Capital rationing
A threat to energy security

Magne Emhjellen* and Petter Osmundsen***

* *Petoro*

** *University of Stavanger*

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WWW.UiS.no/Osmundsen
https://ideas.repec.org/e/pos49.html

Is oil industry production sustainable?

- In spite of the dramatic investment cuts, oil companies sustain their production levels. According to Schlumberger CEO Paal Kibsgaard this is not sustainable.
- According to him the production levels are masking an underlying problem that may soon hit the oil industry
  - “Underinvestment over the last three years means production is not being replaced by further exploration, leading to faster depletion of known resources, and potentially, a resource crunch in the future.”

http://www.bloomberg.com/news/articles/2016-06-15/oil-industry-to-cut-1-trillion-in-spending-after-price-slump

Capital rationing

- Dramatic fall in the oil price led to extensive capital rationing
  - Protecting dividend programs
  - Reluctant to increase debt rates
- The oil and gas industry will cut USD 1 trillion from planned spending on exploration and development. Worldwide investment in the development of oil and gas resources will be cut by 22 per cent, or USD 740 billion, from 2015 to 2020.
  - Wood Mackenzie Ltd
- Implication
  - Fierce competition between resource extraction countries to attract scarce investment
  - A threat to energy security
- Will tax reductions alleviate the threat to energy security?
- The paper examines the effect of tax design on international capital allocation when companies ration capital.
  - We analyse capital allocation and government take for four equal oil projects in three different fiscal regimes: the US GoM, UK upstream and Norway offshore
  - Implications for optimal tax design are discussed

Emhjellen, M. and P. Osmundsen (2017), "Capital rationing by project metrics", in Bjørndal, M., Gjesdal, F. and A. Mjøs (eds.), Finance in Society, An Anthology in Honour of Thore Johnsen, Cappelen Damm Akademisk.

Current literature

- Oil companies ration capital even when the oil price is rising
  - Know from experience that overly rapid growth leads to lower quality, inadequate project management and cost overruns
- Capital rationing is not accounted for in the current international tax literature
  - Assumes that all project with positive NPVs are sanctioned
- In addition, Norwegian tax authorities presumes a closed economy and partial cash flow discounting
  - Corresponds to a 2% nominal rate of return requirement

Haufler, A. and I. Wooton (1999), «Country size and tax competition for foreign direct investment», *Journal of Public Economics* 71(1), 121-139.
Osmundsen, P., Emhjellen. M., and M. Halleraker 2006, "Transnational Oil Companies' Investment Allocation Decisions", in Jerome Davis, ed. 2006, The Changing World of Oil. An Analysis of Corporate Change and Adaptation, Ashgate Publishers, ISBN 0-7546-4178-3.
Osmundsen, P., Emhjellen, M., Johnsen, T., Kemp, A. and C. Riis (2015), "Petroleum taxation contingent on counter-factual investment behavior", *Energy Journal* 36, 1-20.
Olsen, T. and P. Osmundsen (2011), "Multinationals, tax competition and outside options", *Journal of Public Economics* 95, 1579-1588.

Organisation of presentation

- Present the data and calculate NPV before and after tax in order to;
  - Demonstrate the difference in government take between Norway, the UK and the US Gulf of Mexico.
- We find the solution for the portfolio which maximises NPV given two natural limits on capital budgets
  - USD 40 billion and USD 70 billion in investment, when total possible investments are 117 billion USD
- We describe three different industry metrics applied by industry to rank projects
- We examine the portfolio ranking of model oil and gas projects on the basis of the metrics, and compare them with those obtained by maximising total portfolio NPV, given the constraints
- We presents an analysis of project returns with changes in prices
- We conclude

The tax systems

- Norway
  - Corporate tax 25%
  - Special petroleum tax 53%
  - 6 years linear tax depreciation
  - Uplift 22%, split over four years
- UK
  - Corporate tax 30%
  - Supplementary charge 32%
  - Investments directly expensed
  - Uplift 62.5% in same year as investment
- GoM
  - Signature bonus
  - Royalty of 12.5%
  - Corporate tax 35%
  - 8 year depreciation, front-end loaded

