# Resource Economics
# Lecture 8 (& 9)

Daniel Spiro

8: The resource curse (or blessing?)

9: National regulation of resource markets

# Overview

- The previous lectures have been analyzing some models and mechanisms that determine aggregate (world) extraction and price.
- This lecture is about
  - The effect for a single country of having resources.
  - How that country should manage its wealth.
  - No general equilibrium, resource wealth and international prices are usually exogenous.

# Why resource income should be good

- Resource income (for a single country) can be looked upon as a gift which simply expands the budget constraint:

Without resources: $c_t = F(k_t, h_t)$

With resources: $c_t = F(k_t, h_t) + R_t$

# Why resource income should be good - a basic theory of wealth

$$\max_{c_t} \sum \beta^t u(c_t)$$

BC without resources:

$$A_t + c_t = A_{t-1} r_t + F(k_t, h_t)$$

BC with resources:

$$A_t + c_t = A_{t-1} r_t + F(k_t, h_t) + R_t$$

Avoid infinite borrowing

$$A_t \geq \bar{A}$$

# Results

- Consumption smoothing
- A poor country which is growing should consume all of its current income (also the resource) and additionally borrow to expand consumption today. Pay back what it borrowed with the help of future resource income.
- A middle income country which is growing should consume its resource initially but not borrow. Eventually start saving the resource income.
- A high income country (which is not growing rapidly) should save most of its resource income and thereby expand future consumption.

# An additional benefit

With borrowing constraints: $A_t \geq \bar{A} = 0 \rightarrow$

$$\max_{c_t} \sum \beta^t \, u(c_t) \quad = \max_{c_t} \sum \beta^t \, u(F_t)$$

I.e., a poor growing country would like to borrow but cannot and hence cannot smooth consumption.

Marginal utility is very high and hence adding resources allows for very large increases in utility.

$$\sum \beta^t u(F_t + R)$$

# And another benefit

Ignore assets for a second and focus on production. Poor countries are often capital scarce and hence produce very little. While this should imply that international investors should invest in the country, this often does not happen.

$$\max_{c_t} \sum \beta^t u(c_t)$$

BC without resources:

$$k_{t+1} + c_t = F(k_t, h_t)$$

Very slow convergence to higher income.

BC with resources:

$$k_{t+1} + c_t = F(k_t, h_t) + R$$

Can spur capital accumulation in poor countries and hence leap-frog to a higher income level.

# The total result from basic theories

- All countries should gain from having resource income.
- But poor countries should gain the most since they are the most helped by consumption smoothing – i.e. high growth in the short run.

