The Economics of Natural Resource Extraction

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Natural (non-renewable) Resources

- non-renewable resources
  - not replaced by natural means at the rate they are consumed
    - Geological time vs human time
  - Earn rents
    - Why? fixed in supply, not produced; part of country’s capital stock
    - rents: difference between the price of commodity and the average cost of producing it

- What to do with rents? advance development path
  - Move up capital and consumption paths
Windfall → Save and invest more

Consumption increment greatest after windfall – current generation is poorest

Accumulated assets rise → bring forward development / move up the development path

Resource revenues used for:

i. domestic investment
ii. paying off foreign debt
iii. front-loading consumption
Requirements (challenges) to Advance Development Path
To transform non-renewable natural resources into development requires getting policy right in three areas:

1) Efficient resource extraction in order to maximize resource rent generated
   • foreign expertise require

2) A system of taxes and royalties that enables government to recover rents
   • get fair share

3) A clear policy for investment of resource rent in productive assets
   • SWF: parking fund

IMF (2017): Natural resource revenues are macro-critical for one-third of member countries.
Challenges: Intergenerational equity

• transform a temporary windfall into a permanent one

• Intergenerational equity: share with current and future generations
  • Rawls: who speaks for the future

• e.g. Mick Jagger

• Norway vs UK: similar gas deposits
  • UK lower prices; Norway cheaper extraction

• Norway: USD 1.2 trillion ($240,000 pp)
• UK: 0 (used to fund tax cuts)
• could’ve had $624 billion (James et. al., 2022) ($10,000 pp)
Challenges: Resource Curse: paradox of plenty

- Correlation between resource abundance and poor economic growth (Sachs and Warner, 1995)

- Why?
  - ‘Dutch disease’
  - Revenue volatility
    - Macroeconomic instability
  - Enclave effects
  - Human capital
  - Political-economy
    - Democracy
    - Conflict
    - Limited govt capture of benefits
    - Weaker institutions (elites capture benefits)
Dutch ‘Disease’ (Corden, Neary, 1982)

- Economy has 3 sectors
  - booming export sector (e.g. LNG)
  - lagging (traditional) export sector (agriculture, manufacturing)
  - non-traded goods sector (retail trade, service industry, construction)
- Windfall: boom in resource sector (e.g. jump in LNG exports: higher prices/volumes)
- Spending effect: ↑ income => spent on non-traded goods => ↑ price on non-traded goods → real exchange rate appreciates => traditional exports sector less competitive
- Resource movement effect: ↑ price on non-traded goods => workers and capital attracted to non-traded sector (out of traditional export sector) => further contraction in traditional exports

- Boom → appreciation of (real) exchange rate → ↓ traditional export sector
Dutch ‘disease’: damaging effects on economy

• Contraction of manufacturing sector reduces long-run growth
  • learning-by-doing: accumulation of skills over time => higher productivity => growth

• macroeconomic instability
  • greater dependence on volatile resource revenues

• export sector becomes focused on non-renewable resources
  • exports become less diversified: more susceptible to resource price volatility

• Solution to avoid Dutch Disease: save windfall outside the country in SWF
Challenge: Macroeconomic Instability

• Macroeconomic stabilization fund (SWF)

• buffer against resource revenue volatility caused by price fluctuations
  • capital-scarce country can’t borrow in global markets
    • Causes: price volatility, volume changes
    • Project cycle

• stabilize government take (Davies, Schroder, 2022)
  • avoids difficult downward adjustments in the RER e.g. PNG 2014-2021
  • Take more revenue upfront (Davies and Schroder (2022), IMF Article IV (2022))
    • e.g. royalties, ad valorem revenue

• macroeconomic instability (via RER) bad for growth – resource curse
RRDCs Country Characteristics:

<table>
<thead>
<tr>
<th></th>
<th>RRDCs</th>
<th>ORRCs</th>
<th>G7</th>
<th>OLDCs</th>
<th>PNG</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNI/GDP</td>
<td>0.91</td>
<td>0.97</td>
<td>1.01</td>
<td>1.05</td>
<td>0.90</td>
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<tr>
<td>Resource GDP/GDP</td>
<td>0.26</td>
<td>0.25</td>
<td>0.01</td>
<td>0.03</td>
<td>0.23</td>
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</table>

Notes: ORRCs refers to other resource rich countries which includes Australia, Botswana, Brazil, Canada, Chile, Kuwait, Norway, Oman, Qatar, Saudi Arabia, and United Arab Emirates. Government take is calculated as the ratio of total fiscal resource revenue to resource GDP. Cameroon is excluded from the RRDC-group because of unreliable resource GDP data. OLDCs belong to the group of least developed countries (LDCs) that are not at the same time classified as RRDCs. A list of OLDCs is in the appendix. Sample period: 2000-2019. Source: Compiled from national accounts data and World Development Indicators.

