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Testing the split of economic ownership for petroleum resources in Norway

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Gang Liu

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Preface

An updated *System of National Accounts* (SNA) is planned to be adopted as international statistical standard in 2025. During the global consultation of a drafted guidance note (GN WS.6: 'Accounting for the Economic Ownership and Depletion of Natural Resources') provided by the UN Task Team working for the SNA updating, a testing work was carried out at Statistics Norway in order to determine whether the recommendations in the note can be implemented in practice and how to best record the flows of the asset from government to the extractor. This paper is one outcome of this testing work.

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Statistisk sentralbyrå, 22 May 2023

Lasse Sandberg

Abstract

Based on the Norwegian experiences, a long-term average pattern is identified as regards the distribution of resource rent due to petroleum activities, which can be used to split the economic ownership of oil and gas between the government and the oil and gas sector in Norway. The splitting is suggested to be carried out in the year when extracting activities start and no further splitting is needed for the following years until significant changes in extraction arrangements take place. In addition, the actual flows of the resource rent as recorded in both the National Accounts and the Government Finance Statistics between the government and the extractor in each year are suggested not to be changed. Though the concrete implementation is conditional on the final choice of the definition and estimation of the resource rent and the resource value, splitting asset is feasible. Another conclusion from the paper is that the current practice in Norway for setting up and managing the GPFG fund is in line with a sustainability criterion.

Contents

1. Introduction

The petroleum or oil and gas sector on the Norwegian continental shelf plays an important role in the Norwegian economy.[1] With only 2% of total employed persons in Norway, this sector accounted for 24% of value added, 17% of investment, and 51% of export in 2021. In addition to the direct impact, the oil and gas sector has generated substantial demand for goods and services that are produced by other industries located in the Mainland Norway, [2] thus contributing indirectly but significantly to the overall economic growth in Norway (e.g., Cappelen *et al*., 2013; Hungnes, *et al*., 2021).

Oil and gas are non-renewable resources which in the national accounts should be classified as 'Mineral and energy reserves (AN212)' under the category of 'Natural resources (AN21)', the latter being part of 'Non-produced non-financial asset (AN2)', according to the international standards, such as the *System of National Accounts 2008* (hereafter SNA) (United Nations *et al*., 2009) and the *European System of Accounts 2010* (Eurostat, 2013).

In the Norwegian National Accounts (NNA), extracted oil and gas from petroleum activities [3] are recorded as output in the production accounts of the oil and gas sector, with most of them being exported to the rest of the world. However, petroleum resource by its own right has not yet been registered in the balance sheet accounts for non-financial assets. Apparently, an important link is missing between oil and gas as a stock (capital) and as a flow (capital services).

In Norway, accounting for natural resources has a long history ever since 1970s,[4] and measuring oil and gas as part of national wealth has been carried out on several occasions (e.g., Brekke *et al*., 1989; Aslaksen *et al*., 1990; Lindholt, 2000; Greaker *et al*., 2005; Brunvoll, *et al*., 2012; Norwegian Ministry of Finance, 2012a; Liu, 2016). In Liu (2016), a special effort was made, trying to incorporate oil and gas into balance sheet accounts in the NNA, by using mainly national accounts data and following the recommendations as suggested in the *System of Environmental-Economic Accounting 2012 – Central Framework* (hereafter SEEA-CF) (United Nations *et al*., 2014).[5] This work paved a foundation for possible further harmonisation of compiling accounts in accordance with both the SNA and the SEEA-CF at Statistics Norway.

Conceptually, there exist some differences between the two current international standards, i.e., the SNA and the SEEA-CF, as regards the recording of natural resources.[6] For instance, in the 2008 SNA, a natural resource is recorded on the balance sheet of the legal owner, usually the government, as a default option, depletion is recorded as an 'other change in the volume of assets' in the accounts of the owner, and the receipts of the owner from the extractor for the permission to exploit the resource reserves are recorded as (resource) rent (United Nations *et al*., 2009).

On the other hand, the SEEA-CF explicitly considers the depletion as a production cost and recommends recording it in the production and generation of income accounts of the extractor as deductions from value added and operating surplus. In addition, it recommends allocating the cost of depletion in line with the appropriation of expected incomes by the legal owner and the extractor,

[1] The oil and gas sector consists of two types of activities/industries, one is the 'oil and gas extraction', and the other is 'service activities incidental to oil and gas'.
[2] Mainland Norway (*Fastlands-Norge* in *Norwegian*) refers to all Norwegian industries excluding the offshore industry extracting oil and gas, and pipeline transport of oil and gas, as well as maritime transport.
[3] The three terms, i.e., 'oil and gas sector', 'petroleum activities', and 'petroleum sector' are used interchangeably throughout this paper.
[4] For a brief overview on wealth accounting practices and its relationship with the work for natural resource accounting in Norway, see Liu (2013).
[5] Note that reporting to Eurostat the estimates for natural resources including oil and gas as non-financial assets is still on a voluntary basis (see Eurostat, 2014).
[6] To avoid complicating the discussion, this paper focuses exclusively on non-renewable resources such as oil and gas.

via a new entry entitled 'Depletion borne by government', reflecting that the rent received by the government includes its share of total depletion (United Nations *et al*., 2014).

As pointed out by van de Ven and de Haan (2021), the SEEA-CF's recommendation could be interpreted as an implicit recognition of a split-asset approach, i.e., splitting the economic ownership of natural resources between the legal owner and the extractor, in proportion to their respective share in the total resource rent generated. Without this split of economic ownership, there is no link between capital (natural resources) used in production and related gross income derived from it.

