The Impact of Judicial (In)Decision and (In)Secure Property Rights on Long Run Economic Growth†

Ian Keay
Department of Economics
Queen's University
Kingston, Ontario
ikeay@econ.queensu.ca

AND

Cherie Metcalf
Faculty of Law
Queen's University
Kingston, Ontario
metcalfc@queensu.ca

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Abstract

The Impact of Judicial (In)Decision and (In)Secure Property Rights on Long Run Economic Growth

In this paper we investigate the impact that judicial decisions relating to the recognition of aboriginal property rights have on long run resource industry and macroeconomic performance. We use four decisions handed down by the Supreme Court of Canada since 1973 to identify a range of economic consequences resulting from discontinuities in the formal, legal recognition of property rights. These consequences include the suppression of investment demand and supply incentives, reductions in resource industry profits, and reductions in real GDP per capita growth. To characterize the nature and importance of these effects we begin with a series of event studies which measure the impact that each court decision had on common share prices for firms engaged in the extraction and processing of Canada's forest resources. The share price effects reflect investors' perception of the decisions' impact on both the forestry firms' current access to resource stocks, and uncertainty surrounding the security of their property rights into the future. Stock access and uncertainty affect industry and macroeconomic performance in different ways. In the second stage of our investigation we use predictions drawn from finance theory and renewable resource theory to construct a partial equilibrium simulation model. With this model we quantify the impact that the stock access and uncertainty effects implied by the results of our event studies have on the forestry sector's economic fundamentals. In the third and final stage of our investigation we use the industry profit effects derived from the simulation model in a highly stylized general equilibrium model of the Canadian economy to estimate the impact that the Court's decisions had on real GDP per capita growth performance during the 1970-2005 period. Under certain circumstances the performance effects we measure can be substantial, but the cumulative impact varies widely depending on the combination of stock access and uncertainty implied by each of the Supreme Court decisions we study.

1. Introduction

Economists have long emphasized the important role played by stable and secure property rights in promoting economic growth.[1] Potential inefficiencies associated with transaction costs, market integration, information asymetries, and natural resource use are closely related to the quality and consistency of institutions in general, and property rights in particular.[2] Theories about optimal resource exploitation, for example, focus on the security of stock access and ownership as a key determinant of investment incentives, extraction patterns, and management decisions.[3]

This paper seeks to contribute to the empirical literature that investigates the impact that formal legal recognition of property rights has on the economic performance of an economy that specializes in resource extraction and processing activities. To isolate and quantify economic effects that may be attributed to discontinuities in formal legal recognition, we focus on four specific changes in property rights related to resource access that were triggered by the Supreme Court of Canada's efforts to accommodate aboriginal groups' constitutional rights. In Canada, because the constitutional text itself is so spare and views on its meaning have varied widely prior to judicial clarification, the substance of constitutional aboriginal rights had to be established through litigation and has only evolved in response to judicial interpretation. Because aboriginal rights are often closely tied to land and particular natural resource stocks, the landmark cases of Canada’s Supreme Court in this area provide examples of unanticipated changes in the structure of property rights that have the potential to affect the economic performance of specific resource industries and the economy as a whole. Decision makers among Canada's resource industries have suggested that these judgments create uncertainty surrounding the security of their contemporaneous and future property rights. This uncertainty, it is argued, imposes significant economic costs on the producers' operations -- undermining their investment incentives, constraining their profitability, and slowing aggregate Canadian economic growth. In this paper we seek to test this claim using the Canadian forestry sector between 1970-2005 as a case study.

[1] Widely cited examples include de Soto (2000), or Acemoglu and Johnson (2005).
[2] The seminal references include North (1990), Coase (1960), and Demsetz (1967).
[3] See Hardin (1968), Gordon (1954) or Scott (1955) .

We begin our investigation with a series of event studies in which we estimate Canadian financial market participants' responses to four key Supreme Court judgments that are widely regarded as having significantly altered the landscape of aboriginal, and by extension the resource industries', property rights in Canada. We perform our analysis by considering changes in the forestry sector's common share prices on Canada's largest formal equity market, the Toronto Stock Exchange (TSX), immediately following the *Calder* decision (January 31, 1973), the *Sparrow* decision (May 31, 1990), the *Van Der Peet* decision (August 21, 1996), and the *Delgamuukw* decision (December 11, 1997). Significant abnormal returns in response to these decisions signal unexpected shocks in market valuation. The results from these event studies indicate that financial markets perceived measurable economic effects stemming from unanticipated changes to the security of Canadian forestry firms' property rights. However, differences in the size and direction of these effects in response to each of these decisions preclude any simplistic characterization of their source.

In the second stage of our investigation we use a partial equilibrium simulation model that has been constructed to be consistent with theoretical predictions derived from renewable resource and finance theory, to try to identify the source of the share price effects we measure in our event studies. The simulation model allows us to document changes in both uncertainty and contemporaneous stock access that can generate simulated changes in share prices that match those we estimate with the event studies. The model also allows us to assess the long run impact of these uncertainty and access effects on the economic fundamentals that determine the performance of the forestry sector in Canada during the post-1970 period. More specifically, our model allows us to assess the extent to which the Canadian forestry sector responds to the uncertainty and stock access shocks that could have produced the event studies' share price effects, through their production decisions, reproducible and natural capital investment incentives, the cost of their external investment funds, and their profitability performance.

In the third and final stage of our investigation we use a highly stylized general equilibrium model to establish a lower bound on the possible long run real GDP per capita growth consequences associated with the changes in the forestry sector's simulated fundamentals we document in the second stage of our study. These growth effects represent a lower bound on the macroeconomic impact of the Court's property rights decisions because the construction of the model requires a series of admittedly unrealistic assumptions regarding the integration of Canadian labour and capital markets, and the absence of positive or negative spillovers linking resource intensive production to other more labour or capital intensive industries. Even at this lower bound, under some circumstances the long run effects of the formal recognition of aboriginal property rights on aggregate economic performance are substantial. Our findings, therefore, are not inconsistent with the claims made by the forestry sector's decision makers -- the resource industries' economic fundamentals, and hence macroeconomic performance, appear to have been quite sensitive to judicial indecision and the resultant uncertainty over contemporaneous stock access and the security of future property rights.

2. Why a Canadian Case Study?

Canada has been, and continues to be a wealthy, industrialized, diversified economy that has specialized in resource intensive extraction and processing activities throughout its development process. At the end of the twentieth century Canada's purchasing power adjusted real GDP per capita ranked sixteenth in the world (just ahead of Denmark and just behind Australia), industrial activities accounted for approximately 16% of GDP, and 77% of the population lived in an incorporated urban centre. Despite the urban-industrial nature of the economy, Canada has persistently maintained a high degree of resource intensity in its macroeconomic activities, with the forestry sector accounting for a particularly large fraction of inputs employed and outputs produced. Between 1990-1999 Canadian forestry industries employed 2.5% of the workforce and 5% of the reproducible capital stock, while generating 4% of Canada's GDP and almost 14% of Canada's total export earnings.[4] In addition to these direct contributions to

[4] For a more detailed discussion of the resource intensity of Canadian production and a description of the construction and composition of the available evidence see Keay (2007). There are many histories of the Canadian forestry sector that describe the important economic and technological episodes in its development. For some examples see Lower (1933), Nelles (1974), Dick (1982), or Marchak (1983). Although Canadian exports are destined primarily to the US, they never amount to more than a small fraction of total US sales. This fact, combined with the observation that the long run correlation between changes in Canadian and US forest product prices between 1900-1999 was 0.745, implies that Canadian producers remain price takers on international markets.

aggregate performance there have been substantial spillovers linking resource intensive activities to more labour and capital intensive activities through, for example, lower domestic raw material prices, less volatile domestic raw material prices, demand generation within labour and capital intensive industries, and market density and scale effects. Keay (2007, Table 3) estimates that the value of these indirect contributions may account for as much as 44% of the total contribution made by Canada's energy, forestry and mining industries to long run real GDP per capita growth during the twentieth century.

Resource extraction and processing activities clearly occupy a central place in the Canadian economy. Access to *in situ* resource stocks and the security of this access into the future, therefore, plays a vital role not just in resource sector performance, but in the performance of the domestic economy as a whole. It is in this context of remarkably successful resource based economic development that the Supreme Court of Canada has had to repeatedly intervene to clarify and resolve particular aspects of the conflict between constitutionally protected aboriginal rights over land and resources, and the security of Canada's resource industries' property rights over stock access.

The existence of aboriginal rights and questions about the legal status of aboriginal peoples have been a unique aspect of the Canadian legal landscape throughout the country's history. As part of the culmination of the struggle between the French and the British for control over the colonial territory of present day Canada, the British issued a *Royal Proclamation* (1763) which specifically addressed aboriginal lands.[5] The *Proclamation* reserved lands not already included within the colonial government boundaries for the use of the Indians, and precluded any settlement until the lands were "ceded or purchased" from the aboriginal occupants. This *Proclamation*, therefore, appears to recognize the continued legal force of aboriginal land rights under the British colonial legal regime, which eventually became the Canadian legal regime.

The process of historic treaty-making that followed the *Proclamation* and preceded settlement may also have recognized the legal status of aboriginal peoples' interests in their traditional lands. What makes the Canadian legal environment

[5] The *Royal Proclamation* (1763) may be accessed at: http://avalon.law.yale.edu/18th_century/proc1763.asp.

particularly compelling from our perspective is that considerable uncertainty evolved as a result of the incompleteness of this treaty-making process. Large areas of Canada were settled or left without any resolution of the status of aboriginal land claims.[6] Subsequent legal decisions viewed the *Royal Proclamation* not as acknowledging any legal rights to the land, but merely granting personal and usufructuary rights for aboriginal peoples to continue their traditional uses of the land, until such time as the Crown might choose to end these privileges.[7] The legal status of aboriginal rights and particularly land claims, therefore, appeared to weaken until the last decades of the twentieth century.

It was not until a Federal Government *White Paper* (1969) declared aboriginal land claims to be too vague and insubstantial to amount to potential legal rights, relegating their status to outstanding political grievances that would best be addressed by eliminating any legal distinctions that applied to aboriginal peoples, that renewed interest and vigour was directed towards questions surrounding the constitutional status of aboriginal property rights in Canada. A series of Supreme Court cases, beginning with *Calder* in 1973, addressed these questions, and the resultant decisions have been characterized as abrupt discontinuities in the formal legal recognition of aboriginal property rights. The recognition of these rights necessarily affects the security of resource stock access and future property rights for non-aboriginal stakeholders, including Canada's resource industries.

Our ability to document the central role played by resource intensive activities in the Canadian economy, combined with the unique legal history of aboriginal property rights provisions in Canada, present us with an opportunity to empirically assess the nature and importance of the economic consequences that result from discontinuous changes in the recognition of formal legal property rights. This documentation process must begin with an identification of discontinuities worthy of detailed study.

3. Discontinuities in Aboriginal Property Rights in Canada Since 1970

[6] Prominent examples include the Maritime provinces, which are covered by "peace and friendship" treaties that do not specifically address any rights to land. British Columbia was also largely settled without any prior treaty resolution of competing aboriginal and colonial claims to land, and the process of treaty negotiation is ongoing. While much of Canada's territory is the subject of treaties that purport to extinguish aboriginal claims to traditional lands in exchange for the allocation of reserve lands, their interpretation as land surrender treaties has been increasingly contested by aboriginal signatories.

[7] For example, see *St. Catherine's Milling and Lumber Co. v. R.* [1888], 14 App. Cas. 46 (P.C.).

On January 31, 1973 the Supreme Court of Canada released a decision in *Calder v. British Columbia (Attorney General)*, [1973] S.C.R. 313. In the *Calder* case the Nishga'a people of the Nass Valley in north-western British Columbia were seeking a declaration that they held unextinguished aboriginal title to their traditional lands. While the result was a split decision that did not give the Nishga'a the declaration they were seeking, the majority of the Court regarded aboriginal title as a continuing legal interest in traditional lands. The Crown might extinguish aboriginal title, but where it had not clearly done so, the aboriginal interest in lands and resources continued to have legal force. This judicial decision prompted a shift in the perception of aboriginal claims, requiring them to be considered legal rights, and thus introducing uncertainty with respect to the scope of any these rights that might conflict with other property interests the government had created in lands and resources, including the security of stock access for forestry firms. Of course, the unilateral power to extinguish aboriginal rights retained by the Crown in *Calder* meant that any insecurity in rights could be relatively easily repaired -- at least in theory.