Davies and Schroder 2022
Table 2: Government take comparison

<table>
<thead>
<tr>
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<th>RRDCs</th>
<th>ORRCs</th>
<th>PNG</th>
</tr>
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<tbody>
<tr>
<td>Government Take ($\bar{a}$)</td>
<td>0.37</td>
<td>0.66†</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Notes: Government take is calculated as the ratio of total fiscal resource revenue to resource GDP. Cameroon is excluded from the RRDC-group because of unreliable resource GDP data. ORRCs refers to other resource rich countries which includes Australia, Botswana, Brazil, Canada, Chile, Kuwait, Norway, Oman, Qatar, Saudi Arabia, and United Arab Emirates. Sample period: 2000–2018. † calculated based on available data from the following countries: Botswana, Chile, Kuwait, Norway, Qatar, and Saudi Arabia.

Source: Compiled from national accounts data, World Development Indicators, and the Government Revenue Dataset published by the International Centre for Tax and Development.

Davies and Schroder 2022
Estimate of Government Take (% Natural Resources Rents): Papua New Guinea

Source: Compiled from PNG Budget Database and the Government Revenue Dataset published by the International Centre for Tax and Development.

Government take: ratio of fiscal resource revenue to resource output: proxy for resource rent extraction

Davies and Schroder 2022
Estimate of Government Take (% Natural Resources Rents): Selected Countries: Asia Pacific

Source: Authors
Estimate of Government Take (% Natural Resources Rents): Selected Countries: Sub-Saharan African

Source: Authors
Policy to get a better bargain (improve take)

- Improve outside options $\rightarrow$ increase $\pi^*_G$
- Better macro policy: “need the next resource projects to save us”
- Less dependence on resources sector for:
  - Growth
  - Revenue
  - Foreign exchange
- Better policies in non-resource sector
  - Agriculture, tourism
- Less dependence also decreases impatience and fear of breakdown $\rightarrow$ increase $\alpha$
- Lower political risk and reduce corruption $\rightarrow$ increase $\alpha$
- Stable policies towards MNCs
  - Encourage entry of MNCs $\rightarrow$ more competition $\rightarrow$ reduces MNCs bargaining strength $\rightarrow$ increases $\alpha$
- Leaving it in the ground for future exploitation is a valid outside option
Challenge: Macroeconomic Instability: project cycle

- **P1: investment phase**
  - Physical capital and infrastructure investments
    - Build capacity for the production phases
    - High demand local resources
      - Positive shock to economy (appreciates RER)
    - PNG LNG construction phase 2010-2013

- **P2: high production, low government take**
  - Project partners use rents from production to recoup costs
    - Tax revenues low: incentives to MNE that backload resource revenues: tax concessions etc
    - PNG LNG current phase

- **P3: high production, high government take**
  - Significant increase in govt’ take (tax receipts high)
    - Project investment costs recouped
      - Tax exemptions/deferments expire
    - PNG LNG 2026? (IMF Article IV 2022)

- **P4: falling production yields – revenues falling**
  - As resource exhausted, production yields fall
  - Tax revenues (and govt’ take) trend downward.
Phases of Resource Project

Figure: Projected fiscal resource revenue, Mozambique LNG projects, 2020–2035

Source: Akap Energy
How should Papua New Guinea set policy for large resource projects?

• **P1: Investment**
  • Boom: resource sector hires local worker for construction
  • Policy
    • save now for future periods
      • Positive net spending detrimental as further appreciate RER (PNG gov’t in 2012)

• **P2: high production, low revenue**
  • Policy
    • borrow against future revenues: smooth consumption
  • Risks
    • resource price collapses (PNG in 2014)
    • project not as productive as expected – resolved in P2

• **P3: high production, high revenue**
  • Policy
    • save – times are good
    • payback borrowing from P2, save for P4
  • Challenges
    • saving in P3 is tough
      • just been handed keys to Ferrari
    • politically difficult to do these two things (save, depreciate)
    • risk: if don’t do the right thing, suffer in P4 (nothing to eat when you retire)

• **P4: falling production, falling revenues**
  • Policy
    • spend savings from P3
    • e.g. Timor in P4: drawing down SWF
Consumption: no-insurance vs optimal consumption
Exchange rate: no-insurance vs optimal policy
Lessons and discussion

• Lesson:
  • P1: restrain spending (didn’t happen with PNG LNG)
  • P2: Take more revenue upfront (Davies and Schroder (2022), IMF Article IV (2022))
    • e.g. royalties, ad valorem revenue
      • don’t have to borrow as much in P2
  • P3:
    • saving is very important
      • payback borrowing in P2 and to spend in P4

• Breaking the ring-fence
  • repayment of investment costs of Papua LNG applied against revenue from PNG LNG
    • holds PNG LNG in P2 for longer, shortens P2 for Papua LNG
      • both projects: simultaneous emergence to P3
    • smoother revenue streams are preferred
      • PNG cannot easily access global capital markets

• Multiple large projects in different phases
  • calibrate policy with this analysis in mind
PNG LNG: what has happened?

• PNG LNG
  • P1: investment phase, 2010-2013
    • construction: LNG partners hire PNG labor and capital, wages bid up
    • Kina appreciates, RER appreciates
    • Gov’t spending increased (in advance of windfall) – (hold recommendation)
  • P2: production starts: mid-2014, take low (zero)
    • Energy prices halved (bad shock)
    • Government spending increased (right direction, but too much)
    • RER depreciated but adjustment resisted by BPNG (forex rationing and import compression)
  • P3: sometime soon? (IMF Article IV (2022), 2026 onwards)
    • gov’t will want to spend but must save!