Good News for Growth in Natural Resource-Rich Economies:

There's Nothing Special about Natural Resources

Presentation Plan
Keep It Simple: Sometimes the most Obvious Things are Forgotten

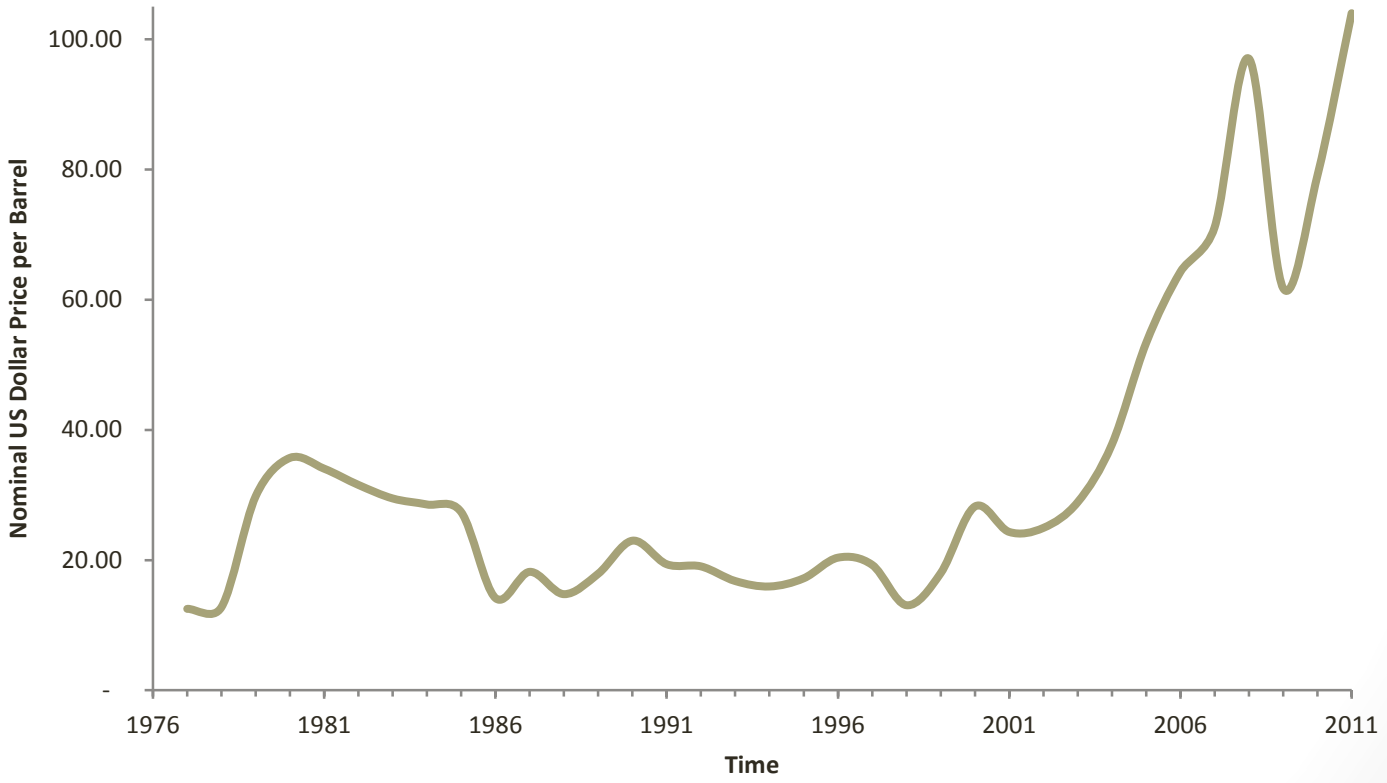
- Unique characteristics of the oil and mining industries may not matter for policy.
- Contracts are complicated but there are only three ways to get money from a buyer (other than confiscation). If form follows function, then there may be reasons for particular types of payment schemes in contracts.
- Reserves in the ground are an input, not an output. Royalties may be efficient and Pure Income Taxes if they subsititute for royalities may be inefficient.
- Revenue is NOT income.

