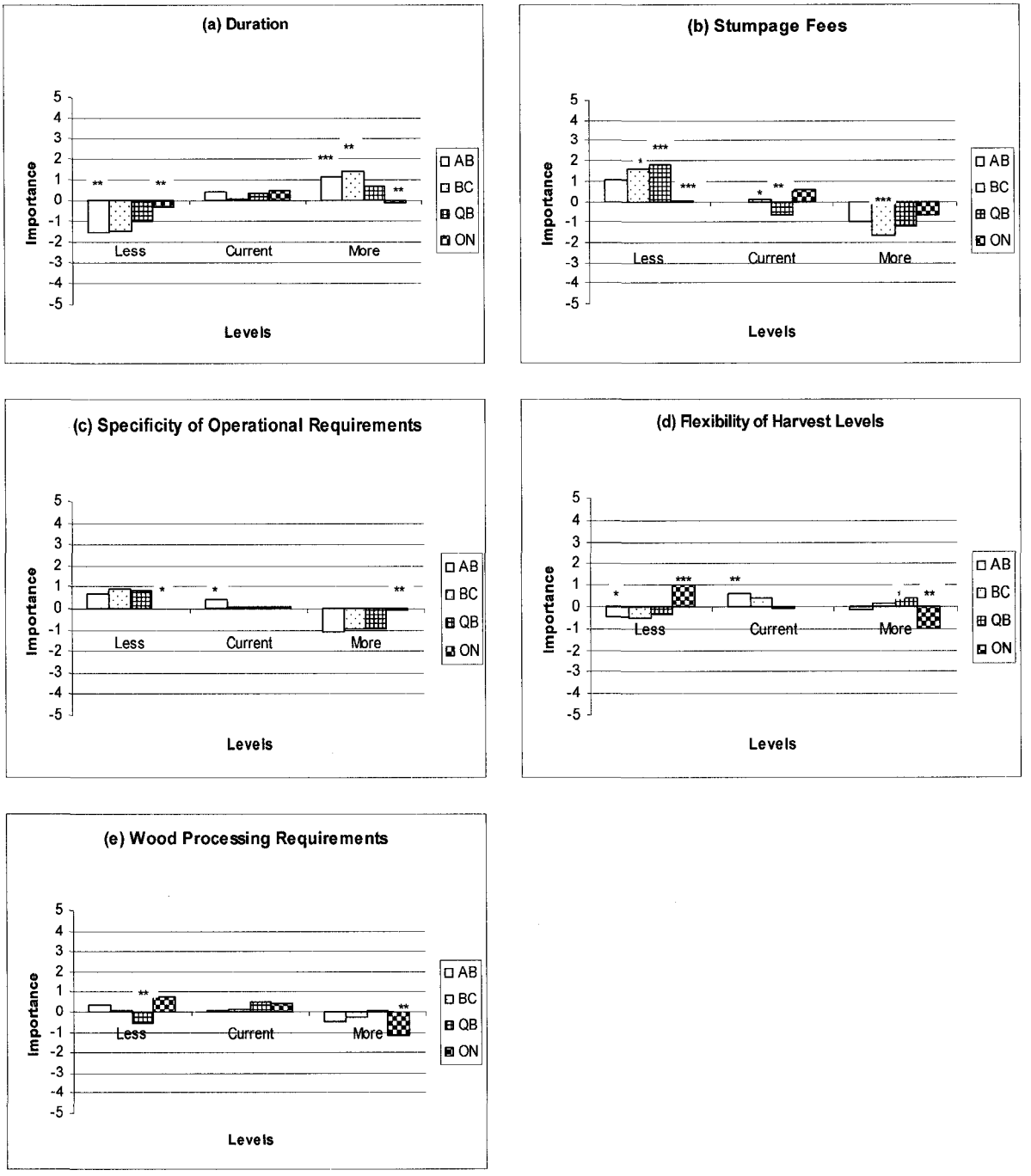




[8] The asterisks in the figures denote the levels of significance: *** indicates that the level is significant at 99% confidence level; ** indicates that the level is significant at 95% confidence level; * indicates that the level is significant at 90% confidence level.

Figure 4.5 suggests that respondents across provinces appear to have no statistical significant differences in their preferences regarding the current levels of tenure characteristics with respect to environmental integrity, except that those from Quebec significantly dislike current stumpage fees. As for possible changes in tenure characteristics, respondents across provinces have almost consistent perceptions for duration, stumpage fees and operational requirements. They still agree that further attenuating these features of their tenure would have negative effects on environmental integrity, but increasing flexibility of them would facilitate maintaining this objective. The exception here is that respondents from Ontario dislike increasing duration. Respondents across provinces have some different ideas about changing the flexibility of harvest levels and wood processing requirements. Concerning the flexibility of harvest levels, respondents from Alberta, British Columbia and Quebec have almost the same evaluations of less or more harvesting flexibility, close to zero, indicating that they have uncertain perceptions of the impacts of reducing or increasing the flexibility of harvest levels on environmental integrity. Respondents from Ontario, however, strongly agree that less harvesting flexibility would restrict over harvesting behavior thus promoting environmental integrity, and increased flexibility would have negative effects on environmental integrity. The figure also implies that respondents from all provinces do not think that changing wood processing restrictions (reducing or increasing) have significant impacts on the environmental integrity except that those from Quebec strongly disagree with eliminated wood processing requirements.

Figure 4.5 Histogram of tenure preference parameters from the choice models for the environmental integrity social objective for respondents across provinces[9]

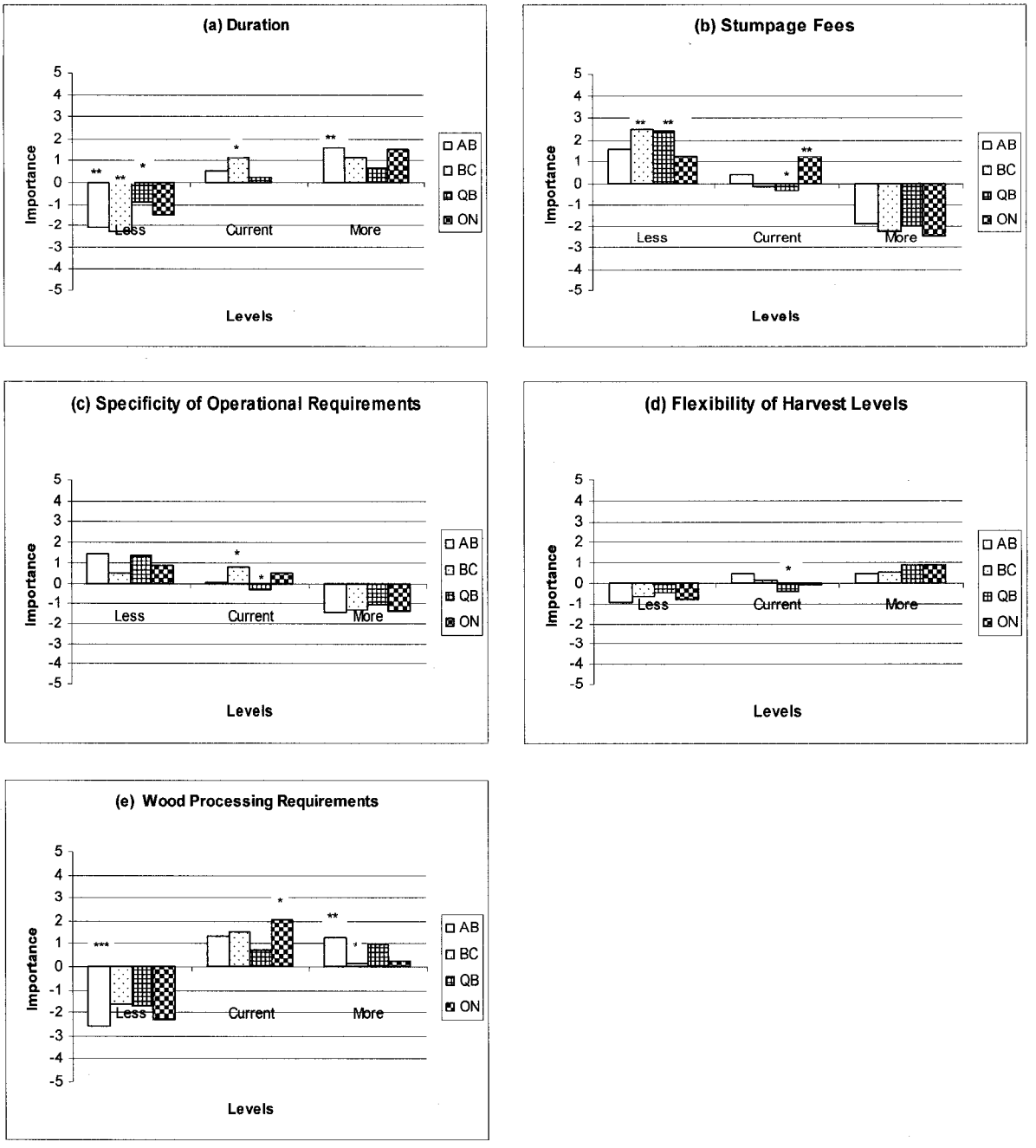


[9] The asterisks in the figures denote the levels of significance: *** indicates that the level is significant at 99% confidence level; ** indicates that the level is significant at 95% confidence level; * indicates that the level is significant at 90% confidence level.

Figure 4.6 displays perceptions from different provinces with respect to the impacts of tenure characteristics on community stability. Most respondents across provinces have no significant perceptions of the current levels of tenure characteristics regarding community stability except Quebec's significantly negative responses on stumpage fees, operational requirements and flexibility of harvest levels. As for possible changes in tenure attributes, respondents from all provinces have consistent perceptions. They agree that attenuating these features of their tenure would negatively affect community stability while increased flexibility of them would sustain community stability, except that remaining some of wood processing requirements would support community stability positively but having no wood processing requirements would have negative effects.

In general, results from the choice models with respect to competitiveness and community stability are almost consistent with the general results from the frequency model. There are no significant differences between provinces when considering the changes of tenure characteristics. As for environmental integrity, results from the choice models indicate some differences across provinces, which cannot be reflected in the frequency model. Regarding the status quo of tenure characteristics, most provinces have no statistical significant differences in their preferences regarding the three social objectives. Quebec is an exception that respondents from this province are not satisfied with the impacts of current stumpage fees on the three social objectives and they also dislike the current specificity of operational requirements with respect to competitiveness and community stability. The small sample size employed in this analysis should suggest caution in reading too much into the lack of statistical significance in preferences across provinces.

Figure 4.6 Histogram of tenure preference parameters from the choice models for the community stability social objective for respondents across provinces[10]



[10] The asterisks in the figures denote the levels of significance: *** indicates that the level is significant at 99% confidence level; ** indicates that the level is significant at 95% confidence level; * indicates that the level is significant at 90% confidence level.

4.4 Respondents' General Attitudes to Current Tenure Characteristics and Possible Changes

In the industry survey, respondents are asked if they were satisfied with the current levels of tenure characteristics and how they expected the value of the tenure to their company with the possible changes of the tenure characteristics. It would be instructive to compare these results with those from the analysis of preferences for tenure attributes reported above.

The specific questions employed in assessing respondent attitudes were designed in a rating format. For current tenures, respondents were asked to rate on a scale from 1 to 5, where 1 was strongly agree, 2 was somewhat agree, 3 was neither agree nor disagree (neutral), 4 was somewhat disagree and 5 was strongly disagree. For expectation of their tenure's value, the rating scale was also from 1 to 5, where 1 was greatly increase, 2 was increase somewhat, 3 was stay the same, 4 was decrease somewhat, and 5 was greatly decrease.