The legal interpretation of aboriginal rights changed dramatically following their explicit inclusion in the *Constitution Act* (1982). A new constitutional provision (s. 35(1)) stated that, "...the existing aboriginal and treaty rights of the aboriginal people of Canada are hereby recognized and affirmed." While the intention was to further develop the content of these rights through negotiation and subsequent amendment of the Constitution, these plans have not yet materialized. Resolving any uncertainty regarding the new constitutional aboriginal rights was left to the courts. In the years following the *Constitution Act* there were a succession of major decisions released by the Supreme Court that built on the *Calder* decision, in the sense that they had an explicit and substantive impact on the interpretation of aboriginal and non-aboriginal property rights that was relevant to participants in the commercial exploitation of resource stocks in Canada.

The Supreme Court first considered the meaning of s. 35(1) in *R. v. Sparrow*, [1990] 1 S.C.R. 1075. In this case the claimant, Sparrow, had been charged with a regulatory offense for fishing with an illegal net. He argued that the fisheries regulations under which he was charged did not apply to him, as he was exercising a constitutional right. A number of significant implications for the right to resource access flowed from the decision. First, in *Sparrow* the Court decided that aboriginal rights protected by s. 35(1) were affirmed in an un-regulated form. The existence of a regulatory regime that governed potentially competing and conflicting claims to a resource did not in itself indicate that aboriginal rights were extinguished, or even limited in scope by the existing regulations. The precise test for recognizing an aboriginal right and delimiting its contents was not articulated in *Sparrow,* but the Court appeared to base its acknowledgement of the right in the case on a pattern of historic use and occupation. However, while anchored in historic use, the right was not affirmed in a "frozen" form -- it could evolve to be exercised in a "modern" form. This expanded the potential scope of aboriginal rights. A very significant result of the *Sparrow* decision was the Court's conclusion that once established by an aboriginal claimant, government could not infringe upon an aboriginal right without meeting a test for constitutional justification. This test involved a two-pronged approach, requiring first that government pursue objectives of sufficient importance to limit a constitutional right, and second that the way in which aboriginal rights were limited respected the special fiduciary relationship between the Crown and aboriginal peoples. In practical terms, the decision accepted that interests of conservation, or protection of existing rights-holders might justify restricting aboriginal rights, but that general limitations "in the public interest" were impermissibly vague. The fiduciary relationship was also articulated as requiring that a priority must be put on aboriginal rights to resources, which in the case itself was interpreted as a first claim to the resource. The implication was that aboriginal rights could take precedence over competing (commercial) rights to harvest and use resources, even if such government allocations could be justified.

There can be little doubt that when *Sparrow* was released on May 31, 1990 a substantial wake of uncertainty regarding government regimes that allocated rights to resources and regulated conditions under which resources could be harvested must have followed. The potential scope of aboriginal constitutional rights prior to *Sparrow* was unclear. It was argued in the case that any constitutionally protected rights would correspond to the scope of common law aboriginal rights, which were narrowed (extinguished) by inconsistent legislation. The Court's approach to characterizing the constitutional rights at stake in *Sparrow* generated a much broader scope for s. 35(1) aboriginal rights, and presumptively rendered government regulatory regimes that interfered with these rights unconstitutional. The grounds upon which limitations could be justified were considerably narrowed, focused on prioritizing aboriginal rights, and subordinating conflicting resource claims. For the first time limitations imposed by the Court had the potential to not only impose new and indeterminate restrictions on contemporaneous stock access for commercial resource users, but they threw the security of all future access into doubt.

VAN DER PEET ???

The legal status of aboriginal title again came before the court as an aspect of s. 35(1) in the case of *Delgamuukw v. British Columbia*, [1997] 3 S.C.R. 1010. The Gitskan and Wet'sewet'en aboriginal peoples brought claims of "ownership and jurisdiction" over their traditional lands in British Columbia, arguing that their title had never been extinguished. In this decision, the Court outlined a test that aboriginal people must meet to establish title -- requiring them to prove exclusive use and occupancy prior to the assertion of Crown sovereignty, with a degree of continuity to present occupation. Once established, title was identified as a constitutionally protected right that gives aboriginal peoples exclusive rights to use and occupy the land for purposes that need not be in themselves aboriginal rights.[8] The Court refused to hold that determining occupancy would be by application of either exclusively common law or exclusively aboriginal law concepts, and instead drew on the core purpose of reconciliation that underlies s. 35(1) to conclude that aboriginal title was a *sui generis* legal right, that must incorporate perspectives from both cultures. So, both aboriginal law and physical occupation might be relevant to the test for title. In *Delgamuukw* the Court also adopted a principle that addressed the admissibility of evidence, suggesting that it should be

[8] Title is also characterized by special features that distinguish it from fee simple title -- it is held by the collective, cannot be alienated except by surrender to the Crown, and cannot be put to uses that are irreconcilable with the inherent cultural ties to the land that are subsumed in the historic occupation of the land by aboriginal people. The latter "internal limit" precludes some resource harvesting that might otherwise conflict with other users' claims -- commercial forestry, for example.

approached sensitively and flexibly in the context of aboriginal rights claims. In particular, oral tradition evidence could be admitted as evidence of historic use and occupation.[9] Both the approach to establishing title through occupancy and the evidentiary rulings expanded the potential scope for title claims. Once proven, the court held in *Delgamuukw* that aboriginal title is constitutionally protected against any unjustified government infringement. Government allocated resource access that overlaps with lands subject to aboriginal title claims would thus be potentially unconstitutional.

To further compound complications surrounding the security of stock access, *Delgamuukw* also expanded the test for justified infringement of aboriginal rights to include a broader range of objectives, including the commercial development of mining or forest resources. The concept of priority for aboriginal rights that characterized the second branch of the test for justified limitation of rights in *Sparrow* was modified in *Delgamuukw*. In relation to aboriginal title, what was required is that both the process by which a resource is allocated, and the actual allocation, must reflect the prior interest of aboriginal rights-holders. The Court was unclear about exactly what this should involve, but the decision uses an example in which resource access reflects the prior occupation of aboriginal title holders, while simultaneously allowing existing commercial title-holders to participate in "resource development". This justification can be linked to a second aspect of justified interference with aboriginal title developed in *Delgamuukw* -- aboriginal rights-holders must be consulted in any circumstances in which there may be interference with their rights. The obligation of consultation occupied a spectrum that ranged from provision of notice to a possible veto, depending on the nature of the interference with aboriginal title. The duty of consultation reflected aboriginal peoples' inherent right to decide what activities should take place on their titled lands and meant they had to be involved in decision making if any use of titled lands interfered with their exclusive rights. Going even further, the Court also suggested that there is a need for "fair compensation" when title is infringed. Despite the fact that the test for justified

[9] This effectively overturned the rulings from the Courts below that dismissed the claim on the basis of insufficient evidence of occupation. The Supreme Court held that the lower Courts should have considered the claimants' oral traditions as evidence in the form of a collection of highly formalized stories (adaawk) and spiritual song or dance (kungax).

infringement of title may be interpreted to be more flexible than the initial approach in *Sparrow*, the *Delgamuukw* test is disconcertingly vague. In a number of respects, the *Delgamuukw* decision rendered existing resource rights more fragile, and created a complex, obscure and contextual test for justified infringement. It again appears that the decision must have triggered potentially costly adjustments to Canada's resource industries' expectations regarding their current and continued access to *in situ* resource stocks.[10]

In response to the uncertainty that followed from the *Delgamuukw* decision, there have been a flurry of more recent cases in which the Supreme Court has made an effort to clarify the requirement for occupation (*R. v. Marshall* and *R. v. Bernard*, [2005] 2 S.C.R. 220) and the duty to consult (*Haida Nation v. B.C. (Minister of Forests)*, [2004] 3 S.C.R. 511 and *Taku River Tlingit First Nation v. B.C. (Project Director)*, [2004] 3 S.C.R. 550). While these decisions deal explicitly with aboriginal property rights, they are focused primarily on expanding upon the discontinuous nature of the property rights provisions established in *Calder, Sparrow, Van Der Peet* and *Delgamuukw*. We do not, therefore, extend our investigation to include these most recent cases.

The four decisions we do focus our investigation on obviously comprise only a small subsample of the Supreme Court's decisions addressing the meaning of s. 35(1) aboriginal rights. However, *Calder, Sparrow, Van Der Peet* and *Delgamuukw* are uniquely relevant for our study because of the impact they have had on the security of property rights for Canada's commercial resource industries, particularly the forestry sector. They represent the first precedents on the critical issues of the existence and scope of aboriginal rights, the implications for government granted access, the regulation of potential conflict with aboriginal rights, and the extent to which aboriginal rights-holders need to be directly involved in decision making about resource use. These decisions established legal standards in previously uncharted territory, and the Court's approach often departed from any common law precedent, in effect crafting a unique and novel body of law. The novelty and discontinuous nature of the decisions diminished the degree to which the results could have been anticipated. Their abrupt impact on the

[10] This is how the President of the Canadian Mining Association described the decision to the Standing Committee on Aboriginal Affairs two years after the judgment, "[*Delgamuukw*] has cast a dark shadow of uncertainty on resource investment and development in British Columbia and elsewhere in Canada…"

security of property rights, both through contemporaneous stock access and uncertainty surrounding future stock access, makes them ideal candidates for facilitating the empirical identification of substantial industry and macroeconomic performance effects.

4. Decision Makers' Perception of the Court's Decisions

The Supreme Court's decisions in *Calder*, *Sparrow, Van Der Peet* and *Delgamuukw* formally changed the legal recognition of aboriginal rights with respect to land and resource stock access. These changes in aboriginal rights necessarily had a significant impact on the security of property rights enjoyed by non-aboriginal groups, including commercial firms engaged in the extraction and processing of forest resources. To measure the macroeconomic impact of these changes in property rights provisions, we must first establish some lower bound on the net effect that the Supreme Court's decisions had on the performance of Canada's resource industries. To estimate the size of this net effect we can perform a series of event studies, which allow us to determine how informed decision makers participating on Canadian financial markets perceived (and valued) the consequences of these decisions for a specific set of resource intensive producers -- domestic forestry firms.

We focus our investigation on the responsiveness of the forestry sector not only because of the availability of appropriate, consistent and high quality data for the full 1970-2005 period, but also because the sector plays a key role in the performance of the aggregate economy, and the security of resource access is of vital importance to the firms that make up the sector. The perceptions of financial market participants matter because we expect these individuals to acquire and efficiently use all available information to anticipate and value discontinuities in industry performance into the indefinite future. This implies that the impact of new information that potentially affects performance, and hence firm values, should be reflected in the decisions these participants make regarding their willingness to supply investment funds to forestry firms through Canada's largest formal equity market -- the Toronto Stock Exchange (TSX).

The *Calder, Sparrow, Van Der Peet* and *Delgamuukw* judgments of the Supreme Court altered the landscape of Canadian law in a way that could not have been predicted *a priori*, and as a result, equity market participants could not have known which of the competing positions on aboriginal rights would be endorsed by the Court. We therefore treat these four landmark property rights decisions as "events" that produced new and unanticipated information relevant to the economic performance of Canada's forestry sector. Decision makers' best estimate of the net economic impact of these events should be reflected in the forestry firms' common share prices on the TSX.

4.1 Event Study: Methodology

The use of an event study to estimate the net economic impact of a discontinuity in property rights is based on the "efficient markets hypothesis" -- which assumes that equity markets rapidly and efficiently absorb and process information -- and "firm valuation theory" -- which assumes that in equilibrium the price of a firm's common shares will reflect the present discounted value of the stream of earnings that the owners of the shares are entitled to.[11] These two assumptions imply that the economic impact of any unanticipated event may be quantified by measuring share price movements immediately following the announcement of the event. According to the efficient markets hypothesis, an event's impact on a firm's performance will be rapidly accessed by investors, and subsequent changes in the firm's share prices in response to the new information will reveal participant's perception of the net economic "cost" of the event. This methodological approach to the identification of net economic impacts has been employed to answer a wide variety of questions in a wide variety of environments, and it has proven itself to be one of the most effective means of empirically estimating the economic consequences of legal and/or policy discontinuities.[12]

The structure of an event study is quite straightforward.[13] The first step is to identify an unanticipated event of interest. The announcement date must be unique and

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[11] In their development of the event study methodology, Fama et al. (1969) describe in detail the relationship between the required assumptions and the results.