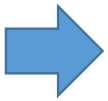
The Projects: Summary, Capex and Mbbl

	CAPEX(Mill USD)	Oil(Mill Bbl)
Large	15000	1200
Large Marignal	15000	840
Medium	8000	500
Small	1000	35

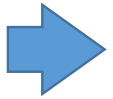
The Projects NPV and Government take in the different fiscal regimes (as given by percentage of NPVs)

		NPV Before tax	NPV after tax Consolidated	NPV after tax Ring fenced	NPV tax Consolidated	NPV tax Ring fenced	Gov. take % Cons.	Gov. take % Ringf.
USA GoM	Large maginal	4863	456	381	4407	4482	90,6 %	92,2 %
Norway	Large marginal	4863	1002	337	3861	4526	79,4 %	93,1 %
Norway	Small	483	107	74	376	409	77,8 %	84,7 %
Norway	Medium	5978	1392	1211	4586	4767	76,7 %	79,7 %
Norway	Large	12600	2982	2530	9618	10070	76,3 %	79,9 %
USA GoM	Small	483	133	106	350	377	72,5 %	78,1 %
USA GoM	Medium	5978	2140	2132	3838	3846	64,2 %	64,3 %
USA GoM	Large	12600	4812	4786	7788	7814	61,8 %	62,0 %
UK Up.	Large	12600	6529	6049	6071	6551	48,2 %	52,0 %
UK Up.	Medium	5978	3227	2997	2751	2981	46,0 %	49,9 %
UK Up.	Small	483	332	307	151	176	31,3 %	36,4 %
UK Up.	Large marginal	4863	3393	2671	1470	2192	30,2 %	45,1 %

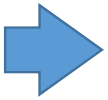
USA GOM Large marginal extremely high governmet take, 90,6% and 92,2%



Norway very high goverment take, 76,3%-79,4% and 79,7%-93,1% ring fenced



US Gom goverment take, 61,8%-72,5% and 62%-78,1% ring fenced



UK lowest goverment take, 30,2%-48,2% and 36,4%-52% ring fenced

Company portfolio selection with constraint

The value of the portfolio of projects may be written as:

$$NPV_p = \sum_{i=1}^{N} V_i \; X_i$$

In equation 2.1, V_i denotes the NPV of project *i,* and X_i the relative percentage invested in project *i*, (i=1,..N).

maximised subject to:

$$X_i \geq 0$$

$$X_i \leq 1$$

and

$$\sum_{i=1}^{N} I_i X_i \leq 40.000 \ ,$$

		Capex Mill USD	NPV Consolidated
Norway	Large	15000	2982
Norway	Large Marignal	15000	1002
Norway	Medium	8000	1392
Norway	Small	1000	107
USA GoM	Large	15000	4812
USA GoM	Large Marignal	15000	456
USA GoM	Medium	8000	2140
USA GoM	Small	1000	133
UK Up.	Large	15000	6529
UK Up.	Large Marignal	15000	3393
UK Up.	Medium	8000	3277
UK Up.	Small	1000	332
Sum	Total	117000	26555

Ranking with before-tax constraint
Results <=40.000

		Percentage Included
Norway	Large	
Norway	Large Marignal	
Norway	Medium	
Norway	Small	
USA GoM	Large	100 %
USA GoM	Large Marignal	
USA GoM	Medium	13 %
USA GoM	Small	
UK Up.	Large	100 %
UK Up.	Large Marignal	
UK Up.	Medium	100 %
UK Up.	Small	100 %

Norway not included, US only with a portion of medium sized project. UK with all!

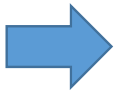
Results <=70.000

		Percentage Included
Norway	Large	53 %
Norway	Large Marignal	
Norway	Medium	
Norway	Small	
USA GoM	Large	100 %
USA GoM	Large Marignal	
USA GoM	Medium	100 %
USA GoM	Small	
UK Up.	Large	100 %
UK Up.	Large Marignal	100 %
UK Up.	Medium	100 %
UK Up.	Small	100 %

Norway only with 53% of Large project, US with Large And Medium sized project. UK with all!

