

# Nationalization of natural resources

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# Overall motivation

- Decisions on exhaustible resources markets (e.g. oil, coal, iron ore) are to a large degree made by governments in terms of exploration, ownership rights, transport, speed of extraction etc.
- A simple conjecture is then that various politico-economic considerations would have effects both on behavior within an individual country and on outcomes in a general equilibrium (e.g. on world prices).

# Overall motivation

The literature on exhaustible resources has two main strands:

- 1 General equilibrium models with profit maximizing firms. Political behavior, if exists, is exogenous.
- 2 Resource curse literature. Political processes modeled but aggregate outcomes (prices) are exogenous.

Hardly any papers look at interaction

political decisions  $\leftrightarrow$  aggregate outcomes.

Exceptions: Acemoglu et al, 2011; Gerlagh & Liski, 2011.

## Specific motivation - nationalization

- Nationalization of resources has taken place many times historically (Middle east oil in 70:s, South American resources in later years).
- Nationalization typically takes place when prices are high (Stroebel & Bentham, 2010; Guriev et al, 2009, Duncan, 2006, Chang et al, 2010).
- Nationalization takes place in both autocracies and democracies (Duncan, 2006).
- There are costs of nationalization in the form of lower effort in extraction efficiency (Chang et al, 2010).
- Other papers typically look at contracting and interaction in a one country (partial equilibrium) setting: Bohn & Deacon (2010), Baldursson & vd Fehr (2012)

# This paper

- How do firms behave if expecting nationalization?
- When do individual countries nationalize given firm behavior and expectations on other countries nationalization decisions?
- What is the political and economic "general equilibrium"?

# The story

- Firms facing expropriation will extract at the maximum speed and leave as little as possible to the expropriator → Prices stay low and yield no scarcity rents.
- To stop the fast extraction the government wants to expropriate early.
- But if expropriating before other countries there will be a wait until profits can be made since prices are low until the others have nationalized too.
- Total effect is that if the governments in all countries can coordinate they nationalize early.
- But if they cannot coordinate they nationalize at a (later) date at which they are sure it is individually optimal for each government to nationalize.

# Model building blocks

- 1 A continuum of mass 1 of countries having each containing an equally sized resource stock.
- 2 At the onset the resource is owned by a firm in each country.
- 3 The gov in each country may nationalize at a date of their choice at a fixed cost.
- 4 There is a constant marginal cost of extraction (whoever extracts).
- 5 Private and competitive firms buy the resource and produce  $F$  which they sell at a price 1 to consumers (not modeled).

## Resource firm's problem

Suppose the firm in a country  $i$  believes that their resource will be nationalized at time  $t_{N,i}$ , then:

$$\begin{aligned} \max_E \int_0^{t_{N,i}} (p_t e_t - A e_t) \exp^{-\rho t} dt \\ \dot{s} = -e, s > 0, s(0) = s_0 \end{aligned}$$

## Resource firm's problem

Following Spiro (2012) there are two alternative solutions to this problem, roughly:

- 1 If  $t_{N,i}$  is sufficiently short and/or the firm believes  $t_{N,\sim i}$  is sufficiently long then it will extract as much as it can without the marginal cost doesn't exceed the price for all periods up to  $t_N$ . Total extraction among firms will be  $E_{\max} \equiv F'(A)^{-1}$ . The stock will not be exhausted by the firm.
- 2 If not, the stock is binding, then the firm will exhaust the stock at exactly  $t_N$ .

Under 1, the price will be constant at  $p = A$  until the last country nationalizes.

Why last country? With constant marginal extraction costs the remaining private firms will increase the supply until  $p = A$ .

# Government's problem

Choose date of nationalization and extraction path afterwards.

$$\max_{t_N, E} \int_{t_N}^{\infty} (p_t e_t - A e_t) \exp^{-\rho t} dt - N \exp^{-\rho t_N}$$

$$\dot{s} = -e, s > 0, s(t_{N,i}, t_{N,\sim i}) = s_{t_N} \text{ given from the firms problem}$$

After nationalization the problem is simply a Hotelling result:

- 1 If all others have nationalized, extract so that the scarcity rent increases at the rate of discount.
- 2 If some countries have not yet nationalized then do not extract anything yet.