Table 4.4 summarizes the results of these rating exercises. The mean ratings indicates that respondents were satisfied with the current levels of duration, stumpage payments, specificity of operational requirements and flexibility of harvest level with most of them providing a rating between "strongly agree" and "somewhat agree" for each of these characteristics. However, they provided a neutral rating (2.94, which is close to 3, neither agree nor disagree) with removing wood processing requirements. As for the possible changes in the next 20 years, respondents expected that the values of duration, stumpage payments, operational requirements and flexibility of harvest level to their companies would maintain the same levels as they are currently. But they did not agree that the wood processing requirements would be removed. Generally, these ratings display results that are consistent with those derived from the best-worst models (section 4.2). For example, both results indicate that respondents are satisfied with current levels of tenure characteristics.

Table 4.4 Statistics of Industry Respondents' Attitudes to Current Tenure Characteristics and Their Possible Changes
(n = 127)

Tenure Characteristics	Whether the current tenure characteristic is important to the company or not		Whether the importance of the tenure characteristic will increase or decrease if it changes in the next 20 years	
	Mean[1]	Std.	Mean[2]	Std.
Duration	1.4144	0.6392	3.1892	0.8368
Stumpage Payments	1.3909	0.7431	3.1927	0.8550
Operational Requirements	1.3694	0.6866	3.1532	1.0108
Flexibility of Harvest Levels	1.6364	0.7749	2.8727	0.8790
Wood Processing Requirements	2.9369	1.3703	3.5000	1.2663

[1] The numbers indicate the degree of satisfaction with current tenure characteristics, where 1= strongly agree, 2 = somewhat agree, 3 = neither agree nor disagree (neutral), 4 = somewhat disagree, and 5 = strongly disagree.
[2] The numbers indicate the degree of changes in tenure characteristics, where 1 = greatly increase, 2 = increase somewhat, 3 = stay the same, 4 = decrease somewhat, and 5 = greatly decrease.

In the government survey, respondents were asked to rate the acceptability of various changes of tenure characteristics to different interest groups. The rating scale was from 1 to 5, where 1 was strongly agree, 2 was somewhat agree, 3 was neither agree nor disagree (neutral), 4 was somewhat disagree and 5 was strongly disagree. Table 4.5 summarizes the results of these ratings. The mean ratings indicate that government respondents thought that increasing duration would be more acceptable to the forest industry than other groups because the forest industry had the lowest rating (1.49), which was between "strongly agree" and "somewhat agree". They selected environmental non-governmental organizations (ENGOs), which had the lowest rate (2.0), as the one that would be most likely to accept decreasing duration. Increasing stumpage payments was believed to be the most acceptable to ENGOs, while decreasing stumpage payments would be acceptable to the forest industry. More specificity of operational requirements would be acceptable to ENGOs and less specificity of operational requirements would be acceptable to the forest industry. In the government respondents' opinion, forest industry firms would be the most likely to accept increasing the flexibility of harvest levels and ENGOs would accept decreasing the flexibility of harvest levels. For removing wood processing requirements, government respondents thought that all five groups would be

indifferent towards removing wood processing requirements. This is demonstrated by the mean values being in the 2.5 – 3.5 range (between "somewhat agree" and "somewhat disagree"). Overall, these ratings, to some extents, support the results from the empirical models, showing that government respondents have some different perceptions of tenure characteristics from industry respondents. For example, in best-worst models, results indicate that government respondents believe that increasing stumpage fees would promote environmental integrity, but industry respondents have a negative evaluation of increasing stumpage fees. The rating exercises also display that forest industry group would not accept increasing stumpage fees, ENGOS, however would accept this change because they are more concerned about environmental integrity. The similar consistency between the two types of results also can be found in the specificity of operational requirements and flexibility of harvest levels.

Table 4.5 Statistics of Government Respondents' Attitudes to Tenure Changes

(n = 36)

Tenure Characteristics	Interest Groups	Potential Changes			
		Who would accept increasing the characteristic?		Who would accept decreasing the characteristic?	
		Mean[1]	Std.	Mean	Std.
Duration	Forest Industry	1.4857	0.7425	4.5143	0.7017
	Financial Institutions	1.5714	0.9167	4.4571	0.7005
	Public	3.6857	1.0784	2.4286	0.8148
	ENGOS	4.1143	1.1054	2.0000	0.9701
	Provincial Government	3.2059	1.0668	3.0588	0.9192
Stumpage Payments	Forest Industry	4.5000	0.971	1.1667	0.4472
	Financial Institutions	4.0278	1.0278	1.6389	0.7232
	Public	2.2222	1.0173	3.8889	0.8873
	ENGOS	1.8889	0.9791	4.4167	0.6918
	Provincial Government	2.6571	0.9983	3.4286	0.9167
Operational Requirements	Forest Industry	4.4167	1.2734	1.1944	0.4672
	Financial Institutions	3.6944	1.037	1.8889	0.7475
	Public	2.3056	0.9202	3.8889	0.6667
	ENGOS	1.9444	1.2861	4.6571	0.6835
	Provincial Government	3.2286	0.8432	3.0857	0.8179
Flexibility of Harvest Levels	Forest Industry	1.3889	0.5989	4.6389	0.5426
	Financial Institutions	1.8333	0.8106	4.0556	0.7908
	Public	3.9167	0.6918	2.5833	0.8409
	ENGOS	4.4444	0.8087	1.9722	1.1081
	Provincial Government	3.5143	0.9194	3.1429	0.9438
Wood Processing Requirements	Forest Industry	-	-	2.5429	1.336
	Financial Institutions	-	-	2.9143	1.2217
	Public	-	-	3.4571	1.0939
	ENGOS	-	-	3.1143	1.1574
	Provincial Government	-	-	3.3529	1.2764

Note 1: The numbers in the table indicate the degree of acceptability, where 1= strongly agree, 2 = somewhat agree, 3 = neither agree nor disagree (neutral), 4 = somewhat disagree, and 5 = strongly disagree.

4.5 Summary

According to the results from the choice models, an implicit ranking of the characteristics within each most preferred tenure profile can be derived by comparing the magnitudes of the estimated coefficients associated with the tenure attribute levels. Table 4.6 indicates which characteristic is perceived to play a more important role than others in improving the tenure system. The industry and government respondents have different priorities for tenure attributes. Stumpage payments and specificity of operational requirements were selected by the industry respondents as the most important characteristics that should be considered when pursuing the social objectives. The government respondents, however, prioritized the tenure characteristics differently for different social objectives. For competitiveness, reducing specificity of operational requirements was listed as the most important factor, followed by duration, wood processing requirements, stumpages and flexibility of harvest levels. For environmental integrity, the rank was changed into specificity of operational requirements, flexibility of harvest levels, wood processing requirements, duration and stumpages. For community stability, the most important attribute became wood processing requirements, followed by stumpage, duration, specificity of operational requirements and flexibility of harvesting.

Table 4.6 Ranks of the Most Preferred Tenure Attributes and Their Levels for Industry and Government Respondents[11]

	Competitiveness		Environmental Integrity		Community Stability	
Rank	**Industry**	**Government**	**Industry**	**Government**	**Industry**	**Government**
1	STUMP 0	OPER 0	STUMP 0	OPER 1	STUMP 0	PROC 2
2	OPER 0	DUR 1	OPER 0	HARVEST 0	OPER 0	STUMP 0
3	HARVEST 2	PROC 0	DUR 2	PROC 1	PROC 1	DUR 2
4	DUR 1	STUMP 1	PROC 0	DUR 2	DUR 2	OPER 1
5	PROC 0	HARVEST 1	HARVEST 1	STUMP 2	HARVEST 2	HARVEST 1

In addition, respondents from various provinces had different ranks associated with the three social objectives (see Table 4.7). In Alberta and Quebec, stumpage fees are listed as the most important factor for promoting competitiveness. British Columbia,

[11] In this table, 0, 1 and 2 indicate three levels of each attribute and respectively are: reduced current level, current level and increased current level.

however, believe that wood processing requirements should be considered first. It seems that respondents in Ontario have no statistical significant differences in their preferences regarding the priorities of tenure characteristics. For environmental integrity and community stability, respondents from Alberta emphasize the importance of increasing duration, while those from British Columbia and Quebec agree that reducing stumpage fees should be the first consideration. Respondents from Ontario think that reducing flexibility of harvest levels has the most important influence on environmental integrity and remaining some proportion of wood processing requirements should be considered first for sustaining community stability.

Table 4.7 Ranks of the Most Preferred Tenure Attributes and Their Levels for Respondents across Provinces[12]

Competitiveness			
AB	**BC**	**QB**	**ON**
STUMP 0	PROC 0	STUMP 0	
DUR 2		OPER 0	
		HARVEST 2	
Environmental Integrity			
AB	**BC**	**QB**	**ON**
DUR 2	STUMP 0	STUMP 0	HARVEST 0
HARVEST 1	DUR 2	HARVEST 2	
Community Stability			
AB	**BC**	**QB**	**ON**
DUR 2	STUMP 0	STUMP 0	PROC 1
	DUR 1		
	OPER 1		

Note: Only the attribute levels significant at the 10% level are involved in the ranks.

[12] In this table, 0, 1 and 2 indicate three levels of each attribute and respectively are: reduced current level, current level and increased current level.

Chapter 5

Conclusions and Future Research

5.1 Introduction

The goal of this research was to investigate preferences for possible changes in current tenure systems associated with three social objectives – competitiveness, environmental integrity and community stability. To accomplish these objectives, this study analyzed different stakeholders' perceptions of the status quo of tenure systems and their potential changes associated with the different social objectives. An approach called the best-worst scaling (BWS) method was applied to the study. A survey based on the theory of BWS was distributed in the spring of 2006. The survey included five key characteristics of tenures. Two types of BWS models, a frequency model and a series of choice models, were estimated using combined industry and government data collected from the survey. Results indicate that there are some different understandings or expectations on the five selected tenure characteristics between industry and government and across provinces.

5.2 Overview of Findings

5.2.1 Attitudes towards Current Tenure Systems

Industry respondents seem satisfied with current duration and some proportion of wood processing requirements and have indifferent perceptions of other tenure characteristics when considering competitiveness. Government respondents appear to be satisfied with current stumpage fees and the current flexibility of harvest levels but have no significant preferences for the current levels of other tenure characteristics. Regarding environmental integrity, industry respondents have no significant perceptions of the current level of tenure characteristics except duration, where they provided positive evaluations. Government respondents are highly satisfied with the current level of the specificity of operational requirements, but they have no significant perceptions of other current tenure characteristics. As for community stability, industry respondents are satisfied with current duration and remaining some proportion of wood processing requirements. They have no statistically significant preferences for the current levels of

other characteristics. Government respondents like the current level of the specificity of operational requirements and agree that remaining some wood processing requirements would improve community stability, but they have no clear preferences regarding current duration, stumpage fees and flexibility of harvest levels.

There were also no significant differences between provinces regarding the evaluation of the current tenure policies. In most cases, the values provided by respondents from different provinces are either positive or very close to zero. Only Quebec respondents expressed significant disagreement with current stumpage fees, the specificity of operational requirements and the flexibility of harvest levels.

5.2.2 Improvements to the Current Tenure Systems

Regarding how to improve the current tenure systems to promote competitiveness, maintain environmental integrity and sustain community stability, industry and government respondents did not always maintain consistent points of view across the social objectives.