The split-asset approach was recommended by the Well-being and Sustainability Task Team (Environmental Accounting Sub-Task Team) during the working process for updating the current SNA for adoption by the United Nations Statistical Commission in 2025 (van de Ven and de Haan, 2021).[7] Although conceptually clear, knowledge has so far been limited as regards whether this split-asset approach is feasible and how to implement it in practice.

The purpose of this paper is to test the split-asset approach, based on the Norwegian experiences as regards the petroleum extracting activities over the years, to determine whether and how this split-asset approach can be implemented in practice and how to best record the flows of the natural resource rent from the government to the extractor.

The rest of the paper is structured as follows. Section 2 provides a brief overview of petroleum activities in Norway. Section 3 presents the estimated annual total resource rents generated from petroleum activities by means of a method in accordance with the SEEA-CF and based mainly on national accounts data. In Section 4, a time series of the realised annual resource rent accruing to the general government is reported for the period 1970-2021. Section 5 provides a statistical analysis of the actual appropriation share of the government in the total resource rents, with the purpose of identifying whether there exists any stable relationship that can be applied for the allocation of the total resource rent between the government and the oil and gas sector in the long run.

In Section 6, several possible options as regards implementing the split-asset approach and recording the flows of the resource rent between the government and the oil and gas sector in practice are compared, ending with a concrete and feasible suggestion being given. In Appendix B, a fictitious numerical accounting example is presented for elaborating on how to implement the split-asset approach in practice, and how to record various transactions in the detailed accounts of both the government and the extractor in a time series situation. Section 7 concludes.

[7] Also see https://unstats.un.org/unsd/nationalaccount/Towards2025.asp

2. Petroleum activities in Norway

In 1969, crude oil was first discovered in the North Sea, marking the beginning of Norwegian petroleum wealth expansion. In the early 1970s, petroleum extracting production started off on the Norwegian continental shelf. Since then, petroleum activities have been playing an increasingly important role in the whole economy. For instance, according to a recent study funded by the Norwegian Ministry of Petroleum and Energy, about 200,000 people, around 7% of total employed persons in Norway, were directly or indirectly employed in the petroleum sector in 2020 (Fjose and Erraia, 2022).

The net contribution from petroleum activities to the state financing varied owing to the volatility of oil and gas prices in the international market. In early years, a debt build-up due to pre-required investment was also witnessed. But petroleum sector has gradually contributed positively to the financing of the Norwegian welfare state, esp. after the Government Pension Fund Global (GPFG) [8] and its associated fiscal rule were established several decades later. For example, in terms of the contribution to the central government revenue, the petroleum sector accounted for about 10% in 2020 (Norwegian Ministry of Finance, 2022).[9]

Despite enjoying the sole proprietary right by law to all subsea petroleum deposits on the Norwegian continental shelf, the government is not directly operating petroleum production activities. Due to the extraordinary returns that can be generated by extracting petroleum resources, as well as being aware of that the resource rents generated may possibly not be directly obtained in its entirety by the government, a carefully designed financial and legal framework for petroleum activities was put in place in Norway.

The purpose of such a regulatory framework, on the one hand, is to ensure that as large as possible share of the value creation due to petroleum extraction accrues to the government, so that it can benefit Norwegian society as a whole, and even more, not only for the present generation but also for the future generations. On the other hand, the regulatory framework should ideally strike the best possible balance between the oil and gas extractor's and the government's interests in order to secure a profitable exploration, development, and production of petroleum resources in the long run.

Formally, the objective of such a regulatory framework is achieved among other things by respecting the Norwegian Petroleum Act,[10] through deliberate taxation policy applied to the petroleum sector, by using the system of government direct interest in the petroleum industry, and through the authorities' oversight of resource management, etc.

Following the legislation passed by the Norwegian Parliament, government revenues from petroleum activities should be transferred to the GPFG, which was set up in 1990, with the purpose of serving as a financial reserve as well as a long-term savings plan over generations so that a path of sustainable development can be maintained. The GPFG fund is only allowed to be invested into global capital market, shielding the Norwegian economy from ups and downs in oil revenue due to price volatility in the international market. A fiscal rule governs that without drawing on the fund's capital, only 4% of the fund's value can be allocated to the government budget each year [11]

[8] *Statens Pensjonsfond Utland* (*SPU*) in *Norwegian*.
[9] The transfers from the GPFG made up this amount. Strictly speaking, the cash flow from the petroleum sector has generated the GPFG fund but returns in the financial markets have also contributed to the accumulation of the fund.
[10] Act of 29 November 1996 No. 72 relating to petroleum activities provides the general legal basis for sound resource management, including the licensing system that gives companies rights to engage in petroleum operations.
[11] The 4% set by Norwegian Ministry of Finance refers to an expected long-term real rate of return to the GPFG. Actual withdrawals could vary, sometimes higher than 4% in certain years, e.g., during financial crisis, but the rule serves as a ceiling

(Norwegian Ministry of Finance, 2000). Recently, the fiscal rule of 4% was replaced by a more stringent 3% rule (Norwegian Ministry of Finance, 2017).

Although only about half of the estimated recoverable petroleum resources on the Norwegian continental shelf have been extracted and sold up to the present, the GPFG has over the years grown up to become one of the largest sovereign wealth funds in the world. At the end of 2022, the GPFG had a market value of NOK 12 429 billion (Norges Bank Investment Management, 2023).

benchmark from a long-term point of view, i.e., over time, spending over the fiscal budget should not be larger than the real return estimated at 4%.