[12] See Fama (1991, Pg. 1599-1602) for a review of recent literature dealing with the efficient markets hypothesis. See Ma, McGilvray and Common (2003, Pg. 366-7) for a review of recent literature dealing with discounted cash flow valuation techniques. A broader literature review is provided by MacKinlay (1997). See Bhagat and Romano (2002, Pg. 141) for a review of the appropriate application of the methodology.

[13] The methodological detail described here is drawn primarily from MacKinlay (1997), although similar descriptions of the approach are available in numerous references. For examples see Bhagat and Romano

represent a discontinuity in information. If the time at which the information becomes available cannot be pinned down fairly precisely, the event study methodology cannot be used.[14] Because the exact time at which investors gain access to the relevant information may be imprecise, or because markets may not react instantly and completely to information (semi-strong efficient markets), empirical applications typically specify an "event window" during which market participants act on the new information and share prices respond. This window is usually specified as narrowly as possible, since the power of the study's statistical results will diminish, conditional on sample size, as the window grows.[15]

The next step is to measure the observed return on the affected securities and compare this with the return we might expect in the absence of any new information. The difference between the observed and expected returns reflects the response to the event, or the "abnormal return" (AR_{it}). Event studies can be carried out to examine the impact of a single event on a single firm, or they can be carried out for broader samples that average results across affected firms, sectors, or events. To assess the impact of a particular event on a single firm or sector, the abnormal return for sector *i* in time *t* may be defined as:

$$AR_{it} = R_{it} - E(R_{it} \mid X_{it})$$

Where X_{it} is the conditioning information upon which expectations are formed. One of the most common approaches to estimating expected returns in the literature is to employ a capital asset pricing model (CAPM) -- which assumes that the expected return on any given security is a stable linear function of a constant, the risk free rate of return, and the composite market return.[16] A basic CAPM model takes the form:

$$(R_{it} - rf_t) = \alpha_i + \beta_i (R_{mt} - rf_t) + \varepsilon_{it}$$

(2002) (legal audience), Binder (1998) or Brown and Warner (1985) (technical audience), or Gupta and Goldar (2005) and Rock (2003) (applications).

[14] Event studies have been used to investigate the impact of regulatory changes, which can involve less precision in identifying a specific event date. For discussion of the application of the methodology with more ambiguous event windows see Lamdin (2001).

[15] For a discussion of statistical effects associated with varying the length of the event window see MacKinlay (1997, Pg. 29-34), or Bhagat and Romano (2002).

[16] The CAPM approach was first developed by multiple researchers during the early 1960s. The form of the model used here is close to the specification described by Lintner (1965). Cragg and Malkiel (1982) survey a wide range of empirical CAPM applications.

Where R_{mt} is the composite market return at time t, rf_t is the risk free return on long term government bonds at time t, and e_{it} is an independently and identically distributed error term $\sim N(0, \sigma_{\varepsilon i})$.[17]

To calculate the expected return for an individual firm or sector i during period t, the CAPM equation is estimated by OLS regression. Under the maintained assumptions of the model OLS is both consistent and efficient.[18] Once the parameters of the model have been estimated, they can be used to predict the expected return for security i throughout the event window. The difference between the actual and predicted returns following the event will reveal the abnormal returns, which are equal to the change in the value of the firm or sector in response to the event.

$$\begin{aligned} AR_{it} &= R_{it} - \hat{R}_{it} \\ &= R_{it} - \hat{\alpha}_i - \hat{\beta}_i (R_{mt} - rf_t) - rf_t \end{aligned}$$

The abnormal return is just the forecast error of the CAPM equation, calculated on an out of sample basis. If the sample period for estimation is long enough, under the null, excess returns will be normally distributed with $E(AR_{it}) = 0$ and $\sigma^2_{AR_{it}} = \sigma^2_{\varepsilon_i}$.

The final step involves the assessment of the statistical significance of the event. Abnormal returns are aggregated over the event window ($T_1 \rightarrow T_2$) to determine the cumulative abnormal returns (CAR_i) attributable to the event for firm or sector i, and the variance of these cumulative abnormal returns is calculated.

$$CAR_i(T_1, T_2) = \sum_{t=T_1}^{T_2} AR_{it}$$

$$\sigma_i^2(T_1, T_2) = (T_2 - T_1 + 1)\sigma^2_{\varepsilon_i}$$

The firm or sector specific hypothesis that the cumulative abnormal returns are zero can then be tested with a simple Z-statistic, distributed normally with the variance defined above. Statistically significant cumulative abnormal returns indicate that market participants altered their behaviour in response to the new information embodied in the event. Changes in the participants' behaviour reflect changes in their perception of the

[17] Other models for calculating the expected return may also be used, including the market return model, the arbitrage pricing model, or the factor loading approach. From a theoretical and empirical perspective there is little to distinguish among these approaches. For a more detailed discussion see MacKinlay (1997, Pg. 18-19).
[18] See MacKinlay (1997, Pg. 20).

firm or sector's performance, which in turn reflects their perception of the value of the net economic impact of the event.

4.2 Event Study: Data and Results

Using the methodological approach described above, we measure Canadian financial market participants' valuation of the net economic impact of the release of four Supreme Court of Canada judgments that embodied discontinuities in the formal legal recognition of aboriginal property rights over natural resource assets. The *Calder* decision was released on January 31, 1973; the *Sparrow* decision was released on May 31, 1990; the *Van Der Peet* decision was released on August 21, 1996; and the *Delgamuukw* decision was released on December 11, 1997. We use the date that each judgment was formally released by the Court as the relevant event date for our estimation. In other contexts, event dates may be difficult to identify precisely due to the possible leakage of information in advance of a major announcement. Uncertainty about the precise timing of an event is often addressed by extending the event window to include a day or two prior to the researcher's best guess for the event date. Because the deliberation process of Canada's Supreme Court is highly confidential and judgments are released under tightly controlled circumstances at a clearly identifiable point in time, it is extremely unlikely that information about the result of the judgments would have been available to market participants in advance of the formal release dates.[19]

While our event dates may be safely aligned with the formal release of the judgments, it is less clear how long market participants may have needed to assess the impact of the decisions. Under the strongest version of the efficient markets hypothesis, we would expect the information to be processed and integrated into participants' market decisions extremely quickly. Because longer event windows reduce the power of the cumulative abnormal return tests, if we were comfortable with the efficient markets

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[19] For a detailed description of the Court's procedure for releasing judgments, see Supreme Court of Canada, Media Portal, Decisions of the Court, Release of Decisions of the Court (http://www.scc-csc.gc.ca/mediaportal/decisionscourt/index.asp). Decisions are always released at 09:45 EST, so that closing prices for the event day are the relevant measure of the decisions' immediate impact. In other work we have estimated abnormal returns for event windows that span the formal release dates for the judgments. These sensitivity tests not only guard against the possibility of information leakage, but they can also be used to test for the influence of confounding events that may have occurred within our event windows. For a more detailed discussion see Metcalf and Graham (2010).

hypothesis, the event window could be kept as short as possible -- one or at most two days.[20] However, Supreme Court judgements relating to constitutional rights, particularly judgements that provide landmark legal rulings of the sort studied in our investigation, are unlikely to have been fully disseminated and understood until market participants could obtain opinions from legal experts about the meaning and impact of the decisions. This process would likely take considerably longer to trigger a measureable response, relative to the response lags associated with the release of information more accessible to financial market participants, such as earnings forecasts, natural disasters or even regulatory changes. To account for potentially lengthy lags in the market's response, we consider event windows from one to five days in length -- defining the date on which the judgment is released as the event day [0], we estimate cumulative abnormal returns over five event windows: [0,0] [0,1] [0,2] [0,3] and [0,4].

A sample period of 200 trading days prior to each of the judgements' formal release dates has been used to estimate the relevant parameters from our CAPM equations. For the *Calder* decision, daily information on the TSX's Forest Products Common Share Price Index were taken from the *Globe and Mail's Report on Business*, the Composite Market Common Share Price Index was derived from the Industrial Composite Common Share Price Index published in the *Toronto Stock Exchange Monthly Review*, and the risk free rate of return was constructed from weekly long term Federal Government bond yields and the Bank of Canada's daily 90 day treasury bill rate. For the *Sparrow*, *Van Der Peet* and *Delgamuukw* decisions the TSX's Forest Products Common Share Price Index, Composite Market Common Share Price Index and long term Federal Government bond yields were all accessed from the Canadian Financial Markets Research Centre (CFMRC) Summary Information Database.[21]

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[20] Bhagat and Romano (2002) discuss the choice of event windows in detail.

[21] For additional information on the construction and composition of these indices, see Computing in the Humanities and Social Sciences, University of Toronto (CHASS) Data Centre at http://ww.chass.utoronto.ca/cgi-bin/chassnew/display.pl?page=index. Because the forest sector index is a subset of the composite market index, there may be some possibility of endogeneity in our CAPM estimates. Even though forestry firms have traditionally played an important role on the TSX, after 1970 the composite market was strongly dominated by other resource, manufacturing and service sector components. As a result, we do not attempt to adjust our market index or estimation strategy to account for any endogeneity that may be present.

The *Calder* decision did not grant the Nishga'a people of north-western British Columbia unfettered property rights over their traditional lands, but it did recognize that aboriginal title existed until the Crown clearly and explicitly extinguished those rights. Although the immediate effect of this decision was to preserve the provisions regulating non-aboriginal commercial access to resource stocks in British Columbia, the longer run effects were much more uncertain. Because the Court introduced an entirely new interpretation of aboriginal rights, stock access for Canada's forestry firms that had been secure and guaranteed by both the Federal Government and the courts, was thrown into doubt. We might reasonably expect that the decision's effect on short term stock access, particularly in the Naas Valley, could have been viewed in a favourable light by those supplying investment funds to the forestry sector, but the more indefinite state of aboriginal property rights in general must have caused some discomfort and considerable uncertainty among financial market participants. The market's valuation of the net effect of *Calder*, therefore, is not easy to anticipate. The results from our event study reflect the conflicting economic and legal forces affecting the security of the forestry firms' contemporaneous and future property rights over the resource stocks. From Table 1 we can see that the cumulative abnormal returns in the days immediately following January 31, 1973 were positive, reflecting the most obvious "good news" (at least with respect to the commercial resource firms' contemporaneous stock access) interpretation of the Court's decision. However, only the cumulative abnormal returns from the two day event window [0,1] are statistically distinguishable from zero. This reflects the small size of these abnormal returns -- even the significant abnormal returns from the [0,1] window amount to a return in excess of expectations of less than 2.7% over two trading days -- which in turn may reflect both the market's uncertainty about the interpretation of the decision, and the market's difficulty in valuing the net effect of the resultant changes in property rights.

