The wealth of Norwegian oil and gas: 1970-2015

Gang Liu

Statistics Norway

Presentation at UNECE CES Group of Experts on National Accounts
Fifteenth session, Geneva, 17-20 May 2016

Structure of the presentation

1. Introduction

2. Methodology

3. Empirical results

4. Concluding remarks

1. Introduction

❑The Norwegian offshore industry extracting oil and gas

▪ Direct contribution to economic growth through export of oil and gas

▪ Indirect contribution through demand for goods and services produced by other industries

▪ Budgetary rule as regards oil income that can be used for public financing

▪ Balance sheets accounts within the SNA

▪ Asset accounts with physical and monetary dimensions within the SEEA

2. Methodology

❑The Net Present Value (NPV) approach

(1)
$$V_t = \sum_{\tau=0}^{T_t} \frac{NR_{t+\tau}}{(1+\delta_t)^\tau} \ ,$$

where
V_t = value of the asset at time t;
T_t = remaining asset life at time t;
$NR_{t+\tau}$ = nominal resource rent at time $t+\tau$, $\tau = 0, 1, 2 \dots T_t$;
δ_t = nominal discount rate at time t.

(2)
$$NR_{t+\tau} = RR_{t+\tau}(1+\rho_t)^\tau \ ,$$

where
$RR_{t+\tau}$ = real resource rent at time $t+\tau$, $\tau = 0, 1, 2 \dots T_t$;
ρ_t = expected general rate of inflation at time t.

(3)
$$V_t = \sum_{\tau=0}^{T_t} \frac{RR_{t+\tau}}{(1+r_t)^\tau} \ ,$$

where
r_t = real discount rate at time t and is defined as:

$$r_t = \frac{1+\delta_t}{1+\rho_t} - 1 \ .$$

3. Empirical results

❑ Approaches to measuring resource rent

- The appropriation method

- The access price method

- The residual value method

3. Empirical results (cont.)

☐The residual value method

Table 1. Deriving resource rent from the SNA measures

Output (sales of extracted environmental assets at basic prices, includes all subsidies on products, excludes taxes on products)
***Less* Operating costs**
Intermediate consumption (input costs of goods and services at purchasers' prices including taxes on products)
Compensation of employees (input costs for labor)
Other taxes on production plus other subsidies on production
***Equals* Gross operating surplus—SNA basis**
***Less* Specific subsidies on extraction**
***Plus* Specific taxes on extraction**
***Equals* Gross operating surplus—for the derivation of resource rent**
***Less* User costs of produced assets**
Consumption of fixed capital (depreciation) + return to produced assets
***Equals* Resource rent**
Depletion + net return to environmental assets

Source: United Nations (2013)

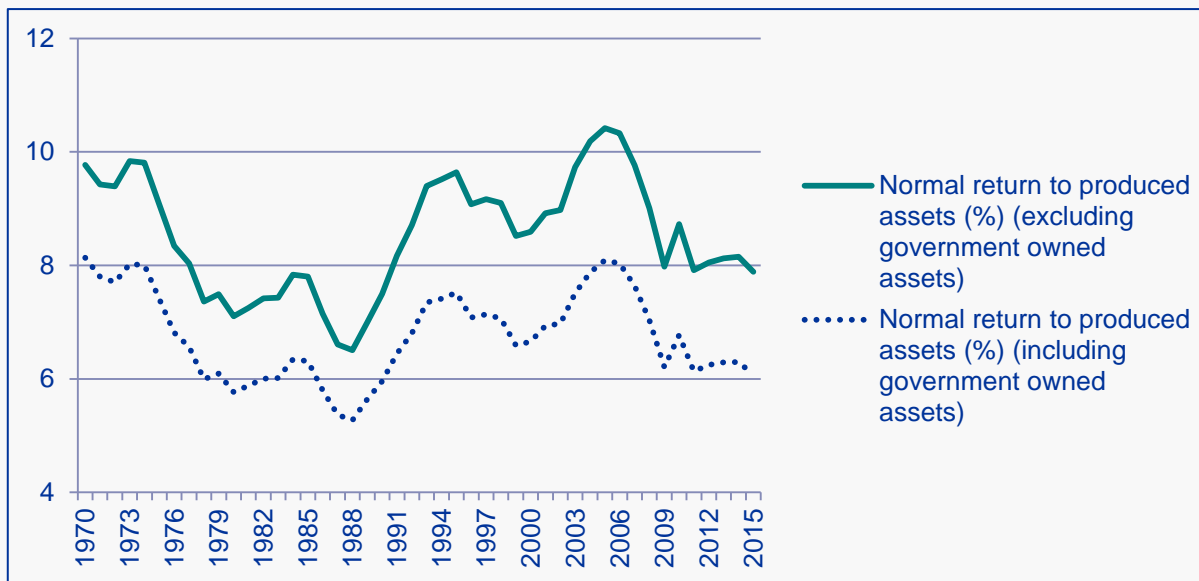# 3. Empirical results (cont.)

