UNIVERSITY OF VICTORIA

Political economy of resource extraction

An application to BC

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1. Introduction

Citizens of British Columbia collectively own ninety-four per cent of the province that is Provincial Crown Land. It is the voting public who influences resource-use decisions by their choice of government. However, there is an agency problem here. The elected government who is responsible for making resource extraction decisions may have different incentives from their constituents. Officially, the government follows the Crown Land Allocation Principles, which state that "Crown land values are managed for the benefit of the public" (2011). But the public includes future citizens, and politicians may manage resources based on short time horizons.

The current political climate in BC provides a useful illustration for the more general problem of inefficient resource management, as the provincial government is taking an active and "aggressive" approach to developing the Liquefied Natural Gas (LNG) industry (Speech from the throne, 2014). One implication of an aggressive approach is faster extraction rates. The present analysis attempts to work out the implications of assumed motivating factors in the BC government's active involvement in the LNG sector, and in politicized resource allocation more generally.

All resource decisions are inherently intertemporal. There is evidence that political leaders plan on shorter time horizons, which may lead to faster extraction rates, leaving less for future generations (Robinson, Torvik and Verdier, 2006). One possible explanation is that the electoral process modifies the structure of incentives for elected decision makers, a mechanism that I explore further below. Decisions in the public interest can be represented by the concept of a socially optimal extraction rate. Deviations from this benchmark can then be modelled to show the conditions that would lead to inefficient resource extraction schedules. To what extent do political incentives skew the resource extraction rate from the socially optimal benchmark?

To illustrate the general scenario, I construct a two-period utility maximization model in which an incumbent politician chooses an extraction rate and receives payoffs based on first and second period rents. An election is held between the two periods, affecting the probability of receiving second-period payoffs. For simplicity, I assume no discounting. Instead, the probability of re-election is modelled as a function of first period extraction, meaning the extraction decision can impact the probability of receiving second period payoffs. I find that the extraction decision is skewed towards the first period as compared to the benchmark.

There are a number of political economy models in the resource curse literature. I build off a model presented by Caselli and Cunningham (2009), in which they demonstrate how a “resource windfall” might influence investment elsewhere in the economy. The authors primarily discuss centralized mechanisms, in which the rents accrue directly to the political leader, and the level of investment in the non-resource sector determines if a resource windfall is a “blessing” or a “curse”. Investment decisions influence the probability of remaining in power, but in their model the actual extraction rate is given as exogenous. Caselli and Cunningham (2009) are primarily concerned with authoritarian regimes, but their framework can be modified to apply to democratic jurisdictions such as BC.

While the Caselli and Cunningham model is useful, the resource revenue is exogenous and constant in both periods, whereas the current question regards a politician’s choice of extraction rate of a fixed resource. Now there is a tradeoff implicit in the choice: extra units extracted in the first period mean fewer units available for the second period. I explore how the extraction rate might become biased towards the present when the endogenous extraction choice influences the probability of re-election. Whereas Caselli and Cunningham (2009) define the probability of retaining power as a function of spending decisions, in this case the probability of re-election is a function of the resource extraction rate.

Interestingly, when the electorate is more responsive to the resource extraction decisions and the economic activity it generates, there is a decrease in the first period extraction rate. While perhaps counter-intuitive, the model's results makes sense when considering that the benefits from increasing first period extraction are offset by the opportunity costs of not having the resource available in the second period. When the electorate is more sensitive to the extraction decision, the politician's continued control becomes more likely, and they are therefore more likely to use a longer time horizon in resource planning and to choose an extraction rate closer to the social optimal. Potentially, then, if voters were to respond more to resource extraction decisions, the outcome might be closer to the dynamically efficient outcome.

Before I explore this result in greater depth, the following section presents in more detail some background on the resource curse and the relevant pieces of the Caselli and Cunningham model. Next, I introduce the parameters and framework for the current analysis. The results and interpretations are provided with a focus on the BC case.