Characteristics of Natural Resources and Natural Resource Markets

- Are these “unique” characteristics sufficient to warrant differential tax or public policy treatment?
  - Long and costly exploration and development (lead times)
  - High geological and technical risks
  - Volatility and uncertainty in prices
  - Resource exhaustion (“rents”)
  - Government ownership of reserves

Volatility and Uncertainty in Prices

Figure 1: Volatile Oil Prices
(from IMF Financial Statistics)



Volatility and Uncertainty in Prices

Table 3. Coefficient of Variation (CV) in Real Annual Average Prices, 1977-2011	
Commodity	Coefficient of Variation
COAL (Australia)	0.51
COPPER (LME)	0.46
GOLD (LME)	0.44
IRON ORE (Brazil)	1.04
CRUDE OIL (world average)	0.52
BANANAS (Ecuador)	0.17
COCOA BEANS (Ghana)	0.85
COFFEE (Brazil)	0.74
COFFEE (other mild)	0.61
SUGAR (US)	0.27
WHEAT (US)	0.30
SOYBEANS (US)	0.36
MAIZE (US)	0.33
SWINE (US)	0.65
DOW JONES INDUSTRIAL AVERAGE	0.61
S&P 500	0.59
US Federal Funds Annual Effective Rate	0.99

Government Ownership

- Mineral rights are held by the state in most countries
- Governments may also own public services, electricity, airlines, etc.
- For example, with publicly-supplied electricity, state needs to set price
- Only difference with natural resources is that they are a factor of production – need to figure out how to manage derived demand for a flow of services from a factor of production
- Government ownership is the basis of contracts with mining firms (even that fact may not be unique)

Resource Exhaustion ("Rents")

- Will discuss more below
- Historically, "rent" measures the marginal value of the return (the flow price) from owning the stock. I own the apartment house. You pay me rent.
- Economic rent: Demanders pay less than their maximum Willingness to Pay and suppliers get more than the minimum they have to be paid. (Area under the Compensated Demand Function and above Economic Supply Curve)
  - The distribution of rent between consumers and producers may arise from:
    - Using a technology with decreasing returns to scale
    - Market power (monopoly)

Contracts are complicated

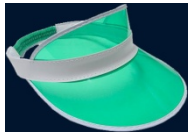
- Types of Contracts
  - Royalty – Tax Arrangements
  - Production Sharing
  - Service Contracts
- Terms
  - Equity Participation (Free or Purchased)
  - Employment
  - Fixed Payments
  - Management
  - State Ownership

Know Two Things

- Call the contract whatever you want.
  - I can arrange terms so that if you want 50% of a project's NPV, I can get it.
  - The risk-sharing characteristics will be different.
    - Under a royalty – tax regime, the risks might be shared 40% Government to 60% investor
    - Under a pure service contract, the risks might be 95% Government to 10% investor.

- Call it whatever you want, but there are only three ways for a buyer to pay a seller:
  - A fixed fee (an auction) which is independent of the amount purchased. ("I give you the right to buy as much as you want for $10.00.")
  - An amount per unit of sales (a royalty). ("I give you the right to buy as much as you want for $1.00 per unit.")
  - An amount based on profits. ("I give you the right to buy as much as you want in exchange for 10% of your profit.")

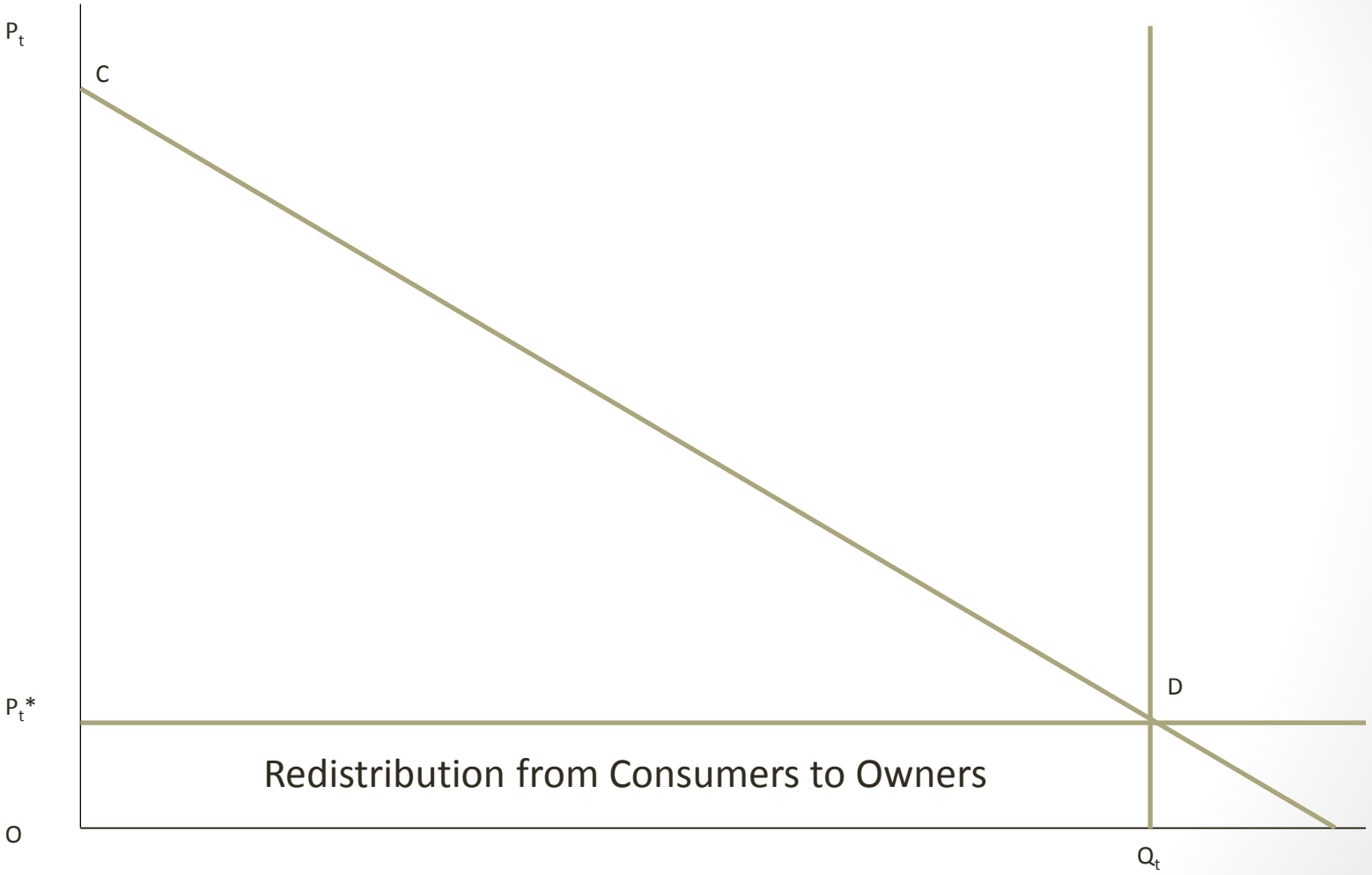
Contract Terms May Imply that the Government May Wear up to Four Hats