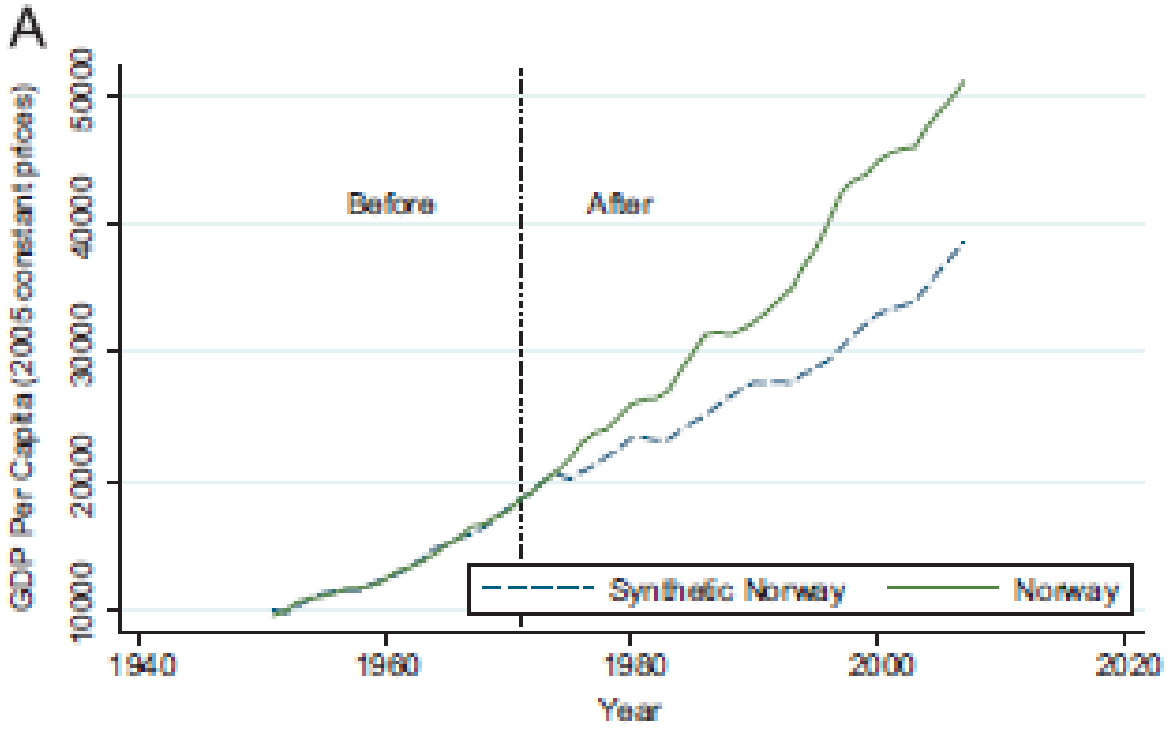
# Case 1 - Nigeria

- Oil revenues per capita increased from US$33 in 1965 to US$325 in 2000.
- Income per capita has stagnated at around US$1100 (real ppp) since 1960
- Nigeria among the fifteen poorest in world
- 26% had <1$/day in 1970 and 70% in 2000
- Dramatic increases in inequality.
- Capital increases but low utilization (suggesting most investment were “White elephant” projects)
- Rampant corruption and political instability.
- Many poor and resource rich countries show a similar picture.

# Case 2 - Norway

- No increases in inequality
- Institutional stability.
- Economic growth from a poor/middle OECD country to (almost) the richest.
- HDI, life satisfaction… are top of the world.