2. Lessons from the Resource Curse literature

2. a. *Background of resource curse theory in a political context*

To be considered a resource curse, “natural-resource abundance must lower living standards for the average person” (Caselli and Cunningham, 2009, p. 632). What has BC to do with the resource curse? When a democratic jurisdiction is reliant on revenue from fossil fuels, it is possible for resources to be managed inefficiently without a direct causal linkage to impacts on average living standards in the present time period. For example, some say Canada is becoming a "petro state" with accelerating bitumen extraction in Alberta driving economic growth. But the economic benefits may be elusive: "Canadian workers flock to Alberta for higher wages, while the provincial government, paradoxically, has run five deficits in a row" (Nikiforuk, 2014, p. 18). Residents may support such an industry because of the jobs it creates, but the negative impacts of increased bitumen extraction will be felt by the future.

There are two roles for economists in discussing the resource curse: first to empirically document that resource windfalls lead to lower living standards, and second to "identify possible theoretical mechanisms through which the curse, if there is one, operates" (Caselli and Cunningham, 2009, p. 629). Most of the current research indicates a resource curse primarily in developing countries with weak institutions, especially for mineral or point-source resources (Butkiewicz and Halit, 2010). Evidence also suggests that there is a correlation between openness to trade and low levels of growth in mineral-rich countries (Butkiewicz and Halit, 2010; Falkinger and Grossman, 2005).

BC exhibits many of the characteristics that are thought to cause a resource curse. For example, the province is rich in minerals and point-source resources, and relies on resource exports. Exports account for over 40 per cent of BC's GDP, leaving the province vulnerable to resource commodity cycles. In 2009, 70 per cent of the total exports were wood, minerals and energy commodities (Brkich, 2010). Mineral-rich democratic regions like BC may not stand up to a strict definition of the resource curse, but mechanisms identified in the resource curse literature may be transferrable to these contexts. For example, a general stream of thought is that political leaders make resource decisions based on short time horizons (Robinson, et. al., 2006). In a democratic context, BC has election cycles of four years, possibly influencing incentives for the elected politician, who may prioritize short-term gain to increase political popularity and likelihood of re-election.

Resource policy both in BC and federally has been aggressive, with a focus on energy resources. Whether these resource policies are inefficient is an empirical question; here I present a theoretical mechanism to illustrate that democratic countries are not immune to inefficient resource development policy. I show that "the process can be individually rational for all actors" (Caselli and Cunningham, 2009, p. 629).

2. b. *General modelling framework*

Assume a fixed quantity of a resource which is normalized to 1. Some proportion is extracted in period 1, and some proportion is extracted in period 2, such that the total is less than or equal to 1. In order to eliminate corner solutions and to simplify the model, assume that net marginal rents are always positive, so the resource will be entirely extracted over two time periods.

The proportion extracted in the first period is α, and in the second period is $(1-\alpha)$. With scarcity, the marginal user costs are increasing and the marginal benefits are decreasing. Using the Hotelling result for socially optimal resource allocation, the extraction rates should meet the dynamic efficiency criterion, under which "the efficient allocation is the one that maximizes the present value of net benefits" (Tietenberg, 2006, p. 90).

The dynamically efficient allocation without discounting is illustrated in Figure 1, where the net benefit curve from period 1 is read from left to right, and the net benefit curve from period 2 is read from right to left. Every point along the horizontal axis represents an allocation between the two periods equal to the total quantity of the resource reserves, which is 1. Where the two net benefit curves intersect is the efficient allocation at α=0.5.