With respect to promoting competitiveness, respondent groups have few conflicts on changing tenure characteristics. They prefer increasing the flexibility of tenure characteristics but reject decreasing them. Specifically, increasing duration, reducing stumpage fees, reducing the specificity of operational requirements, increasing the flexibility of harvest levels and having no wood processing requirements are preferred and deemed to be a good way to promote competitiveness.

As for maintaining environmental integrity, both industry and government respondents believe that increasing duration and having no wood processing restrictions would be good policy changes. However, they have different perceptions of other tenure characteristics. Industry respondents support reducing stumpage fees and reducing the specificity of operational requirements to improve environmental integrity, while government respondents have opposite ideas that increasing stumpage fees and increasing the specificity of operational requirements would be good. Industry respondents are not

sure about how to change the flexibility of harvest levels to achieve environmental objectives. But government respondents strongly suggest reducing the harvesting flexibility for enhancing environmental integrity.

Regarding community stability, both industry and government respondents have similar perceptions that attenuating tenure characteristics would negatively affect community stability. The exception is that they believe remaining some proportion of wood processing requirements, instead of removing all requirements, would support community stability.

In addition, perceptions across provinces regarding competitiveness and community stability are consistent. For environmental integrity, all provinces had consistent perceptions that increasing duration, reducing stumpages and less specificity of operational requirements are good policy changes except that those from Ontario express more satisfaction with current duration. Except those from Ontario, who prefer reducing harvesting flexibility, all provinces have no significant preferences for the flexibility of harvest levels. No provinces show significant preferences for wood processing requirements when considering environmental integrity.

In general, concerning competitiveness and community stability, all respondents agree that further attenuating tenure characteristics would have negative effects. For environmental integrity, however, respondents from different stakeholder groups or different provinces have different perceptions of the impacts of tenure characteristics.

5.2.3 General Observations of Stakeholders' Perceptions

There are a number of observations of the stakeholders' perceptions that arise from this research. One is the emphasis that industry respondents appeared to place on the importance of stumpage fees to the three social objectives (Table 4.6). It is clear that less stumpage fees would reduce costs to industry operations and increase their profits, promoting their competitiveness. However, it is difficult to link stumpage fee levels with environmental integrity and community stability since stumpage fees likely have only

indirect effects on these two social objectives. One possible explanation is that lower stumpage fees would reduce industry costs thus increasing their capability to participate in external activities associated with environmental protection. In addition, lower stumpage fees may also encourage industries to expand production and create more employment opportunities for communities, thus stabilizing local economies.

Industry respondents also seemed to prefer reducing the specificity of operational requirements in promoting the three social objectives. Less specificity of operational requirements means that industries can obtain more freedom to operate their business and pursue increased profits, which could improve their competitiveness. Also, less specificity of operational requirements could motivate industries' incentives to expand production and increase employment opportunities for communities, which is an important indicator for community stability. As for environmental integrity, less specificity of operational requirements could provide industries with more flexibility so that they can adjust their operational plans to reflect local environmental issues, maintaining long-term profitability and perhaps a "win-win" situation between industrial forest use and environmental integrity.

Government respondents had different concerns than industry respondents with respect to the three social objectives. Government respondents perceived that reducing the specificity of operational requirements was the most important for promoting competitiveness while the current specificity of operational requirements played a dominant role in maintaining environmental integrity. As for community stability, they preferred full wood processing requirements as the first consideration. All of these preferences are likely because government respondents focused more on social interests rather than private industry interests. Since governments are the ones that set tenure attributes at various levels with social objectives in mind, the differences between industry and government perceptions are not surprising.

Ranks of tenure characteristics provided by respondents across provinces (Table 4.7) indicate that respondents from Quebec believed that reducing stumpage fees would be the

most important factor for enhancing and maintaining the three social objectives and respondents from British Columbia agreed that this characteristic would be considered first for promoting environmental integrity and community stability. This is because the forest industries in these two provinces currently face some of the highest stumpage fees across the country. Overall, industry respondents across provinces agreed that reducing stumpage fees and reducing specificity of operational requirements were the most important factors for the three social objectives.

Respondents from Alberta believed that increasing duration should be considered first for promoting environmental integrity and community stability. Currently, the levels of tenure duration faced by tenure holders (FMAs) in this province are 20 years and renewable, which are shorter than those permitted in British Columbia and Quebec (Appendix F). It seems that respondents want a longer duration to ensure the safety of their operation and investment.

5.3 Contribution

One contribution of this research is the comprehensive empirical analysis of stakeholder preferences for tenure characteristics and their impacts on various social objectives. Previous studies mainly focused on selected characteristics such as stumpage, security or harvesting constraints. This research analyzed and compared five key tenure characteristics simultaneously. In addition, previous studies investigated the impacts of tenure characteristics on tenure holders or industry without considering impacts on other social objectives such as environmental concerns or community responsibilities. This research, however, represents an effort to fill this gap by exploring the impacts of tenure policies not only on tenure holders themselves but also on environmental integrity and community stability. For example, reducing stumpage fees is deemed to be good for promoting industry competitiveness. However, as government respondents perceived, increasing stumpage fees would be good for environmental integrity, preventing damage to forests caused by over-harvesting behavior. Therefore, this research provides more comprehensive information to policy makers.

The second contribution related to this research is that it investigated the perceptions from both industry and government respondents. The results suggest that these stakeholders have different concerns of tenure characteristics and their link to different social objectives. The different preferences between them provide meaningful policy implications that both industry and government concerns should be considered when reforming tenure policies.

Another contribution of this research relates to the method applied. Unlike most of previous studies, which only provided conceptual analysis, this research created an empirical link allowing subjects to trade-off tenure characteristics among social objectives. Specifically, the Best-worst Scaling Method was introduced to the analysis of the forest policies. In addition to reducing tasks faced by respondents, BWS has an important advantage - it can provide both inter- and intra-attributes comparisons (Cohen, 2003). By using this method, the research compared the different levels of each tenure attribute and uncovered the most and the least preferred levels. At the same time, it also derived the ranking of all tenure attributes in terms of their impacts on social objectives. Results from the comparisons provide useful information to researchers and policy makers.

5.4 Limitations

One limitation with this research relates to the inherent limitations of the BW model. For example, since the BW model is a stated preference choice method, its hypothetical survey setting can be problematic if respondents do not understand the task that they are being asked to carry out (Louviere, Hensher and Swait 2000). This may be behind the fact that a small portion of the surveys were left unfinished by respondents. In addition, respondents may feel that the tasks are tedious and therefore refuse to complete a survey when the hypothetical scenarios are complex and repetitive (Bennett and Blamey, 2001). Besides, errors in tenure policy design may occur when the survey draws responses mainly from industry since the respondents may simply consider industry interests, without considering public preferences regarding the environment and community

sufficiently. There is a potential risk that the BW models may have been biased when most responses are from industry stakeholders.

A second limitation with this research is that this research focused on investigating stakeholders' preferences for specific tenure characteristics. It tested which tenure characteristic is the most preferred by different stakeholders for different social objectives. However, the results from this research cannot tell us whether the stakeholders are satisfied with a given complete tenure system, combined with different characteristics, regarding different social objectives.

A third limitation with the research is the lack of specificity in defining some changes of tenure characteristics. The survey was designed with no specific degree of the changes of tenure characteristics except duration and stumpage fees, defined with exact changes. Respondents would be confused and have no clear concepts of the vague changes of tenures if they are not sure what the current levels are. Thus, there may have been a lack of useful information in making judgments for some of the tenure characteristics.

Another limitation linking with this research is the lack of the information of why respondents want the tenure characteristics to be changed. Such information would increase our insights to understanding respondents' perceptions.

5.5 Further Research

Further research could focus on a number of modifications or extensions of this study. One way that the study could be improved is to increase the number of responses from governments. The survey could also be sent to other public groups. For example, researchers are a group that may provide independent and objective responses since they are not direct beneficiaries of forest tenures.

This study did not examine the residents of forest reliant communities' opinions on tenure characteristics. Forest communities are mainly supported by the forest economy. Changes in tenure policies have direct effects on local employment and disposable

income. It is important and relevant to collect opinions from this stakeholder group. Therefore, it is suggested that forest community members' perceptions of tenure characteristics associated with different social objectives be investigated in any extended study.

Another possible extension could be the examination of the attractiveness of each given tenure scenario (a combination of different levels of the five tenure attributes) relative to the respondents' current position. The best-worst task itself gives no information on this (Flynn et al., 2007). An extra question, "how would you rate this tenure in terms of maintaining or enhancing competitiveness", included in the survey, should be applied to analyze which combination of tenure characteristics is desirable for respondents from different interest groups. In addition, external information of the reasons for tenure change preferences is suggested to be collected in the further study.

5.6 Conclusion

This research provided an assessment of current tenure systems and possible improvements in achieving SFM criteria. The research applied the Best-worst Scaling Method to evaluate the effects of tenure characteristics on maintaining or enhancing competitiveness, environmental integrity and community stability. The results indicate that respondents were satisfied with some of the current tenure characteristics while indifferent with others. As for the improvement of tenure policies, respondents consistently agreed that attenuating tenure characteristics would negatively affect competitiveness. In addition, attenuation of all tenure characteristics, except wood processing requirements, would not be desirable for sustaining community stability. However, stakeholder groups had different concerns of changing tenure characteristics with respect to environmental integrity. Differences were also found between provinces mainly regarding environmental integrity.

Stumpage fees were generally deemed to be more important than other characteristics for pursuing the social objectives. The specificity of operational requirements was also important to industry stakeholders.

It is suggested that any adjustment to tenure policies should consider both industry and government concerns over various social objectives. Ignoring one of the two groups or any social objective could cause improper policy decision-making which does not support the criteria of SFM. Further studies are suggested to increase the number of responses from groups other than industry and government, and to explore evaluations of tenure characteristics from residents of forest dependent communities. It is believed that responses from these groups would provide important information to policy makers. Future research could also investigate respondents' attitudes towards various tenure attribute combinations, which might provide a more comprehensive framework for assessing forest policy changes. In addition, it would be instructive to collect the information showing why respondents prefer particular tenure changes.

References

Alavalapati, J.R.R. and M.K. Luckert. 1997. *Modeling the Effect of Institutional Constraints on Short-run Timber Supply on Public Land: A Case Study of Quota Holders in Alberta.* Natural Resource Modeling, 10(4):263-282.

Alberta Reforestation Standards Science Council (ARSSC), 2001. *Linking Regeneration Standards to Growth and Yield and Forest Management Objectives.* Prepared for Alberta's Minister of Sustainable Resource Development.

Ben-Akiva, M. and S. R. Lerman. 1985. *Discrete Choice Analysis: Theory and Application to Travel Demand.* Cambridge, MA: MIT Press.

Bennett, J. and R. Blamey, eds. 2001. *The Strengths and Weaknesses of Environmental Choice Modeling. In the Choice Modeling Approach to Environmental Valuation.* Northampton MA: Edward Elgar Publishing, Inc. pp. 227-242.

Boxall, P. C. and B. MacNab. 2000. *Exploring the Preferences of Wildlife Recreationists for Features of Boreal Forest Management: A Choice Experiment Approach.* Canadian Journal of Forest Research, 30: 1931-1941.

Chapman, R. G. and Staelin, R. 1982. *Exploiting Rank Ordered Choice Set Data within the Stochastic Utility Model.* Journal of Marketing Research, 19: 288-301.