3. Estimating resource rent

In the NNA and the Government Finance Statistics (GFS) at Statistics Norway, a transaction of resource rent on petroleum resources (D.45) is registered as uses (paid) by the petroleum extracting industry, and as resources in the NNA or revenues in the GFS (received) by the government. But the scope of this transaction covers only royalties[12] (production levies) imposed on petroleum extracting activities, which, according to standard economics theory, is merely a part of total resource rent that could be generated from lucrative petroleum extracting activities in Norway. As a result, the current practice of recording resource rent due to petroleum resources at Statistics Norway is not entirely in line with the recommendations as suggested in the SEEA-CF (United Nations *et al*., 2014).

In a recent report of accounting the wealth of Norwegian raw oil and natural gas over the period 1970-2015, a concrete and viable measurement methodology for estimating natural resource rent due to oil and gas was presented, which was primarily based on annual national accounts data, and was in accordance with the recommendations as suggested by both the SNA and the SEEA-CF (see Liu, 2016). Formally, annual total resource rent due to petroleum extracting activities was calculated in the report by using annual national accounts data and following the procedure as listed in Table 1, which is a direct copy of Table 5.5 in the SEEA-CF.

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: Table 5.5 in United Nations *et al*. (2014)

The resource rent derivation procedure as recommended in Table 1 is conceptually clear, but there are several concerns relating to its implementation in practice. For instance, how to calculate the return to produced assets is not very clear. In Liu (2016), a normal return is defined in each year as the net operating surplus divided by the net stock of produced assets in the Mainland Norway (excluding government owned assets) for that year. The rationale is that in equilibrium, investors should expect the same return from petroleum extraction as that from the other (market) sector in

Norway. In addition, the data for net operating surplus and net stock of produced assets in the Mainland Norway can be directly drawn from annual NNA datasets. However, other factors may lead to an upward-biased estimate of the normal rate of return. [13]

[12] *Produksjonsavgift* in *Norwegian*.
[13] For detailed discussion on this issue, please refer to Liu (2016).

Table 2. Total resource rent in current prices (NOK billion), 1970-2021

	Using estimated rate of return		Using 7% as rate of return	
Year	With specific taxes	Without specific taxes	With specific taxes	Without specific taxes
1970	-0.14	-0.14	-0.12	-0.12
1971	-0.24	-0.24	-0.20	-0.20
1972	-0.29	-0.29	-0.22	-0.22
1973	-0.48	-0.48	-0.38	-0.38
1974	-0.81	-0.81	-0.60	-0.60
1975	1.31	1.31	1.55	1.55
1976	2.28	2.18	2.53	2.43
1977	1.77	1.71	2.08	2.02
1978	6.94	6.89	7.07	7.01
1979	13.53	13.47	13.73	13.68
1980	31.35	31.28	31.41	31.34
1981	36.76	36.69	36.95	36.88
1982	38.75	38.68	39.15	39.08
1983	47.62	47.54	48.10	48.03
1984	59.54	59.46	60.66	60.58
1985	60.85	60.63	62.16	61.94
1986	18.28	18.08	18.56	18.36
1987	13.22	12.98	12.36	12.12
1988	-0.51	-0.69	-1.72	-1.90
1989	20.59	20.37	20.58	20.35
1990	34.47	34.22	35.88	35.62
1991	32.05	30.66	35.52	34.13
1992	24.86	22.32	30.36	27.83
1993	21.12	18.29	29.56	26.73
1994	20.00	17.30	29.30	26.60
1995	23.84	20.72	34.14	31.03
1996	64.71	60.76	73.32	69.38
1997	70.06	66.40	79.74	76.08
1998	10.74	6.98	21.03	17.27
1999	52.96	49.14	60.93	57.11
2000	214.54	211.37	222.90	219.73
2001	191.13	187.28	201.54	197.70
2002	148.00	144.54	158.19	154.73
2003	151.72	148.20	166.64	163.13
2004	212.42	208.62	230.69	226.89
2005	300.28	296.70	321.52	317.94
2006	372.67	366.95	395.15	389.44
2007	327.27	322.63	348.66	344.02
2008	451.57	446.04	469.69	464.17
2009	245.92	242.19	254.84	251.11
2010	274.73	271.17	292.63	289.07
2011	390.06	386.32	399.80	396.06
2012	407.08	403.05	419.14	415.10
2013	359.49	354.56	374.40	369.47
2014	284.08	277.97	300.56	294.44
2015	159.96	153.47	172.75	166.27
2016	71.34	64.82	83.75	77.24
2017	190.07	183.95	199.23	193.10
2018	311.84	304.86	316.87	309.90
2019	183.90	177.02	185.16	178.28
2020	48.94	41.92	39.12	32.10
2021	560.65	554.51	546.35	540.21

Source: Author's own calculation based on data from Statistics Norway.

Under other circumstances, an exogenously given rate of return is applied. For example, a fixed 4% is used as the real rate of return to produced assets by the Norwegian Technical Calculation

Committee for Wage Settlements [14] for resource rent calculation. According to Norwegian Ministry of Finance (2012b), for public projects with normal risk and a horizon of under 40 years, a real rate of return of 4% is recommended, which consists of a risk-free part of 2.5% and a risk-adjustment of 1.5%.

However, for other projects with high systematic risk such as those in the petroleum sector, the use of a higher rate of return is required. For instance, in a report to the Norwegian Parliament by the Ministry of Petroleum and Energy as regards the development and operation of new oil fields, 7% is recommended to be used as the rate of return (Norwegian Ministry of Petroleum and Energy, 2018). In a recently published report, both 4% and 7% are utilised as rate of return to produced assets for calculating resource rent in two scenarios due to petroleum extraction in Norway (Greaker and Lindholt, 2022).