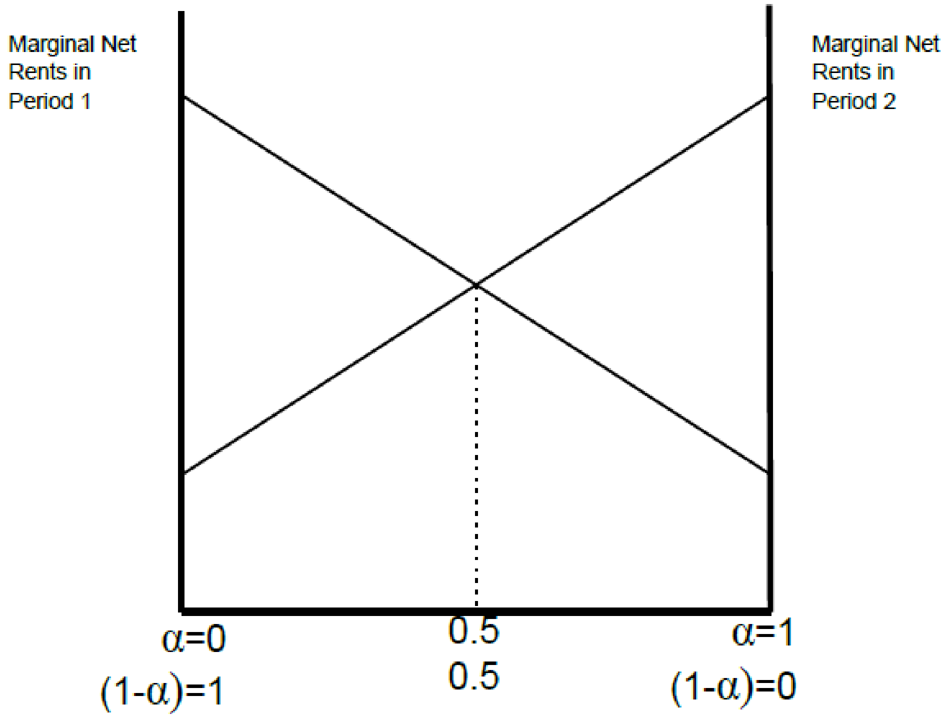


Figure 1: The dynamically efficient allocation with no discounting. Modified from Tietenberg, 2006

Marginal net benefits are decreasing because of the increasing marginal cost. When α is larger than 0.5, as by moving to the right along the downward sloping net benefit curve for period 1, net benefits in period 2 are larger than net benefits in period 1. Therefore, these solutions are inefficient and create deadweight loss. By extracting more than half in the first period, the second period opportunity costs exceed the first period benefits received from those units in excess of α=0.5. The dynamically efficient benchmark α=0.5 will be used as a comparison to the elected politician's choice of α* in the utility maximization problem. For the general decision making framework, we now turn to the political economy theory.

In the model presented by Caselli and Cunningham (2009), a political leader receives an exogenous resource "windfall" in the first period and, with some probability, in the second period. The political leader can influence their probability of retaining power through spending and investment decisions. Also, the size of the resource windfall impacts the probability function in the following way: an increase in resource revenue increases the value of being in power, which increases the likelihood of a challenge to that power, and therefore decreases the probability of retaining power.

Similarly, an increase in investment in the non-resource sector increases the value of outside options for potential challengers, and therefore decreases the likelihood of competition and increases the political leader's probability of retaining power. For the political leader, then, the probability of retaining power is dependent on incentives of potential challengers. To modify the interpretation for a democratic context such as BC, the probability function presented in the model below is dependent on characteristics of the electorate rather than of challengers.

Using the basic framework from Caselli and Cunningham's model, I present a general mechanism to explain how endogenous resource extraction decisions can vary from a dynamically efficient outcome. In the following section, the probability of re-election is used to illustrate shorter planning horizons which can lead an elected politician to inefficient resource extraction decisions. The probability function effectively acts as a higher discount rate than that of society as a whole.