Cohen, S. H., 2003. *Maximum Difference Scaling: Improved Measures of Importance and Preference for Segmentation.* Available at www.sawtoothsoftware.com

Dowdle, B. 1984. *The case for selling federal timber lands. In Selling the Federal Forests.* Edited by A.E. Gamache. University of Washington. Seattle, Wash. Pp. 21-46.

Ellefson, P.V. and P.D. Miles. 1985. *Protecting Water Quality in the Midwest: Impact on Timber Harvesting Costs.* North Journal of Applied Forestry, 2(2): 57-61.

Finn, A. and J. J. Louviere, 1992. *Determining the Appropriate Response to Evidence of Public Concern: the Case of Food Safety.* Journal of Public Policy and Marketing, 11(1): 12-25.

Flynn, T.N., J.J. Louviere, T.J. Peters and J. Coast. 2007. *Best-worst Scaling: What It Can Do for Health Care Research and How to Do It?* Journal of Health Economics, 26:171-189.

Garrod, G. D. and K. G. Willis. 1997. *The Non-use Benefits of Enhancing Forest Biodiversity: A Contingent Rank Study.* Ecological Economics, 21: 45-61.

Goodman, L.A. 1968. *The Analysis of Cross-classified Data: Independence, Quasi-independence, and Interactions in Contingency Tables with or without Missing Entries.* Journal of the American Statistical Association, 63: 1091-1131.

Grafton, R.Q. and R.W. Lynch. 1998. *British Columbia's Stumpage System: Economic and Trade Policy Implications.* Canada Public Policy - Analyse de Politiques, Vol XXIV, Supplement / Numero Special 2. pp. 41-50.

Grafton, R.Q., W.Adamowicz, , D.Dupont, , H. Nelson, R.J. Hill and S. Renzetti. 2004. *The Economics of the Environment and Natural Resources.* Blackwell publishing. pp. 263-270.

Gustafsson, A., F. Ekdahl and B. Bergman. 1999. *Conjoint Analysis: A Useful Tool in the Design Process.* Total Quality Management, 10(3): 327-343.

Haider, W. and H. Rasid, 1998. *Assessing Lay Preferences for Water Level Management in A Regulated River System in Northwestern Ontario: Application of A Stated Preference Model.* Canadian Water Resources Journal, 23(3): 289-307.

Haley, D. and M. K. Lukert, 1990. *Canadian Forest Tenures: a Framework for Policy Analysis.* Information Report E-X-43. Forestry Canada, Ottawa.

Hoberg, G. 2002. *Finding the Right Balance: Report of Stakeholder Consultations on A Results-Based Forest and Range Practices Regime for British Columbia. Report for* the Results-based Forest Practices Code Consultation Process.

Klosowski, R., T. Stevens, D. Kittredge, D. Dennis. 2001. *Economic Incentives for Coordinated Management of Forest Land: A Case Study of Southern New England.* Forest Policy and Economics 2: 29-38.

Lickwar, P., C.Hickman and F.W. Cubbage. 1992. *Costs of Protecting Water Quality During Harvesting on Private Forestlands in the Southeast.* Southern Journal of Applied Forestry, 16(1):13-20.

Louviere, J. J., J. Swait and D. Anderson. 1995. *Best-worst Conjoint: A New Preference Elicitation Method to Simultaneously Identify Overall Attribute Importance and Attribute Level Partworths.* Working paper. University of Alberta.

Louviere, J., D. Hensher, J. Swait. 2000. *State Choice Methods - Analysis and Application.* University of Cambridge Press, Cambridge, UK.

Luckert, M.K. 1988. *The Effect of Some British Columbia Forest Tenures on the Distribution of Economic Rents, the Allocation of Resources, and Investment in Silviculture.* Unpublished Ph.D. Thesis, University of British Columbia. Vancouver, Canada.

Luckert, M.K. 1990. *The Perceived Security of Institutional Investment Environments of Some British Columbia Forest Tenures*. Canadian Journal of Forest Research, 21:318-325.

Luckert, M.K. 1991. *Effect of Canadian Forest Tenures on Rent Distributions and Resource Allocations: a British Columbia Case Study*. Forest Science 37(5): 1441-1462.

Luckert, M.K. 1997. *Towards a Tenure Policy Framework for Sustainable Forest Management in Canada.* Forestry Chronicle, 73:211-215.

Luckert, M.K. and D. Haley. 1990. *The implications of various silvicultural funding arrangements for privately managed public forest land in Canada.* New Forests, 4(1):1-12.

Luckert, M.K. and F.J. Salkie. 1998. *Forestry in Canada: Transitions and Emerging Policy Issues*. Canada Public Policy - Analyse de Politiques, Vol XXIV, Supplement / Numero Special 2, S1-S10.

Luckert, M.K. and J.T. Bernard. 1993. *What is the Value of Standing Timber? Difficulties in Merging Theory with Reality*. The Forestry Chronicle, 69(6):680-685.

Manski, C.F. 1975. *The Structure of Random Utility Models*. Theory and Decision, 8(3):229-254.

Marley, A.A.J.and J.J. Louviere. 2005. *Some Probabilistic Models of Best, Worst, and Best-worst Choices*. Journal of Mathematical Psychology, 49:464-480.

McFadden, D. 1986. *The Choice Theory Approach to Market Research*. Marketing Science, 5:275-297.

Morrison, M. D., R. K. Blamey, J. W. Bennett, J. J. Louviere. 1996 *A Comparison of Stated Preference Techniques for Estimating Environmental Values*. Choice Modeling Research Report No. 1. ISSN 1327-810X

National Forest Stategy, 2003. *Sustainable Forests - A Canadian Commitment*. Canadian Council of Forest Ministers, Ottawa, Canada. 4p.

Natural Resources Canada. 2006. *The State of Canada's Forests 2005-2006: Forest Industry Competitiveness*. Canadian Forest Service, Ottawa. 79p.

Nautiyal, J.C. 1988. *Forest Economics: Principles and Applications*. Canadian Scholar's Press, Toronto. 518p.

Pearse, P. H. 2001. *Ready for Change: Crisis and Opportunity in the Coast Forest Industry.*

A Report of BC Minister of Forests, Victoria, British Columbia, Canada.

Pearse, P.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. pp. 115-155.

Ross, M.M.1995. *Forest Management in Canada.* Canadian Institute of Resources Law, The University of Calgary. pp. 125-203.

Schaberg, R. H., T. P. Holmes, K. J. Lee, and R. C. Abt. 1999. *Ascribing Value to Ecological Processes: An Economic View of Environmental Change.* Forest Ecology and Management, 114: 329-338.

Stier, J.C., and D.N. Bengston. 1992. *Technical Change in the North American Forestry Sector: A Review.* Forest Science, 38:134-159.

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

Zhang, D. 1996. *The Effect of Forest Tenure on Environmental Quality in British Columbia.* In Proceedings of the International Conference on Land Tenure and Administration in Developing Countries. Nov 12-14, University of Florida, Gainsville, FL. Available from http://www.surv.ufl.edu/publications .

Zhang, D. and P.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, D. and P.H. Pearse. 1997. *The Influence of the Form of Tenure on Reforestation in British Columbia.* Forest Ecology and Management 98: 239-250.

Appendix A: Survey

Preferences and Opinions on Forest Tenure Reform in Canada – A Nation-wide Survey of Industry, Government and Communities

This survey is designed to elicit opinions and preferences on how well the agreements made between forest industry firms and provincial governments are working. These agreements are referred to as forest tenures, which define the rights and obligations of private companies harvesting timber on Crown lands. We are interested in the conditions of these agreements that regulate the industrial use of forest resources on Crown lands.

1. Which of the following best describes your position in your company? Please check only one.

   ☐ You work in a headquarters office that is primarily involved in central planning

   ☐ You work in a regional office that is primarily involved in operational planning

   ☐ Neither of the above.

Section 1

In this section, we focus on several conditions of forest tenures that will be referred to as tenure characteristics. These are:

- **The duration of the tenure**: how long private firms may harvest timber and/or other forest resources before renewal is necessary.

- **Stumpage fees**: the amounts that private firms are required to pay to the province in return for harvesting timber.

- **Flexibility of operational requirements**: the degree to which requirements concerning utilization of wood in harvesting; measures to protect the forest environment; reforestation and other forestry operations are prescribed. Highly prescribed requirements do not allow the firm much flexibility in carrying out forestry operations compared to less prescribed requirements.

- **Flexibility of timber harvest levels**: the amount that private firms are allowed to deviate from projected annual allowable cuts

- **Wood processing requirements**: the proportion of wood that a company harvests that must be processed in plants owned or operated by the tenure holder.

Each of these tenure characteristics has the potential to influence how well forestry operations meet or align with the various benefits that Canadians desire from their forests. In the questions that follow, we ask for your thoughts on how changes in current tenure characteristics may, or may not, be important in influencing the following social objectives from forests: competitiveness, promoting or maintaining the environmental integrity of forests, and promoting or maintaining community stability.

Competitiveness

Competitiveness refers to the ability of Canadian forest companies to compete in global markets. Increased competitiveness would lead to an expanding forestry sector, thereby leading to more jobs and/or capital investments.

Below are profiles made up of various combinations of tenure characteristics. In this section please think of tenure agreements in terms of their implications for the competitiveness of the forest industry. Then, choose **one Best and one Worst** characteristic for maintaining or enhancing competitiveness.

Question 1a: Suppose that the province introduces a form of tenure with the following characteristics. Which characteristic, in your opinion, is the **best** for maintaining or enhancing **competitiveness**, and which one is the **worst**? (Please check on answer in **each** column)

Best characteristic (Please check only one)	Tenure Characteristics	**Worst** characteristic (Please check only one)
☐	Current duration of tenure is increased by 10 years.	☐
☐	Stumpage fees remain at current levels	☐
☐	Operational requirements for tenure holders remain as currently prescribed.	☐
☐	The amount of flexibility that tenure holders are allowed around their AAC remains at the current level.	☐
☐	None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	☐

Question 1a.2 Overall, how would you rate a tenure made up of this combination of characteristics in terms of maintaining or enhancing competitiveness?

Highly desirable	Somewhat desirable	Neutral	Somewhat undesirable	Highly undesirable
1	2	3	4	5

Question 1b: Now, suppose that the province introduces a form of tenure with the following characteristics. Which characteristic, in your opinion, is the **best** for maintaining or enhancing **competitiveness**, and which one is the **worst**? (Please check on answer in **each** column)

Best characteristic (Please check only one)	Tenure Characteristics	**Worst** characteristic (Please check only one)
☐	Current duration of tenure is maintained.	☐
☐	Stumpage fees are increased to twice current levels.	☐
☐	Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.	☐
☐	The amount of flexibility that tenure holders are allowed around their AAC is half current levels.	☐
☐	All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	☐

Question 1b.2 Overall, how would you rate a tenure made up of this combination of characteristics in terms of maintaining or enhancing competitiveness?

Highly desirable	Somewhat desirable	Neutral	Somewhat undesirable	Highly undesirable
1	2	3	4	5

Question 1c: Now, suppose that the province introduces a form of tenure with the following characteristics. Which characteristic, in your opinion, is the **best** for maintaining or enhancing **competitiveness**, and which one is the **worst**? (Please check on answer in **each** column)

Best characteristic (Please check only one)	Tenure Characteristics	**Worst** characteristic (Please check only one)
☐	Current duration of tenure is reduced by 10 years.	☐
☐	Stumpage fees remain at current levels.	☐
☐	Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	☐
☐	The amount of flexibility that tenure holders are allowed around their AAC is twice of current level.	☐
☐	Some proportion of the wood (e.g. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	☐

Question 1c.2 Overall, how would you rate a tenure made up of this combination of characteristics in terms of maintaining or enhancing competitiveness?