Another practical concern by applying Table 1 is how to determine the so-called 'Specific taxes/subsidies'. For instance, some people may think that levied 'Environmental taxes' and 'Area fees' to oil and gas extraction are 'specific' to the petroleum extracting activities, while others regard them not as 'specific' since they may also be imposed on other industries.

The above-mentioned concerns are not the focus of this paper, which is about the testing of the split-asset approach, rather than the estimation of resource rent *per se*. To move forward, the resource rent will be calculated and presented in the main text of this paper by using estimated rate of return to produced assets as suggested in Liu (2016), and by using a fixed 7% as rate of return, respectively. In Appendix A, the resource rent calculated by using a fixed 4% rate of return to produced assets is reported for comparison purpose in Table A1.

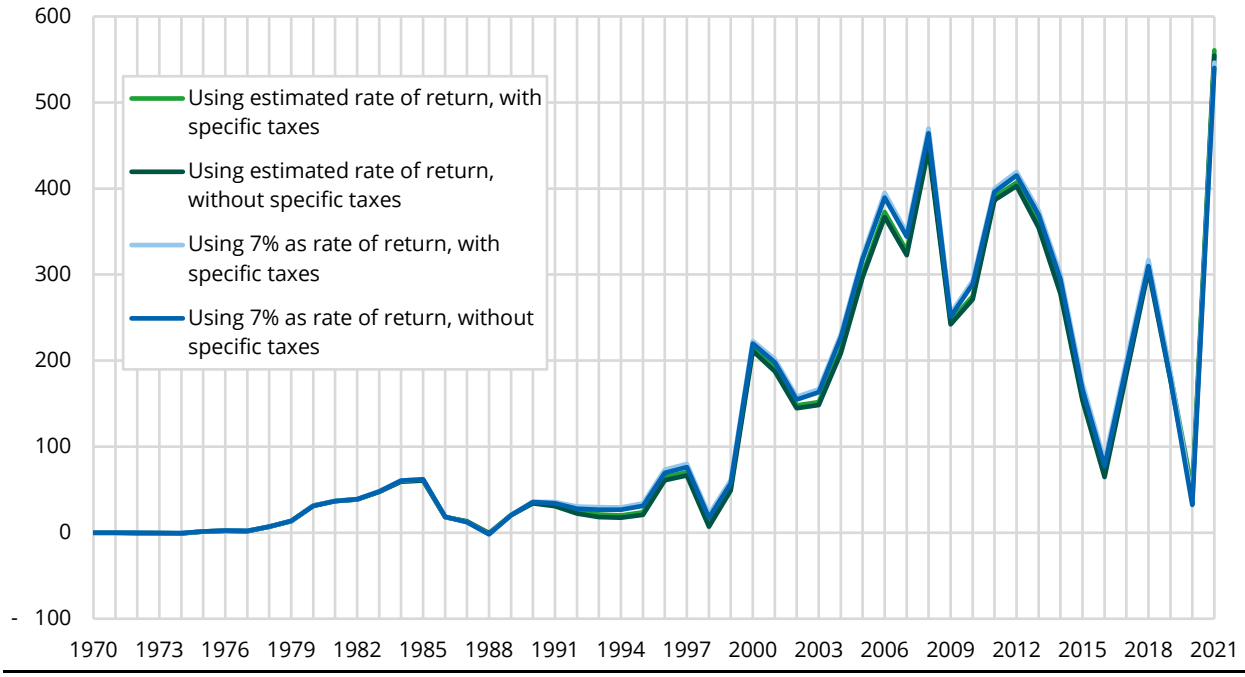
In addition, the resource rent is separately calculated for two cases: one 'With specific taxes' case, (i.e., considering both 'Environmental taxes' and 'Area fees' as 'Specific taxes on extraction'), and the other 'Without specific taxes' case (i.e., considering neither 'Environmental taxes' nor 'Area fees' as 'Specific taxes on extraction'), for each selected rate of return to produced assets in this paper.

Based on the decision made in this paper, the estimated annual realised total resource rent in current prices due to oil and gas resources in Norway over the period 1970-2021 are reported in Table 2.[15] The estimated results are also displayed in Figure 1.

As shown in Table 2 and Figure 1, in general, the estimated resource rent 'With specific taxes' is marginally larger than that 'Without specific taxes', given that imposed both 'Environmental taxes' and 'Area fees' are, albeit positive, relatively small (see Table 3 in Section 4). In addition, the estimated resource rent by using estimated rate of return is lower than that by using the fixed 7% as rate of return, because the estimated rate of return is generally larger than 7%, with its average value over the period 1970-2021 being around 8.3%. As visualized in Figure 1, the four estimated time series of realised annual resource rent show a very similar pattern, and the differences among them are almost indiscernible for many years in the Figure.

[14] *Det tekniske beregningsutvalget for inntektsoppgjørene (TBU)* in *Norwegian*.
[15] The national accounts data used for estimating resource rent in this paper are downloaded in November 2022 from the online StatBank at Statistics Norway (https://www.ssb.no/en/statbank).

Figure 1. Estimated resource rent from petroleum activities in Norway (current prices, NOK billion)



Source: Author's own calculation based on data from Statistics Norway.

Over the entire observed period 1970-2021, there appeared various ups and downs of the realised annual total resource rent. At the beginning of the 1970s, annual resource rent generated from petroleum resources was rather low, and then it increased slowly to its first peak in 1985. Since then, annual resource rent had kept at a low level, and it took about ten years before it was above its 1985 level in 1996. Right after a substantial decrease in 1998, annual resource rent climbed rapidly and firmly up until 2008 to its second highest level, though with several back and forth during this ten years' period. After 2008, despite very large swings, annual generated resource rent stayed broadly at higher level and reached its all-time peak in 2021, the end of the observed period.