The *Sparrow* decision was the first significant judgement interpreting aboriginal rights protected by s. 35(1) of the *Constitution Act*. This decision gave aboriginal rights substantive content by defining them outside of any existing regulatory schemes and it seemed to outline a test for justified infringement that prioritized aboriginal rights over existing property rights. As a first step in the process of clarifying and formalizing the language that comprises s. 35(1), the definition and justification test provided in the *Sparrow* decision must have cast even more doubt on the security of resource harvesting tenures provided for under long established Federal regulatory regimes. We might reasonably expect, therefore, that because the *Sparrow* decision introduced new questions about the security of both contemporaneous and future resource access for commercial producers, decision makers on Canada's financial markets should have reacted vigorously and negatively to the news. From Table 1 we can see that there is little evidence of such a reaction -- the cumulative abnormal returns from all five event windows are small, positive, and statistically indistinguishable from zero. These results suggest two possible interpretations: market participants may not have known how to interpret a decision that so radically altered the legal recognition of aboriginal property rights, at least within the first five days following its release, so reactions were muted; or market participants may have been anticipating even greater contemporaneous and future restrictions on commercial stock access, so their response may reflect relief that the decision was not as devastating as they feared *a priori*.[22]

Table 1: Event Study Results

	Calder	*Sparrow*	*Van Der Peet*	*Delgamuukw*
CAR [0,0]	0.014	0.006	0.011	**-0.019***
Z [0,0]	1.388	1.163	1.447	-1.952
(P Value)	(0.165)	(0.245)	(0.148)	(0.051)
CAR [0,1]	**0.027****	0.006	**0.019***	**-0.029****
Z [0,1]	1.961	0.808	1.768	-2.106
(P Value)	(0.050)	(0.419)	(0.077)	(0.035)
CAR [0,2]	0.020	0.009	**0.027****	**-0.031***
Z [0,2]	1.163	0.978	2.039	-1.802
(P Value)	(0.245)	(0.328)	(0.041)	(0.072)
CAR [0,3]	0.021	0.015	**0.035****	-0.030
Z [0,3]	1.069	1.380	2.341	-1.508
(P Value)	(0.285)	(0.168)	(0.019)	(0.132)
CAR [0,4]	0.022	0.018	**0.034****	-0.014
Z [0,4]	1.003	1.493	2.056	-0.643
(P Value)	(0.316)	(0.136)	(0.040)	(0.521)

[22] We do not report the estimates for event windows that span the release date. For the *Sparrow* decision, there were no significant *CAR* estimates in pre-event windows. The market returns do not reflect any significant anticipation of the decision prior to the announcement of the judgment that might influence our reported *CAR* results.

Note: Cumulative abnormal returns (*CAR*) defined in text. $Z[T_1, T_2] \sim N(0, (T_2 - T_1 + 1)^{1/2}\sigma_e)$.
*, **, *** indicate statistical significance with 90%, 95%, 99% confidence, respectively.

Although careful and measured legal study has eventually come to view the *Van Der Peet* decision as a complex and subtle interpretation of the conflict between commercial and traditional applications of aboriginal resource rights, the most obvious aspect of the decision explicitly limited aboriginal access for commercial purposes. The financial markets' initial response to the decision reflects this more immediately obvious interpretation. The cumulative abnormal returns reported in Table 1 are positive, relatively large, and four of the five are statistically distinguishable from zero. The largest cumulative abnormal return we estimate for any of the four decisions we study comes from the *Van Der Peet* decision's [0,3] event window -- a return in excess of expectations of 3.5% over the four day window. The stronger quantitative and statistical market responses we observe for the *Van Der Peet* (and *Delgamuukw*) decision may reflect increased attention being paid to the Court's judgements regarding aboriginal rights, and a new degree of legal sophistication on behalf of those individuals supplying investment funds to Canada's forestry firms.

From Table 1 we can see that participants on the TSX had a very strong, negative reaction to the *Delgamuukw* decision -- all five event windows have negative cumulative abnormal returns and the first three windows' returns were statistically distinguishable from zero. During the three days following the release of the decision [0,2] the forestry sector experienced a reduction in their common share prices in excess of expectations by more than 3%. In this case, the market participants' initial reactions to *Delgamuukw* appear to have been consistent with what were to eventually become well justified concerns about uncertain contemporaneous and future non-aboriginal commercial stock access. The judgment recognized constitutionally protected aboriginal title, but limited the exclusivity of these rights to lands and resources that had been continuously occupied by aboriginal claimants since before the assertion of Crown sovereignty. This aspect of the decision must have been met with relief by non-aboriginal commercial interests. However, the decision went on to assert that aboriginal title, once established, would be beyond the power of the Federal Government to extinguish, unless aboriginal people surrendered those rights. Perhaps even more troubling for the security of commercial access, the judgment also took a more generous approach to the type of evidence that might be used to prove exclusive occupation, and the type of acts that might qualify as occupation. The test for justified infringement set out in *Van Der Peet* was expanded in *Delgamuukw* to explicitly include some forms of commercial resource development. *Delgamuukw* almost immediately seemed to cast a cloud over the security and stability of property rights in the areas of Canada subject to claims of aboriginal title. The impact of this uncertainty is clearly visible in our estimates of the cumulative abnormal returns experienced by Canada's forestry sector following the decision.[23]

The results from these event studies quite strongly suggest that the release of the Canadian Supreme Court's decisions in *Calder, Sparrow, Van Der Peet* and *Delgamuukw* triggered measureable responses from financial market participants who were supplying investment funds to domestic forestry firms through the Toronto Stock Exchange. These responses reflect the participants' interpretation of the value of the net economic impact of the changes in property rights provisions embodied in these decisions. As we have discussed, the market's responses often defy any easy or obvious interpretation, but they do seem to be consistent with initial expectations regarding the decisions' impact on contemporaneous stock access and uncertainty surrounding future access for resource extraction and processing firms. Of course, measuring the value of the net impact of these stock access and uncertainty effects on forestry firms' common share prices tells us little about *why* these effects matter to the financial market participants. To determine why stock access and uncertainty matters, we must investigate the impact that these effects had on the forestry firms' economic fundamentals, including their reproducible and natural capital investment decisions, output decisions, and profitability. Armed with a better understanding of the relationship between the estimated investment supply effects and (in particular) profitability, we can then go even further and measure the macroeconomic growth consequences stemming from the stock access and uncertainty effects underlying the cumulative abnormal returns reported in Table 1.

5. The Decisions' Impact on the Forestry Sector's Economic Fundamentals

[23] Graham and Metcalf (2010, Table 3 and 4) report the results from event studies investigating the economic impact of the *Haida* (2004), *Taku River* (2004), and *Marshall and Bernard* (2005) decisions that have substantively added to the Canadian jurisprudence on aboriginal property rights since *Delgamuukw*.

Our event studies reveal the value financial market participants' placed on the net economic impact of the property rights discontinuities that were embodied in the four landmark Supreme Court decisions we studied. We have argued that the valuation of Canada's forestry firms was most likely to have been affected by the contemporaneous stock access and uncertainty effects stemming from these decisions. We now turn our attention to the question of *why* and *how much* these effects mattered for the domestic forestry firms. More specifically, on the basis of predictions made by renewable resource and finance theory we have developed a partial equilibrium simulation model to help us trace out the channels through which stock access and uncertainty effects can have an impact on the economic fundamentals that characterized the Canadian forestry sector during the 1970-2005 period.[24] With our model we perform a series of simulation exercises which allow us to identify the set of coincident changes in stock access and uncertainty that can account for the investment supply effects we measure with our event studies. We then assess the impact of these coincident changes on the forestry sector's production decisions, demand for reproducible and natural capital, and profitability.

5.1 Simulation Model: Renewable Resource, Finance and Production Theory

Virtually all theories of optimal renewable resource extraction assume that resource industries choose their production levels to maximize the present value of the stream of expected profits.[25] Decision makers within the resource industry face a series of constraints when seeking to maximize profits, including a technological constraint described by a standard production function, a reproducible capital accumulation constraint described by an investment demand function, and a natural capital accumulation constraint described by both investment demand determinants and biological determinants. To facilitate the exploitation of the information we have derived from our event studies, we augment a standard dynamic optimal resource extraction model, which includes an objective function and the three constraints, with an additional

[24] The model used in this paper is based on a similar model described in detail in Keay (2010).
[25] For a more detailed description of optimal extraction theory see Neher (1990, Chapter 17), or Hartwick and Olewiler (1998, Chapter 10).

multi-factor CAPM external investment supply constraint. The theoretical structure underlying our simulation model takes the form:

Objective Function: $Max_Q \int^T E(\Pi_t)e^{-rft}dt$

Definitions:
(i) Profit Function: $\Pi_t = P_t Q_t - C(Q_t, wk_t, wl_t)$
(ii) Production Function: $Q_t = f(A_t, k_t, l_t, b_t)$

Constraints:
(i) Reproducible Capital Accumulation: $\Delta k_{t+1} = h(Q_t, P_t, \sigma_{Pt}, wk_t, wl_t, R_t)$
(ii) Natural Capital Accumulation: $\Delta b_{t+1} = g(\Pi_t, \sigma_{Pt}, R_t, Temp_t, Pcip_t, Q_t)$
(iii) Investment Supply: $R_t = m(rf_t, R_{mt}, \Delta E(\Pi_t), \sigma_{Pt})$

In the decision maker's objective function, expected industry profits are discounted by a risk free interest rate (*rf*). The choice of optimal production levels (Q_t), and the resultant industry profits (Π_t), hinge on the trade-off between extraction costs (*C(...)*) and output prices (P_t).[26] Extraction costs are typically considered to be dependent on standard cost determinants, which include input prices (wk_t and wl_t), and the scale of production (Q_t).[27] Productivity (A_t), capital intensity (k_t/l_t) and the size of the resource stock *in situ* (biomass -- b_t) affect costs through their impact on Q_t. Depletion of the *in situ* stock is expected to be positively related to extraction and processing costs, hence negatively related to profits.

The technological environment faced by forestry firms is simply modeled as a production function in which output is determined by productivity, capital intensity, and the resource stock. No returns to scale constraints are imposed on this technology. Labour in this model is assumed to be supplied elastically at an exogenously determined price.

[26] Although a large fraction of Canadian forestry output has traditionally been exported to the United States, exchange rates have very little explanatory power in any of our empirical estimates. As a result, we do not include exchange rates in our exposition of the theoretical foundations for our simulation model. See Keay (2010, Table 2).
[27] For a detailed discussion of the standard cost determinants and their inclusion in resource extraction models see Varian (1992, Chapter 5) and Neher (1990, Chapter 6).

To link the economic fundamentals that characterize forestry firms' production, cost, and profit functions to the determinants of investment demand and supply, three constraints are imposed on the resource industry's decision makers. First an investment demand, or reproducible capital accumulation function assumes that the desire to accumulate machinery and equipment for next period (Δk_{t+1}) will be determined by the industry's output levels and output prices in the current period, uncertainty -- measured as output price volatility (σ_{Pt}) -- an exogenously determined wage rate for labour (wl_t), an exogenously determined average user cost for capital (wk_t), and an endogenously determined cost for investment funds raised on the domestic equity market (R_t).[28] The investment demand function for natural capital assumes that the firm's financial incentive to augment resource stock levels for next period (Δb_{t+1}) will vary with this period's profits, uncertainty and the cost of external investment funds, but these incentives will operate in concert with biological determinants of natural growth rates, including past extraction rates (Q_t), average temperatures ($Temp_t$), and average precipitation levels ($Pcip_t$).[29]

The final constraint imposed in the model is the multi-factor CAPM investment supply function that endogenously determines the cost of acquiring investment funds from the domestic equity market. Given their capital intensity, it is not surprising to find that the forestry industry actively engages in raising funds from the largest formal equity market in Canada -- the Toronto Stock Exchange. Equity market performance is included in the model because increases in common share prices imply a reduction in the cost associated with raising investment funds from formal capital markets for Canada's forestry firms. If we assume that the firms treat investment supply sources as close substitutes (capital is fungible), then rising share prices may be considered representative of a more general increase in investment supply from external sources. The basic CAPM approach used in our event studies depicts the evolution of equity prices on formal stock exchanges as a function of nothing more than the risk free rate of return (rf_t) and the market average rate of return (R_{mt}). This basic approach is theoretically justified and

[28] The investment demand function for reproducible capital is based on the application of *Sheppard's Lemma* to a standard, well defined cost function, as described in Varian (1992, Chapter 5).
[29] There is a vast literature on natural capital accumulation functions (biological growth functions) for forest resources. For surveys of this literature see Pearce (1990) or Statistics Canada (1993).

empirically appropriate in the event study stage of our investigation.[30] However, in the construction of our simulation model, which focuses on longer run movements in the forestry sector's economic fundamentals, a multi-factor CAPM that includes unanticipated changes in industry profits ($\Delta E(\prod t)$), and the effect of uncertainty in the formation of expectations regarding the path of future profits (σ_{Pt}), allows us to formally model the links connecting endogenously determined investment supply decisions to investment demand incentives, output decisions, and ultimately industry profits.[31]

Drawing on our analysis of the *Calder, Sparrow, Van Der Peet* and *Delgamuukw* decisions and the results from our event studies, our focus in the employment of this theoretical model is on shocks to contemporaneous stock access and uncertainty that trigger investment supply effects. Contemporaneous stock access is captured in the model through the natural capital accumulation constraint, while uncertainty appears in all three of the model's investment constraints. Of course, the endogenous variables characterized by the model's constraints are also determinants of output levels, which implies that the cumulative impact of any changes in stock access and uncertainty on the objective function will be dependent on the specific structure and calibration of the theoretical model. After providing structure and appropriate calibration, simulation exercises may be used to identify the direction, strength, and persistence of stock access and uncertainty effects on the forestry sector's economic fundamentals, and hence macroeconomic performance.