# Case 2 - Norway




Source: Mideksa, 2012

# Economic growth

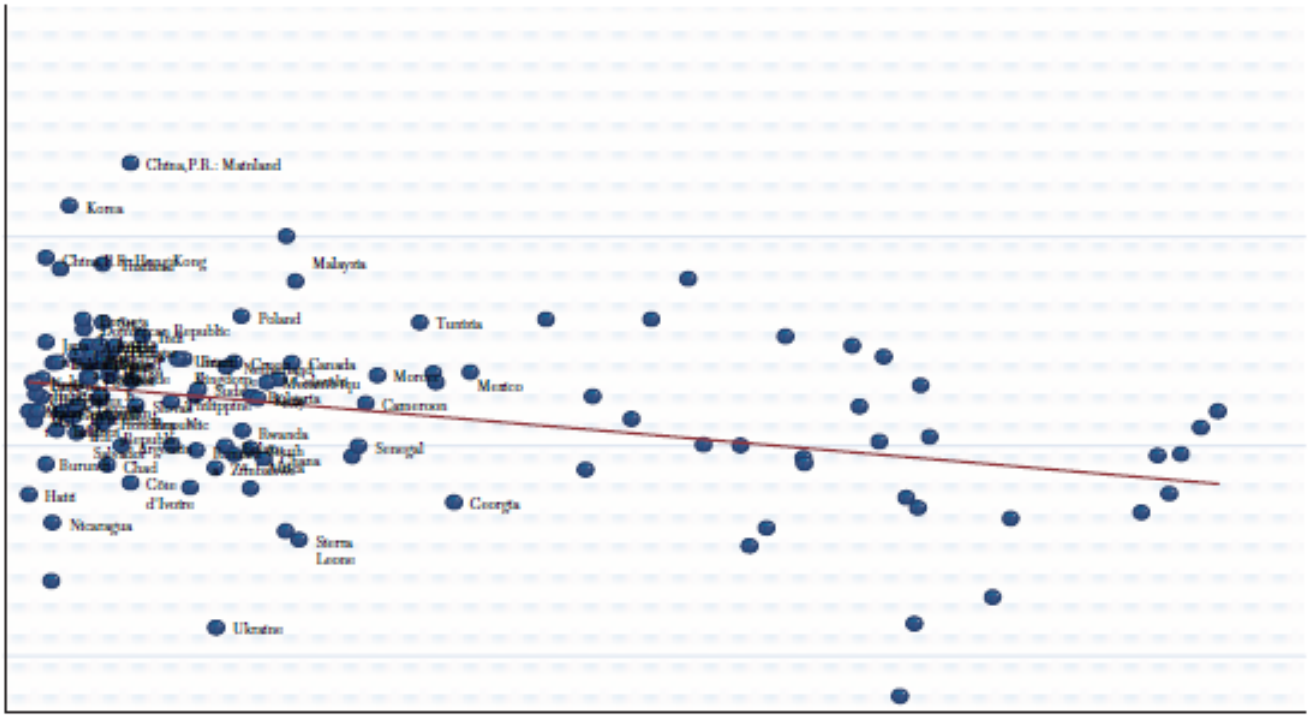



*Figure* 1. Growth and Natural Resource Dependence

Source: vd Ploeg, 2011

# Industry structure

TABLE 1
TOTAL, NATURAL, PRODUCED AND INTANGIBLE CAPITAL, 2000
(*$ per Capita and Percentage Shares*)

| Income group | Natural capital | Produced capital | Intangible capital | Total wealth | Natural capital share | Produced capital share | Intangible capital share |
|---|---|---|---|---|---|---|---|
| Low-income countries | 1,925 | 1,174 | 4,434 | 7,532 | 26% | 16% | 59% |
| Middle-income countries | 3,496 | 5,347 | 18,773 | 27,616 | 13% | 19% | 68% |
| High-income OECD countries | 9,531 | 76,193 | 353,339 | 439,063 | 2% | 17% | 80% |
| World | 4,011 | 16,850 | 74,998 | 95,860 | 4% | 18% | 78% |

*Note:* All dollars at nominal exchange rates. Oil states excluded.

*Source*: World Bank 2006, table 2.1.

Source: vd Ploeg, 2011

# General picture

- Poor countries do badly after discovering resources
- Rich countries do well.
- Some exceptions:
  - Botswana – poor initially but economic improvements after discovering diamonds, also maintained institutional stability and low inequality.
  - Chile

# Theories

1. Deindustrialization and currency appreciation
2. Negative growth effects
   a) Accounting explanation
   b) Learning by doing
3. Institutions
   a) Grabber or producer friendly
   b) Presidential systems
   c) Effect of resources on institutions and corruption
4. Volatility of resource prices
5. Conflicts
6. Unsustainability of gov policies

# Industry structure - theory

- The “Dutch disease”.
- Suppose two sectors. Hairdressers and shoe manufacturers.
- Resource revenues lead to
- …higher demand for both shoes and haircuts.
- Haircuts cannot be bought from abroad hence prices rise and wages rise.
- Wages need to be equal in all industries hence wages rise also in shoe production.
- Becomes expensive to produce shoes while world prices of shoes are fixed. Hence imports of shoes increase.
- This is coupled with exchange rate appreciation since everything produced in the country is more expensive.

# Industry structure - conclusions

- In itself this mechanism is not a problem. It only implies that there is an efficient reallocation of jobs within the country.

- The country is still better off but cannot fully utilize the resource income since there are spillover effects.

- This should therefore not be called a disease.

# Industry structure - empirics

- Mixed evidence

- But later studies show:
  - Resource income leads to lowering of non-resource exports (by 35-70%) and increase in imports (by 0-35%).
  - Resource rich countries (>30% of GDP) have a 15% smaller tradable (“shoe”) sector.

# Growth effects – accounting explanation

- Resource rich countries experience lower growth.
- Suppose:

$$\frac{F_{t+1}}{F_t} = g > 1$$

Then

$$\frac{F_{t+1} + R}{F_t + R} < \frac{F_{t+1}}{F_t}$$

while

$$\frac{F_1 + R}{F_0} > \frac{F_{t+1}}{F_t}$$

i.e. an initial boost to the economy but then lower growth.

This has no negative welfare effects.