3. The Model

3. a. *An elected politician's utility function*

What follows is a resource extraction model in which an elected politician maximizes their utility over two time periods by choosing some level of first period extraction, α*. The politician receives some benefits from the rents in period one and, with some probability, from the rents in period two, as shown in Equation 1. The probability of re-election is a function of α, and the parameters on the probability function represent population characteristics of the electorate, for example the likelihood that a change in α will affect voting decisions.

$$u = (rents_{t=0}) + \pi(\alpha) \cdot (rents_{t=1}) \qquad (1)$$

The choice of α enters into the elected politician's utility function in two ways: directly, through the rents, and indirectly, through the probability of re-election. Here the interpretation varies from that of Caselli and Cunningham, since the rents do not directly accrue to the elected politician. However, the level of rents still influence the utility function, since more rents mean more public money and also impacts the reputation of the politician and their affiliated political party.

Furthermore, there is resource scarcity, so the total quantity of the resource is not sufficient to fill the demand in both periods. Therefore, an increase in first-period extraction comes with increasing user costs in the second period. The rents in both periods are assumed to have convex costs and positive marginal rents such that the entire quantity of the resource will be extracted. World price is given exogenously. The full utility function is shown in Equation 2.

$$u = (p\alpha - c\alpha^2) + \pi(\alpha) \cdot [p(1-\alpha) - c(1-\alpha)^2] \qquad (2)$$

An increase in α can simultaneously increase the value of the payoffs in the first period, and make the probability of the second period more likely, thereby increasing the felt second period user costs of an increase in α. In the utility maximization problem, the first order condition is presented in Equation 3.

$$\frac{du}{d\alpha} = p - 2c\alpha + \pi'(\alpha) \cdot [p(1-\alpha) - c(1-\alpha)^2] + \pi(\alpha) \cdot [2c(1-\alpha) - p] \qquad (3)$$

It is difficult to solve for a general result because of the ambiguity in the last two terms. That is, without further specification, it is not clear which is larger: the marginal second period rent multiplied by the total probability, or the marginal probability multiplied by the total second period rents. In other words, an increase in α both marginally increases the probability of re-election, and marginally decreases the second period payoffs, and it is not clear which of these is larger. To get a better indication of the relationship, I specify the form of the probability function and test the comparative statics for certain ranges in the parameter values.

3. b. *The probability of re-election*

An incumbent politician will be re-elected with some probability, π. Many factors influence π, but in this case we are interested in the first period resource extraction decision, α. We want to know to what extent the extraction rate can influence π, or how the electorate reacts to resource decisions.

For example, a recent Kamloops poll suggests widespread support for mining in BC, with 89 per cent of nearly 3,000 respondents generally in favour, while only 35 per cent of respondents were in support of the proposed Ajax mine to be located within the city limits (Youds, 2013). While most respondents believe the Ajax mine will have a positive impact on business and employment, many think it will have a negative impact on tourism and international student enrolment at the university, and that it will have adverse environmental impacts including dust and noise. If residents were to show their dissatisfaction with the mining proposal by changing their voting behaviour, then resource decisions would have an impact on the probability of re-election.

The probability of re-election is modeled as a quadratic function to allow for positive or negative marginal probability. An increase in α can either marginally increase or marginally decrease the probability of re-election. The choice of functional form is meant to capture the divisive nature of resource management decisions. Imagine that the population is divided into two broad groups; those who are always in favour of resource extraction or the related job creation, and those who oppose further resource extraction, perhaps due to adverse environmental impacts.

The first category includes towns like Fort Nelson, where people rely on mining or other non-renewable resource industries for jobs. Fort Nelson, a "one-industry town," depends on LNG and natural gas, and those industries enjoy broad public support. Meanwhile, the second category includes Fort Nelson First Nation or Kamloops residents who are opposed to the Ajax mine, and other people who oppose further resource extraction (Moore, 2014).

The probability of re-election and its first derivative are presented in Equations 4 and 5, respectively.

$$\pi(\alpha) = b + r\alpha \cdot (1 - \frac{\alpha}{k}) \tag{4}$$

$$\pi'(\alpha) = r - \frac{2r\alpha}{k} \tag{5}$$

The parameters of the probability function represent characteristics of the electorate, or the likelihood that the electorate will re-elect the incumbent politician. First, consider the sensitivity of the electorate to resource extraction decisions. A high profile example comes from the export town of Kitimat, where a recent vote had a majority of residents opposed to the Northern Gateway pipeline's export infrastructure to go through their town. The key point here is that there was a 71 per cent voter turnout, much higher than the previous election's 56 per cent (Gilchrist, 2014). When the vote was about a resource management decision, it changed the behaviour of eligible voters and got more people out to the polls.