1. Resource Owner 
2. Tax Collector 
3. Investor 
4. Mine Operator 

Payment Types May Reflect the Different Roles of Government

- My advisory work and papers have been about the function of each payment in the context of each role played by government.
- Concentrate now on GOVERNMENT AS RESOURCE OWNER.
- KEEPING IT SIMPLE MAY LEAD TO INSIGHTS ABOUT THE SUPPOSED EFFICIENCY OF INCOME TAXES (BROWN TAXES, RESOURCE RENT TAXES) RELATIVE TO ROYALTIES.

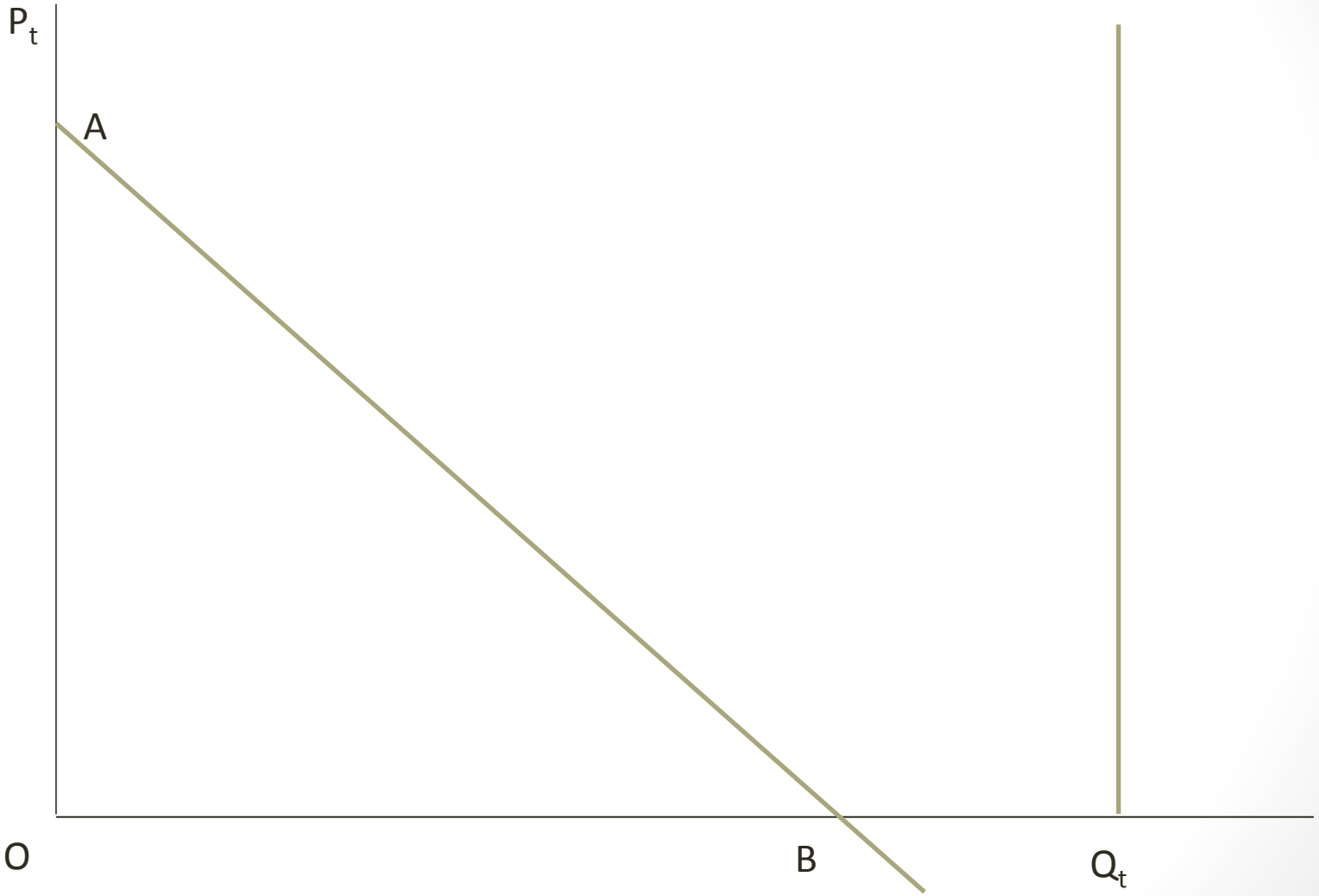
Traditional Rent
Manna from Heaven is Economically Scarce
NOT RELEVANT FOR RESERVES