5.2 Simulation Model: Calibration and Diagnostics

[30] By moving to a multi-factor CAPM specification we can relax our assumption that all traders exhibit quadratic preferences, or all risky assets have normally distributed returns. See Ross (1976) for a discussion of the theoretical implications associated with the movement from the basic CAPM approach to the multi-factor arbitrage pricing theory approach.

[31] In an efficient, competitive equity market, anticipated changes in profitability should already be fully reflected in equity prices. This implies that changes in equity market performance should be related to deviations from expected profitability rather than aggregate changes in profits. Although there are an infinite number of ways to model expectations (or deviations from expectations), we simply assume that investors on the TSX expected changes in forestry profits to be determined by last years' profits. This implies that all of the annual change in forestry profits may be considered unanticipated. Sensitivity tests reveal that our qualitative conclusions are unaffected by our assumption regarding the anticipation of expected profits, and the iterative solutions for the simulation model are simplified by the use of the more basic "consecutive year" expectations formation model.

After making a series of assumptions about functional forms and choosing appropriate parameters, we could derive a set of first order conditions that characterize the dynamic optimal extraction path that solves the model described above. These first order conditions would include a set of equations describing the demand and supply conditions that determine the optimal time path for natural and reproducible capital, an equation that describes the optimal production decision at each point in time, and a *portfolio balance* equation that describes the optimal trade-off between current extraction (earning a return on financial capital) and delayed extraction (earning a biological return from natural growth and a financial return from appreciation in the value of the stock *in situ*). The difficulty with this approach lies in making the theoretical solution to the problem empirically tractable. In particular, the portfolio balance equation requires an estimate of the time path of shadow prices (marginal resource rents) for the forestry stock. These figures are not only currently unavailable, they are probably impossible to derive with confidence over the long run. We do, however, have information on aggregate economic profits for the forestry sector in Canada between 1970-2005. Therefore, rather than deriving the optimal time paths that are characterized by the first order conditions, we assume that the underlying structure of the model reflects the objectives and constraints faced by decision makers in Canada's forestry sector, and we then look to the data to tell us about the direction and strength of the relationships implied by this structure. The evidence, therefore, will tell us about the time paths actually taken by the endogenous variables, and these time paths will allow us to trace out the channels linking the stock access and uncertainty effects that were triggered by property rights discontinuities, to profits, output decisions and investment incentives.

To calibrate the model we use parameters drawn from an econometric estimation of a system of five equations based on the optimal resource extraction model's objective function and constraints. We make only two changes to the variables specified in the theoretical model to make the empirical estimation feasible and appropriate. First, because we are interested in the Canadian forestry sector's responses to discontinuities in property rights provisions, we must isolate deviations that are sector specific from movements in the macroeconomy that are unrelated to the legal recognition of aboriginal rights. Specifically, we measure all of the model's endogenous and exogenous variables relative to similarly defined national aggregates. Second, because our ultimate goal is to document the long run growth effects resulting from the Supreme Court's interpretation of aboriginal rights, we measure all variables as log-differences (annual percentage changes) over time.[32] Following these two adjustments, the five equations that make up our estimation (and simulation) model take the form:

Profit Function:

$$relforent_t = \alpha 0 + \alpha 1\ relforq_t + \alpha 2\ relforp_t + \alpha 3\ relwkwl_t + \varepsilon_t \qquad (1)$$

Production Function:

$$relforq_t = \beta 0 + \beta 1\ relfora_t + \beta 2\ relforkl_t + \beta 3\ relforb_t + \varepsilon_t \qquad (2)$$

Reproducible Capital Accumulation Function:

$$relforkl_{t+1} = \gamma 0 + \gamma 1\ relforq_t + \gamma 2\ forprem_t + \gamma 3\ relforp_t + \gamma 4\ relpvol_t + \gamma 5\ relwkwl_t + \varepsilon_t \qquad (3)$$

Natural Capital Accumulation Function:

$$relforb_{t+1} = \eta 0 + \eta 1\ relforent_t + \eta 2\ relpvol_t + \eta 3\ forprem_t + \eta 4\ reltemp_t + \eta 5\ relprecip_t + \eta 6\ relforq_t + \varepsilon_t \qquad (4)$$

Investment Supply Function:

$$forprem_t = \lambda 0 + \lambda 1\ mktprem_t + \lambda 2\ relforent_t + \lambda 3\ relpvol_t + \varepsilon_t \qquad (5)$$

The endogenous variables in the system include:[33]

- $relforent_t$ = % Δ forestry economic profits (measured as value added less the opportunity cost of labour and the opportunity cost of capital)[34] divided by GDP.
- $relforq_t$ = % Δ real output of forestry sector (measured as value added deflated by an industry specific output price index) divided by aggregate Canadian real GDP.
- $relforkl_t$ = % Δ reproducible capital intensity of forestry sector (measured as nominal value of net fixed capital stock divided by an industry specific fixed

[32] Reinterpreting the variables as log-differences also ensures stationarity over the 1970-2005 period.
[33] A complete Data Appendix with a detailed description of sources and series construction for all variables used in this paper can be accessed at: http://qed.econ.queensu.ca/faculty/keayi/datalinks/dataapp3.pdf.
[34] We assume that the opportunity cost of labour is total employment multiplied by the average annual labour income earned in non-resource intensive manufacturing. We assume that the opportunity cost of capital is the nominal value of net fixed capital times Moody's AAA industrial bond yields. Note that we have not calculated marginal scarcity rents (or shadow prices) for the forestry sector. Scarcity rents have an impact on extraction decisions, but they do not directly determine aggregate profitability. For a detailed discussion of the derivation of scarcity rents in a Canadian context see Livernois, Thille and Zhang (2006).

capital price index and total employment) divided by aggregate Canadian reproducible capital intensity.

- *relforb*$_t$ = % Δ stock of natural capital in forest sector (measured as timber volume *in situ*).[35]
- *forprem*$_t$ = % Δ forestry common share prices (measured as the *TSX Annual Review's* forestry and paper products share price index) less a risk free rate of return (measured as Government of Canada long term bond yields).[36]

The exogenous variables in the system include:

- *relfora*$_t$ = % Δ forestry TFP (measured as a Tornqvist weighted average of partial factor productivities, with value added used as the output measure and average income shares used as weights) divided by aggregate Canadian TFP.
- *relforp*$_t$ = % Δ forestry output price index divided by GDP deflator.
- *relwkwl*$_t$ = % Δ user cost of reproducible capital (measured as value added less wages and salaries paid to labour divided by real gross reproducible fixed capital employed) relative to an index of hourly wages in forest and wood products industries divided by aggregate Canadian user cost of reproducible capital relative to aggregate Canadian hourly wage index.
- *reltemp*$_t$ = deviations from linear trend in average annual North American air temperature (measured across monitoring stations in contiguous US).
- *relprecip*$_t$ = deviations from linear trend in average annual volume of North American precipitation (measured across monitoring stations in contiguous US).
- *mktprem*$_t$ = % Δ composite market common share price index (measured as the *TSX Annual Review's* composite share price index) less a risk free rate of return.
- *relpvol*$_t$ = % Δ standard deviation in forestry output price index over previous 15 years divided by standard deviation in GDP deflator over previous 15 years.[37]

[35] Note that valuing the timber stock would require the estimation of scarcity rents or shadow prices for all forest stands. The calculation of these values is, if not impossible, certainly impractical. No estimates of aggregate natural capital exist for Canada until the very end of our sample period.

[36] Information on Canadian government bond yields for the earliest part of the twentieth century is scarce. I have used the series compiled by McInnis: http://library.queensu.ca/webdoc/ssdc/cbdksnew/HistoricalMacroEconomicData.

The econometric estimation of the parameters included in Equations (1)-(5) uses annual data covering the years 1970-2005 from the extraction, primary processing and secondary processing industries that comprise the Canadian forestry sector. Identification of Canada's forestry industries follows the North American Industrial Classification System (NAICS) definitions used by Natural Resources Canada in 2004.[38] Before estimating Equations (1)-(5) the time series properties of the data were explored using Phillips-Perron unit root tests.[39] Non-stationarity can be rejected with at least 99% confidence for all of the log-differenced series employed.[40] The means and standard deviations for the variables included in the model are reported in Table 2. These summary statistics represent differences in growth rates, with negative values -- for example, economic profits, output, or share prices -- indicating that the aggregate economy grew faster than the forestry sector over the post-1970 period, and positive values -- for example, reproducible capital intensity, natural capital stock, or uncertainty (output price volatility) -- indicating more rapid forestry sector growth.

Table 2: Summary Statistics for Endogenous and Exogenous Variables (1970-2005)

	Average Annual % Δ	Standard Deviation
Endogenous Variables:		
$relforent_t$	-0.003	0.343
$relforq_t$	-0.016	0.123
$relforkl_{t+1}$	0.016	0.101
$relforb_{t+1}$	0.011	0.042
$forprem_t$	-0.025	0.194

[37] 15 years has been chosen as the period over which standard deviations have been calculated in an effort to span business cycles in both the forestry sector and the aggregate economy. Comparing volatility in manufacturing prices, export prices, and the GDP deflator indicates that the inclusion of non-tradables does not substantially mute volatility in the denominator.

[38] The composition of the industries used in this study is described in Keay (2009, Figure 1).

[39] A complete set of econometric results is available by request from the authors.

[40] Despite the fact that almost all variables are I(1), we cannot find any statistically significant evidence of a long run, stable, cointegrating relationship among the equity price premia, relative resource rents, or relative price volatility series when measured in levels.

Exogenous Variables:		
relfora$_t$	0.011	0.128
relforp$_t$	0.001	0.083
relwkwl$_t$	0.024	0.303
reltemp$_t$	0.001	0.018
relprecip$_t$	0.001	0.091
mktprem$_t$	-0.009	0.163
relpvol$_t$	0.019	0.134

Note: Data series definitions provided in text. Standard deviation calculated as: $\sigma = [\Sigma^n (x_i - \mu)^2 / (n-1)]^{½}$.

To implement an estimation strategy, we assume that the decision makers within the Canadian forestry sector made joint investment and production decisions, which leads us to estimate the system of five equations using an iterative seemingly unrelated regressor technique that generates estimates equivalent to maximum likelihood estimation. This technique corrects the standard errors reported for each parameter estimate to account for correlation across the error terms from each equation.

Table 3: Econometrically Estimated Parameters for Simulation Model

	Profit Function: *relforent*$_t$	Production Function: *relforq*$_t$	Reproducible Capital Demand: *relforkl*$_{t+1}$	Natural Capital Demand: *relforb*$_{t+1}$	Investment Supply / CAPM Function: *forprem*$_t$
relforent$_t$				**0.064**	**0.336**
				(0.043)	(0.000)
relforq$_t$	**1.304**		**0.994**	**-0.228**	
	(0.001)		(0.000)	(0.001)	
relforkl$_t$		**0.544**			
		(0.000)			
relforb$_t$		**0.526**			
		(0.000)			
forprem$_t$			0.026	**0.160**	
			(0.763)	(0.000)	
relfora$_t$		**0.930**			
		(0.000)			
relforp$_t$	**2.982**		**0.642**		
	(0.000)		(0.040)		
relwkwl$_t$	**-1.625**		**-0.437**		
	(0.000)		**(0.000)**		
relpvol$_t$			-0.006	-0.098	-0.203
			(0.966)	(0.180)	(0.338)
reltemp$_t$				0.562	
				(0.104)	
relprecip$_t$				-0.053	
				(0.435)	
mktprem$_t$					**0.435**
					(0.000)
constant	-0.064	**-0.041**	**0.036**	**0.015**	-0.013
	(0.212)	(0.004)	(0.090)	(0.097)	(0.631)

R^2	0.675	0.588	0.187	0.165	0.338
X^2	0.000	0.000	0.000	0.000	0.000

Note: Equation structure, estimation procedure and data series definitions are provided in text. P-values are specified in parentheses and statistically significant parameter estimates are reported in bold font. χ^2 represents the probability that all explanatory variables are jointly statistically insignificant.