Company portfolio selection with after tax cost constraint

		Capex Mill USD	PV after tax cost	Percent Incl.
Norway	Large	15000	4206	100 %
Norway	Large Marig	15000	4051	
Norway	Medium	8000	2301	100 %
Norway	Small	1000	290	
USA GoM	Large	15000	11479	53 %
USA GoM	Large Marig	15000	11041	
USA GoM	Medium	8000	6200	
USA GoM	Small	1000	751	
UK Up.	Large	15000	3948	100 %
UK Up.	Large Marig	15000	3802	100 %
UK Up.	Medium	8000	2081	100 %
UK Up.	Small	1000	237	100 %



Norway included with Large and Medium,
US only with 53% of Large and UK with all!

Implications

- A before tax capital constraint: represents a proxy for other constraints in the organization (qualified managers, skilled professional etc.). When these are the real constraints, not capital, the Norwegian tax system is very unfavourable. This is also the case for the marginally profitable field with large investments in the US GOM fiscal system.
- A real after tax constraint: in a situation where costs of a project may be offset against other company income, makes the Norwegian offshore tax system more favourable and the US GOM more unfavourable. UK, as with the before tax constraint, gets all of its projects included.
- Both the portfolio optimisations with constraints limit the investments so that positive NPV Projects are not undertaken. But the after tax constraint is even more strict (next page illustrates this)

Comparison with portfolio selection based on metrics

IRR

$$NPV = \sum_{t=0}^{T} \frac{X_t}{(1+IRR)^t} = 0$$

NPV index

$$NPVI = \sum_{t=0}^{T} \frac{X_t}{(1+r)^t} / \sum_{t=0}^{T} \frac{I_t}{(1+r)^t}$$

Breakeven price

$$NPV = \sum_{t=0}^{T} \frac{(x_t P)(1-s) - C_t}{(1+r)^t} = 0$$

Projects	IRR metric	% Included	NPVI metric	% Included	BEP metric	% Included
Norway large	16,0 %	100 %	0,30	53,3 %	35,4	100 %
Norway large marg.	11,0 %		0,10		48,9	
Norway medium	15,9 %	100 %	0,25		37,7	100 %
Norway small	16,3 %	100 %	0,14		44,1	
US large	15,1 %	40 %	0,49	100 %	42,4	53 %
US large marg.	8,8 %		0,05		58,7	
US medium	15,1 %		0,38	100 %	44,9	
US small	16,6 %	100 %	0,17		51,6	
UK Large	28,2 %	100 %	0,66	100 %	25,6	100 %
UK Large Marg.	20,1 %	100 %	0,34	100 %	34,9	100 %
UK medium	31,4 %	100 %	0,58	100 %	26,5	100 %
UK small	64,4 %	100 %	0,43	100 %	27,8	100 %

IRR metric gives lowest portfolio NPV after tax but highest IRR after tax. **No link to portfolio selection choice**

The NPV index gives same result as portfolio selection with before tax constraint.

The Break even price metric gives same result as Portfolio selection after tax!

Summary Conclusions

- The government take, as percentage of NPV, is generally the highest in Norway
- The Norweagian tax is not favourable for investments given before tax investment constraints (often used as proxy for other organisational constraints)
- The after tax constraint is even more strict than the before tax constraint (given same level of before tax investments)
- The UK tax is favourable, compared to both Norway and the US tax, and with both before and after tax constraints
- The US GOM tax system is unfavourable for a project with marginal profitability and large investments
- With real constraint after tax the Norwegian tax allows for more project selection than with before tax constraint
- The NPV Index as metric gives selections in accordance with a before tax constraint while the Breakeven price gives project selections according to an after tax constraint
- Since companies often use both before tax and after tax constraints, it is likely that as prospectivity falls for a mature Norwegian continetal shelf, tax change in the direction of the UK will be necessay to attract investments.

Topics for future research

- Optimal tax design under capital rationing
  - Net present value index
  - Break-even price
- Complication with changes in corporate investment metrics
  - Priority of stable tax system
  - Common feature of rationing metrics is a higher implicit return requirement
- Correcting tax systems for the fact that society has a lower rate of return requirement (or rather, there is other value elements not included in project economics that also may have less systematic riskiness)
  - Beneficial for governments to carry a large fraction of initial investments