# Growth effects – learning by doing

- The theory about industry reallocation implies less people in manufacturing of traded goods.
- Suppose there is learning by doing – i.e. a positive externality where technology and human capital is improved in the sector people are working in.
- Then, *if* there is more scope for technology improvement in the traded manufacturing sector (shoes) than in the non-traded sector (hairdressers) and in the resource sector (mineral)...
- ...the country will grow slower and be lagging once it runs of out resources.
- Possibly net welfare losses from resources.

# Growth effects – empirics

- Learning by doing may possibly be greater in manufacturing than in services.

- But less clearly that more learning by doing in manufacturing than in resource industry (e.g. Norwegian oil sector drives technology. But in poor countries all such technology may be imported).

# Growth effects - empirics

TABLE 4
EFFECTS OF RESOURCE DEPENDENCE AND INSTITUTIONAL QUALITY ON ECONOMIC GROWTH

| Annual growth in real GDP per capita | Sachs and Warner (1997a) | Based on data in Sachs and Warner (1997b) | Mehlum, Moene, and Torvik (2006b) |
|---|---|---|---|
| Initial income | –1.76 (8.56) | –1.28 (6.65) | –1.26 (6.70) |
| Openness | 1.33 (3.35) | 1.45 (3.36) | 1.66 (3.87) |
| Resource dependence | –10.57 (7.01) | –6.69 (5.43) | –14.34 (4.21) |
| Rule of law | 0.36 (3.54) | — | — |
| Institutional quality | — | 0.6 (0.64) | –1.3 (1.13) |
| Investments | 1.02 (3.45) | 0.15 (6.73) | 0.16 (7.15) |
| Interaction term | — | — | 15.40 (2.40) |
| Number of countries | 71 | 87 | 87 |
| Adjusted $R^2$ | 0.72 | 0.69 | 0.71 |

Source: vd Ploeg, 2011, replication from other articles

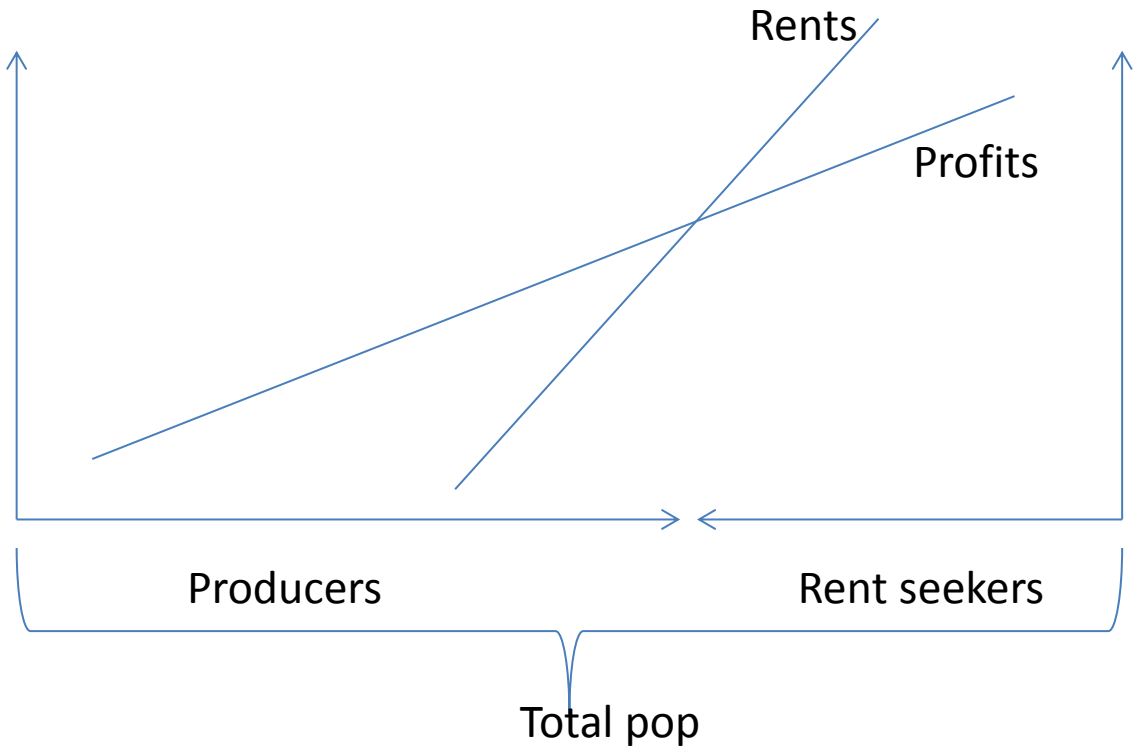
- Sachs & Warner (1995) show negative correlation resource dependence ←→growth
- They control for initial income.
- Econometric issues, e.g. GDP on right hand side of regression since resource dependence=resource/GDP.
- Also, this does no prove that learning by doing is the mechanism.