No Mine Has Ever Been Exhausted

Good Recovery from Oil is less than 40%

Traditional Rent When Manna is Not Exhausted
Manna from Heaven in Excess Supply
NOT RELEVANT FOR RESERVES



Reserves are an INPUT not an OUTPUT

$$X_t = F(K_t, L_t, R_t)$$

Where:

X_t = Reserves extracted

K_t = Capital services used in period t (which might be owned by the shareholders of an international company)

L_t = Labor services used in period t

R_t = Reserve services used in period t (owned by the government for our purposes.

The Mining Company's Problem is to make as much money as possible given the contract.

Max: $\pi_t = P_t F(K_t, L_t, R_t) - w_t L_t - (r_t + \rho) K_t - Z(R_t, \pi_t)$

Where: $Z(R_t, \pi_t)$ = Contractual Payments

Note: This is NOT the social problem even if we include the physical exhaustion constraint. Government owns the reserves.

Government's Problem As Resource Owner

- Max: $A = -H(S_t) + Z(R_t, \pi_t) + H(S_t - R_t)$

- Subject to: $R_t \leq S_t$

  $A \geq 0$

Where: S_t = Stock of reserves remaining in the ground

H() = Value of the remaining stock of reserves and surface rights.

Note: This is not, economically speaking, the social problem

The value of remaining reserves is the country's problem, not the contractor

This is the Social Problem

Max: $W = P_t F(K_t, L_t, R_t) - w_t L_t - (r_t + \rho) K_t - H(S_t) + H(S_t - R_t)$

Subject to: $R_t \leq S_t$

The contract goes away because it serves only to distribute the net gains between the buyer and seller.

The issue is: Are there contract terms that will satisfy the social conditions for efficiency?

If the Contract is Economically Efficient, then:

For Profit-Related Charge:

$$(1-Z'_{\Pi_t})(P_tF'_{L_t}-w_tL_t)=(P_tF'_{L_t}-w_tL_t)=0$$

$$(1-Z'_{\Pi_t})(P_tF'_{K_t}-(r_t+\rho)K_t)=(P_tF'_{K_t}-(r_t+\rho)K_t)=0$$

$$(1-Z'_{\Pi_t})(P_tF'_{R_t}-Z'_{R_t})=(P_tF'_{R_t}-Z'_{R_t})=0$$

A BROWN TAX or an Income will satisfy the conditions above.

In addition, for a per unit charge to be efficient the condition is:

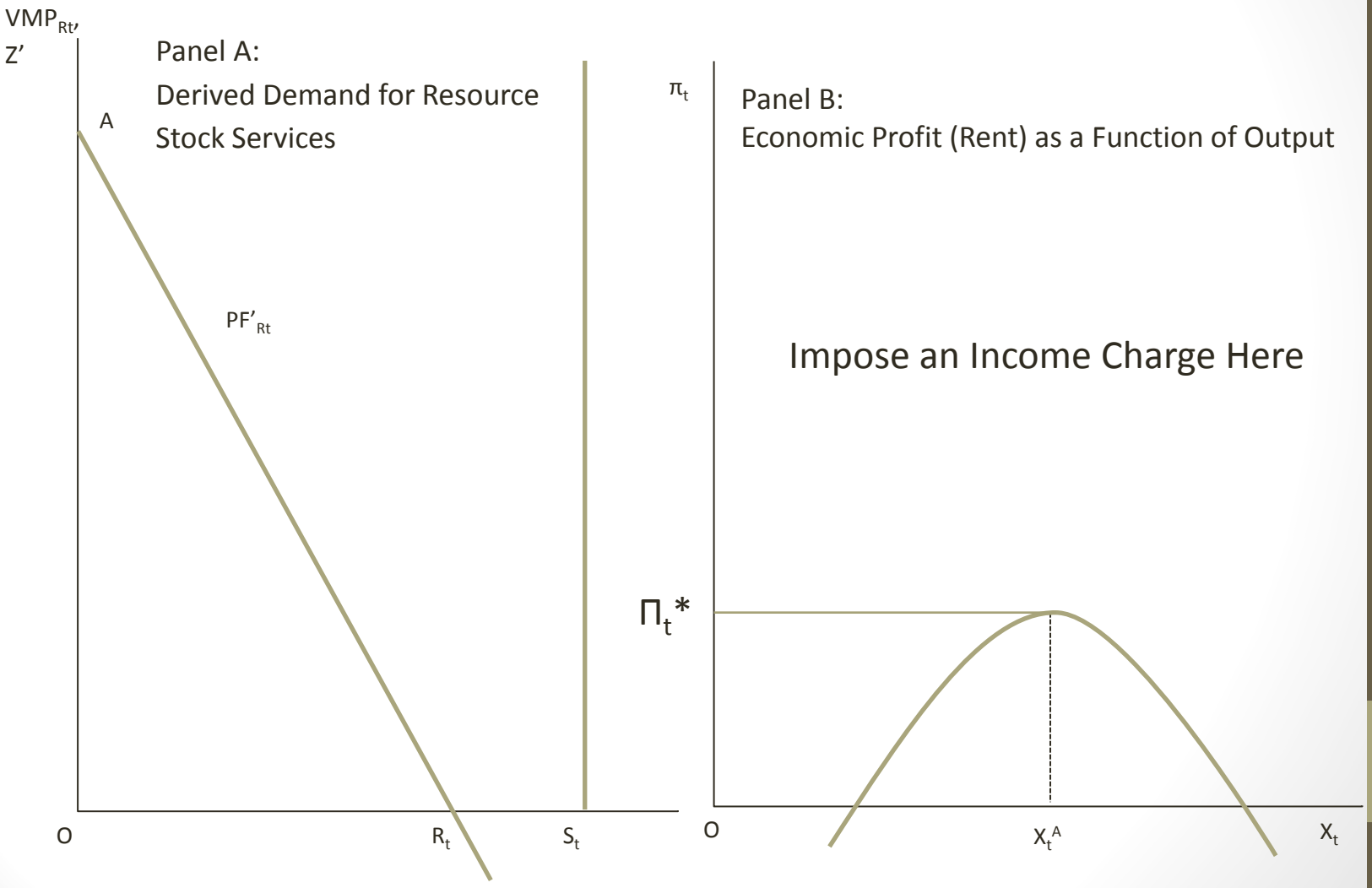
$$Z'_{R_t}-H'_{R_t}=0$$

A non-zero per unit charge, a royalty, is efficient if the opportunity cost of extraction is not zero at the margin.