In Table 3 we report the parameter estimates (and their p-values) that characterize the fully calibrated simulation model described by Equations (1)-(5). The parameter estimates are used with the observed (or counterfactual) exogenous variables to iteratively solve for each of the five endogenous variables for 35 consecutive periods. From the estimates reported in Table 3 we can see that shocks to contemporaneous stock access have a significant and positive effect on production decisions. The point estimate on *relforb* in the production function (Equation (2)) indicates that, holding all else constant, a reduction in stock access equivalent to a 1% change in the average annual biomass growth rate has been associated with a reduction in the growth rate of production levels of over 0.5%. Increases in uncertainty, captured in our simulation model in the form of output price volatility relative to the volatility of the GDP deflator, suppressed the incentive to supply investment funds through the Toronto Stock Exchange, and reduced the forestry firms' incentive to accumulate both reproducible and natural capital. However, relative to stock access these effects appear small and statistically insignificant when estimated over the post-1970 period.[41] The point estimates on *relpvol* in the investment demand equations (3) and (4) indicate that a 1% increase in uncertainty has been associated with a 0.01% decrease in the intensity of reproducible capital use, and a 0.1% decrease in the accumulation of *in situ* timber volumes. The forestry firms' share prices appear to have been slightly more sensitive to output price fluctuations, but the relationship is still statistically insignificant -- the CAPM equation indicates that a 1% increase in uncertainty has been associated with a 0.2% decrease in the forestry firms' share prices since 1970.

Of course, production decisions, reproducible capital intensity, natural capital stocks, and the cost of raising investment funds on external financial markets have

[41] There is a much stronger statistical connection between uncertainty and equity market performance over the first half of our sample period relative to the second half. Keay (2010, Table 2) shows that the uncertainty effects are stronger still if we consider an even longer time period that spans the twentieth century.

subsequent, and in many cases statistically significant, indirect effects on the forestry sector's economic fundamentals. There is a substantial degree of persistence implied by the size and significance of the interactions among the endogenous variables that are documented in Table 3. To trace out the cumulative long run effect that stock access and uncertainty shocks can have on the fundamentals describing the profitability, investment, and production decisions being made by Canada's forestry industries, we must conduct a series of simulations using our fully parameterized model.

Before engaging in a detailed discussion of the simulations that reveal the channels through which discontinuities in property rights' provisions affect a resource intensive industry's economic fundamentals we must pause to briefly comment on the ability of the underlying model to replicate the observed endogenous variables. We have used the parameter estimates reported in Table 3 with the observed exogenous variables describing the Canadian forestry sector over the 1970-2005 period to simulate the five endogenous variables over 35 periods. We have then compared the distribution of each of the simulated endogenous variables to the distribution of each of the observed endogenous variables. For simplicity we confine our attention to the first two moments of these distributions.

Table 4: Comparing Simulated and Observed Endogenous Variables (1900-1999)

	$relforent_t$	$relforq_t$	$relforkl_{t+1}$	$relforb_{t+1}$	$forprem_t$
Observed:					
Mean	-0.003	-0.016	0.016	0.011	-0.025
StdDev	0.343	0.123	0.101	0.042	0.194
Simulated:					
Mean	**-0.006**	**-0.020**	**0.016**	**0.013**	**-0.030**
(P Value)	(0.969)	(0.845)	(0.925)	(0.830)	(0.861)
StdDev	0.372	0.126	0.043	0.037	0.162

Note: Data series definitions are provided in text. Simulated means are calculated over 35 iterations. P values reported in parentheses represent results from a z-test of the null hypothesis that simulated means are equal to observed means. Our inability to reject this null (reported in bold font) indicates that the simulated means cannot be distinguished from the observed means with any standard level of statistical confidence.

From Table 4 we can see that the mean simulated endogenous variables differed from the mean observed endogenous variables by less than 0.5 percentage points in every case.[42] Even for the CAPM and production functions, which generated simulated values that deviated the farthest from the observed variables, the absolute differences in growth rates are small and statistically insignificant. We can also see that, with the exception of the reproducible capital demand function, the simulation model captures much of the volatility in the observed endogenous variables. Aside from the simulated *relforkl* series, which is dramatically less volatile than the observed series, the standard deviations among the four remaining simulated series relative to the observed series vary from a high of 108.5% for the *relforent* series, to a low of 83.5% for the *forprem* series. We are confident in claiming that over 35 simulation periods our model fits the observed variables quite well.

5.3 Simulation Model: Results

Our event studies reveal that the Supreme Court of Canada's *Calder, Sparrow, Van Der Peet* and *Delgamuukw* decisions triggered statistically identifiable responses from financial market participants who were trading forestry firms' common shares on the Toronto Stock Exchange. These responses reflect the market participants' valuation of the economic impact of the property rights discontinuities embodied in these decisions. We have argued that the net economic impact of each decision was likely an aggregation of contemporaneous stock access and uncertainty effects. The event studies document short run responses to the release of the Court's decisions, but because these responses are motivated by financial market participants' expectations regarding the forestry firms' economic performance into the indefinite future, they may be associated with much longer run implications over a wide range of performance determinants.

Our simulation model includes contemporaneous stock access and uncertainty effects, and explicitly links these effects to long run equity market performance *and* profitability, production decisions, and reproducible and natural capital investment decisions. This structure facilitates the identification of combinations of stock access and uncertainty shocks that could have produced the equity price responses we measure with

[42] A Cook's distance test identifies 1974 as a statistical outlier within the profit function. As a result, the means and standard deviations reported in Table 4 have been calculated after dropping 1974 from the *relforent* equation in the simulation. Although the inclusion of 1974 decreases the simulated mean for *relforent*, the simulated and observed means remain statistically indistinguishable (p value on the test for common means drops to 0.612).

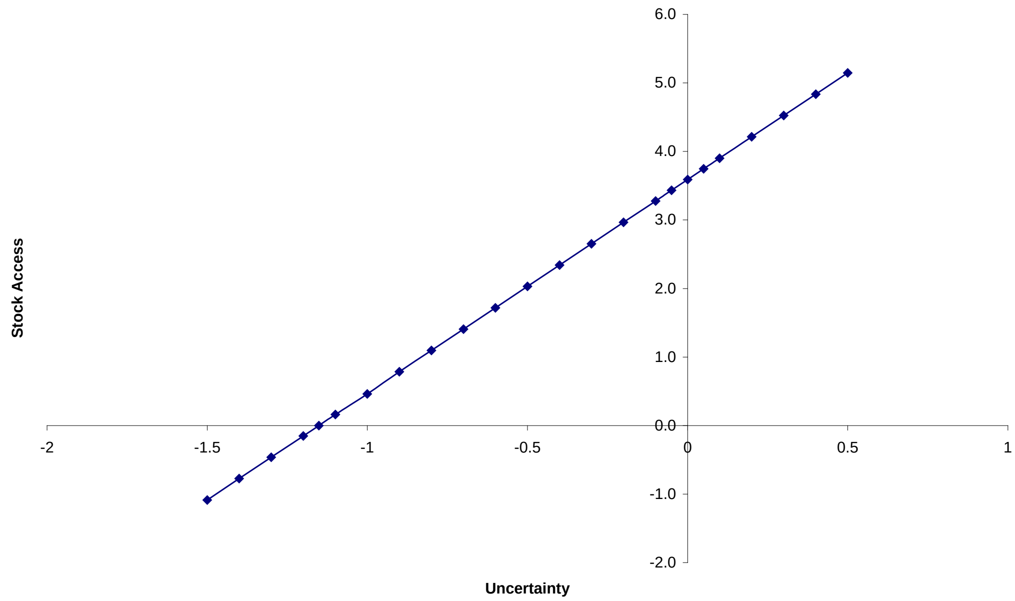
our event studies, while also allowing us to track the longer run, cumulative changes in all of the forestry sector's key economic fundamentals that result from these shocks. In the model, *reductions* in contemporaneous stock access decrease output levels and increase extraction costs, both of which drive down profits and equity prices in future periods. *Increases* in uncertainty, on the other hand, directly and immediately reduce equity prices and the incentive to accumulate both reproducible and natural capital. These investment effects decrease output levels and increase extraction costs in subsequent periods, again reducing profits and further lowering equity prices. Constraining stock access and fostering uncertainty, therefore, both exert downward pressure on profits and equity market performance, and this pressure accumulates over time as the direct and indirect effects filter through the model. As this suggests, any given change in common share prices may be triggered by a combination of stock access and uncertainty shocks.

To identify the combination of stock access and uncertainty shocks that can produce equity price effects equivalent to those estimated from our event studies, and to document the impact of these effects on the Canadian forestry sector's economic fundamentals, we begin by setting all exogenous variables in the model at their long run means, calculated over the 1970-2005 period. We then iteratively solve the model's five equations through 35 periods, generating a series of simulated endogenous variables that are constant and equal to their long run means. After imposing a shock to contemporaneous stock access at an arbitrary date ($t=0$), we can measure the initial equity price response to this shock through the investment supply function (*forprem*). By simultaneously adjusting the level of uncertainty (*relpvol*) at $t=0$, the equity price response can be varied until it matches the results from our event studies. By repeating this process we can identify a range of uncertainty-stock access combinations that generate each of the equity price responses we measure with our event studies. To complete the exercise, for each of the uncertainty-stock access pairs we run the simulation model forward a minimum of 10 additional periods ($t=10$) to track the long run, cumulative effects of these coincident shocks on all five of the endogenous variables.

We could report a set of uncertainty-stock access shocks that could have produced each of the equity price responses reported in Table 1. However, in an effort to focus the discussion, we have chosen to confine our attention to the upper and lower bounds of the equity market responses reported in Table 1. The largest and smallest statistically significant cumulative abnormal returns we have derived from our event studies form a range over which discontinuities in property rights provisions can affect the performance of a resource intensive industry. The four day event window [0,3] following the release of the *Van Der Peet* decision generated the largest cumulative abnormal return (+3.5%), while the three day window [0,2] following *Delgamuukw* generated the smallest cumulative abnormal return (-3.1%).

In Figure 1 we illustrate the combination of stock access and uncertainty shocks that generate an equity price response in *t=1* equal to the upper bound established in our event studies: +3.5% from *Van Der Peet* [0,3]. Changes in uncertainty are measured as a fraction of one standard deviation in the observed relative output price volatility series (*relpvol*). A value of 1.0 on the horizontal axis in Figure 1, therefore, represents an increase in uncertainty equivalent to a one standard deviation increase in the volatility of forest product prices relative to the GDP deflator. Changes in contemporaneous stock access are measured as a fraction of one standard deviation in the observed growth rates of *in situ* Canadian timber volumes (*delforb*). A value of 1.0 on the vertical axis in Figure 1, therefore, represents an increase in stock access equivalent to one standard deviation in the long run annual average growth rate in natural capital within the forestry sector.

Figure 1: Uncertainty and Stock Access Combinations
(*Van Der Peet:* Δ Equity Price = 0.035)



From Figure 1 we can see that if financial market participants had attributed no uncertainty effects to the *Van Der Peet* decision in August 1996, then the estimated +3.5% equity market response would have required a substantial shock to stock access, equivalent to more than 3.5 standard deviations in the long run growth rate of *in situ* biomass. In contrast, the forestry sector's equity prices appear to have been considerably more sensitive to changes in uncertainty, at least in the short run. If financial market participants had attributed no contemporaneous stock effects to the *Van Der Peet* decision, then the largest equity market response we have measured would have required a shock to uncertainty equivalent to just 1.2 standard deviations in the relative volatility of Canadian forest product prices.