# Institutions

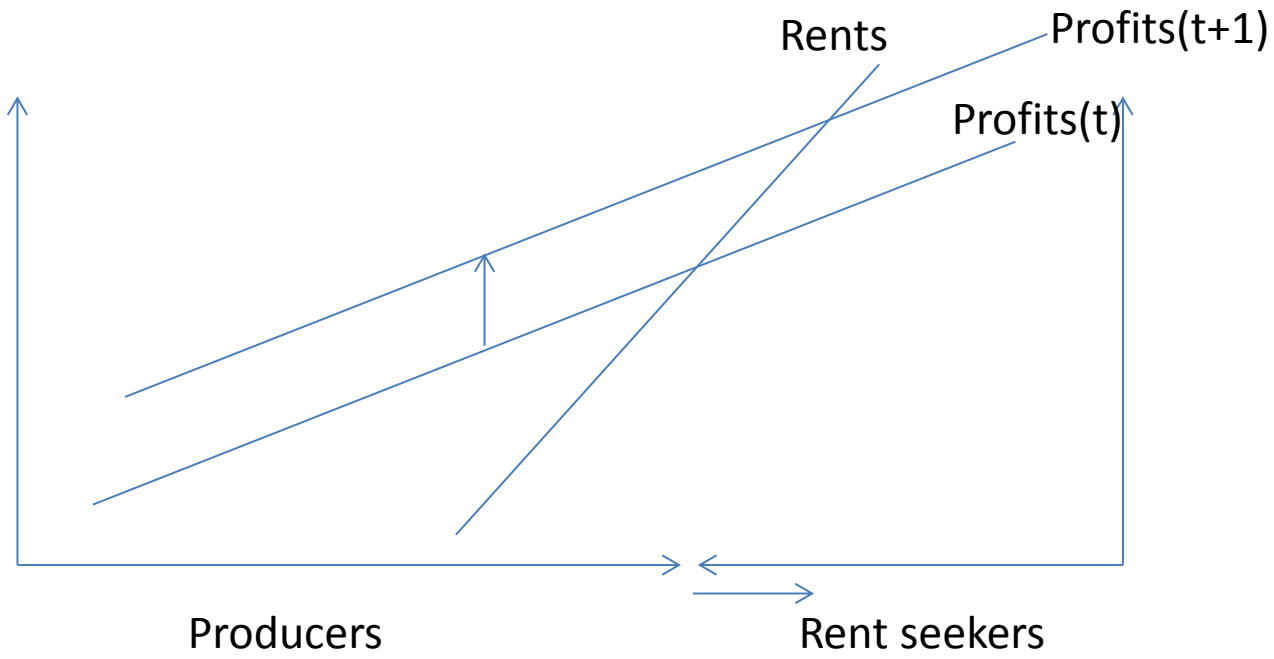
- How countries evolve after discovering resources depends largely on the political and economic institutions in place before the discovery.