Need to Answer Two Questions to Determine if a Royalty is Efficient

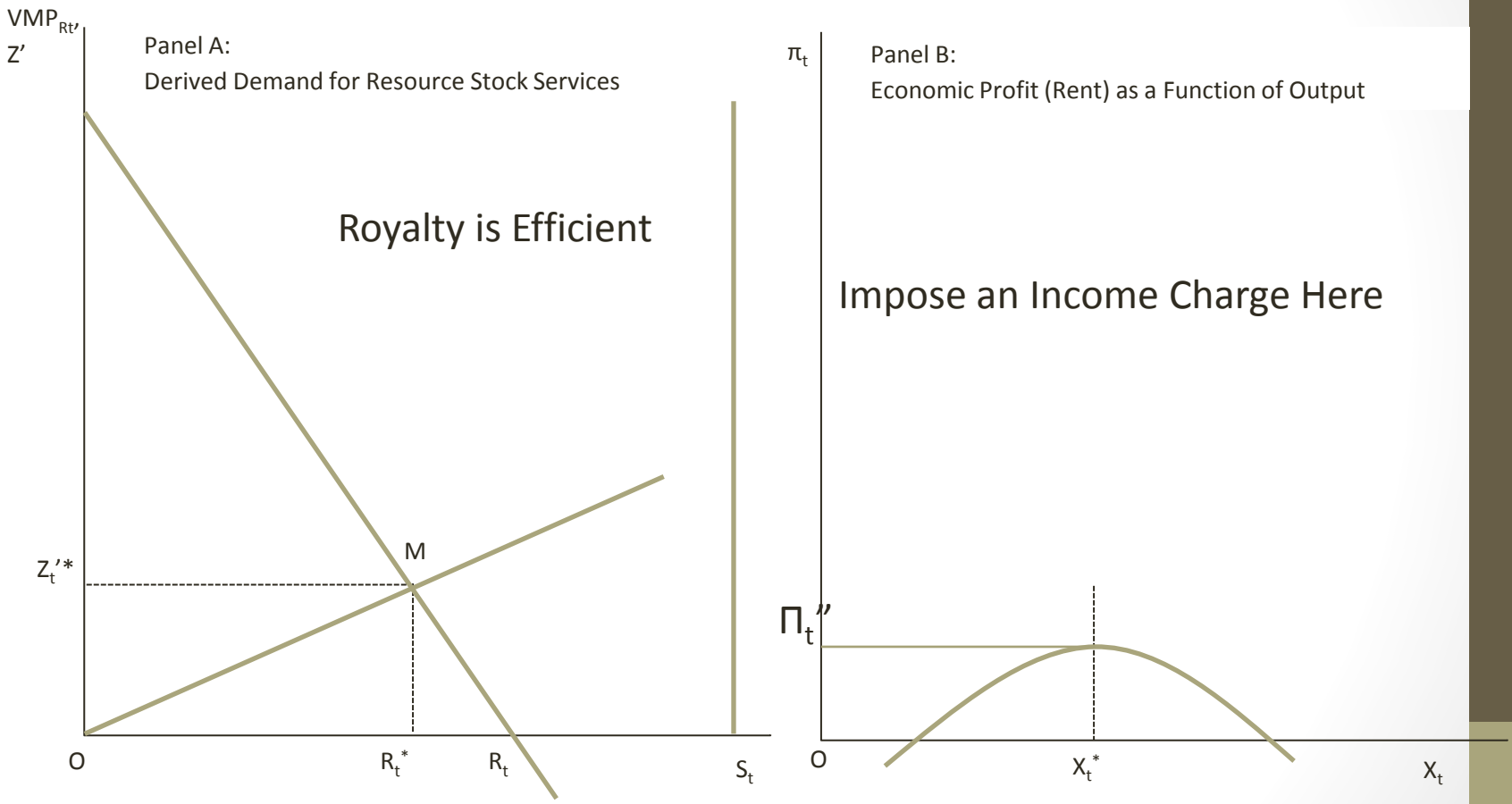
- Do Reserves have value?
- Does the value of reserves decrease with extraction?

This is the Resource Problem
Derived Demand: Resource Stocks in Excess Supply: Royalty is Inefficient
Reserves might have value for society, but that value is not in either picture.



Derived Demand: Resource Stocks are NOT in Excess Supply:
Issue is: Does Society Value Reserves at the Margin?