As shown in Figure A1 in Appendix A where the resource rent calculated by using a fixed 4% rate of return to produced assets is displayed, the differences of the calculated resource rent by using the two selected fixed rate of return (i.e., 4% vs. 7%) are relatively larger than those as displayed in Figure 1, and especially, over the years when peaks and troughs occurred. However, the trend of the estimated resource rent time series over the observed period 1970-2021 is quite similar by using either of the three selected rate of return, i.e., the estimated rate of return and the two fixed rates of return, 4% and 7%.

4. Resource rent accruing to government

As shown above, the estimated annual realised resource rent generated from petroleum extracting activities had been quite substantial over the observed period 1970-2021. For instance, the realised annual total resource rent, if measured by using estimated rate of return and with specific taxes included, was NOK 561 billion in 2021, accounting for roughly 19% of the GDP in basic prices of the Mainland Norway.

After more than fifty years since the oil and gas was found, it is possible to assess how the regulatory framework for petroleum activities (as briefly described in Section 2) has worked in Norway. A particularly interesting question is how the large amount of value creation from lucrative petroleum activities is distributed among different sectors, and for the purpose of this paper, between the government ('General government sector' (S.13)) and the oil and gas sector (part of 'Non-financial corporations sector' (S.11)).

Table 3 presents the realised government revenue and its various components from petroleum activities in Norway over the period 1970-2021 in current prices. The realised annual government revenue (i.e., Column (8)) is the sum of seven components (i.e., Columns (1) to (7)) in each year as listed in the table. For example, in 1991, the total value of the government revenue in current prices, NOK 35.43 billon, is the sum of the seven components from Column (1) to Column (7), i.e., 12.33 + 5.64 + 0.81 + 0.58 + 8.94 + 5.63 + 1.50 = 35.43 NOK billon.

The first two columns in Table 3 are income taxes levied on oil and gas companies' net profit. Column (1) is 'Ordinary taxes', calculated based on the ordinary company tax rate which was 22% in 2021.[16] Column (2) is called 'Special taxes', which is specifically imposed on petroleum activities, and was stipulated in the Norwegian Petroleum Taxation Act set out in 1975 [17].

Both the NNA and GFS use accrual basis as a fundamental valuation principle, in accordance with the relevant international statistical standards[18]. Staff at Statistics Norway has adjusted both 'Ordinary taxes' and 'Special taxes' as reported in Table 3 to an accrual basis rather than a cash payment basis. However, in Table A5 in Appendix A, realised net government cash flow from petroleum activities over the period 1971-2021 in current prices are presented for comparison purpose.

The rationale behind the 'Special taxes' is that due to the extraordinary returns on production of petroleum resources, the oil and gas companies should be subject to an additional special income tax, otherwise the oil and gas companies are no different from ordinary companies. To ensure a neutral taxation system, however, paid ordinary company taxes can be written off when calculating the special tax base. The special taxes are calculated by using a tax rate of 71.8 %, which leads to a combined marginal tax rate of 78 % on the oil and gas companies' net profit.[19]

[16] The ordinary company tax rate in Norway varied across years but was in general stable with the value being around 23%.
[17] Act of 13 June 1975 No. 35 relating to the taxation of subsea petroleum deposits, etc., see https://www.regjeringen.no/en/topics/the-economy/taxes-and-duties/Act-of-13-June-1975-No-35-relating-to-th/id497635/.
[18] The 2008 SNA (United Nations et al., 2009) and the Government Finance Statistics Manual 2014 (International Monetary Fund, 2014).
[19] In addition to paid ordinary company tax, the special tax base has larger deductions at times, related to e.g., investments, than the ordinary company tax base.

Table 3. Realised government revenue from petroleum activities in Norway, 1970-2021 (current prices, NOK billion)