# Institutions - grabbing

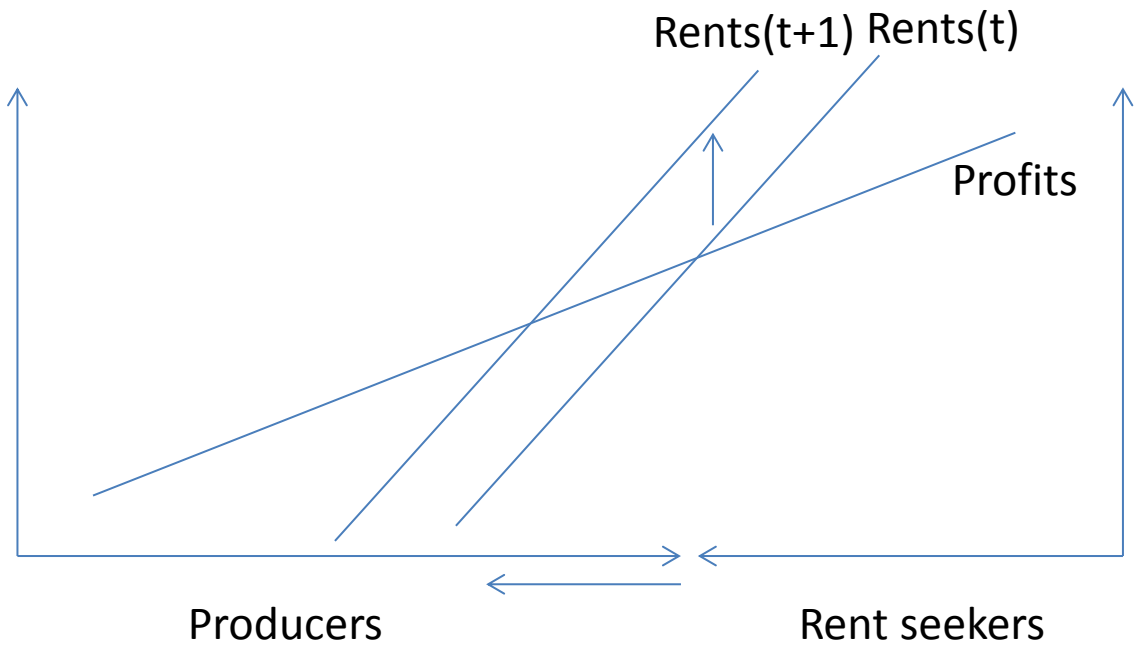
- Mehlum et al (2006)
- Suppose an individual chooses between rent seeking (grabbing) or producing something.
- The more producers the more lucrative to seek rents.
- The more producers the more lucrative to produce (but less so than effect on rent seeking)



# Resource effect if production friendly institutions



# Resource effect if grabber friendly institutions



# Institutions - data

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- Resources negatively correlated with growth
- Institutions negatively correlated with growth (since rich, slowly growing, countries have good inst)
- Resource*Institutions positively correlated with growth.
- →Sufficiently good institutions reverse the resource curse.

- Additional data (Boschini et al, 2007) – Interaction between easily appropriable resources and bad institutions

# Institutions - Presidential systems

- Presidential systems are less accountable and less representative → easier to extract rents.
- President + elites take the income

# Effect of resources on institutions

- Resources tend to lead to:
  - Easier buying of opposition, less dissent and questioning of policy.
  - Corrupt bureaucrats
  - Less accountability
  - Less schooling.

- All these problems hamper growth.

- Examples:
  - 10% higher corruption in Sao Tome compared to Cap Verde (Vicente, 2010).
  - Brazilian municipalities: 10% increase of oil→20% increase in corruption.
  - These results are convincing since they don't suffer from problems of cross-country data.

# Volatility

- Resource prices can be very volatile – increases by several hundred percent between years.
- Suppose gov budget is 50 units from resources on average (e.g. 0 or 100 every second year) and 50 from labor tax. Then the budget will fluctuate with hundreds of percent from year to year.
- Additional effects on exchange rates make investment riskier.
- Demand shifts due to fluctuating income leads to bankruptcies.
- Well documented that budget and exchange rate volatility lead to slower growth, potentially decline.

# Resources and conflict

- There is more to fight over when resources are there.

- Coffee price negatively correlated with conflict (DalBo & DalBo,2011)…
- …while oil price positively correlated with conflict.

- Why? Coffee labor intensive, increase in price→higher wages→less conflict

- Price falls in capital intensive resources (oil, minerals) will have the opposite effect since then the game is about gaining control over the resource.

- Resource dependency is a problem in both cases:
  - A country dependent on renewable resources can suffer conflict if prices fall
  - A country dependent on point-source resources can suffer if prices increase.
- Diamond resources prolong conflicts (western Africa).

