**FINDERS, KEEPERS?**

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## Abstract

## Will resource exploration firms get to keep their findings ex post, or will these be heavily taxed? To analyze this question we consider resource taxation when the government cannot commit to tax rates beyond the current period and when firms have to invest in developing new, long-lived resource deposits. In contrast with previous literature but in line with standard assumptions about rational economic behavior, taxes and exploration are both affected by anticipated decisions of future governments and firms. This dynamic hold-up problem creates a phenomenon often observed in resource producing countries: repeated cycles of exploration and taxation. In such a cycle, large findings induce a high tax which lowers exploration investment and thereby future findings, which in turn leads governments to reduce tax rates again. Such tax oscillations are more pronounced when the mining profile is more backloaded, and less pronounced in countries with more stable governments. This rich yet tractable model is the first rational expectations approach to optimal resource taxation under threat of expropriation.

## Background

Taxation of resource sectors is a large, and sometimes dominant, source of government revenue in many countries. For these governments, getting a large share of the profits without inhibiting investment is a problem of first order importance. In the simplest theory, the problem has an elegant solution: if the government could commit, the first best option would be to auction the exploration rights. This would induce firms to pay the total expected profits and explore efficiently thereafter. In practice it takes decades from first getting the right to explore until a valuable finding has been made, until a mine has been established, until extraction leads to any actual revenues and finally until the mine is exhausted. Since few governments can make credible promises on behalf of future governments, the issue of commitment becomes a real concern. In particular, a later government has incentives to tax a finding *ex post*. This is possibly the reason for the rare occurrence of pure auction systems when it comes to exploration.

The issue of commitment is also problematic for taxation as the government today may want a low tax to induce exploration, while a later government may increase the tax in order to appropriate the profits. Rational firms and governments anticipate such future behavior. Firms will choose investment based both on current and expected future taxes. Likewise, the current government expects future reneging and hence sets the current tax taking the reaction of the firms and the future government into account. In particular, a current government may recognise that (because of expected high taxes *ex post*) it has to set taxes to a low level to encourage any investment at all, but then this low level of rent taxation is in turn seen as justifying later expropriation; a cycle that has been dubbed the “natural resources trap”. Such problems are very prevalent, particularly in developing countries lacking robust institutions, but also in wealthier countries. Expropriation of resource extraction firms is particularly common, for example in many Latin American countries in 2006 and 2007.

## Model

We analyze this strategic interaction in a simple infinite horizon model with rational expectations. Resources are developed through costly exploration investments, but the government cannot commit to not taxing the resulting resource rents beyond a single period. In any given period, two types of mines generate resource profits: old mines discovered in the previous period and new mines discovered in the current period. In order to maximize profits from the old mines, the government would want to set a high tax, but that would harm current investment and hence profits from new mines. However, since the new mines today will, tomorrow, be taxed by the next government, today’s government has to take the future government's reaction into account, which itself depends on the reaction of the government the day after tomorrow, and so on. This means that, although the government may not directly care about the tax revenue tomorrow, it does care about how that tax affects today's firms' behavior. Hence, today's government has to consider the effect its tax has on all future taxes.

The model predicts that taxes and exploration will be cyclical. This is consistent with empirical stylized facts about the nature of taxation and investment in resource-producing countries. Following anearlier large discovery, high taxes ensure the government gets a large share of the bonanza. This in turn will inhibit new investments, implying fewer mines tomorrow, and hence a lower tax as the government refocuses to ensure a sufficient level of new investments. We also study how the mining profile affects the tax. If the mining profile is backloaded, so that most of the mining profits come with a lag, then the government today knows that firms mainly care about the tax tomorrow. This makes mining investment insensitive to today's taxes, implying they are set high. This of course happens in all periods, which implies a high tax level throughout time. This inhibits investment. The backloaded mining profile dampens the tax oscillations.

This paper is by no means the first to analyze resource taxation. However, to the best of our knowledge, we are the first to explicitly model the interaction between successive governments that, like firms, hold rational expectations. Also, unlike many existing papers, expropriations are not exogenous events but rather result from rational forward-looking behaviour by firms and governments.

Our model is rich enough to reflect the stylized empirical fact of tax and investment cycles with agents that hold rational expectations but without the need to exogenously assume expropriations. It is also simple enough to be a logical starting point for a promising agenda of new research related to optimal taxation under imperfect commitment. For example, the model can be extended to allow for stochastic resource discoveries, changing land prospectivity and imperfect competition. It also offers many testable implications that empiricists could take to the data.