Year	Ordinary taxes (1)	Special taxes (2)	Environmental taxes (3)	Area fees (4)	Royalties (5)	Operating surplus from SDFI (6)	Equinor dividend (7)	Government revenue (8) = (1) + (2) + (3) + (4) + (5) + (6) + (7)
1970	-	-	-	-	-	-	-	-
1971	-	-	-	-	-	-	-	-
1972	-	-	-	-	0.04	-	-	0.04
1973	-	-	-	-	0.07	-	-	0.07
1974	-	-	-	-	0.12	-	-	0.12
1975	0.80	0.34	-	-	0.21	-	-	1.34
1976	1.65	0.74	-	0.10	0.71	-	-	3.20
1977	1.88	0.71	-	0.06	0.65	-	-	3.29
1978	3.37	1.38	-	0.05	1.21	-	-	6.01
1979	6.02	2.20	-	0.05	1.61	-	-	9.88
1980	11.93	7.32	-	0.06	3.64	-	-	22.95
1981	12.77	8.06	-	0.07	5.31	-	-	26.20
1982	14.12	8.95	-	0.08	5.76	-	0.37	29.28
1983	16.38	10.50	-	0.08	7.66	-	0.35	34.97
1984	19.90	12.47	-	0.08	9.72	-	0.80	42.98
1985	23.87	15.54	-	0.22	11.63	-0.63	0.72	51.34
1986	7.22	3.75	-	0.20	8.17	-0.89	1.25	19.69
1987	5.78	1.74	-	0.24	7.52	-3.80	0.89	12.37
1988	3.63	1.21	-	0.18	5.48	-5.87	0.00	4.62
1989	7.74	3.12	-	0.22	7.29	0.12	1.48	19.98
1990	13.01	6.11	-	0.26	8.47	5.22	0.80	33.87
1991	12.33	5.64	0.81	0.58	8.94	5.63	1.50	35.43
1992	6.83	10.18	1.92	0.62	8.13	3.93	1.40	33.01
1993	6.42	9.06	2.27	0.55	7.85	8.07	1.25	35.48
1994	7.66	10.39	2.56	0.14	6.60	8.95	1.08	37.36
1995	8.77	11.29	2.56	0.55	5.88	10.58	1.61	41.24
1996	14.05	18.16	2.79	1.16	6.30	26.78	1.85	71.08
1997	13.01	16.19	3.04	0.62	6.22	38.02	1.60	78.70
1998	4.99	5.13	3.23	0.53	3.76	18.99	2.94	39.56
1999	11.07	13.62	3.26	0.56	3.22	32.45	0.14	64.32
2000	36.04	56.38	3.05	0.12	3.46	95.40	1.70	196.15
2001	37.62	61.08	2.86	0.98	2.48	84.91	5.75	195.67
2002	35.08	56.29	3.01	0.45	1.32	60.23	5.05	161.42
2003	37.06	60.10	3.06	0.46	0.77	62.70	5.13	169.27
2004	50.02	81.97	3.31	0.50	0.72	76.81	5.22	218.54
2005	68.63	116.30	3.35	0.22	0.36	99.33	8.14	296.33
2006	80.21	137.89	3.41	2.31	0.04	124.86	12.59	361.31
2007	66.60	120.04	3.88	0.76	-	108.82	14.01	314.10
2008	87.57	159.68	3.68	1.84	-	152.58	16.94	422.30
2009	50.12	95.52	2.26	1.47	-	98.29	15.49	263.15
2010	60.67	114.46	2.19	1.37	-	100.26	12.82	291.77
2011	80.09	146.66	2.23	1.52	-	125.82	13.35	369.66
2012	78.80	152.02	2.26	1.78	-	148.45	13.89	397.20
2013	63.23	119.01	3.23	1.70	-	131.60	14.42	333.19
2014	44.31	95.85	4.58	1.54	-	121.45	22.65	290.37
2015	17.74	51.98	4.93	1.55	-	93.86	15.38	185.44
2016	5.79	33.55	5.11	1.40	-	67.19	10.72	123.75
2017	17.64	61.49	5.19	0.94	-	86.62	8.40	180.28
2018	45.03	98.36	5.19	1.78	-	114.51	14.98	279.86
2019	34.03	80.21	5.37	1.51	-	97.38	20.06	238.55
2020	16.80	-38.20	5.60	1.42	-	59.08	15.03	59.73
2021	94.65	204.57	5.20	0.94	-	181.94	10.49	497.79

Source: Statistics Norway

Notes: '-' stands for 'Not available' and is treated as nil in computation in this paper. 'Ordinary taxes' and 'Special taxes' are calculated on accrual basis.

Column (3) in Table 3 is another source of government tax revenues which is called 'Environmental taxes'. In the petroleum sector, these taxes include mainly the carbon tax and the NOx tax. Norway was one of the first countries in the world to introduce a carbon tax in 1991. This is levied on all combustion of gas, oil, and diesel in petroleum operations on the Norwegian continental shelf and

on releases of CO_2 and natural gas, in accordance with the CO_2 Tax Act on Petroleum Activities. The petroleum sector is also included in the emissions trading system, in which companies that are licensees on the Norwegian continental shelf must therefore purchase emission allowances if their greenhouse gas emissions (GHGs) exceed their allocated amount for the year.

'Area fees' are shown in Column (4) in Table 3, which are intended to ensure that awarded acreage for economic activities is explored efficiently by the oil and gas sector. 'Royalties' are reported in Column (5) in the table, which are imposed on petroleum production.

In the NNA and the GFS, only 'Royalties' (Column (5)) and 'Area fees' (Column (4)) are currently counted as 'Rents on subsoil assets' (D.45), while both 'Ordinary taxes' (Column (1)) and 'Special taxes' (Column (2)) are treated as 'Current taxes on income, wealth, etc.' (D.5), and 'Environmental taxes' (Column (3)) is considered as 'Other taxes on production' (D.29) at Statistics Norway.

Column (6) in Table 3 is 'Operating surplus from SDFI' which is a revenue drawn from the State's Direct Financial Interest (SDFI).[20] The SDFI is a system under which the Norwegian state owns holdings in a number of oil and gas fields, pipelines and onshore facilities. For oil and gas fields, the proportion is determined when production licences are awarded, and varies from field to field. As one of several owners, the government covers its share of investments and costs, and receives a corresponding share of the income from production licences.

It is worth mentioning that 'Operating surplus from SDFI' is conceptually different from another concept which is called 'Net cash flow from SDFI', the latter being often used for calculating 'Net government cash flow' from petroleum activities on a cash payment basis. 'Net government cash flow' and its components including 'Net cash flow from SDFI' are reported by Table 11012 (Central government fiscal account) at Statbank in Statistics Norway and are also published at the official website managed by the Norwegian Ministry of Petroleum and Energy and the Norwegian Petroleum Directorate.[21] On the contrary, 'Operating surplus from SDFI' is considered more appropriate for calculating the government revenue from petroleum activities, consistent with the compilation practice in both the NNA and GFS at Statistics Norway.

The SDFI system was established on January 1st, 1985. Before this, the Norwegian government only had ownership interests in production licences through Equinor, formerly Statoil, which is the Norwegian State Oil Company established in 1972. From 1985, these interests were split in two: one part became the SDFI, and the other part remained with Equinor. When Equinor was listed on the stock exchange in 2001, the responsibility for managing the SDFI portfolio was transferred from Equinor to a new state-owned management company, Petoro. At the end of 2021, the SDFI portfolio consisted of financial interests in 184 production licences, 37 producing fields and holdings in 17 joint ventures that own pipelines and onshore facilities.