❑Actual resource rent (1970-2015)

- Normal return to produced capital is defined as the net operating surplus divided by the net stock of produced assets in the mainland-Norway

- Possible biases?

- Upward biases:

- Downward biases:

3. Empirical results (cont.)

❑Actual resource rent (1970-2015)

**Figure 1. Annual normal return to produced assets (1970-2015) (%)**

Normal return to produced assets (%) (excluding government owned assets)

Normal return to produced assets (%) (including government owned assets)

Source: Author's calculation based on data from StatBank Norway

3. Empirical results (cont.)

❑Actual resource rent (1970-2015)

Figure 2. Actual resource rent from oil and gas (current prices, NOK millions)
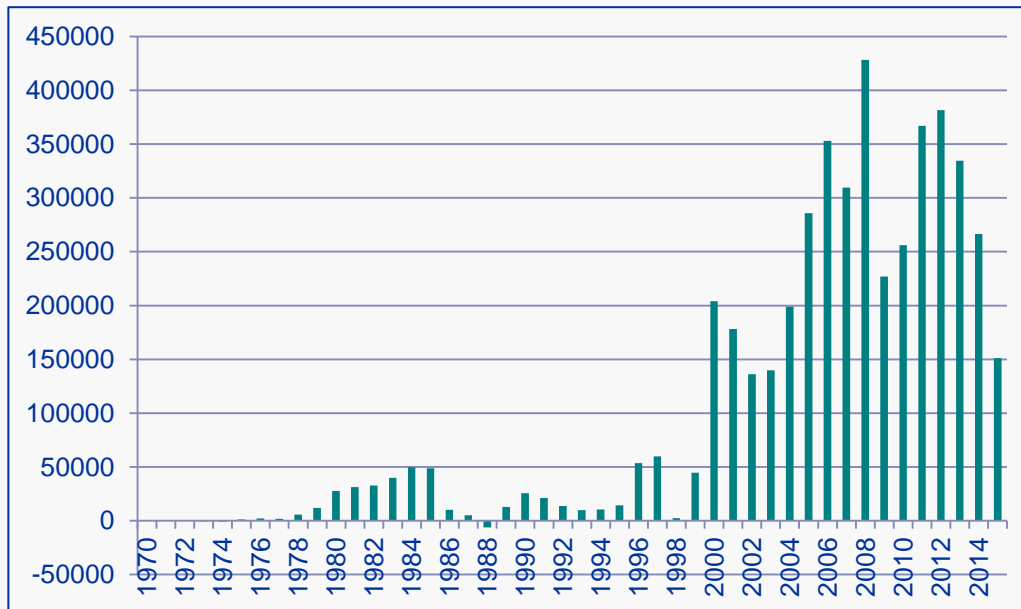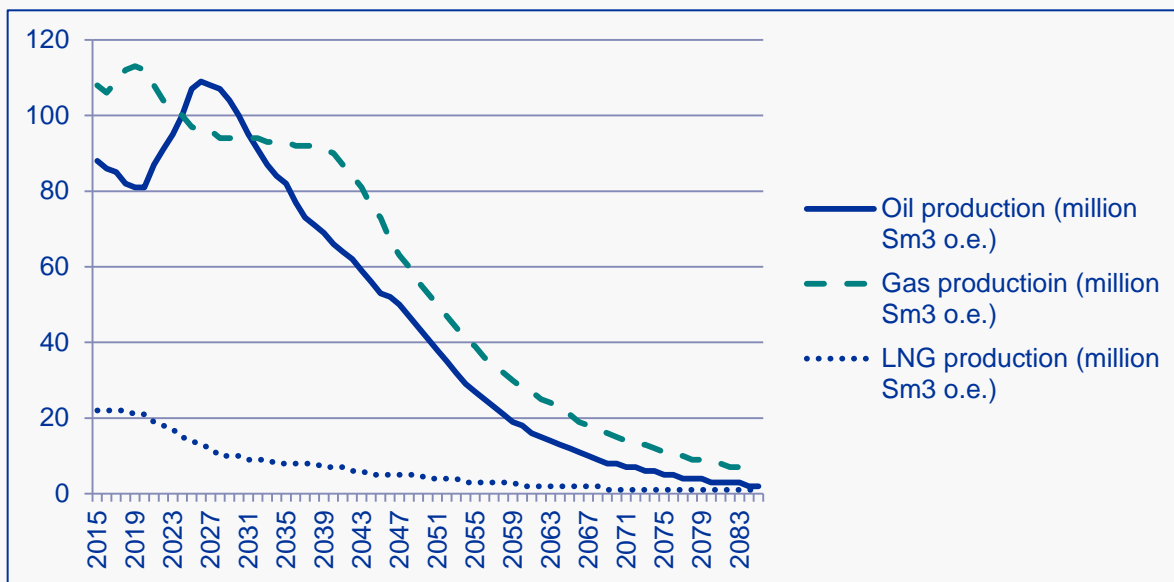