The *r* parameter represents the sensitivity of the electorate to resource decisions. It changes the slope of the probability function everywhere, which also necessarily changes the level of the probability, as shown in Figure 2. But it is the slope that measures the sensitivity, or how likely it is that an increase in α influences π.

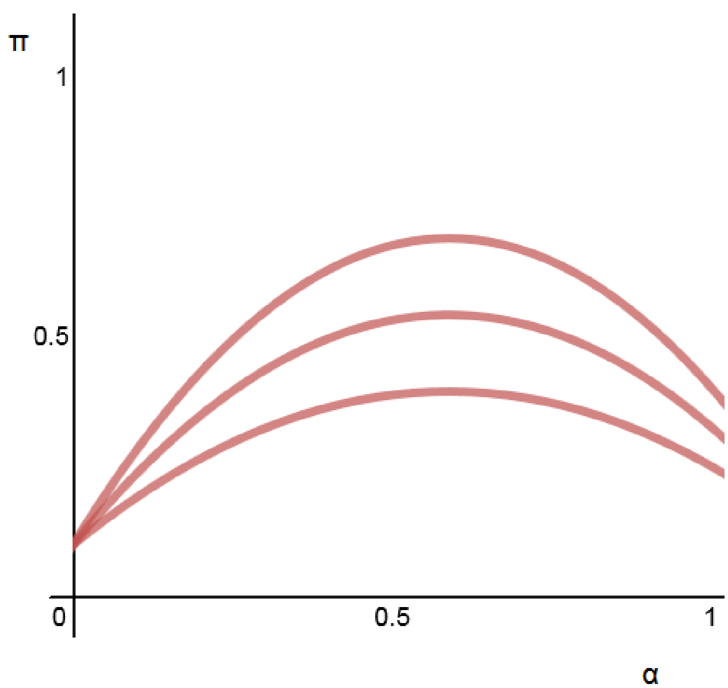


Figure 2 : Effect of changing r on π

When $r=0$, the intercept term b acts as a discount factor. The b parameter can be interpreted as a portion of the probability of re-election that is influenced by factors other than resource extraction decisions. Increasing the intercept term increases the value of the entire function, so a higher probability of re-election results. The value of b might be in the range of 0.2 to 0.4, compared to a typical discount factor in the range of 0.9.

Finally, k is a shape parameter that widens or compresses the function. It can be interpreted as the average discount rate of the electorate. For example, $k=1$ is the social discount rate, which in this case is no discounting, since the maximum probability of re-election is achieved at the socially optimal benchmark of α=0.5. Values of k that are smaller than 1 represent a negative discount rate, or a population that values the future more than they value today. In this case, the maximum of the probability function occurs at values of $\alpha < 0.5$. Finally, values of k that are larger than 1 represent positive discounting, and the maximum probability is achieved at levels of $\alpha > 0.5$.