- Resources especially problematic in countries with many groups.

# Unsustainability of government policies

- Resource discoveries often lead to optimism → Borrowing too much with resource as collateral.
- Especially if government does not care about future generations.
- Critique by opposition falls (since everyone is so well off) which leads to unsustainable policies…
- … and investment in unproductive projects.
- Or keeping taxes low which erodes taxation capacity.
- Investing in investment capacity is important but is often neglected in poor countries when they find resources.

# Resource Economics
# Lecture 9

Daniel Spiro

National policies for resource rich countries

# Questions

- 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 firms.

- 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 (hold-up problem).

- 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 huge finding is made.

# Taxation: The hold-up problem

- Consider a firm that invests in t=1 in exploration and extracts in t=2.
- Profits of firm depends on tax in t=2 which is set by gov.

- With commitment: a Laffer-curve of optimal tax.

- Without commitment: tax=1 and no exploration investment.

- Partial commitment → effective tax equals or in between optimal and 1.
- Large current extraction leads to higher tax.

- Examples: Uganda, Israel, Greenland, Venezuela, Russia.

# The hold-up problem – partial commitment

- Partial commitment 1:
  - Gov «promises» tax in period t
  - Gov can renege on promise at a cost – the larger the broken the more costly
  - Firms care about the actual taxes they have to pay
  - Costly for gov to change → effective tax equals or in between optimal and 1.
  - Result: Promise low tax to tie hands of yourself in the future.
  - Result: Finally implemented tax is optimal from point of view of gov.
  - Firms explore efficiently
- Partial commitment 2:
  - Old mines exist in period t but firms also do new exploration.
  - Gov sets tax in period t to maximize revenues from old mines…
  - …while not choking off new investments.
  - Result: effective tax equals or in between optimal and 1.
- Examples: Uganda, Israel, Greenland, Venezuela.

# 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.
  - Risk of inefficient searching? Firm and gov have same profit function, so only a problem if firm hands in fraudulent receipts (also a problem with profit tax)

# 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.
  - Inefficient extraction
  - Biased regulation
  - Especially hard to run small companies (e.g. Norway owns Statoil but not smaller firms).
- Learning within country to get improvements in human capital.
- Learning for better management of industry.
- 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.

- Resource firms often discount future profits heavily (ROI>20%/year and break-even within few years). → Set low tax today and increase later

# 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 (see lecture resource curse).

- 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 (see lecture resource curse).

- Tension between getting maximum profits and getting maximum welfare…

# When to consume

- Consumption smoothing.
- Resource income smoothing.
- Bird in hand (Norway).
- Maximize long run returns.

# 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 (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 (bird-in-hand).
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.
- (Population growth as a possible complication for developing country).

# Investment alternatives

- Tax cuts.
  - Reduce distortions.
  - Lose taxation capacity for when resources run out.
- Infrastructure
  - Complements private capital
- SWF
- Lending to private sector
  - If borrowing constraints
  - Otherwise crowding out of private investments
- Give to citizens
  - Too little saving?
  - No smoothing of demand

# SWF or local capital?

- Why not invest in “roads” or schools instead of SWF?
- Economically depends on returns on investment in global assets vs local infrastructure and schools.
- SWF with spending rule gives clear accountability for what happens to resource income.
- Inefficiency and absorption in poor countries.
- Important to invest in absorption capacity.
- Fund can hedge against resource price.
  - High price increases gov income
  - High price increases local resource industry

# 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 (e.g. ***Natural Resource Charter***).
- Hard to get in place since few politicians will set up institutions which constrain themselves when expecting future resources.

# More on when to spend and resource curse

- Need legitimacy for resources→spend now
- Transparency→spend some later
- To manage trade-off important with strong finance ministry
- Open data on revenues, extraction etc
- Strong state comptroller
- Devil is often in details
- Saving for future bad politicians?
  - Set up rules when exploration starts but before expectations are accurate.

# Other trade-offs

- Is commitment good?
  - Yes for stability
  - But may be hard to foresee special circumstances
- Are strict spending rules good?
  - Yes for transparency
  - But may be hard to foresee special circumstances
- Is it possible to create binding rules?