Source: Author's calculation based on data from StatBank Norway

3. Empirical results (cont.)

❑Expected resource rent (2016-2085)

Figure 3. Expected production profiles for raw oil and natural gas (2015-2085)

Source: Norwegian Ministry of Finance (2015)

3. Empirical results (cont.)

❑Expected resource rent (2016-2085)

- Expected price profiles for raw oil, natural gas and the LNG
 *Source: National Budget 2016 (Norwegian Ministry of Finance, 2015)*

- Oil: the current price per barrel is assumed to be NOK 440, NOK 474, and NOK 562 in 2016, 2017 and 2018, respectively. From 2018 onwards, the real price will keep constant, while the nominal price is assumed to increase at a rate of 2% per year.

- Gas: the current price per Sm^3 o.e. is assumed to be NOK 2.15, NOK 2.25, and NOK 2.08 in 2016, 2017 and 2018, respectively. From 2018 onwards, the real price will keep constant, while the nominal price is assumed to increase at a rate of 2% per year.

- LNG: the same as that for oil.

3. Empirical results (cont.)

❑Expected resource rent (2016-2085)

- ▪ The future cost profiles

Figure 4. The relationship between output and total cost (1970-2015)
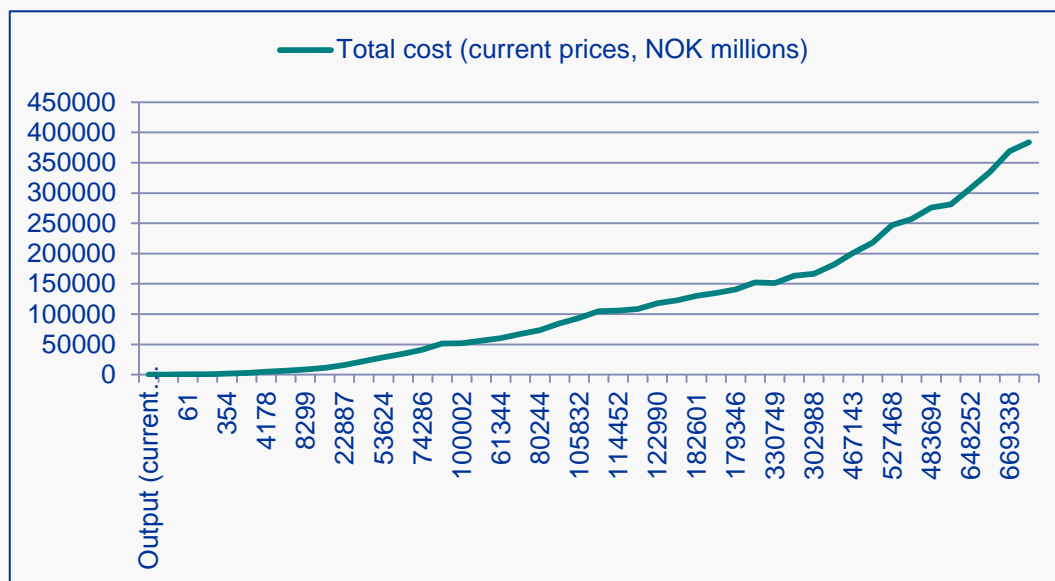
Source: StatBank Norway

3. Empirical results (cont.)

❑Expected resource rent (2016-2085)

- The future cost profiles (cont.)
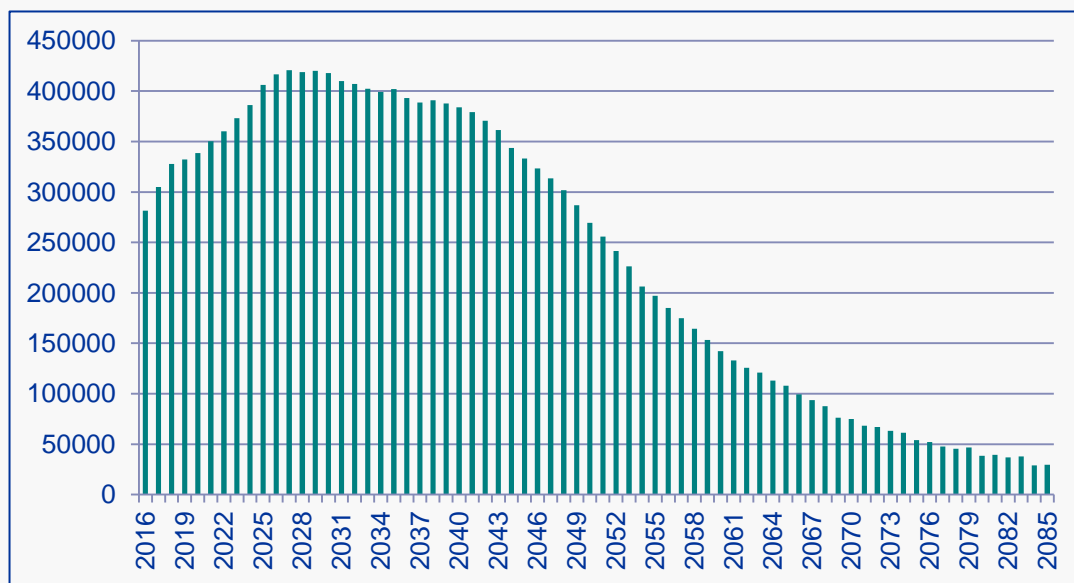
$$y_t = a x_t^b + \sigma_t \ ,$$

where
yt =   the total cost at time t;
xt =   the output at time t;
a, b =   parameters to be estimated;
σt =   a random error term, assumed to be lognormal distributed.

