

Resource Economics

Lecture 6

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Policy and regulation of exhaustible
resource markets

Overview

1. Global and national policies in governing resource markets (globally). Climate change regulation.
2. National policies for resource rich countries

Regulating global resource markets

- Suppose we want to change the speed of extraction of resources. For example:
 - because we want more to be left for future generations.
 - because there are some negative externalities associated with extraction of consumption of resources, e.g. climate change.
- What would be an effective policy in doing so?
 - Profit tax?
 - Unit tax?
 - Lower own consumption?
 - Leave resources in the ground?

Hotelling with value added tax

- Consider the model by Hotelling but where there is, in addition, a profit tax every period.

Hotelling with profit tax - results

- If the tax is constant then there is no change to the extraction path.
- If the tax is increasing then extraction becomes higher early on and lower in later periods. Same amount is extracted.
 - This is called the green paradox (Sinn, 2008), announcement of future CO2 taxes will (in this model) increase pollution today.
- If the tax is decreasing then extraction is lowered today and increased tomorrow. Same amount is extracted.
 - To keep postponing extraction, the tax has to go to zero and then turn into a subsidy.
- In either of the scenarios the scarcity rents change hands, from the seller to the one that taxes.

Hotelling with royalty-like tax

- Consider Hotelling model with a fixed tax for every unit of extraction.

Results

- A positive but constant tax level increases extraction early.
- To decrease early extraction the tax has to be negative – a subsidy.

Investing in R&D under Hotelling

- R&D investment into finding substitute technologies or increasing energy efficiency reduces the future profits and hence increases extraction today – the green paradox.
- Total effect on climate is ambiguous.

Lowering oil-consumption in a single country under Hotelling

- Suppose one country lowers its consumption.
- That reduces the price which increases consumption in other countries.
- Aggregated over time the same amount will be extracted → 100% leakage.

Inexhaustible resource with value added tax

- Suppose instead that current extraction costs are the only thing that limit extraction.
- A profit tax lowers extraction in all time periods – more resources are left in the ground.
- This holds no matter if the tax is constant or changing over time.

Inexhaustible resource with royalty-like tax

- A fixed tax per unit of extraction.
- Lower extraction in all time periods.

Investing in R&D if non-exhaustible

- No effect on extraction today.
- Once the backstop or energy saving technology is "invented" extraction is lower.

Lowering consumption in a single country with inexh. resource

- A shift of demand down.
- Price is lower, other countries buy more.
- But not 100% leakage.

Effectiveness of taxes - summary

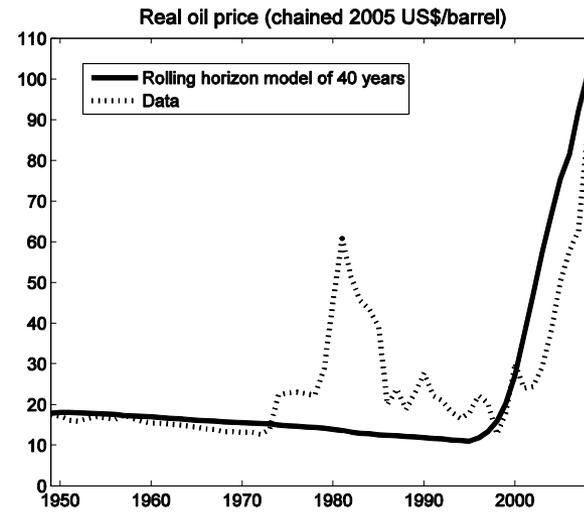
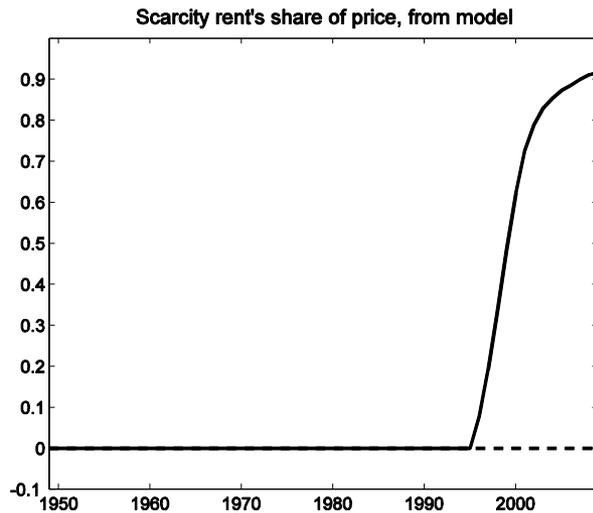
Instrument and reason	Exhaustibility an important aspect	Exhaustibility not important aspect
Value added tax (VAT) to decrease total extraction	Inefficient	Efficient
VAT to push the extraction	Inefficient	Efficient
VAT to get tax revenue	Efficient	Inefficient
VAT to reduce environmental effects	Inefficient	Efficient
Tax per sold unit	Efficient	Efficient
Emission cap for consumption in all or certain countries	Efficient	Efficient
Announce future taxes	Possibly efficient, but increased extraction today	Efficient
Subsidize research on renewable substitutes	Possibly efficient, but increased extraction today	Efficient
Reduced consumption in a single country due to considerations for environment or intergenerational equity.	Inefficient	Efficient but some leakage
Emission cap for production in some countries.	Inefficient	Efficient but some leakage
Emission cap for production in all countries.	Efficient	Efficient