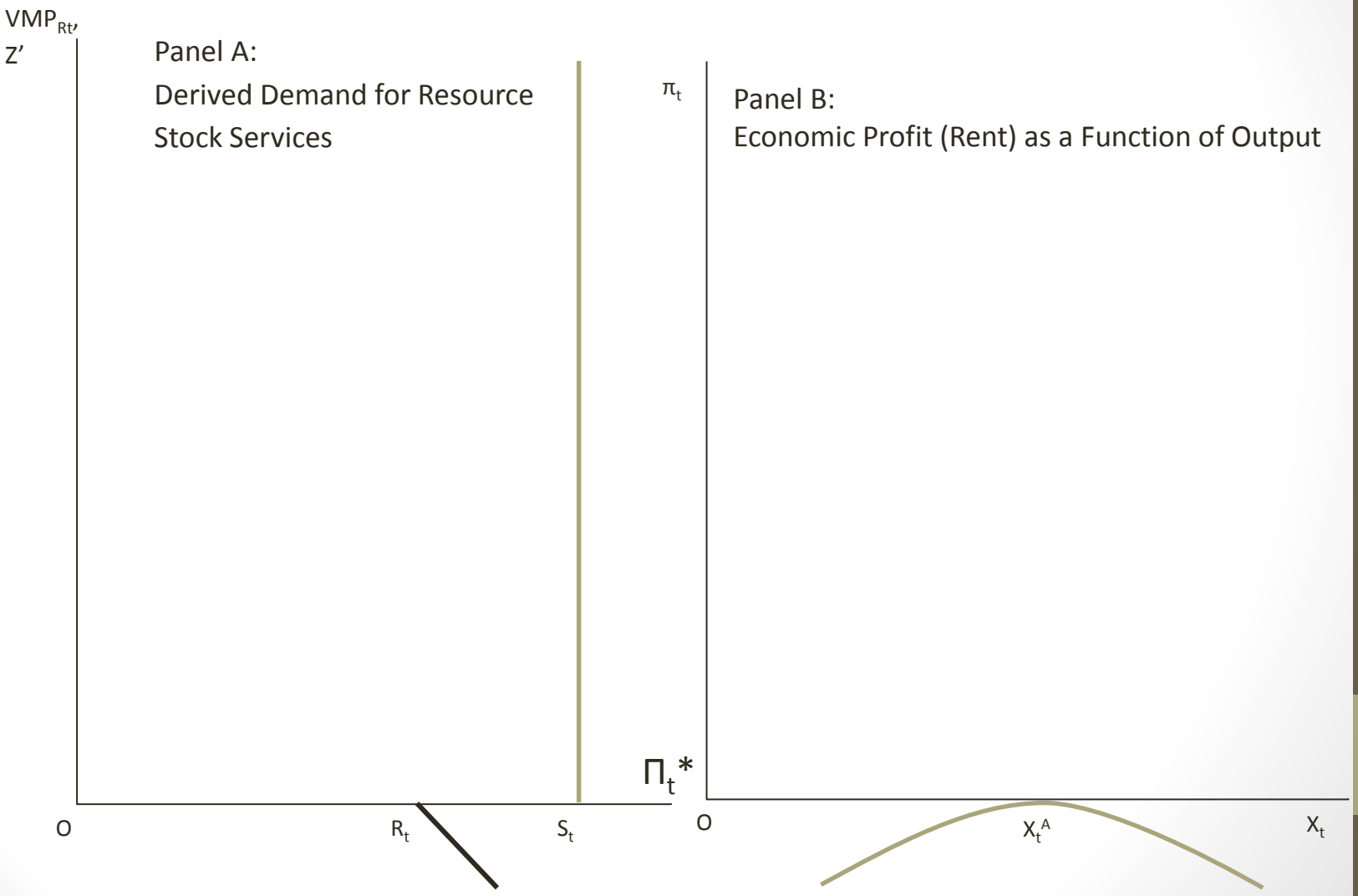
Now total social cost is the area under the supply function.



Reasons to Believe that Marginal Opportunity Costs of Reserves are Not Zero

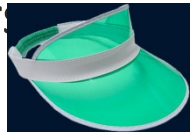
- Extraction may be valuable in the future
- The country may last longer than the contract
- People may want to farm, build houses, or fish
- There may be profitable uses of other resources (Dutch Disease)
- May want to have someone else produce
- Some reserves may have value in an uncertain world

If You Value at Zero then Zero is What You Might Get



Policy Implications – Good News

1. You own something of value at the margin: Act lik
   - Charge a royalty if you believe that extraction of reserves will reduce the wealth of your economy at the margin.
   - Try to get as much as you can (just like the mining company will try to get as much as it can from sales). You are constrained by competition just like the mining company.
2. If there are rents, then tax them in all sectors



   - Income taxation
   - Provisions for mining
     - Capitalization of exploration and development
     - Deduction for contributions to rehabilitation funds
3. Contracts might be more standard
   - Marginal social cost of extraction should be the same across deposits

4. Saving: Revenue is Not Income

- Need to determine two things:
  - What is the base of saving?
    - Total revenue
    - Natural resource revenue
  - How much to save?
    - Proposed Rule: Permanent Income Hypothesis: Save 100% of income
    - Revenue is not income
    - Income = Revenue – Depletion (Amortization)