3. Empirical results (cont.)

❑Expected resource rent (2016-2085)

Figure 5. Expected resource rent from oil and gas (current prices, NOK millions)

Source: Author's calculation based on data from StatBank Norway

3. Empirical results (cont.)

❑Real resource rent (1970-2085) (2015 prices)

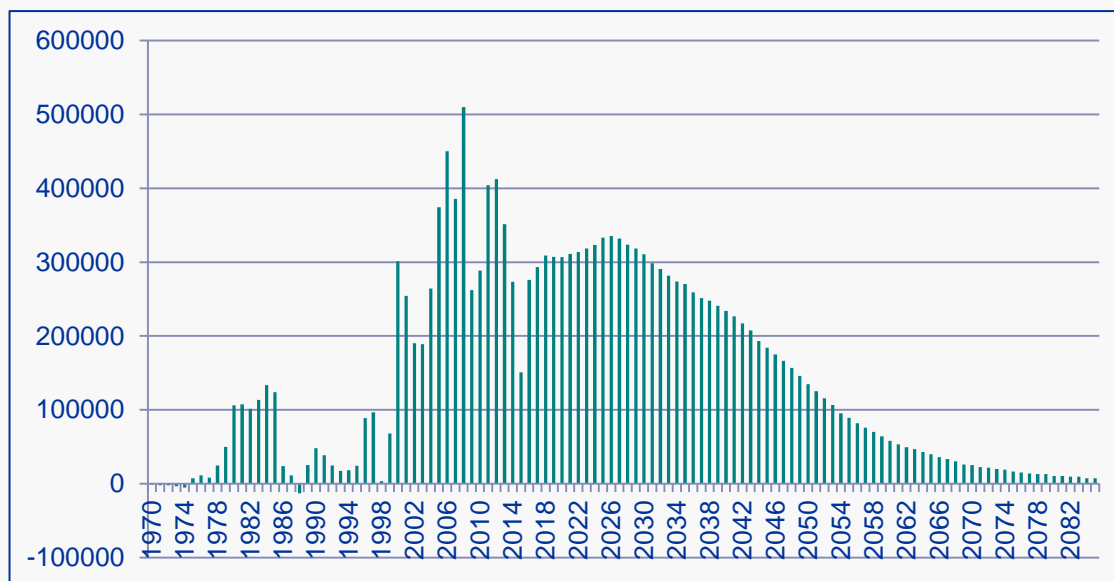$$NR_{t+\tau} = RR_{t+\tau}(1 + \rho_t)^\tau = RR_{t+\tau} * P_{t+\tau} \,,$$

where the price index $Pt+\tau$ is defined as the following:

$$P_{t+\tau} = (1 + \rho_t)^\tau, \tau = 0, 1, 2...T_t \,.$$

3. Empirical results (cont.)

❑Real resource rent (1970-2085) (2015 prices) (cont.)

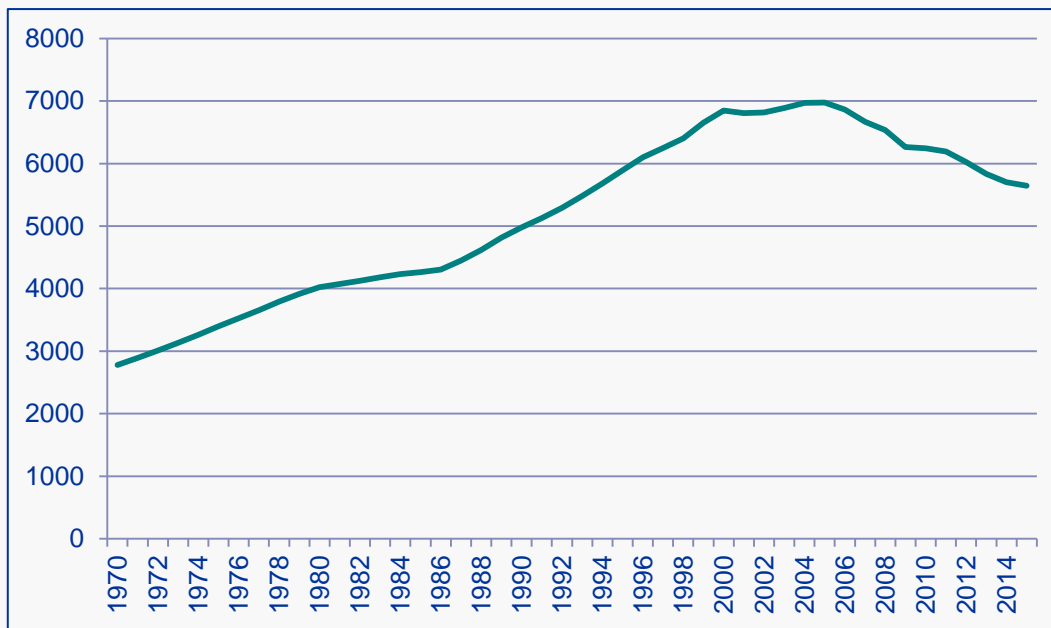**Figure 7. Real resource rent from oil and gas (constant 2015 prices, NOK millions)**