Highly desirable	Somewhat desirable	Neutral	Somewhat undesirable	Highly undesirable
1	2	3	4	5

Environmental integrity of forest

Environmental integrity of forests is a broad concept that includes multiple factors associated with forest resources. Maintaining and/or increasing environmental integrity would support enhanced biodiversity, wildlife populations, and forest recreation. Moreover, increasing integrity of the forest environment may help sustain the benefits associated with harvesting non-timber forest products (e.g. berries, mushrooms, etc.).

Now, please think of tenure agreements in terms of environmental integrity of forests. Choose **one Best and one Worst** factor that can maintain or enhance environmental integrity of forests.

Question 2a: Suppose that the province introduces a form of tenure with the following characteristics. Which characteristic, in your opinion, is the **best** for maintaining or enhancing **environmental integrity**, and which one is the **worst**? (Please check on answer in **each** column)

Best characteristic (Please check only one)	Tenure Characteristics	**Worst** characteristic (Please check only one)
☐	Current duration of tenure is reduced by 10 years.	☐
☐	Stumpage fees are increased to twice current levels.	☐
☐	Operational requirements for tenure holders remain as currently prescribed.	☐
☐	The amount of flexibility that tenure holders are allowed around their AAC is twice current levels.	☐
☐	Some proportion of the wood (e.g. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	☐

Question 2a.2 Overall, how would you rate a tenure made up of this combination of characteristics in terms of maintaining or enhancing environmental integrity?

Highly desirable	Somewhat desirable	Neutral	Somewhat undesirable	Highly undesirable
1	2	3	4	5

Question 2b: Now, suppose that the province introduces a form of tenure with the following characteristics. Which characteristic, in your opinion, is the **best** for maintaining or enhancing **environmental integrity**, and which one is the **worst**? (Please check on answer in **each** column)

Best characteristic (Please check only one)	Tenure Characteristics	**Worst** characteristic (Please check only one)
☐	Current duration of tenure is increased by 10 years.	☐
☐	Stumpage fees are reduced to half of current levels.	☐
☐	Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.	☐
☐	The amount of flexibility that tenure holders are allowed around their AAC remains at the current levels.	☐
☐	None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	☐

Question 2b.2 Overall, how would you rate a tenure made up of this combination of characteristics in terms of maintaining or enhancing environmental integrity?

Highly desirable	Somewhat desirable	Neutral	Somewhat undesirable	Highly undesirable
1	2	3	4	5

Question 2c: Now, suppose that the province introduces a form of tenure with the following characteristics. Which characteristic, in your opinion, is the **best** for maintaining or enhancing **environmental integrity**, and which one is the **worst**? (Please check on answer in **each** column)

Best characteristic (Please check only one)	Tenure Characteristics	**Worst** characteristic (Please check only one)
☐	Current duration of tenure is maintained.	☐
☐	Stumpage fees remain at current levels.	☐
☐	Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	☐
☐	The amount of flexibility that tenure holders are allowed around their AAC is half current levels.	☐
☐	All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	☐

Question 2c.2 Overall, how would you rate a tenure made up of this combination of characteristics in terms of maintaining or enhancing environmental integrity?

Highly desirable	Somewhat desirable	Neutral	Somewhat undesirable	Highly undesirable
1	2	3	4	5

Community stability

Promoting or maintaining community stability means that communities are vibrant places that maintain current residents and attract newcomers. Such communities are sufficiently robust that they are able to weather economic downturns and continue to prosper. Continuous and long-term jobs and income stay within the local economy.

Please think of tenure agreements in terms of community stability. Choose **one Best and one Worst** factor for maintaining or enhancing community stability.

Question 3a: Suppose that the province introduces a form of tenure with the following characteristics. Which characteristic, in your opinion, is the **best** for maintaining or enhancing **community stability**, and which one is the **worst**? (Please check on answer in **each** column)

Best characteristic (Please check only one)	Tenure Characteristics	**Worst** characteristic (Please check only one)
☐	Current duration of tenure is increased by 10 years.	☐
☐	Stumpage fees are increased to twice current levels.	☐
☐	Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	☐
☐	The amount of flexibility that tenure holders are allowed around their AAC is half current levels.	☐
☐	Some proportion of the wood (e.g. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	☐

Question 3a.2 Overall, how would you rate a tenure made up of this combination of characteristics in terms of maintaining or enhancing community stability?

Highly desirable	Somewhat desirable	Neutral	Somewhat undesirable	Highly undesirable
1	2	3	4	5

Question 3b: Now, Suppose that the province introduces a form of tenure with the following characteristics. Which characteristic, in your opinion, is the **best** for maintaining or enhancing **community stability**, and which one is the **worst**? (Please check on answer in **each** column)

Best characteristic (Please check only one)	Tenure Characteristics	**Worst** characteristic (Please check only one)
☐	Current duration of tenure is maintained.	☐
☐	Stumpage fees are reduced to half of current levels.	☐
☐	Operational requirements for tenure holders remain as currently prescribed.	☐
☐	The amount of flexibility that tenure holders are allowed around their AAC is twice current levels.	☐
☐	None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	☐

Question 3b.2 Overall, how would you rate a tenure made up of this combination of characteristics in terms of maintaining or enhancing community stability?

Highly desirable	Somewhat desirable	Neutral	Somewhat undesirable	Highly undesirable
1	2	3	4	5

Question 3c: Now, Suppose that the province introduces a form of tenure with the following characteristics. Which characteristic, in your opinion, is the **best** for maintaining or enhancing **community stability**, and which one is the **worst**? (Please check on answer in **each** column)

Best characteristic (Please check only one)	Tenure Characteristics	**Worst** characteristic (Please check only one)
☐	Current duration of tenure is reduced by 10 years.	☐
☐	Stumpage fees remain at current levels.	☐
☐	Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.	☐
☐	The amount of flexibility that tenure holders are allowed around their AAC remains at the current level.	☐
☐	All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	☐

Question 3c.2 Overall, how would you rate a tenure made up of this combination of characteristics in terms of maintaining or enhancing community stability?

Highly desirable	Somewhat desirable	Neutral	Somewhat undesirable	Highly undesirable
1	2	3	4	5

Section 2

In this section we will ask you to answer questions about your perceptions of the forest management agreement (i.e. forest tenure) between the Provincial Government and your company. We are interested in your opinion as an employee of your company. Please consider the likelihood of, and consequences of, possible changes to this agreement. In many of these questions you are asked to answer questions regarding the value of this tenure to your company. For these questions we ask you to consider the "value" of this tenure in terms of its influence on the long term profitability and competitiveness of your company. When you are asked about the importance of a specific attribute of the tenure, we ask that you consider the importance of this attribute relative to other attributes of the tenure. There are also several questions that ask how future changes to the tenure will affect its value to your company. In these questions it is important that you consider each change as if it is the only change being made to the tenure (i.e. all other aspects of the tenure will stay the same).

Please indicate which province you primarily work in and which type of forest tenure held by your company in that province with which you are most familiar. If the type of forest tenures that you are most familiar with is not on the list, please choose "Other" and indicate the type of tenure you would like to answer for:

Province

- ☐ **Alberta**
- ☐ **British Columbia**
- ☐ **Manitoba**
- ☐ **New Brunswick**
- ☐ **Newfoundland and Labrador**
- ☐ **Nova Scotia**
- ☐ **Ontario**
- ☐ **Québec**
- ☐ **Saskatchewan**

Tenure Agreement Type

- ☐ **Forest Management Agreement (FMA)**
- ☐ **Timber Quota**
- ☐ **Tree Farm Licence (TFL)**
- ☐ **Forest Licence (FL)**
- ☐ **Timber Sale Licence (TSL)**
- ☐ **Forest Management Licence Agreement (FML)**
- ☐ **Timber Sale Agreement (TSA)**
- ☐ **Crown Timber Licence (CTL)**
- ☐ **Long Term Timber Licence (LTTL)**
- ☐ **Long-term Licence and Management Agreement (LMA)**
- ☐ **Sustainable Forest Licence (SFL)**
- ☐ **Forest Resource Licence (FRL)**
- ☐ **Contrat d'approvisionnement et d'aménagement forestier (CAAF)**
- ☐ **Forest Management Agreement (FMA)**
- ☐ **Other:** _____

Please answer the questions in the following section of the survey with respect to the most important (e.g. largest volume or area) tenure held by your company of the type that you indicated above in the province you selected.

Please answer the following questions with respect to the security of your company's tenure. Note that we refer to the security of your tenure in terms of the agreement your company holds with the government, and not to security in terms of future conditions in the forest products market:

		Very secure		Somewhat secure			Somewhat insecure		Very insecure
2.1	I perceive my company's current tenure to be...	1		2	3	4	5	6	7

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.2	Overall, it is likely that one or more important changes in the conditions of my company's tenure will occur in the next 20 years.	1	2	3	4	5

		Greatly increase	Increase somewhat	Stay the same	Decrease somewhat	Greatly decrease
2.3	Considering all of the tenure changes that I think are likely to occur, it is likely that the value of this tenure to my company will...	1	2	3	4	5

		Full compensation		Partial compensation		No compensation
2.4	If changes in the conditions of my company's tenure occur, and decrease the value of this tenure to my company, the level of government compensation that my company is likely to receive is...	1	2	3	4	5

Please answer the following questions with respect to requirements that your company own and operate a timber processing facility:

2.5.1 Is your company required by contract with the Provincial Government (either as part of your tenure contract or in a separate contract with the government) to own and/or operate a timber processing facility?

☐ Yes ☐ No

If you answered "Yes" to question 2.5.1, please answer questions 2.5a & 2.6a and then proceed to question 2.7. If you answered "No" to question 2.5.1, please answer questions 2.5b & 2.6b and then proceed to question 2.7

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.5a	With respect to the value of this tenure to my company, removing the requirement that it own and/or operate a timber processing facility would be important.	1	2	3	4	5
2.6a	It is likely that the requirement to own and operate a timber processing facility will be removed from my company's tenure in the next 20 years.	1	2	3	4	5

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.5b	With respect to the value of this tenure to my company, maintaining the status quo in which my company is not required to own and/or operate a timber processing facility would be important.	1	2	3	4	5
2.6b	It is likely that the requirement to own and operate a timber processing facility will be added my company's tenure in the next 20 years.	1	2	3	4	5

Please answer the following questions with respect to the ability and right of your company to export unprocessed timber outside the province:

If you work in Manitoba or Saskatchewan, please answer questions 2.7a & 2.8a and then proceed to question 2.9. If you work in any other province, please answer questions 2.7b & 2.8b and then proceed to question 2.9

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.7a	With respect to the value of this tenure to my company, removing restrictions on exporting unprocessed timber outside the province would be important.	1	2	3	4	5
2.8a	It is likely that restrictions on exporting unprocessed timber outside the province will be removed in the next 20 years.	1	2	3	4	5

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.7b	With respect to the value of this tenure to my company, maintaining the status quo in which there are no restrictions on exporting unprocessed timber outside the province would be important.	1	2	3	4	5
2.8b	It is likely that restrictions on exporting unprocessed timber outside the province will be added in the next 20 years.	1	2	3	4	5

Please answer the following questions with respect to the ability and right of your company to sell/transfer its current tenure:

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.9	With respect to the value of this tenure to my company, removing restrictions that require government approval for the sale of this tenure would be important.	1	2	3	4	5
2.10	It is likely that restrictions requiring government approval to sell this tenure will be removed in the next 20 years.	1	2	3	4	5

Please answer the following questions with respect to the rights that your company has or does not have to harvest trees and manage other forest resources:

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.11	With respect to the value of this tenure to my company, gaining rights to earn revenues from forest recreation would be important.	1	2	3	4	5
2.12	It is likely that the right to earn revenue from forest recreation will be added to this tenure in the next 20 years.	1	2	3	4	5
2.13	With respect to the value of this tenure to my company, gaining rights to earn revenues from non-timber forest products, such as mushrooms and berries, would be important.	1	2	3	4	5
2.14	It is likely that the right to earn revenue from non-timber forest products, such as mushrooms and berries, will be added to this tenure in the next 20 years.	1	2	3	4	5
2.15	With respect to the value of this tenure to my company, gaining the right to receive carbon credits from forest management would be important.	1	2	3	4	5
2.16	It is likely that carbon credits from forest management will be added to this tenure in the next 20 years.	1	2	3	4	5

Please answer the following questions with respect to the length of time (duration) that your company can hold its tenure before it expires and/or renewal is necessary:

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.17	With respect to the value of this tenure to my company, the duration of this tenure is important.	1	2	3	4	5
		Greatly increase	Increase somewhat	Stay the same	Decrease somewhat	Greatly decrease
2.18	It is likely that, in the next 20 years, the duration of this tenure will change, such that its value to my company will...	1	2	3	4	5
		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.19	With respect to the value of this tenure to my company, the assuredness of renewal of this tenure is important.	1	2	3	4	5
		Greatly increase	Increase somewhat	Stay the same	Decrease somewhat	Greatly decrease
2.20	It is likely that, in the next 20 years, the assuredness of renewal of this tenure will change such that its value to my company will...	1	2	3	4	5

Please answer the following questions with respect to your company's AAC and the flexibility that your company is allowed around it:

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.21	With respect to the value of this tenure to my company, the flexibility allowed in harvest levels around the AAC is important.	1	2	3	4	5

		Greatly increase	Increase somewhat	Stay the same	Decrease somewhat	Greatly decrease
2.22	It is likely that, in the next 20 years, the amount of flexibility allowed in my company's harvest levels around the AAC will change, such that the value of this tenure to my company will...	1	2	3	4	5

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.23	With respect to the value of this tenure to my company, the AAC of this tenure is important.	1	2	3	4	5

		Greatly increase	Increase somewhat	Stay the same	Decrease somewhat	Greatly decrease
2.24	It is likely that, in the next 20 years, the AAC of this tenure will change, such that its value to my company will...	1	2	3	4	5

Please answer the following question with respect to the timber that your company obtains from within this tenure and from sources outside of this tenure:

		Greatly increase	Increase somewhat	Stay the same	Decrease somewhat	Greatly decrease
2.25	If my company were to lose sources of timber outside of this tenure, thus having to rely solely on this tenure for timber, the value of my company would...	1	2	3	4	5
2.26	If my company were to lose this tenure, thus having to rely solely on outside sources of timber, the value of my company would...	1	2	3	4	5

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.27	It is likely that, in the next 20 years, my company will lose sources of timber outside of this tenure.	1	2	3	4	5

Please answer the following question with respect to the operational requirements of your company's tenure:

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.28	With respect to the value of this tenure to my company, the amount of flexibility and discretion that it is allowed in how forestry objectives are pursued is important.	1	2	3	4	5

		Greatly increase	Increase somewhat	Stay the same	Decrease somewhat	Greatly decrease
2.29	It is likely that, in the next 20 years, the amount of flexibility and discretion my company is allowed in how forestry objectives are pursued will change, such that the value of this tenure to my company will...	1	2	3	4	5

Please answer the following questions with respect to the stumpage fees paid by your company for this tenure:

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.30	With respect to the value of this tenure to my company, the amount of stumpage fees my company pays for this tenure is important.	1	2	3	4	5
		Greatly increase	Increase somewhat	Stay the same	Decrease somewhat	Greatly decrease
2.31	It is likely that, in the next 20 years, the amount of stumpage fees paid by my company will change such that the value of this tenure to my company will...	1	2	3	4	5

Please answer the following questions with respect to the market in which your company operates:

		Greatly increase	Increase somewhat	Stay the same	Decrease somewhat	Greatly decrease
2.32	It is likely that, in the next 20 years, harvesting and production costs, net of inflation, borne by my company will...	1	2	3	4	5
2.33	It is likely that, in the next 20 years, market prices, net of inflation, for my company's products will....	1	2	3	4	5

Please answer the following questions with respect to incentives for your company to invest in timber processing facilities:

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.34	One or more features of my company's tenure negatively influence my company's willingness to invest in its timber processing facilities.	1	2	3	4	5
		Greatly increase	Increase somewhat	Neither increase nor decrease	Decrease somewhat	Greatly decrease
2.35	It is likely that changes to my company's tenure in the next 20 years will have the following impact on my company's willingness to invest in its timber processing facilities.	1	2	3	4	5

Please answer the following questions with respect to incentives for your company to invest in silviculture within your tenure's management area:

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.36	One or more features of my company's tenure negatively influence my company's willingness to invest in silviculture within the tenure's management area.	1	2	3	4	5

		Greatly increase	Increase somewhat	Neither increase nor decrease	Decrease somewhat	Greatly decrease
2.37	It is likely that changes to my company's tenure in the next 20 years will have the following impact on my company's willingness to invest in silviculture within the tenure's management area.	1	2	3	4	5

Please answer the following questions with respect to the influence of this tenure on your company's competitiveness:

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.38	One or more features of my company's tenure limit the competitiveness of my company in the global marketplace.	1	2	3	4	5

		Much more competitive	Somewhat more competitive	Neither more nor less competitive	Somewhat less competitive	Much less competitive
2.39	It is likely that changes to my company's tenure in the next 20 years will cause my company to become...	1	2	3	4	5

Please answer the following questions with respect to how this tenure allows you to introduce innovative approaches to forest practices by your company.

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.40	One or more features of my company's tenure limit the ability of my company to engage in innovative practices.	1	2	3	4	5

		Much more innovative	Somewhat more innovative	Neither more nor less innovative	Somewhat less innovative	Much less innovative
2.41	It is likely that changes to my company's tenure in the next 20 years will cause my company to become...	1	2	3	4	5

Please answer the following questions with respect to how this tenure influences the stability of local communities:

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.42	One or more features of my company's tenure negatively influence the stability of local forest dependent communities.	1	2	3	4	5

		Greatly increase	Increase somewhat	Neither increase nor decrease	Decrease somewhat	Greatly decrease
2.43	It is likely that changes to my company's tenure in the next 20 years will have the following impact on the stability of local forest dependent communities.	1	2	3	4	5

Please answer the following questions with respect to how this tenure influences the environmental integrity of forests managed by your company:

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
2.44	One or more features of my company's tenure significantly limit the ability of my company to maintain and/or enhance the environmental integrity of forests managed by my company.	1	2	3	4	5

		Greatly increase	Increase somewhat	Neither increase nor decrease	Decrease somewhat	Greatly decrease
2.45	It is likely that changes to my company's tenure in the next 20 years will have the following impact on my company's ability to maintain and/or enhance the environmental integrity of forests managed by my company.	1	2	3	4	5

Appendix B: Section of Dataset for Frequency Model

BW pairs	Count	Adjusted weight	Logged values	Att1	Att2	Att3	Att4	Att5	A1L1	A1L2	A2L1	A2L2	A3L1	A3L2	A4L1	A4L2	A5L1	A5L2
1	0	0.0010	-6.9441	1	-1	0	0	0	-1	-1	1	1	0	0	0	0	0	0
2	1	1.0010	0.0010	1	-1	0	0	0	-1	-1	0	-1	0	0	0	0	0	0
3	0	0.0010	-6.9441	1	0	-1	0	0	-1	-1	0	0	1	1	0	0	0	0
4	0	0.0010	-6.9441	1	0	-1	0	0	-1	-1	0	0	-1	0	0	0	0	0
5	0	0.0010	-6.9441	1	0	0	-1	0	-1	-1	0	0	0	0	1	1	0	0
6	1	1.0010	0.0010	1	0	0	-1	0	-1	-1	0	0	0	0	0	-1	0	0
7	0	0.0010	-6.9441	1	0	0	0	-1	-1	-1	0	0	0	0	0	0	1	1
8	0	0.0010	-6.9441	1	0	0	0	-1	-1	-1	0	0	0	0	0	0	-1	0
9	1	1.0010	0.0010	1	-1	0	0	0	1	0	-1	0	0	0	0	0	0	0
10	10	10.0010	2.3027	1	-1	0	0	0	1	0	0	-1	0	0	0	0	0	0
11	1	1.0010	0.0010	1	0	-1	0	0	1	0	0	0	1	1	0	0	0	0
12	15	15.0010	2.7081	1	0	-1	0	0	1	0	0	0	0	-1	0	0	0	0
13	3	3.0010	1.0989	1	0	0	-1	0	1	0	0	0	0	0	1	1	0	0
14	0	0.0010	-6.9441	1	0	0	-1	0	1	0	0	0	0	0	-1	0	0	0
15	5	5.0010	1.6096	1	0	0	0	-1	1	0	0	0	0	0	0	0	-1	0
16	7	7.0010	1.9460	1	0	0	0	-1	1	0	0	0	0	0	0	0	0	-1

Appendix C: Section of Dataset for Choice Models

ID	Best / Worst	Alternative	BW choice	A1L1	A1L2	A2L1	A2L2	A3L1	A3L2	A4L1	A4L2	A5L1	A5L2
1110900	B	1	0	0	1	0	0	0	0	0	0	0	0
1110900	B	2	0	0	0	1	0	0	0	0	0	0	0
1110900	B	3	0	0	0	0	0	1	0	0	0	0	0
1110900	B	4	1	0	0	0	0	0	0	0	1	0	0
1110900	B	5	0	0	0	0	0	0	0	0	0	0	1
1110900	W	1	0	0	-1	0	0	0	0	0	0	0	0
1110900	W	2	0	0	0	-1	0	0	0	0	0	0	0
1110900	W	3	0	0	0	0	0	-1	0	0	0	0	0
1110900	W	4	0	0	0	0	0	0	0	0	-1	0	0
1110900	W	5	1	0	0	0	0	0	0	0	0	0	-1

Appendix D: Results from the Choice Models without Interactions

Results from the choice models without interactions are close to those from the frequency models. For promoting competitiveness and community stability, the signs of values in the two models are almost same. For maintaining environmental integrity, a difference between the two types of models is related to the attribute "flexibility of harvest levels". The frequency model indicates that respondents had no significant preferences for reducing and remaining flexibility of harvesting, but the choice model implies that remaining current flexibility of harvest levels would be the best for environmental integrity.

Besides, according to the values of the coefficients, a rank of the most preferred tenure characteristics is also derived from the choice models (see the table below). For example, OPER 0 has an estimated coefficient of 2.0480 in the competitiveness model, which is greater than the coefficient for STUMP 0 (1.9738) that is greater than the other preferred attribute levels. The ranks indicate that reducing the current level of stumpage payments be the first or second consideration when the three objectives are pursued. Priorities of the other attributes, however, vary when different objectives are considered.

