# Investment allocation with capital constraints. Comparison of fiscal regimes

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## Overview

The recent dramatic fall in oil prices has led to extensive capital rationing in international oil companies, and subsequent fierce competition between resource extraction countries to attract scarce investment. This situation is not adequately addressed by the large literature on international taxation and multinational companies, since it fails to take account of capital rationing in its assumption that companies sanction all projects with a positive net present value. The paper examines the effect of tax design on international capital allocation when companies ration capital.

## Methods

We describe the actual investment policy of multinational oil companies and the effect of tax design on investment location decisions. Oil companies apply capital rationing – ie, a positive NPV is not sufficient to get a project sanctioned. We describe the profitability hurdles (metrics) which projects must surpass and, by applying them to model petroleum fields, analyse how tax design affects capital allocation between countries in a context where capital is being rationed. The first metric we present is the IRR, which is described in many finance textbooks (see Brealey and Myers, 2011, and Copeland and Weston, 2005). It is defined as the rate of return which gives an NPV of zero:

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

where $X_t$ is the expected net cash flow after tax in period *t*. The second metric is the NPVI, defined as the after-tax NPV of the project[1] divided by the before-tax NPV of investment (Kind, Tveteras and Osmundsen, 2005):[2]

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

where $I_t$ is expected investment in period *t* and *r* is the WACC. It is our understanding that this metric is used by the dominant international oil companies in periods when oil prices are fairly stable. The third metric is the BEP of the project (Jovanovic, 1999). It is often used by the oil industry in times like the present, when oil prices are volatile.[3]

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

Where $x_t$ is production in period *t* and *s* is the marginal tax rate, $C_t$ is total cost – ie, the sum of investment and operating cost – and *r* is the WACC. P is the constant price which gives an NPV equal to zero after tax – ie, the BEP. The solution is obtained by iteration. 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.

## *Results*

No Norwegian projects are developed with the tightest capital constraint (USD 40 billion), while three in the UK and two in the USA will be. With a less stringent capital constraint of USD 70 billion, the same two projects in the USA are developed, all four in the UK, and only the large project in Norway. One might therefore question the

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[1] For simplicity, we have assumed 100 per cent equity financing.

[2] Companies apply traditional NPV values – ie, all cash flow components are discounted by the same discount rate. For a discussion of differentiated discount rates applied to partial cash flows, see Osmundsen et al (2015).

[3] The financial press frequently reports on BEPs in different extraction regions, and much attention is currently being paid to the BEP of US tight oil. See, eg, [http://uk.businessinsider.com/cash-cost-breakeven-oil-prices-2015-12?r=US&IR=T](http://uk.businessinsider.com/cash-cost-breakeven-oil-prices-2015-12?r=US&IR=T).

competitiveness of the Norwegian fiscal regime in current market conditions. The US authorities should worry about cream-skimming, since projects perceived to be marginal by capital-rationing oil companies – and which therefore fail to be sanctioned – may be profitable for society. Capital rationing is often implemented by simple decentralised profitability metrics. We have analysed capital allocation under different metrics and tax systems. Juxtaposing the metric results against the results from portfolio NPV maximisation with capital constraints, we find that the NPVI metric provides the same choice as portfolio optimisation with a before-tax constraint. The IRR metric has its own solution with the lowest portfolio NPV. The BEP metric gives an intermediate solution and the same solution as that obtained with a minimising present value of after-tax cost constraint. The solutions obtained by the NPVI (before tax) and the BEP (after-tax) metrics indicate large differences in the company's financing needs with a much lower need given the BEP metric portfolio solution (after tax).

## Conclusions

The international tax literature implicitly assumes that government and companies have the same requirement for the rate of return. Since capital rationing implies a requirement greater than the opportunity cost of capital, the tax analysis must account for the fact that society may require much lower rates of return than the oil companies. An intertemporal model framework is called for. Norway has a real rate of return requirement of seven per cent, for instance, whereas a current stipulation of international oil company requirements is 15 per cent.[4] Thus, it may prove beneficial for government to carry a large fraction of the initial investment, as is the case in the British and Norwegian petroleum tax systems, and secure higher tax revenue later in the project life cycle. The risk premium demanded by the companies for their capital investment may thereby be reduced and expected government revenue maximised. This conclusion is reversed for developing countries with a limited ability to carry risk and an immediate need for revenue.

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