Source: Author's calculation based on data from StatBank Norway

3. Empirical results (cont.)

❑Norwegian oil and gas wealth (1970-2085) (2015 prices)

Figure 8. Norwegian oil and gas wealth, 1970-2015 (constant 2015 prices, NOK billions)
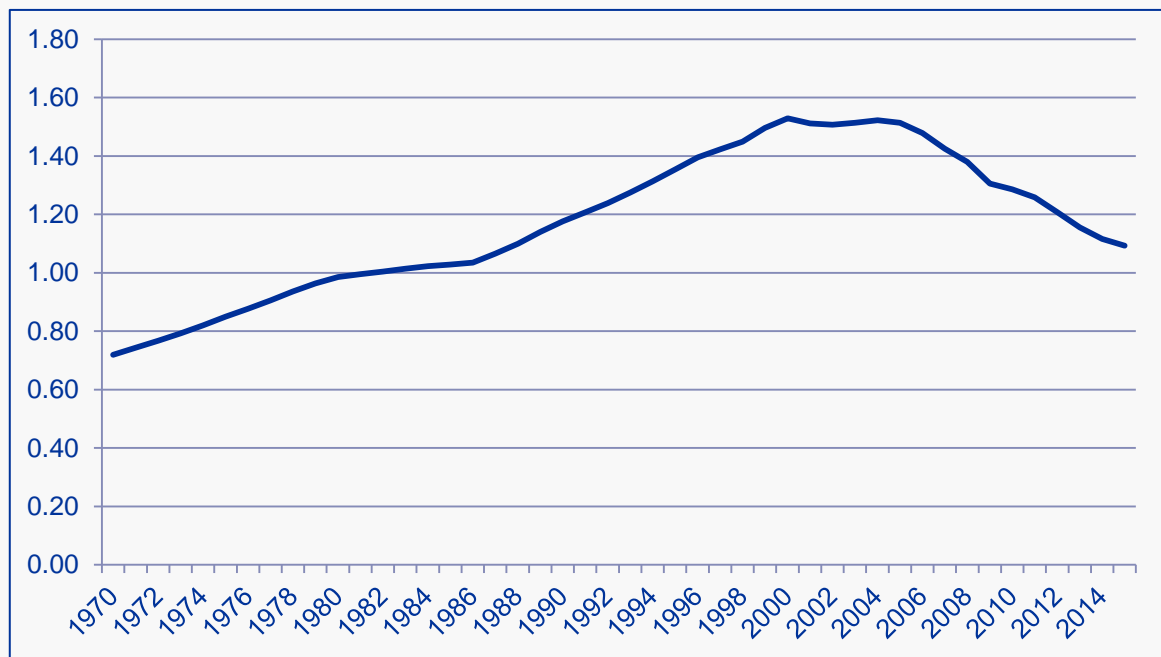

Source: Author's calculation based on data from StatBank Norway

3. Empirical results (cont.)

☐ Norwegian oil and gas wealth (1970-2085) (2015 prices) (cont.)

Figure 9. Norwegian oil and gas wealth per capita, 1970-2015 (constant 2015 prices, NOK millions)

Source: Author's calculation based on data from StatBank Norway

3. Empirical results (cont.)

❑Norwegian oil and gas wealth (1970-2085) (2015 prices) (cont.)