While the simulation results depicted in Figure 1 reveal the relative sensitivity of our investment supply function to stock access and uncertainty shocks, they do not provide any information regarding the cumulative impact that these shocks have on all of the sector's economic fundamentals.[43] The dark blue line in Figure 1 represents the

[43] Note that shocks in our simulation model are defined as fractions of a standard deviation in the observed stock access and price volatility variables. As such, "sensitivity" does not refer to an absolute level, but it is defined relative to the frequency of observing movements of the required magnitude. Recall from Table 2: $\sigma_{\text{stock access}} = 0.042$, $\sigma_{\text{uncertainty}} = 0.134$.

infinite number of stock access and uncertainty combinations that could have triggered *Van Der Peet*'s +3.5% equity price shock in *t=1*. For each of these possible combinations there is a different long run profit, production, and investment outcome for the forestry sector. To fully characterize the performance implications stemming from *Van Der Peet*, we narrow our focus by considering only the uncertainty-stock access combinations that seem consistent with our legal interpretation of the content of the decision.

In our discussion of the *Van Der Peet* decision from Section 3, we argued that the Court's movement towards the imposition of restrictions on the breadth of aboriginal land rights that might preclude non-traditional uses, including the extraction and processing of resource stocks for commercial gain, was likely viewed with considerable favour by those already engaged in commercial exploitation. It seems reasonable to suppose that the *Van Der Peet* decision's "traditional use" test reduced at least some aspects of the uncertainty faced by the Canadian forestry sector with respect to the security of their stock access into the future *and* it was likely viewed as a step towards the preservation of contemporaneous access under the existing Federal regulatory regime. This implies that the combination of stock access and uncertainty effects stemming from *Van Der Peet* probably fell within the north-west quadrant of Figure 1 -- reducing uncertainty and improving contemporaneous stock access -- which in turn implies a maximum uncertainty effect of -1.15 standard deviations if the stock access effect was 0, and a maximum stock access effect of +3.59 standard deviations if the uncertainty effect was 0.

In Table 5 we report the cumulative impact that these upper and lower bounds on contemporaneous stock access and uncertainty shocks have on the forest sectors' economic fundamentals.[44] We can see that although both the "no stock access shock" and the "no uncertainty shock" scenarios trigger an immediate +3.5% equity price response, the cumulative equity price effect after 10 periods are higher still: 4.1% and 6.4%, respectively. The movements in share prices during simulation periods $t=1 \rightarrow t=10$ reflect the lagged impact that cheaper external investment funds (higher common share prices) have on the incentive to invest in reproducible and natural capital, which

[44] The cumulative impact is assessed 10 simulation periods after the imposition of our uncertainty and stock access shocks. After 7 periods the annual changes in the model's five endogenous variables are less than 1% of the pre-shock values for all of the simulation exercises reported here.

encourages production, reduces extraction costs, and eventually improves profitability, which further contributes to subsequent improvements in equity market performance.

If *Van Der Peet* triggered no uncertainty effects in its immediate aftermath but dramatically increased stock access (0,+3.59), our simulation model illustrates the dramatic effect this outcome would have had on the long run profitability, production and capital intensity of the forest sector -- increasing the growth rate of economic profits by 19%, production by 15%, and reproducible capital accumulation by 13% -- but perhaps most surprising is the slight reduction in the accumulation of natural capital following this short run shock to stock access. The 1.1% reduction in long run timber volume growth rates simply reflects the very large impact that this scenario has on our simulated production decisions. Increasing average annual commercial extraction rates by nearly 15% swamps any positive effect that increased investment incentives might have on the sector's desire to accumulate natural capital. These large cumulative effects on the sector's economic fundamentals indicate that the performance of Canada's forestry firms was very sensitive to changes in contemporaneous stock access, even if traders on the TSX were not.

To provide some comparative context we can consider the scenario in which *Van Der Peet* triggered no contemporaneous stock access effects in its immediate aftermath (-1.15,0). In this case, the shock to uncertainty would have had a much smaller impact on the long run profitability, production, capital intensity, and stock accumulation of the forestry sector -- increasing the growth rate of economic profits by just 2.8%, production by 2.1%, reproducible capital accumulation by 2.1%, and natural capital accumulation by 1.9%. The growth rate of the forest sector's *in situ* biomass rises in the "no stock access shock" scenario because the improvement in investment demand incentives associated with the reduction in uncertainty more than offsets the small increase in the rate of extraction.

The cumulative effects of the *Van Der Peet* decision documented in Table 5 clearly indicate that the investment supply function is more sensitive to uncertainty shocks than any of the other equations in the model. This sensitivity reflects the responsiveness of Canadian financial market participants to perceived changes in the risks associated with the long run security of property rights for resource intensive industries. Investors on the TSX crave certainty, and are quick to react to any new uncertainty introduced through discontinuities in property rights provisions embodied in aboriginal rights decisions released by the Supreme Court.

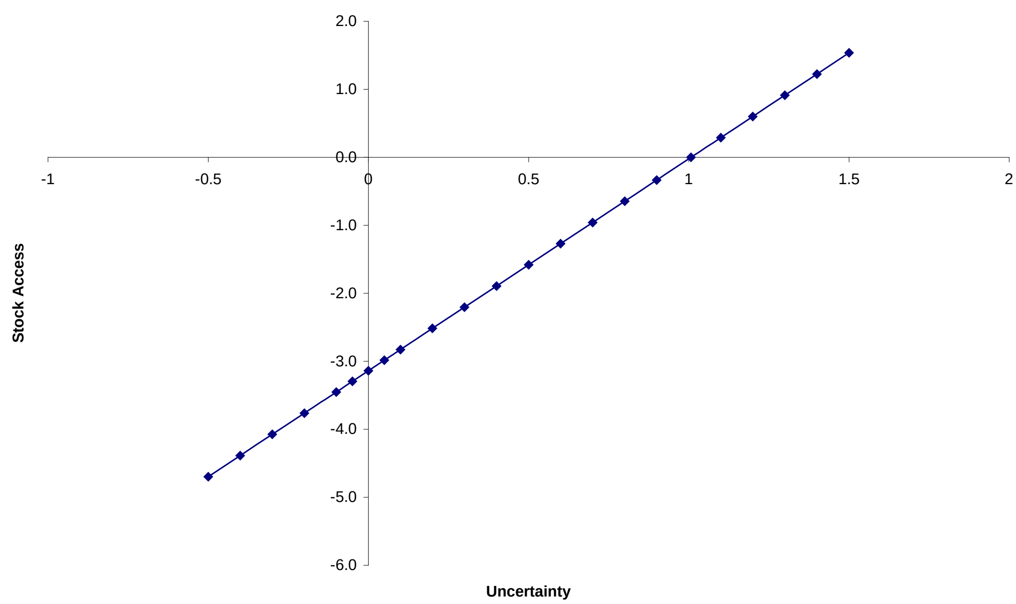
Table 5: Consequences for Economic Fundamentals Stemming from Δ Uncertainty, Δ Access Combinations

	Van Der Peet (Δ Uncertainty, Δ Stock Access)		*Delgamuukw* (Δ Uncertainty, Δ Stock Access)	
	(-1.15, 0)	(0, +3.59)	(+1.01, 0)	(0, -3.14)
Δ relforent	0.028	0.191	-0.024	-0.167
Δ relforq	0.021	0.147	-0.018	-0.128
Δ relforkl	0.021	0.133	-0.018	-0.117
Δ relforb	0.019	-0.011	-0.016	0.010
Δ forprem	0.041	0.064	-0.036	-0.056
Δ GDP/capita	0.0006	0.0046	-0.0005	-0.0029

Note: Δ Uncertainty and Δ Stock Access defined as a fraction of one standard deviation in observed series. Δ economic fundamentals defined as change in the long run simulated growth rates 10 periods after uncertainty and stock access shocks imposed on model.

Turning to our lower bound estimate of the equity market response to property rights discontinuities -- *Delgamuukw*'s [0,2] -3.1% cumulative abnormal return -- we find more evidence that the external suppliers of investment funds were very sensitive to uncertainty shocks, while the forestry sector's other fundamentals were much more sensitive to stock access shocks. In Figure 2 we illustrate the combination of stock access and uncertainty shocks that generate an equity price response in *t=1* equal to the lower bound established in our event studies: *Delgamuukw* [0,2]. We can again see that any equity price effect can be achieved through an infinite number of combinations of offsetting increases in stock access and uncertainty. In our discussion of *Delgamuukw* in Section 3 we argued that the main features of the decision involved the introduction of considerably more flexibility in the application of aboriginal land rights and the requirement that any commercial exploitation that might infringe upon aboriginal rights must be preceded by consultation among stake-holders and possibly compensation. It seems reasonable to suppose that the *Delgamuukw* decision's flexibility and consultation-compensation provisions must have ushered in an entirely new dimension of uncertainty with respect to the security of property rights and the value of these rights even if they remained secure. The contemporaneous stock access effects are less obvious, but they could not have been favourable from the perspective of commercial exploitation under the pre-existing Federal regime. This interpretation implies that the combination of stock access and uncertainty effects stemming from *Delegamuukw* probably fell within the south-east quadrant of Figure 2 -- increasing uncertainty and reductions in contemporaneous stock access -- which in turn implies a maximum uncertainty effect of +1.01 standard deviations if the stock access effect was 0, and a maximum stock access effect of -3.14 standard deviations if the uncertainty effect was 0. Again, we can see that for any given equity price effect, the investment supply function is less sensitive to stock access shocks than it is to uncertainty shocks, where sensitivity is defined relative to the observed variation in the timber volume and output price volatility series.

Figure 2: Uncertainty and Stock Access Combinations
(*Delgamuukw* : Δ Equity Price = -0.031)



In Table 5 we see the cumulative impact of *Delgamuukw*'s maximum and minimum contemporaneous stock access and uncertainty shocks on the forestry sectors' economic fundamentals. Our qualitative conclusions are very similar to those we proposed with reference to the *Van Der Peet* decision. The cumulative impact of the uncertainty and stock access shocks on equity prices is higher than the initial impact as a result of the suppression of investment demand and eventually profitability, which further undermines equity market performance. The large cumulative output effect following a negative stock access shock offsets the investment demand effect, such that the rate at which firms accumulate natural capital actually rises slightly in the long run in the "no uncertainty shock" scenario. The forestry sector's fundamentals are considerably more responsive to the contemporaneous stock effect required to produce the *Delgamuukw* [0,2] -3.1% equity price shock, relative to the required uncertainty effect. Following a reduction in stock access equivalent to 3.14 standard deviations in the growth rate of *in situ* timber volumes, our simulation model generates a cumulative profit effect of -16.7%, a reduction in output growth of -12.8%, and a slow down in reproducible capital accumulation equal to -11.7%. In contrast, an uncertainty shock equivalent to a 1.01 standard deviation increase in relative output price volatility triggers a cumulative profit effect of just -2.4%, a reduction in output growth of -1.8%, and a reduction in reproducible capital accumulation equal to -1.8%. The simulation results reported in Table 5 for the upper and lower bounds on the uncertainty and stock access effects stemming from the *Delgamuukw* decision simply reinforce our view that the performance of Canada's forestry sector was much more responsive to changes in contemporaneous stock access and much less responsive to changes in uncertainty than external financial market participants. For traders on the TSX, uncertainty in the formation of their expectations about performance seems to have been a more important determinant of their perception of firm value than contemporaneous stock access, even though access was a stronger determinant of cumulative performance.

6. The Impact on Macroeconomic Performance: A General Equilibrium Extension

The simulation results reported in Table 5 refer to the sector specific effects of uncertainty and stock access shocks stemming from the property rights discontinuities embodied in the Supreme Court's *Van Der Peet* and *Delgamuukw* decisions. Changes in the forestry sector's economic fundamentals certainly contribute to macroeconomic performance, but to explicitly link changes in the formal legal recognition of aboriginal rights to the long run performance of a resource intensive economy, we must move from our partial equilibrium simulation model to a more general equilibrium framework. To model the forestry sector's role in the Canadian economy between 1970-2005 we adopt a very simple approach that leans heavily on the model developed by Chambers and Gordon (1966) to estimate the net contribution made by western wheat production to Canadian economic performance in 1911.[45] Following Chambers and Gordon, we assume perfectly elastic labour and capital supplies within the resource sector and we ignore any externalities that may spillover from forestry into other less resource intensive activities. With these two simplifying assumptions Chambers and Gordon have shown that the net impact of a "resource shock" on real Canadian GDP per capita can be fully captured by measuring the impact of the shock on the returns paid to the fixed factor in production -- in their case study, prairie land rents.