Simple-Minded Method

$R_t = (r_t + \delta_t)\, PV_t$

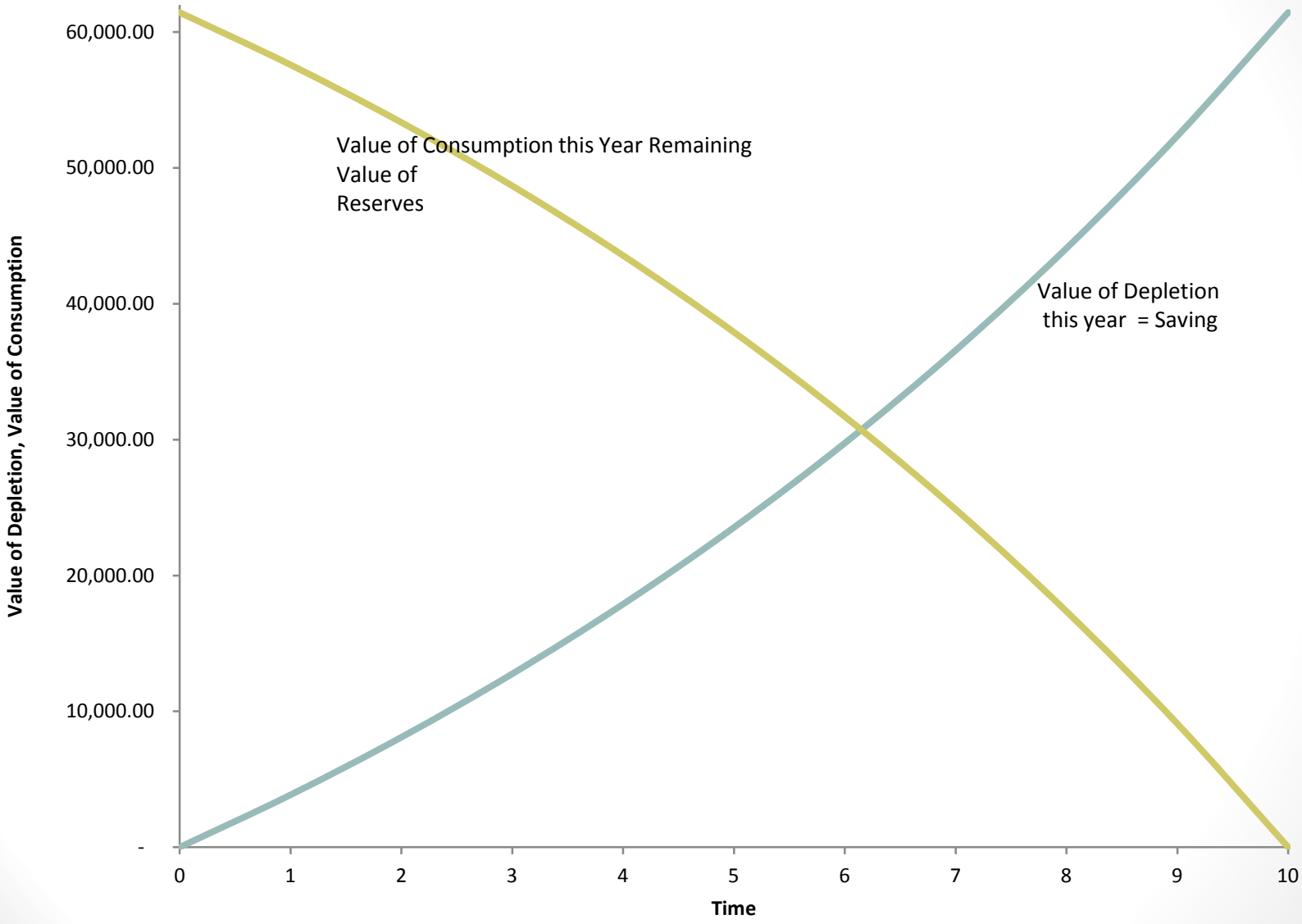
Or

Saving this Year = $\dfrac{\delta_t}{r_t + \delta_t} R$

Consume the Remainder

But there is nothing special about this saving. Need to compute the value of depreciation for all assets (state and private). Need to compute Net National Income.

Figure 2:
Extraction Converted into the Value of Depletion



5. Be Realistic - Resources will not Save you. You have other assets

Oil Reserves and Production (2011): Summary by Region								
Column	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Region	**Proved reserves* (billion barrels)**	**Annual production** (million barrels)**	**Population, total (millions)**	**Per capita proved reserves (barrels)**	**Per capita annual production (barrels)**	**GDP per capita, PPP (current intl $)**	**Estimated Per Capita Annuity**	**Annuity Value as Share of Current Per Capita GDP**
North America	217.50	4,911.10	460.87	471.94	10.66	39,605.77	213.12	0.54%
South/Central America	324.30	2,735.56	359.04	903.25	7.62	12,081.58	152.38	1.26%
Europe/ Eurasia	138.90	6,006.94	357.43	388.61	16.81	24,028.88	336.12	1.40%
Middle East	640.70	7,892.94	101.27	6,326.68	77.94	16,349.02	1,558.80	9.53%
Africa	83.10	2,814.72	427.14	194.55	6.59	3,818.58	131.80	3.45%
Asia Pacific	39.00	2,690.11	3,036.79	12.84	0.89	6,341.95	17.72	0.28%

Note: This is a summary of the table in the paper, which is by country.

* Proved reserves of oil: Generally taken to be those quantities that geological and engineering information indicates with reasonable certainty can be recovered in the future from known reservoirs under existing economic and operating conditions.
** Annual production: Data reported in million annual tonnes, converted to barrels by multiplying by 7.33 (BP conversion factor).

Sources: BP Statistical Review of World Energy June 2012; World Bank World Development Indicators (GDP, Population)

Good News

- The fact that natural resources are a gift of nature has no bearing on their efficient allocation
- There may be a significant difference between economic and physical exhaustion
- Resources are a factor of production. (As an economist it is hard to believe that any productive factor has a zero flow price.)
- Good News
  - Treat resources like any other productive input
  - Treat mining companies like any other business