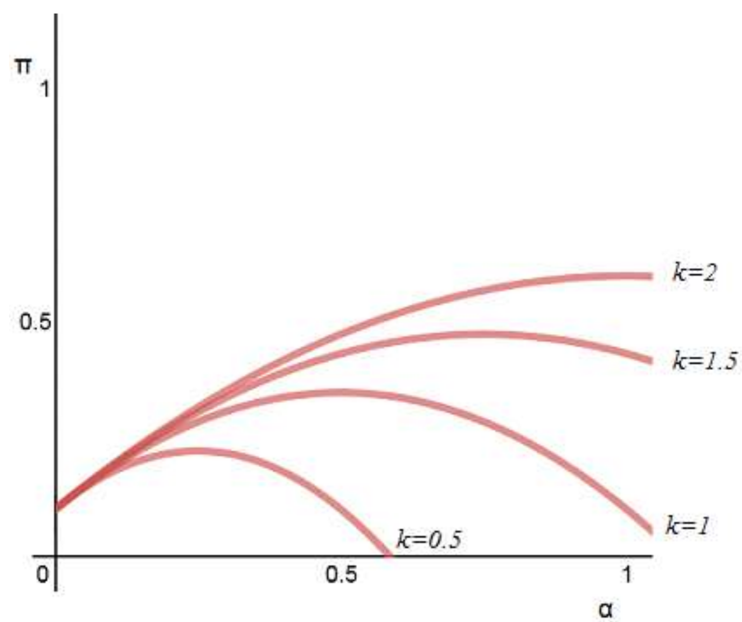


Figure 3: Impact of an increase in k on π

An alternate interpretation of k depends on the concentration of the electorate into the two categories discussed above. It is a measure of tolerance to resource decisions, which moves the maximum of the probability function, and therefore the likelihood that the resource decision will have a negative influence on voting outcomes for the incumbent politician. As k decreases, increasing α will more likely have a negative effect on π, as illustrated in Figure 3.

For example, the electorate may consist of workers in the resource industry who are in favour of job creation, in which case an increase in α may lead to an increase in π. Such may be the case in Fort Nelson mentioned above. Alternatively, the population may consist of environmentalists who are concerned with the adverse impacts associated with intensive resource extraction, in which case an increase in α may lead to a decrease in π. This may be the case with Fort Nelson First Nation, who oppose changes in the Environmental Assessment legislation that exempt new LNG facilities from environmental assessment (Moore, 2014), or with voters in Kitimat who recently voted against the Northern Gateway project (Gilchrist, 2014).

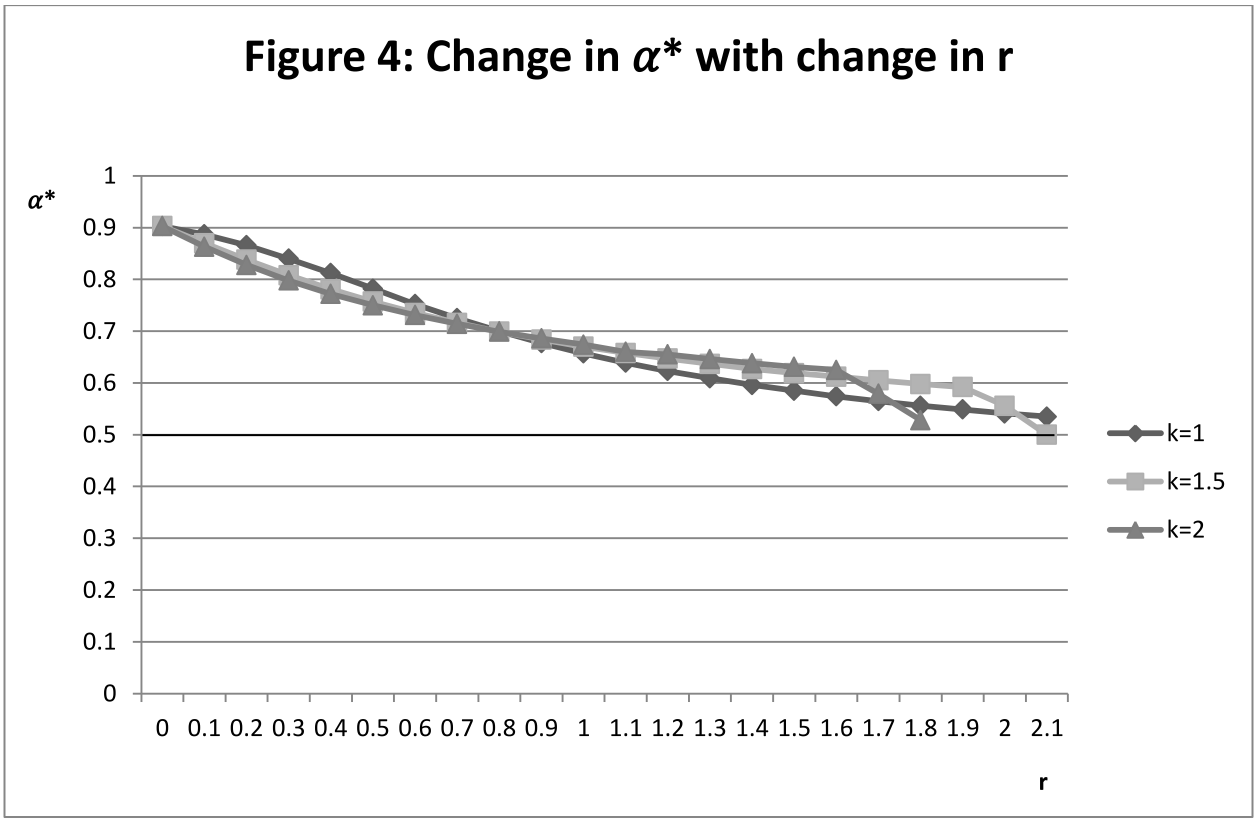
Values of k that are smaller than 1 consistently produce $\alpha^* < 0.5$ which implies an electorate that values the future more than the present. Negative discount rates are not supported in the literature. While some individuals perhaps exhibit this characteristic, it is not likely for an aggregate discount rate province-wide. Further discussion on the model's numerical results is presented in the following section.