Column (7) in Table 3 is called 'Equinor dividend'. Since the Norwegian state owns 67 % of the shares in Equinor, the government receives dividends in the same way as other shareholders. 'Equinor dividend' is currently registered in the GFS at Statistics Norway as 'Dividends from Equinor' under 'Property income' (D.4), separately from those dividends from all other companies.

[20] *Statens Direkte Økonomiske Engasjement (SDØE)* in *Norwegian*.
[21] https://www.norskpetroleum.no/en/

As briefly introduced in Section 2, the Government Pension Fund Act in Norway [22] stipulates that government revenue from the petroleum industry should in its entirety be transferred to the GPFG. However, it does not necessarily mean that the seven components of the government revenue as listed in Table 3 should all be included in the domain of the generated resource rent from a perspective of standard economics theory.

Since the ordinary company taxes are income taxes imposed on all production activities in Norway, they are therefore not 'specific' and exclusively to the petroleum activities. Consequently, the 'Ordinary taxes' as shown in Column (1) in Table 3 should be excluded when making estimates of the resource rent accruing to the government. On the other hand, Columns (2), (5), and (6) in Table 3, i.e., 'Special taxes', 'Royalties', and "Operating surplus from SDFI' should all be included in the domain of the generated resource rent that are distributed to the government because all their incurrences are due to, and specifically to, petroleum extraction activities.

As pointed out in Section 3, there are different views about whether 'Environmental taxes' (Column (3)) and 'Area fees' (Column (4)) should be treated as 'Specific taxes on extraction'. If they should, they have to be added back to the gross operating surplus which are based on the SNA concept to calculate the resource rent by following the recommended procedure as shown in Table 1 (i.e., the 'With specific taxes' case as defined in Section 3), because when calculating the gross operating surplus for petroleum extracting activities in the NNA, both 'Environmental taxes' and 'Area fees' have already been deducted as 'Other taxes on production' from generated value added in the activities. As a result, they should be included as part of resource rent accruing to the government.

On the other hand, if 'Environmental taxes' (Column (3)) and 'Area fees' (Column (4)) are not treated as 'Specific taxes on extraction', they should not be added back to the SNA gross operating surplus for calculating the resource rent (i.e., the 'Without specific taxes' case as defined in Section 3), and accordingly, not to be included as part of the resource rent accruing to the government either.

As regards whether 'Equinor dividend' (Column (7)) should be treated as part of the resource rent accruing to the government, there are also different views. Since historically, Equinor or its predecessor Statoil had on behalf of the government been managing and collecting revenues generated from petroleum activities with the purpose of benefiting all people in Norway, 'Equinor dividend' should naturally be considered as part of the resource rent accruing to the government.

However, even if the above point makes sense from a historical point of view, it may not be still suitable at present as well as in the future. For instance, in recent years, Equinor has been diversifying its investment portfolio by investing widely and considerably in making use of other natural resources, such as offshore wind and solar energy. Because of this, dividend from Equinor will not reflect the resource rent exclusively from extracting petroleum resources, but also from exploiting wind and solar energy resources.

Moreover, treating 'Equinor dividend' as part of the resource rent may open a door which will most likely make accounting under such circumstances more complicated. For instance, if part of dividends from the oil and gas companies are also sent to their foreign shareholders as resources in the rest of the world account of primary incomes and current transfers, it leads to a creation of foreign ownership of Norwegian oil and gas resources in proportion to their respective share in the total resource rent, if the split-asset approach is strictly respected.

[22] See https://lovdata.no/dokument/NL/lov/2005-12-21-123?q=lov+om+statens+pensjonsfond

Table 4. Resource rent accruing to the government (current prices, NOK billion)

Year	Resource rent to Government (With specific taxes, Including Equinor dividend) Definition (I)	Resource rent to Government (With specific taxes, Excluding Equinor dividend) Definition (II)	Resource rent to Government (Without specific taxes, Including Equinor dividend) Definition (III)	Resource rent to Government (Without specific taxes, Excluding Equinor dividend) Definition (IV)
1970	0.00	0.00	0.00	0.00
1971	0.00	0.00	0.00	0.00
1972	0.04	0.04	0.04	0.04
1973	0.07	0.07	0.07	0.07
1974	0.12	0.12	0.12	0.12
1975	0.54	0.54	0.54	0.54
1976	1.55	1.55	1.45	1.45
1977	1.41	1.41	1.35	1.35
1978	2.64	2.64	2.59	2.59
1979	3.86	3.86	3.81	3.81
1980	11.02	11.02	10.96	10.96
1981	13.43	13.43	13.36	13.36
1982	15.15	14.79	15.08	14.71
1983	18.59	18.23	18.51	18.16
1984	23.07	22.27	22.99	22.19
1985	27.47	26.75	27.25	26.53
1986	12.47	11.22	12.27	11.03
1987	6.59	5.70	6.35	5.46
1988	1.00	1.00	0.81	0.81
1989	12.24	10.76	12.01	10.53
1990	20.86	20.06	20.60	19.80
1991	23.10	21.60	21.71	20.21
1992	26.18	24.78	23.65	22.25
1993	29.06	27.81	26.24	24.99
1994	29.70	28.63	27.01	25.93
1995	32.47	30.86	29.36	27.75
1996	57.03	55.18	53.09	51.24
1997	65.69	64.09	62.03	60.43
1998	34.57	31.63	30.82	27.88
1999	53.25	53.12	49.43	49.29
2000	160.11	158.41	156.94	155.24
2001	158.05	152.31	154.21	148.46
2002	126.34	121.30	122.88	117.84
2003	132.21	127.08	128.69	123.56
2004	168.52	163.30	164.72	159.50
2005	227.70	219.56	224.13	215.99
2006	281.10	268.51	275.39	262.80
2007	247.50	233.50	242.86	228.86
2008	334.72	317.78	329.20	312.26
2009	213.03	197.54	209.30	193.81
2010	231.10	218.28	227.54	214.72
2011	289.57	276.22	285.83	272.48
2012	318.39	304.51	314.36	300.47
2013	269.97	255.54	265.03	250.61
2014	246.06	223.41	239.94	217.30
2015	167.70	152.32	161.22	145.83
2016	117.96	107.25	111.45	100.73
2017	162.64	154.24	156.51	148.11
2018	234.83	219.84	227.85	212.87
2019	204.52	184.46	197.64	177.58
2020	42.93	27.90	35.91	20.88
2021	403.14	392.64	397.00	386.51