Although Lewis (1975) has shown that loosening the assumptions regarding perfectly elastic labour and capital supplies can have a significant effect on the net impact of resource shocks, and Keay (2007) has shown that over the twentieth century spillovers linking resource industries to more capital or labour intensive activities were substantial, in an effort to establish a lower bound on the macroeconomic consequences of property rights discontinuities we will maintain Chambers and Gordon's simplifying assumptions. This implies that the key endogenous variable from our simulation model is the growth rate of the forest sector's economic profits. Forestry generates economic profits because extraction and processing activities earn a return off the fixed factor of production -- trees -- without paying a market price for this factor. If we accept that the profits earned by the forestry sector contribute directly to income per capita, and GDP growth is a weighted average of sectoral growth rates (including forestry), then we can calculate a counterfactual change in the average growth rate of real Canadian GDP per capita between 1970-2005 that may be attributed to the cumulative change in forestry profits triggered by the *Van Der Peet* and *Delgamuukw* decisions.

In the last row of Table 5 we report the results from four counterfactual experiments. In these experiments we ask what the change in Canadian income per capita growth would have been in the absence of the Supreme Court's *Van Der Peet* and *Delgamuukw* decisions, had their been either no uncertainty shocks or no stock access

[45] McCloskey (1972) has used the same model to estimate the macroeconomic impact of a reorganization of agricultural property rights in Britain during the late eighteenth and early nineteenth centuries.

shocks associated with each of these rulings. We can see that an increase in the rate of growth of forestry profits of 2.8% (*Van Der Peet* [0,3], no stock access-maximum uncertainty shock) would have lead to an increase in long run intensive growth in Canada equal to 0.06 percentage points. In the no uncertainty-maximum stock access shock scenario, *Van Der Peet* would have increased the rate of growth of forestry profits by 19.1%, which would have improved long run intensive growth over the post-1970 period by 0.46 percentage points.

Following the *Delgamuukw* decision, the counterfactual real GDP per capita growth rate effects fall between -0.05 percentage points and -0.29 percentage points (corresponding to the "no stock access shock" and "no uncertainty shock" scenarios, respectively). If we estimate the cumulative income per capita impact of all four of the landmark aboriginal land rights cases we consider with our event studies by repeating our simulation exercises and counterfactual experiments using the upper and lower bounds on the uncertainty and stock access effects associated with the *Calder* and *Sparrow* decisions, we find that the property rights discontinuities embodied in these decisions contributed between 0.08 and 0.73 percentage points to long run Canadian real GDP per capita growth over the 1970-2005 period.

These estimates may not seem like a very large counterfactual shocks to macroeconomic performance. The small reductions in real GDP per capita growth are an illustration of *Harberger's Law*, which tells us that a fraction multiplied by a fraction is a smaller fraction. In this case, even substantial changes in the rate of growth of forestry profits in response to uncertainty or stock access shocks do not have much effect on the aggregate economy because the forestry sector (more specifically, forestry profits) do not comprise a very large fraction of total economic activity. Of course, the small numbers reported on the last line of Table 5 do not necessarily imply that these counterfactual growth effects were unimportant. One must keep in mind that on average Canadian income per capita grew at 1.97% per year after 1970. This implies that our estimate of the aggregate counterfactual growth effect of all four Supreme Court decisions may have accounted for as much as 37% (or as little as 4%) of the observed income per capita growth in Canada. One must also recall that these estimates should be interpreted with caution. Not only have we constructed our simulation exercise and counterfactual experiment on the basis of a set of assumptions that are intended to establish a lower bound on the macroeconomic impact of these decisions, but we only consider four of the most widely analyzed aboriginal rights decisions. Many other decisions from a wide range of judicial forums have contributed to the cumulative uncertainty and stock access effects associated with s.35[1] of the 1982 *Constitution Act*. We have also confined our attention exclusively to the forestry sector in Canada. Forestry firms comprised a large and important part of the Canadian economy after 1970, but other resource sectors such as mining and energy have been even larger, they have been growing faster, and they may have been even more sensitive to property rights discontinuities.[46]

7. Conclusions

The need for stable and secure property rights to encourage efficient resource use and promote investment in reproducible and natural capital is a common theme both in academic literature, and in the representations industry has made to government in response to the recognition of aboriginal rights through judicial decisions. In this paper, we set out to measure the industry specific and macroeconomic consequences of judicial decisions that recognize aboriginal rights. These decisions necessarily affect market participants' perceptions regarding the security of property rights for non-aboriginal commercial stakeholders in the short and long run. In particular we focus on shocks to Canadian forestry firms' contemporaneous stock access and the security of their property rights into the indefinite future that were embodied in four landmark Supreme Court of Canada decisions -- *Calder, Sparrow, Van Der Peet,* and *Delgamuukw*. Based on the results from a series of event studies, a partial equilibrium simulation model, and a highly stylized general equilibrium framework, we find that discontinuities in property rights provisions embodied in judicial decisions have important consequences for long run performance among resource intensive economies. In Canada since 1970, both industry and macroeconomic performance appears to have been particularly sensitive to shocks to

[46] Between 1970-1999 4.46% of Canada's GDP originated in forestry, 5.29% came from mining and energy contributed 4.60%. Energy was the only Canadian resource sector to experience an increase in their GDP share after 1970. For a more detailed comparison of the resource industries contributions to aggregate economic activity in Canada see Keay (2009).

contemporaneous stock access. Uncertainty effects associated with the Supreme Court's decisions did have a fairly dramatic impact on financial market performance, but their impact on the forestry sector's economic fundamentals and aggregate intensive growth was less dramatic, although still statistically significant. Clearly, the immediate impact of the Court's decisions on commercial access *and* the clarity and decisiveness of the rulings had measureable economic effects.

There are, of course, several important *caveats* associated with our event study approach, the construction of our simulation model and our general equilibrium counterfactual experiments. Despite these reservations, we suggest that our investigation represents a valuable first step towards the provision of some empirical measures of the economic impact of discontinuities in the formal legal recognition of aboriginal and non-aboriginal property rights. The idea that the recognition of aboriginal land claims has been costly for Canada's resource industries, and consequently all Canadians, is pervasive. It is important to try and address the accuracy of these claims, so policy-makers can gauge the importance of trying to clarify and streamline the process of incorporating aboriginal rights into the fabric of Canadian resource law.

8. Bibliography

Acemoglu, D. and S. Johnson (2005), "Unbundling Institutions", *Journal of Political Economy,* Vol. 113, Pg. 949-95.

Bhagat, S. and R. Romano (2002), "Event Studies and the Law, Part I: Technique and Corporate Litigation", *American Law and Economics Review,* Vol. 4, Pg. 141-67.

Binder, J. (1998), "The Event Study Methodology Since 1969", *Review of Quantitative Finance and Accounting*, Vol. 11, Pg. 111-37.

Brown, S. and J. Warner (1985), "Using Daily Stock Returns", *Journal of Financial Economics*, Vol. 14, Pg. 3-31.

Chambers, E. and D. Gordon (1966), "Primary Products and Economic Growth: An Empirical Measurement", *Journal of Political Economy,* Vol. 74, Pg. 315-32.

Coase, R. (1960), "The Problem of Social Cost" *Journal of Law and Economics,* Vol. 3, Pg. 1-44.

Cragg, J. and B. Malkiel (1982), *Expectations and the Structure of Share Prices*, University of Chicago Press: Chicago.

de Soto, H. (2000), *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else*, Basic Books: New York.

Demsetz, H. (1967), "Toward a Theory of Property Rights", *American Economic Review*, Vol. , Pg. 347-59.

Dick, T. (1982), "Canadian Newsprint, 1913-1930: National Policies and the North American Economy", *Journal of Economic History*, Vol. 42 Pg. 659-87.

Fama, E. (1991), "Efficient Capital Markets: II", *Journal of Finance*, Vol. 46, Pg. 1575-617.

Fama, E., L. Fisher, M.C. Jensen, and R.W. Roll (1969), "The Adjustment of Stock Prices to New Information", *International Economic Review*, Vol. 10, Pg. 1-21.

Gordon, H.S. (1954), "The Economic Theory of a Common Property Resource", *Journal of Political Economy*, Vol. 62, Pg. 124-42.

Gupta, S. and B. Goldar (2005), "Do Stock Markets Penalize Environment-Unfriendly Behavior?: Evidence from India", *Ecological Economics*, Vol. 52, Pg. 81-95.

Hardin, G. (1968), "The Tragedy of the Commons", *Science*, Vol. 162, Pg. 1243-48.

Hartwick, J. and N. Olewiler (1998), *The Economics of Natural Resource Use, 2nd Edition*, Addison-Wesley: Toronto.

Keay, I. (2007), "The Engine or the Caboose? Resource Industries and Twentieth Century Canadian Economic Performance", *Journal of Economic History*, Vol. 67, Pg. 1-32.

Keay, I. (2009), "Resource Specialization and Economic Performance: A Canadian Case Study, 1970-2005", *Canadian Public Policy*, Vol. 35, Pg. 291-314.

Keay, I. (2010), "The Impact of Commodity Price Volatility on Resource Intensive Economies", Unpublished Manuscript.

Lamdin, D. (2001), "Implementing and Interpreting Event Studies of Regulatory Changes", *Journal of Economics and Business*, Vol. 53, Pg. 171-83.

Lewis, F. (1975), "The Canadian Wheat Boom and Per Capita Income: New Estimates", *Journal of Political Economy*, Vol. 83, Pg. 1249-57.

Lintner, J. (1965), "The Valuation of Risky Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets", *Review of Economic Studies*, Vol. 47, Pg. 13-37.

Livernois, J., H. Thille and X. Zhang (2006), "A Test of the Hotelling Rule Using Old Growth Timber Data", *Canadian Journal of Economics*, Vol. 39, Pg. 163-86.

Lower, A. (1933), "The Trade in Square Timber", *Contributions to Canadian Economics*, Vol. 6, Pg. 40-61.

MacKinlay, C. (1997), "Event Studies in Economics and Finance", *Journal of Economic Literature*, Vol. 35, Pg. 13-39.

Marchak, P. (1983), *Green Gold: The Forest Industry in British Columbia*, University of British Columbia Press: Vancouver.

McCloskey, D. (1972), "The Enclosure of Open Fields: Preface to a Study of Its Impact on the Efficiency of English Agriculture in the Eighteenth Century", *Journal of Economic History*, Vol. 32, Pg. 15-35.

Metcalf, C. and J. Graham (2010), "Measuring the Impact of Judicial Adjustments to Property Rights: Resource Industries and Aboriginal Rights in Canada", Unpublished Manuscript.

Neher, P. (1990), *Natural Resource Economics: Conservation and Exploitation*, Cambridge University Press: New York.

Nelles, H. (1974), *The Politics of Development: Forests, Mines and Hydro-Electric Power in Ontario, 1849-1941*, Macmillan: Toronto.

North, D. (1990), *Institutions, Institutional Change and Economic Performance,* Cambridge University Press: New York.

Pearce, P. (1990), *Introduction to Forestry Economics*, University of British Columbia Press: Vancouver.

Perman, R., Y. Ma, J. McGilvray and M. Common (2003), *Natural Resource and Environmental Economics, 3rd Edition*, Pearson-Addison-Wesley: Toronto.

Rock, M. (2003), "Public Disclosure of the Sweatshop Practices of American Multinational Garment/Shoe Makers/Retailers: Impacts on their Stock Prices", *Competition and Change*, Vol. 7, Pg. 23-38.

Ross, S. (1976), "The Arbitrage Theory of Capital Asset Pricing", *Journal of Economic Theory*, Vol. 13, Pg. 341-60.

Scott, A.D. (1955), "The Fishery: The Objectives of Sole Ownership", *Journal of Political Economy*, Vol. 63, Pg. 116-24.

Statistics Canada (1993), *Environmental Perspectives, Studies and Statistics*, Statistics Canada: Ottawa.

Varian, H. (1992), *Microeconomic Analysis, 2nd Edition*, Norton: New York.