4. Results and Discussion

4. a. *Comparative Statics*

In general, an increase in r leads to a decrease in α. With an increase in electorate responsiveness to resource decisions, the model predicts a decrease in first-period extraction.

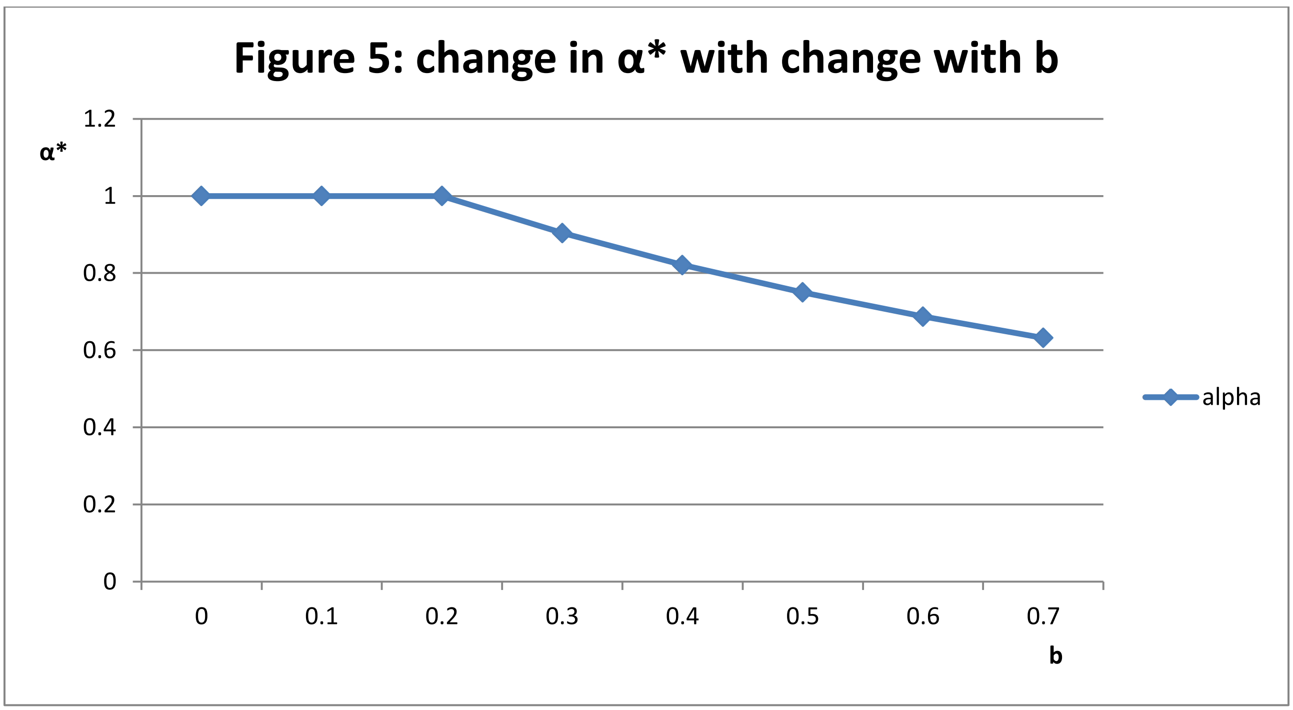
This is the case whether on the positive slope or negative slope of the probability function. An increase in r means the future rents are more valuable in expectation, leading to a decrease in α at equilibrium. Figure 4 illustrates this result for different values of *k*. Now the ambiguity in the first order condition can be worked out. The second period marginal rents are more valuable than the marginal increase in probability from increasing α