The Choice Models without Interactions

		Competitiveness		Environmental Integrity		Community Stability
		n = 940		n = 886		n = 900
		Coefficients		Coefficients		Coefficients
Duration						
DUR 0 = Current duration of tenure is reduced by 10 years	***	-1.3307	***	-1.0727	***	-1.4924
DUR 1 = Current duration of tenure is maintained	***	0.9410	***	0.3899	***	0.5292
DUR 2 = Current duration of tenure is increased by 10 years	***	0.3897	***	0.6827	***	0.9632
Stumpage						
STUMP 0 = Stumpage fees are reduced to half of current levels	***	1.9738	***	1.0372	***	1.5682
STUMP 1 = Stumpage fees remain at current levels		0.2064		0.0377		0.1867
STUMP 2 = Stumpage fees are increased to twice current levels	***	-2.1802	***	-1.0749	***	-1.7549
Operational Req.						
OPER 0 = Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	***	2.0480	***	0.7337	***	1.0909
OPER 1 = Operational requirements for tenure holders remain as currently prescribed.		-0.0656		0.1230		0.0892
OPER 2 = Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.	***	-1.9824	***	-0.8567	***	-1.1802
Harvesting Levels						
HARVEST 0 = The amount of flexibility that tenure holders are allowed around their AAC is half current levels.	***	-1.1610		-0.1110	***	-0.6635
HARVEST 1 = The amount of flexibility that tenure holders are allowed around their AAC remains at the current level.		0.1981	*	0.2485		0.1148
HARVEST 2 = The amount of flexibility that tenure holders are allowed around their AAC is twice current levels.	***	0.9630		-0.1375	***	0.5486
Wood Processing						
PROC 0 = None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	***	0.6730	*	0.2364	***	-1.9443
PROC 1 = Some proportion of the wood (i.e. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	**	0.3428		0.1756	***	1.1170
PROC 2 = All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	***	-1.0158	***	-0.4120	***	0.8273
LL at convergence		-1,148.95		-1,312.40		-1,109.53
LL at constant		-1,497.37		-1,351.34		-1,418.56
pseudo-R2		0.231		0.026		0.216

Ranks of the Most Preferred Tenure Attributes and Levels Based on Choice Models

Rank	Competitiveness		Environmental Integrity		Community Stability	
	Coefficients	Attributes	Coefficients	Attributes	Coefficients	Attributes
1	2.0480	OPER 0	1.0372	STUMP 0	1.5682	STUMP 0
2	1.9738	STUMP 0	0.7337	OPER 0	1.1170	PROC 1
3	0.9630	HARVEST 2	0.6827	DUR 2	1.0909	OPER 0
4	0.9410	DUR 1	0.2485	HARVEST 1	0.9632	DUR 2
5	0.6730	PROC 0	0.2364	PROC 0	0.5486	HARVEST 2

Appendix E: Choice Models with Provincial Interactions

The Choice Models with Provincial Interactions (Alberta)

		Competitiveness	Environmental Integrity	Community Stability
		n = 940	n =886	n =900
		Coefficient	Coefficient	Coefficient
Duration				
DUR 0 = Current duration of tenure is reduced by 10 years	***	-1.0778	*** -0.8661	*** -1.2586
DUR 1 = Current duration of tenure is maintained	***	0.9357	** 0.3855	*** 0.5211
DUR 2 = Current duration of tenure is increased by 10 years		0.1421	*** 0.4806	*** 0.7375
Stumpage				
STUMP 0 = Stumpage fees are reduced to half of current levels	***	2.2828	*** 1.0793	*** 1.5892
STUMP 1 = Stumpage fees remain at current levels		0.0770	0.0595	0.1115
STUMP 2 = Stumpage fees are increased to twice current levels	***	-2.3597	*** -1.1388	*** -1.7006
Operational Req.				
OPER 0 = Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	***	2.1845	*** 0.7637	*** 1.0068
OPER 1 = Operational requirements for tenure holders remain as currently prescribed.	**	-0.3461	-0.0352	0.1026
OPER 2 = Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.	***	-1.8384	*** -0.7284	*** -1.1094
Harvesting Levels				
HARVEST 0 = The amount of flexibility that tenure holders are allowed around their AAC is half current levels.	***	-1.1448	0.0599	*** -0.5578
HARVEST 1 = The amount of flexibility that tenure holders are allowed around their AAC remains at the current level.		0.2431	0.0657	-0.0147
HARVEST 2 = The amount of flexibility that tenure holders are allowed around their AAC is twice current levels.	***	0.9017	-0.1256	*** 0.5725
Wood Processing				
PROC 0 = None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	***	0.5767	0.1800	*** -1.6818
PROC 1 = Some proportion of the wood (i.e. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	**	0.4455	0.2361	*** 1.0556
PROC 2 = All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	***	-1.0222	*** -0.4161	*** 0.6262
AB Interactions				
AB DUR 0	***	-0.9159	** -0.6673	** -0.8515
AB DUR 1		0.0542	0.0161	0.0282
AB DUR 2	***	0.8616	** 0.6512	** 0.8233
AB STUMP 0	***	-1.0049	-0.0526	-0.0650
AB STUMP 1	*	0.5198	-0.0921	0.2845

AB STUMP 2	0.4851	0.1446	-0.2194
AB OPER 0	-0.4663	-0.1010	0.4245
AB OPER 1	*** 0.9227	* 0.4603	-0.0961
AB OPER 2	-0.4564	-0.3593	-0.3284
AB HARVEST 0	-0.1913	* -0.5225	-0.4102
AB HARVEST 1	-0.0515	** 0.5612	0.5169
AB HARVEST 2	0.2427	-0.0387	-0.1067
AB PROC 0	0.3001	0.1814	*** -0.9167
AB PROC 1	-0.3897	-0.1413	0.2556
AB PROC 2	0.0896	-0.0401	** 0.6610
LL at convergence	-1,132.9	-1,303.5	-1,098.0
pseudo-R2	0.239	0.030	0.222

AB respondents' coefficients

	Competitiveness	Environmental Integrity	Community Stability
Duration			
DUR 0 = Current duration of tenure is reduced by 10 years	-1.9937	-1.5334	-2.1101
DUR 1 = Current duration of tenure is maintained	0.9900	0.4016	0.5493
DUR 2 = Current duration of tenure is increased by 10 years	1.0037	1.1318	1.5608
Stumpage			
STUMP 0 = Stumpage fees are reduced to half of current levels	1.2779	1.0268	1.5242
STUMP 1 = Stumpage fees remain at current levels	0.5967	-0.0326	0.3959
STUMP 2 = Stumpage fees are increased to twice current levels	-1.8746	-0.9942	-1.9201
Operational Req.			
OPER 0 = Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	1.7182	0.6627	1.4313
OPER 1 = Operational requirements for tenure holders remain as currently prescribed.	0.5766	0.4250	0.0064
OPER 2 = Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.	-2.2948	-1.0877	-1.4377
Harvesting Levels			
HARVEST 0 = The amount of flexibility that tenure holders are allowed around their AAC is half current levels.	-1.3360	-0.4626	-0.9680
HARVEST 1 = The amount of flexibility that tenure holders are allowed around their AAC remains at the current level.	0.1916	0.6268	0.5022
HARVEST 2 = The amount of flexibility that tenure holders are allowed around their AAC is twice current levels.	1.1445	-0.1642	0.4658
Wood Processing			
PROC 0 = None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	0.8768	0.3614	-2.5985
PROC 1 = Some proportion of the wood (i.e. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	0.0558	0.0947	1.3112
PROC 2 = All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	-0.9326	-0.4562	1.2873

The Choice Models with Provincial Interactions (British Columbia)

	Competitiveness	Environmental Integrity	Community Stability
	n = 940	n =886	n =900
	Coefficient	Coefficient	Coefficient
Duration			
DUR 0 = Current duration of tenure is reduced by 10 years	*** -1.4187	*** -1.0222	*** -1.3754
DUR 1 = Current duration of tenure is maintained	*** 0.9016	*** 0.4467	*** 0.4293
DUR 2 = Current duration of tenure is increased by 10 years	*** 0.5171	*** 0.5755	*** 0.9461
Stumpage			
STUMP 0 = Stumpage fees are reduced to half of current levels	*** 1.9107	*** 0.9608	*** 1.4285
STUMP 1 = Stumpage fees remain at current levels	** 0.2957	0.0263	0.2361
STUMP 2 = Stumpage fees are increased to twice current levels	*** -2.2064	*** -0.9870	*** -1.6646
Operational Req.			
OPER 0 = Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	*** 2.0400	*** 0.7058	*** 1.1880
OPER 1 = Operational requirements for tenure holders remain as currently prescribed.	-0.0062	0.1301	-0.0204
OPER 2 = Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.	*** -2.0338	*** -0.8359	*** -1.1676
Harvesting Levels			
HARVEST 0 = The amount of flexibility that tenure holders are allowed around their AAC is half current levels.	*** -1.2124	-0.0347	*** -0.6766
HARVEST 1 = The amount of flexibility that tenure holders are allowed around their AAC remains at the current level.	0.1336	* 0.2306	0.1039
HARVEST 2 = The amount of flexibility that tenure holders are allowed around their AAC is twice current levels.	*** 1.0788	-0.1959	*** 0.5727
Wood Processing			
PROC 0 = None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	*** 0.4512	* 0.2654	*** -1.9799
PROC 1 = Some proportion of the wood (i.e. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	*** 0.4279	0.1801	*** 1.0574
PROC 2 = All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	*** -0.8791	*** -0.4455	*** 0.9225
BC Interactions			
BC DUR 0	0.3704	-0.4264	** -0.8994
BC DUR 1	0.3174	-0.3921	* 0.7256
BC DUR 2	* -0.6878	** 0.8185	0.1738
BC STUMP 0	0.4153	* 0.6456	** 0.9959
BC STUMP 1	-0.4452	0.0598	-0.3894
BC STUMP 2	0.0299	* -0.7054	-0.6065
BC OPER 0	0.0681	0.1540	-0.6645

BC OPER 1	-0.2925	-0.0444	* 0.8042
BC OPER 2	0.2244	-0.1097	-0.1397
BC HARVEST 0	0.1693	-0.4851	-0.0010
BC HARVEST 1	0.4919	0.1477	0.0278
BC HARVEST 2	-0.6612	0.3374	-0.0268
BC PROC 0	*** 1.3572	-0.1654	0.3321
BC PROC 1	-0.5601	-0.0096	0.4480
BC PROC 2	** -0.7971	0.1749	* -0.7800
LL at convergence	-1,137.1	-1,306.7	-1,099.1
pseudo-R2	0.237	0.028	0.221

BC respondents' coefficients

	Competitiveness	Environmental Integrity	Community Stability
Duration			
DUR 0 = Current duration of tenure is reduced by 10 years	-1.0483	-1.4486	-2.2748
DUR 1 = Current duration of tenure is maintained	1.2190	0.0546	1.1549
DUR 2 = Current duration of tenure is increased by 10 years	-0.1707	1.3940	1.1199
Stumpage			
STUMP 0 = Stumpage fees are reduced to half of current levels	2.3260	1.6064	2.4244
STUMP 1 = Stumpage fees remain at current levels	-0.1495	0.0861	-0.1533
STUMP 2 = Stumpage fees are increased to twice current levels	-2.1765	-1.6924	-2.2711
Operational Req.			
OPER 0 = Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	2.1081	0.8599	0.5235
OPER 1 = Operational requirements for tenure holders remain as currently prescribed.	-0.2987	0.0857	0.7838
OPER 2 = Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.	-1.8094	-0.9456	-1.3073
Harvesting Levels			
HARVEST 0 = The amount of flexibility that tenure holders are allowed around their AAC is half current levels.	-1.0431	-0.5198	-0.6776
HARVEST 1 = The amount of flexibility that tenure holders are allowed around their AAC remains at the current level.	0.6255	0.3783	0.1317
HARVEST 2 = The amount of flexibility that tenure holders are allowed around their AAC is twice current levels.	0.4176	0.1415	0.5459
Wood Processing			
PROC 0 = None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	1.8084	0.1000	-1.6478
PROC 1 = Some proportion of the wood (i.e. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	-0.1322	0.1705	1.5054
PROC 2 = All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	-1.6762	-0.2705	0.1424