How large are the scarcity rents?

- Key question in resource economics.
- It is essential to know whether a scarcity component exists its extent when deciding on climate and other policies.
- Historically the scarcity rents have either been low or inexistent. Extraction costs (and other aspects) have been more important. (Hart & Spiro, 2011).
- For policy we want to know the extent of the scarcity rent in the future.
- If perfect markets then probably low rents in the next decades (Hart & Spiro, 2011).
- If imperfect markets then scarcity rents could be high for oil already today (Spiro, 2012) and possibly be increasing very rapidly for other resources.

Effectiveness of taxes - summary

Boundedly rational
markets



Leave oil in the ground?

- Suppose a model with some degree of scarcity rents (Hotelling) and some degree of extraction costs.
- Hoel (2013).
- If one resource rich country leaves oil in the ground...
- ...then the resource price goes up...
- ...which increases extraction in other countries.
- "Leakage"
- If the resource left in the ground (oil) is replaced by a dirtier substitute (coal) then there is also "pollution leakage". I.e. pollution per unit increase.
- Depending on parameters total emissions may go up.
- A recent study (Fæhn, 2013) calibrates this to be 65% in the case of Norway. I.e. For every CO₂ unit of Norwegian oil left in the ground, global emissions go down by 0.35 units.

Buy Coal?

- Harstad (2012).
- Suppose a single country wants to lower global emissions. What can it do?
- If it lowers its consumption of oil/coal there is leakage since a lower price induces others to consume more (holds under both Hotelling and pure extraction cost models).
- If it lowers its extraction of oil (if it has) there is leakage since a higher price induces others to extract more.
- It should buy the resources which are the most expensive to extract. I.e. those that have the lowest profits per unit.
- Those resources are cheap to buy.
- And since they are the least profitable their absence does not induce more extraction of other resources.
- No leakage.
- But is it possible buy resources from other countries? Would seller country really leave the coal in the ground forever?
- Lease? Would they agree?
- Pay others for not exploring for new resources which are only marginally profitable (Either due to direct costs like Arctic oil or indirect costs like in Svalbard).
- Once exploration has been made, those costs are sunk. Cheaper to buy before exploration takes place.

National policies for resource rich countries

- How can a gov get a share of the profits?
- How fast to extract?
- How fast to consume the profits?
- What should be done with the profits?
- How avoid resource curse pitfalls?

Getting a share of the profits

- Consider a government in a resource rich country that wants to get as much as possible of the profits that the extraction and exploration firms make. It has three overall alternatives.
 - Auction exploration rights
 - Tax
 - Owning the exploration companies.
- The basic problem is that firms need to decide on exploration effort without knowing how much they will find.
- Generally this leads to problems of distortionary taxes and time inconsistent public policies.
- Two levels need to be included for analysis:
 - Findings within a certain area (and market conditions) can be very or not at all profitable → a distribution of future outcomes.
 - Different areas are promising to a varying degree – have different distributions.

Profit sharing – auction

- Let exploration firms bid for the right to explore and award the right to the highest bidder.
- Theoretically: firms will top each other's bids until bid = expected profits of finding.
- Government gets all the profits.
- Firms will explore with economically efficient effort since bid is sunk cost.