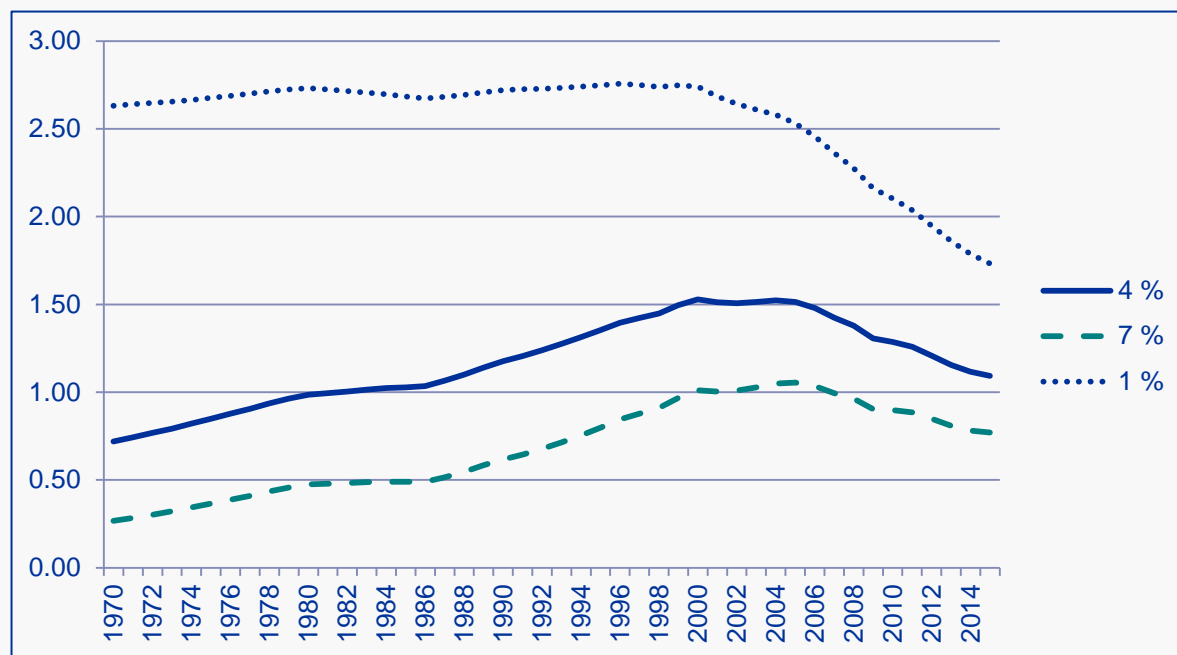**Figure 10. Norwegian oil and gas wealth per capita, 1970-2015 (constant 2015 prices, NOK millions), sensitivity analysis w.r.t. expected annual real discount rate**

Source: Author's calculation based on data from StatBank Norway

4. Concluding remarks

- Based on national accounts statistics, and supplemented with experts' prediction about the expected production and price profiles, this paper makes estimation of the Norwegian oil and gas wealth for the period 1970-2015, using the recommended NPV approach.

- The estimated results show that in per capita terms, the Norwegian oil and gas wealth in constant (2015) prices has already passed its peak around 2000 and now is decreasing, which signals unsustainability if merely oil and gas are considered.

- A number of parameters are exogenously given and more investigations are needed in the future. Sensitivity analysis w.r.t. the expected annual real discount rate shows that while the absolute level of Norwegian oil and gas wealth per capita is sensitive to the choice of this key parameter, the trend over time, however, is not.

- At present, the resource rent is calculated for oil and gas collectively, while a better measurement should be undertaken for oil and gas separately. And an even better measurement could be implemented by exploiting information at more disaggregated level, such as information at oil and gas field level.

- Currently, this paper only calculated the oil and gas wealth as a balance sheets item. How to systematically link the flows (extraction, revaluation and other changes) to the changes of the stock between the consecutive balance sheets accounts within the SEEA framework serves as another topic for future research.