

Taxation and the effect on extraction rates

By

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Traditional tax theory

- Analysis only of the project selection decision
 - Whether to invest or not
 - Everything else is presumed unchanged by tax design
- In reality, tax also affects other decisions
 - Concept design
 - Drainage strategy
- Accordingly, tax does not only affect which projects are selected but also extraction profile and recovery rate from projects selected
- Thus, tax distortions are larger than presumed in traditional tax theory
 - An increase in a distortive tax not only reduces the number of profitable projects sanctioned but also leads to suboptimal production and recovery rates from sanctioned projects.

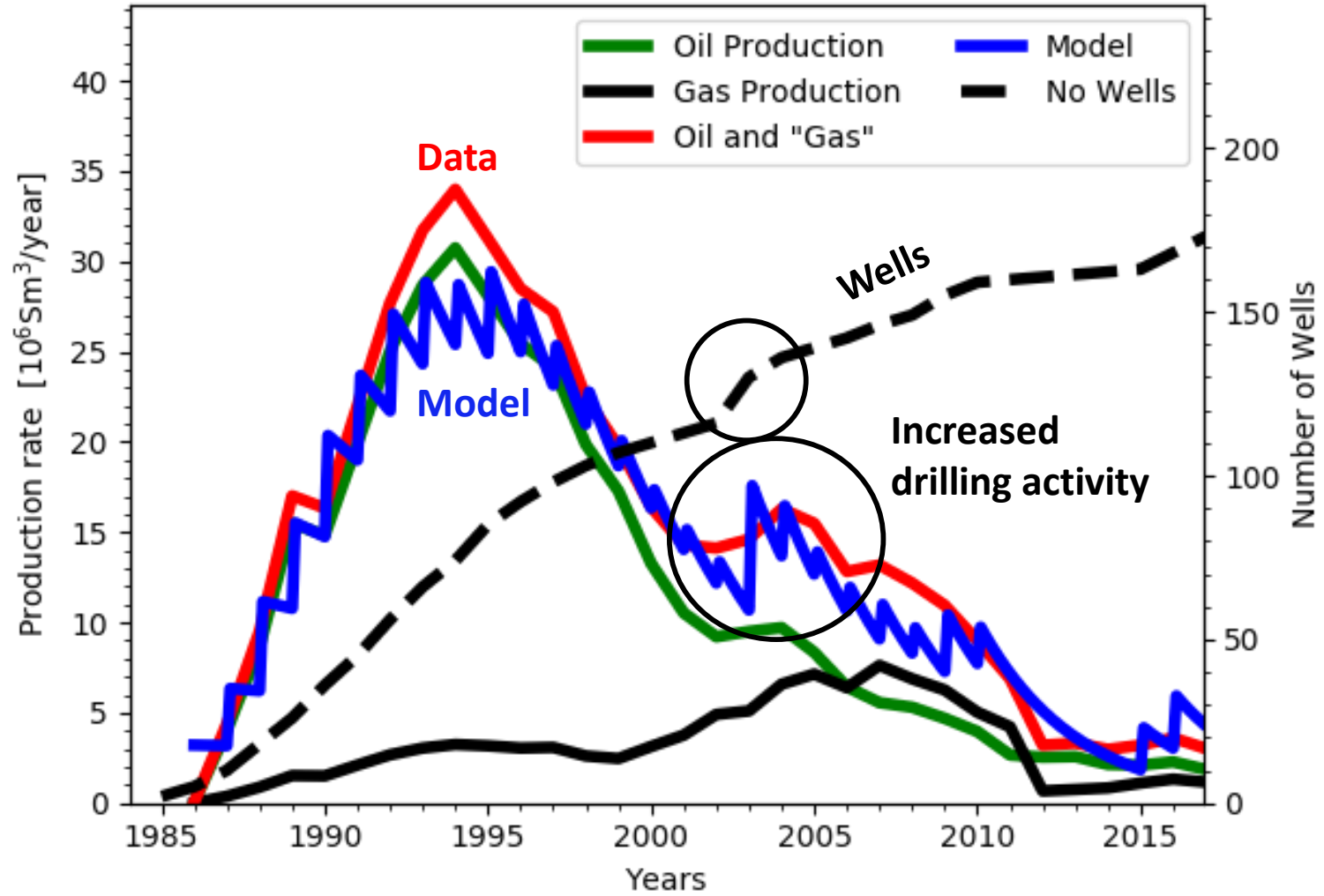
Broader models

- Smith (2014)
 - A novel approach that expands traditional tax theory in several dimensions
 - Tax also affects
 - exploration
 - dimensioning of development projects
 - production profile
 - overall production
 - Opens up for many interesting empirical applications
 - Our paper is the first to do this
- Berg et al (2018) apply the model of Smith to establish the effect of a reduction in uplift on the Norwegian continental shelf (NCS)
 - They find that the traditional assumption of an unresponsive company still holds
 - Our paper does not support this finding
 - We find that it rests on unrealistic assumptions

Our contribution

- Analysing field data from the NCS, we find that the actual production profiles do not resemble the mathematically tractable, theoretical model of a constant decline in production used in Smith (2014) and Berg et al (2018).
- We explain why this is the case for offshore fields.
- We propose a novel theoretical resource model which fits the data from the 41 largest field on the NCS.
 - It is a general resource model that allows for injection from start of production, and where the model of a constant decline in production is a special case.
 - Our model is also a mathematically tractable model of constant decline.
 - But where the decline is at the level of the individual well rather than the field.
 - The recovery rate is thus responsive to the number of wells, and tax design affects the recovery rate.
- Our paper is the first to perform an empirical test of theoretical production models
 - NCS production fits well with our model and not with the traditional constant decline model
- Our findings suggest that companies are responsive to tax changes, and that tax design should take account of distortions in the selection of development concepts.

GULLFAKS
($\tau=469.287$, $q= 0.645$ $n= 1$)



Drilling is the key for achieving a high extraction rate

- Drilling of injection wells essential to maintain reservoir pressure
- Even more important for complex reservoirs
 - Segmented reservoirs need injection into every segment to drain the oil
- The wells in the initial business case are often not sufficient
 - Infill wells may be needed to reach economic production targets

A distortive tax reduces the extraction rate

- Choice of development concept
 - Oil companies start with a lean design
 - Subsequently, they check whether it would be profitable to choose a larger concept which implies higher capital expenditure but also a higher recovery rate.
 - This is examined by applying a delta analysis. The cash flows of the lean and bigger development concepts are compared and the differential (delta) cash flow calculated by simply deducting the cash flow of the lean design from that of the bigger design. The NPV of the delta cash flow is then calculated. If this is positive, a larger concept is considered profitable. An even larger concept is then tested, and this process continues until an increase in scale is no longer profitable.
- A distortive tax – e.g. in the form of reducing uplift below the level which secures neutrality – has the effect of reducing the scale of the selected development concept, including the number of wells. That implies a loss in terms of a suboptimal recovery rate.
- Later in the production phase
 - Infill drilling
 - Each well is a separate business case and insufficient tax incentives will mean fewer wells and suboptimal production.