The Choice Models with Provincial Interactions (Quebec)

	Competitiveness	Environmental Integrity	Community Stability
	n = 940	n =886	n =900
	Coefficient	Coefficient	Coefficient
Duration			
DUR 0 = Current duration of tenure is reduced by 10 years	*** -1.4074	*** -1.1029	*** -1.6333
DUR 1 = Current duration of tenure is maintained	*** 0.9911	*** 0.4115	*** 0.5764
DUR 2 = Current duration of tenure is increased by 10 years	*** 0.4162	*** 0.6914	*** 1.0569
Stumpage			
STUMP 0 = Stumpage fees are reduced to half of current levels	*** 1.6331	*** 0.8833	*** 1.4087
STUMP 1 = Stumpage fees remain at current levels	*** 0.4082	0.1671	** 0.3117
STUMP 2 = Stumpage fees are increased to twice current levels	*** -2.0413	*** -1.0505	*** -1.7204
Operational Req.			
OPER 0 = Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	*** 1.9326	*** 0.7325	*** 1.0309
OPER 1 = Operational requirements for tenure holders remain as currently prescribed.	0.1446	0.1347	0.1855
OPER 2 = Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.	*** -2.0772	*** -0.8672	*** -1.2164
Harvesting Levels			
HARVEST 0 = The amount of flexibility that tenure holders are allowed around their AAC is half current levels.	*** -1.0888	-0.0873	*** -0.6917
HARVEST 1 = The amount of flexibility that tenure holders are allowed around their AAC remains at the current level.	* 0.2753	** 0.3092	0.2215
HARVEST 2 = The amount of flexibility that tenure holders are allowed around their AAC is twice current levels.	*** 0.8135	-0.2218	*** 0.4703
Wood Processing			
PROC 0 = None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	*** 0.8348	*** 0.3757	*** -2.0250
PROC 1 = Some proportion of the wood (i.e. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	* 0.2862	0.1219	*** 1.2144
PROC 2 = All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	*** -1.1211	*** -0.4976	*** 0.8106
QB Interactions			
QB DUR 0	0.4652	0.0792	* 0.7450
QB DUR 1	-0.1775	-0.0683	-0.3233
QB DUR 2	-0.2877	-0.0109	-0.4217
QB STUMP 0	*** 2.3459	*** 0.9401	** 0.9689
QB STUMP 1	*** -1.2913	** -0.8082	* -0.6633
QB STUMP 2	** -1.0546	-0.1319	-0.3056

QB OPER 0	** 1.2090	0.1159	0.3739
QB OPER 1	*** -1.3009	-0.0334	-0.5161
QB OPER 2	0.0919	-0.0825	0.1422
QB HARVEST 0	-0.3347	-0.2426	0.2266
QB HARVEST 1	-0.3758	-0.3683	* -0.6484
QB HARVEST 2	* 0.7105	* 0.6109	0.4218
QB PROC 0	** -0.8088	** -0.9041	0.3419
QB PROC 1	0.4594	0.3299	-0.4722
QB PROC 2	0.3494	0.5742	0.1302
LL at convergence	-1,125.2	-1,302.2	-1,097.9
pseudo-R2	0.245	0.031	0.222

QB respondents' coefficients

	Competitiveness	Environmental Integrity	Community Stability
Duration			
DUR 0 = Current duration of tenure is reduced by 10 years	-0.9422	-1.0237	-0.8883
DUR 1 = Current duration of tenure is maintained	0.8137	0.3432	0.2532
DUR 2 = Current duration of tenure is increased by 10 years	0.1285	0.6806	0.6351
Stumpage			
STUMP 0 = Stumpage fees are reduced to half of current levels	3.9790	1.8234	2.3776
STUMP 1 = Stumpage fees remain at current levels	-0.8831	-0.6411	-0.3516
STUMP 2 = Stumpage fees are increased to twice current levels	-3.0959	-1.1823	-2.0260
Operational Req.			
OPER 0 = Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	3.1417	0.8484	1.4047
OPER 1 = Operational requirements for tenure holders remain as currently prescribed.	-1.1563	0.1013	-0.3306
OPER 2 = Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.	-1.9854	-0.9496	-1.0742
Harvesting Levels			
HARVEST 0 = The amount of flexibility that tenure holders are allowed around their AAC is half current levels.	-1.4235	-0.3299	-0.4652
HARVEST 1 = The amount of flexibility that tenure holders are allowed around their AAC remains at the current level.	-0.1005	-0.0591	-0.4269
HARVEST 2 = The amount of flexibility that tenure holders are allowed around their AAC is twice current levels.	1.5240	0.3891	0.8920
Wood Processing			
PROC 0 = None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	0.0260	-0.5284	-1.6830
PROC 1 = Some proportion of the wood (i.e. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	0.7456	0.4518	0.7422
PROC 2 = All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	-0.7716	0.0766	0.9409

The Choice Models with Provincial Interactions (Ontario)

	Competitiveness	Environmental Integrity	Community Stability
	n = 940	n =886	n =900
	Coefficient	Coefficient	Coefficient
Duration			
DUR 0 = Current duration of tenure is reduced by 10 years	*** -1.4038	*** -1.1757	*** -1.5034
DUR 1 = Current duration of tenure is maintained	*** 0.9445	*** 0.3776	*** 0.5920
DUR 2 = Current duration of tenure is increased by 10 years	*** 0.4593	*** 0.7981	*** 0.9114
Stumpage			
STUMP 0 = Stumpage fees are reduced to half of current levels	*** 2.0519	*** 1.1788	*** 1.6107
STUMP 1 = Stumpage fees remain at current levels	0.1731	-0.0335	0.0776
STUMP 2 = Stumpage fees are increased to twice current levels	*** -2.2250	*** -1.1453	*** -1.6884
Operational Req.			
OPER 0 = Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	*** 2.1228	*** 0.8119	*** 1.1235
OPER 1 = Operational requirements for tenure holders remain as currently prescribed.	-0.0180	0.1396	0.0417
OPER 2 = Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.	*** -2.1048	*** -0.9515	*** -1.1652
Harvesting Levels			
HARVEST 0 = The amount of flexibility that tenure holders are allowed around their AAC is half current levels.	*** -1.2788	* -0.2481	*** -0.6455
HARVEST 1 = The amount of flexibility that tenure holders are allowed around their AAC remains at the current level.	0.2044	** 0.2842	0.1404
HARVEST 2 = The amount of flexibility that tenure holders are allowed around their AAC is twice current levels.	*** 1.0744	-0.0361	*** 0.5051
Wood Processing			
PROC 0 = None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	*** 0.6767	0.1738	*** -1.9205
PROC 1 = Some proportion of the wood (i.e. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	* 0.2723	0.1558	*** 1.0228
PROC 2 = All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	*** -0.9490	** -0.3295	*** 0.8977
ON Interactions			
ON DUR 0	0.5429	** 0.8390	0.0107
ON DUR 1	0.0259	0.0908	-0.5793
ON DUR 2	-0.5688	** -0.9298	0.5685
ON STUMP 0	-0.5302	*** -1.1406	-0.3832
ON STUMP 1	0.3701	0.6448	** 1.1482
ON STUMP 2	0.1600	0.4958	-0.7650
ON OPER 0	-0.4557	* -0.7876	-0.2931

ON OPER 1	-0.4104	-0.0870	0.4961
ON OPER 2	* 0.8661	** 0.8746	-0.2030
ON HARVEST 0	** 0.9135	*** 1.2600	-0.1517
ON HARVEST 1	-0.0011	-0.2772	-0.2348
ON HARVEST 2	** -0.9124	** -0.9828	0.3865
ON PROC 0	0.0499	0.5886	-0.3893
ON PROC 1	0.5722	0.2719	** 1.0546
ON PROC 2	-0.6221	** -0.8605	-0.6653
LL at convergence	-1,141.3	-1,295.3	-1,103.0
pseudo-R2	0.234	0.036	0.218

ON respondents' coefficients

	Competitiveness	Environmental Integrity	Community Stability
Duration			
DUR 0 = Current duration of tenure is reduced by 10 years	-0.8609	-0.3367	-1.4927
DUR 1 = Current duration of tenure is maintained	0.9704	0.4684	0.0128
DUR 2 = Current duration of tenure is increased by 10 years	-0.1095	-0.1317	1.4799
Stumpage			
STUMP 0 = Stumpage fees are reduced to half of current levels	1.5217	0.0382	1.2275
STUMP 1 = Stumpage fees remain at current levels	0.5433	0.6113	1.2259
STUMP 2 = Stumpage fees are increased to twice current levels	-2.0650	-0.6495	-2.4534
Operational Req.			
OPER 0 = Operational requirements for tenure holders become less prescribed so that firms have more discretion and flexibility in how they pursue forestry objectives.	1.6672	0.0243	0.8305
OPER 1 = Operational requirements for tenure holders remain as currently prescribed.	-0.4285	0.0526	0.5378
OPER 2 = Operational requirements for tenure holders become more prescribed so that firms have less discretion and flexibility in how they pursue forestry objectives.	-1.2387	-0.0769	-1.3683
Harvesting Levels			
HARVEST 0 = The amount of flexibility that tenure holders are allowed around their AAC is half current levels.	-0.3653	1.0119	-0.7972
HARVEST 1 = The amount of flexibility that tenure holders are allowed around their AAC remains at the current level.	0.2033	0.0071	-0.0944
HARVEST 2 = The amount of flexibility that tenure holders are allowed around their AAC is twice current levels.	0.1620	-1.0190	0.8916
Wood Processing			
PROC 0 = None of the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	0.7266	0.7623	-2.3099
PROC 1 = Some proportion of the wood (i.e. 50% or 75%) harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	0.8445	0.4277	2.0775
PROC 2 = All the wood harvested by the tenure holder must be processed at plants owned or operated by that tenure holder.	-1.5710	-1.1900	0.2324

Appendix F: Duration across Provinces (Alberta, British Columbia, Quebec and Ontario)

Provinces	Tenure Type	Duration and Renewability
Alberta	FMA	20 years; renewable and provisions for 10-year evergreen
British Columbia	TFL	25 years; non-renewable but with a 25-year replacement
	FL	15 years; non-renewable but with a 15-year replacement
Quebec	CAAF	25 years; renewable every five years
Ontario	SFL	20 years; extendable for an addition 5-year period every 5 years

Source: Alberta: Forest Resource Fact Sheet - Management of Alberta's Forests. Available at http://www3.gov.ab.ca/srd/forests/managing/index.html.
British Columbia: Forest Act 14(a), 15(8), 35(1a) and 36(8).
Quebec: The Forest Act. Available at http://www.mrnf.gouv.qc.ca/english/forest/quebec/quebec-system-management-act.jsp
Ontario: The Crown Forest Sustainability Act (CFSA) 26(2) and 26(4).