All points in Figure 4 represent an intercept value of *b=0.3*. At the left side of the graph, *r=0* and *α*=0.9*. Moving right on the graph, *r* is increasing by increments of 0.1. As *r* gets bigger, α* approaches the 0.5 benchmark. As *k* increases, α* reaches 0.5 faster, but at the corner solution where π=1.

As r increases, for any given α, the reward to the politician is greater in terms of the probability of re-election. As the future becomes more likely, residual rents become more valuable to the elected politician, and they will choose to leave a greater proportion of the resource for the second period.

At the corner solution, when $r=0$ and $b=0$, the politician will not be re-elected and chooses $\alpha^*=1$, meaning everything will be taken in the first time period. However, when $r=0$ and $b>0$, b acts as the discount factor. Because b is likely in the neighbourhood of 0.2 to 0.4, α at this point would still be close to 1, and α is decreasing in b as shown in Figure 5. An upward shift in b might be an increase in popularity from other causes besides resource decisions.



While it will never be the case that $\pi=1$, there is an interesting interpretation for this corner solution. If $\pi=1$ is given exogenously, the decision maker cares equally about the future and will choose $\alpha=0.5$. However, where π is dependent on the choice of α, $\pi(\alpha)=1$ can then only be achieved with levels of α greater than 0.5.

5. Conclusion

Resource use decisions are of key importance when considering intertemporal fairness. One part of the decision is the choice of extraction rate, as presented in the model above. Here I have argued that the incentive structure of an electoral system can potentially skew the extraction decision to an inefficient outcome, with the costs mainly felt in the future time period. A second part of the resource use decision is allocating the rents. The model above has no savings mechanism, especially because of the assumptions about no discounting and extracting the entire quantity of a resource in finite time.

However, an expansion of the analysis should take into account the saving decision, which is very important in the fair and efficient allocation of resource benefits over time. Several regions have set up sovereign wealth funds, most prominently Norway with the largest sovereign wealth fund in the world, which is used to save and manage the rents from the oil industry and to distribute those benefits to future generations. BC has also been discussing a Prosperity Fund, although it is not yet clear how that fund will be managed.

The issue of savings is centrally important to consider. For the purpose of the current analysis, however, the focus has been the choice of extraction rate, and simplifying assumptions have been made to highlight that choice. I found that the extraction rate approaches the socially optimal result when the electorate becomes more responsive to resource use decisions, and that is the case whether they respond positively or negatively to the decision.

Understanding resource management decisions through political institutions is central to understanding why resources are managed inefficiently, sometimes leading to a resource curse or decreased living standards. Here I have explored one mechanism that can influence a democratically elected politician to manage resources poorly.

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