# The nationalization trade-off

- Late nationalization means lower stock once it occurs.
- Early nationalization means incurring cost early and having to wait until prices start rising.

## Coordinated equilibrium

Define  $\lambda(S_0)$  as the scarcity rent on a competitive market with a stock of size  $S_0$ .

**Proposition:** Iff  $\lambda(S_0) S_0 \geq N$  then nationalization at time zero is a nash equilibrium. The price rises over time.

**Proof:** If all nationalize at time zero then prices rise according to Hotelling afterwards and an infinitesimal country makes profits  $\lambda(S_0) S_0$  which are greater than the nationalization costs.

**Corollary:** Nationalization at any time period  $t$  is a NE iff  $\lambda(S_0 - tE_{\max})(S_0 - tE_{\max}) \geq N$ .

**Proof:** Similar reasoning as above but since the individual gov has the option of nationalizing earlier than the others we also need to (and can) show that doing so is not optimal.

## Coordinated equilibrium - stability

- We saw that there are multiple equilibria. A single country will nationalize at the date when it believes the others will (a caveat for dynamic issues not fully solved yet but should not change reasoning).
- But nationalization of resources has not happened so many times historically that it's reasonable to assume that all countries will know which date is the most likely that all others will nationalize at.
- This implies that equilibria where nationalization takes place early are not stable since, loosely, it is pointless to be the first out in nationalizing.

→ Refine equilibrium to be uncoordinated in the spirit of Asheim & Yoo (2008).

# Uncoordinated equilibrium

- Look for an equilibrium where it is optimal for the single country to nationalize even if all others do it later.
- Suppose a single country believes all others will nationalize at a time period  $T_{AN}$ . When will the single country want to nationalize? With constant marginal costs of extraction this can be formulated as

$$\max_{t_N} \lambda (s_0 - E_{\max} T_{AN}^*) (s_0 - t_N E_{\max}) \exp^{-\rho(T_{AN}-t^0)} - N \exp^{-\rho(t_N-t^0)}$$

FOC w.r.t.  $t_N$

$$\lambda (s_0 - E_{\max} T_{AN}^*) E_{\max} \exp^{-\rho T_{AN}} = \rho N \exp^{-\rho t_N}$$

Set  $T_{AN} = t_N$  and  $s_0 = S_0$

$$\lambda (S_0 - E_{\max} T_{AN}^*) = \frac{\rho N}{E_{\max}}$$

# Uncoordinated equilibrium

$$\lambda (S_0 - E_{\max} T_{AN}^*) = \frac{\rho N}{E_{\max}}$$

**Proposition:**

$T_{AN}^* > 0$  iff  $\lambda (S_0) < \frac{\rho N}{E_{\max}}$ .

$T_{AN}^* < \frac{S_0}{E_{\max}}$  (the date when resources run out)

**Corollary:** In an uncoordinated equilibrium the resource price is constant for  $T_{AN}^* > 0$  years. During this period there are no scarcity rents. After this the price and scarcity rents are increasing according to the Hotelling rule.

The trade-off for nationalization is :

- Late nationalization means lower stock once it occurs.
- Early nationalization means incurring cost early and having to wait until prices start rising.

When a gov is approaching the date when all others nationalize the nationalized stock becomes more valueable (it is discounted less) and so is each unit not extracted by the firm. So while the cost of nationalization is the same in each current date, the value of each unit of the nationalized stock increases as one approaches the date when all others nationalize.

## Additional results/issues - not solved

What happens if extraction costs are convex?

What happens if extraction costs are heterogenous, who nationalizes first?

What if a gov observes the nationalization of others, how will it update its strategy?

How do expectations of the firms play a role?

# Summary

- A model where governments nationalize depending on the actions of other governments and depending on the actions of resource firms within their country.
- In equilibrium we get a period of non-increasing prices and scarcity rents in line with stylized facts.
- Nationalization is individually worthwhile only when others do so as well - possibly clustering of nationalization.