Problems – auction

- Winner's curse – winner can expect to make losses.
- Risk aversion
 - What if the firm makes a loss?
- Will gov expropriate or add tax ex-post?
 - Suppose expected value is 99.999% chance of finding nothing and 0.001% of finding a Saudi Arabian oil field. Low bid and politically hard to not tax if finding is made.

Profit sharing – royalty tax

- Royalty is a fixed tax per unit of extraction.
- Used in many countries, especially developing.
- Easy to monitor.
- Distortionary since it makes many smaller findings not profitable → some areas won't be explored.

Profit sharing – profit tax

- A tax which takes a certain share of the profits of extraction firms.
- Less distortionary than royalty tax since a profitable finding remains profitable.
- But, it lowers expected profits in all areas since it takes profits when there are some, but does not compensate when no finding is made.

Profit sharing – tax + subsidy

- By subsidizing costs in areas where pure losses are made at the same rate as the tax on profitable mines the system becomes neutral.
- The expected profits per unit of investment is unaltered by the tax. All areas where profits are expected ex-ante will be explored.
- Theoretically the gov can use a 100% tax and subsidy, i.e. get all the profits.
- Practically can be carried out in different ways...

Tax + subsidy in Norway

- Norwegian system:
 - Earlier: firms could transfer losses from some areas to deduct from profits made in profitable areas.
 - This led to large firms since firm gets cost coverage of failed exploration area only if they have been successful somewhere else.
 - Large firms focus on safe bets and large areas → only large/safe areas explored
 - Today, gov wants to encourage smaller firms to explore in high risk areas →
 - To get cost subsidies firm only needs to “hand in receipts”. No need to be successful anywhere to get subsidies.

Profit sharing – super tax

- Suppose tax + subsidy not possible.
- Political pressure may make it hard to have a low profit tax (that encourages exploration) after a large finding has been made.
- A progressive tax often used (super-tax) which applies to large findings.
- Only marginally distortionary for uniform probabilities.
- Distortionary if exploration is motivated by a small probability to find something large.

Profits sharing – national ownership

- National resource firms exist in many countries, often in parallel to private ones.
- If government owns exploration/extraction firms then it will get all profits – no tax or auction is needed.
- Possibly distortions from political ownership.
- Especially hard to run small companies (e.g. Norway owns Statoil but not smaller firms).
- If distortions from auctions or first best taxation cannot be implemented then national ownership may be preferred.

Profit sharing - Encouraging early activity

- Many countries do not have the knowledge to deal with resource markets, let alone own a company performing exploration.
- Low taxes initially then gradually increase and/or form a national resource company performing exploration.

How fast to extract - theory

- A profit maximizing firm should extract so that its own profits rise at the rate of interest (Hotelling).
- If prices are falling or constant → extract as fast as possible.
- If prices are expected to increase fast → postpone (some) extraction.

How fast to extract - reality

- Many countries face borrowing constraints and need the income now.
 - Then, the poorer you are the faster you should extract (lecture 5).
- Once investments are made it is very costly to lower extraction rate → hard to smooth consumption by postponing extraction.
- With fluctuating profits, income is very volatile (lecture 5).
- Tension between getting maximum profits and getting maximum welfare.

How fast to extract and consume

- To partly solve the tension between consumption smoothing and efficient extraction the country can set up a Sovereign wealth fund.
- This decouples the decision of extraction from the decision of consumption.
- Note: this only works for (rich enough) countries wanting to postpone consumption to later or for those (should be everyone) wanting to smooth income fluctuations.
- Examples
 - Norway
 - Chile
 - Possible to have two funds, one for long run smoothing and one for short run smoothing (possibly Ghana).

Criteria for SWF

Three criteria for setting up a SWF with the purpose of long run smoothing.

1. Enough profits.
2. Rich, developed country.
3. Income has to be “temporary”.

Consumption with a SWF

- Constraints on usage of SWF funds to avoid political temptation. E.g. Norwegian 4% rule has had a moderating effect.
- Optimally the constraints should allow for BC fluctuations. But this enables political temptation.
- Constant rate of usage implies more usage later. This is counter to consumption smoothing for any growing country (even if growing slowly).
- But resources create not only profits but also economic activity while extracting → ok to consume more of the profits later.

How to avoid the resource curse

- Key question in resource and development economics.
- The worse effects come from political problems.
- Build institutions and binding rules before you find something.
- International governance rules for best practice.
- Hard to get in place since few politicians will set up institutions which constrain themselves when expecting future resources.