Source: Author's own calculation based on data from Statistics Norway.

Since oil and gas are non-moveable resources, a notional resident unit has to be established by convention for owning this part of oil and gas resources on behalf of foreign shareholders. Thus, a financial asset (owned by foreign shareholders to the notional resident unit) and its corresponding liability (incurred by the notional resident unit to foreign shareholders) have to be registered in the Balance of Payments accounts. This treatment does not change the apportioning of natural resource between the government ('General government sector' (S.13)) and 'Non-financial corporations sector' (S.11) because the established notional resident unit can be classified in the 'Non-financial corporations sector' (S.11). However, such a treatment is bound to make accounting more, if not unnecessarily, complicated.

Obviously, to solve this issue fully and convincingly is beyond the scope of this paper. Therefore, we will not dwell on the issue further in the paper. In the following, the resource rent accruing to the government will have four different definitions, depending on whether 'Environmental taxes' and 'Area fees' are treated as 'Specific taxes on extraction', and whether 'Equinor dividend' is included or not.

By using data as shown in Table 3, for each year, we have the following four definitions:

(I) Resource rent accruing to government (With specific taxes, Including Equinor dividend)

= (2) + (3) + (4) + (5) + (6) + (7).

(II) Resource rent accruing to government (With specific taxes, Excluding Equinor dividend)

= (2) + (3) + (4) + (5) + (6).

(III) Resource rent accruing to government (Without specific taxes, Including Equinor dividend)

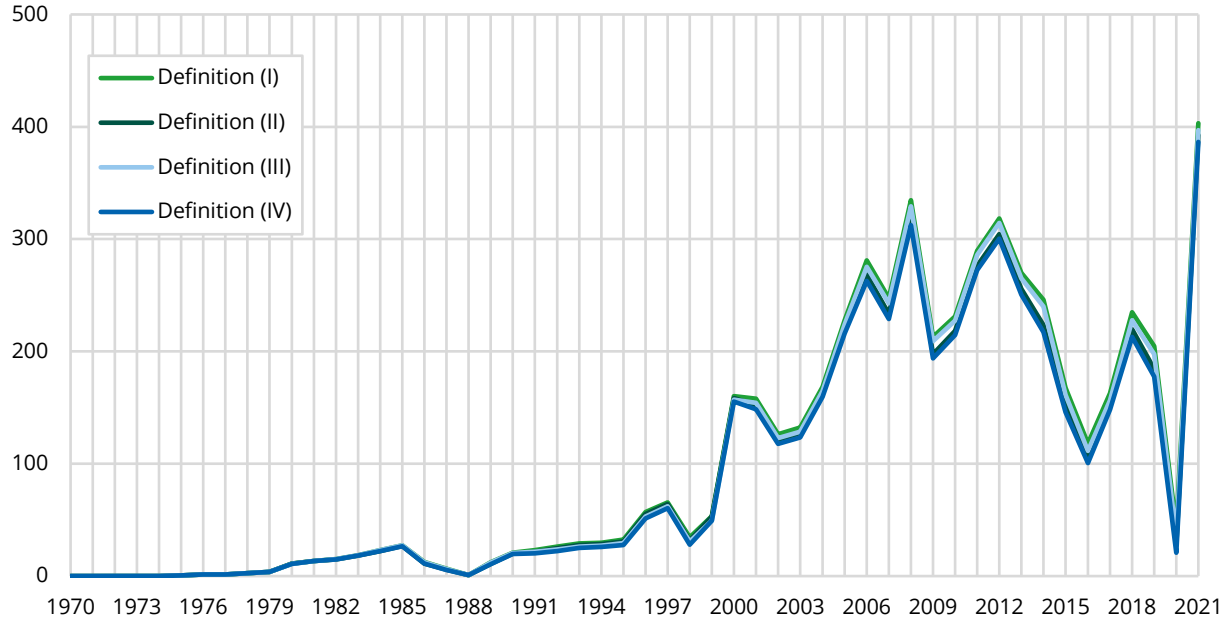
= (2) + (5) + (6) + (7),

(IV) Resource rent accruing to government (Without specific taxes, Excluding Equinor dividend)

= (2) + (5) + (6).

Defined as such, the calculated resource rent accruing to the government by four definitions in current prices over the period 1970-2021 are reported in Table 4. The corresponding results are also display in Figure 2.

Figure 2. Resource rent accruing to the government (current prices, NOK billion), by four definitions



Source: Author's own calculation based on data from Statistics Norway.

Broadly speaking, the estimated resource rent accruing to the government by Definition (I) is larger than that by Definition (II), and so is that by Definition (III) than that by Definition (IV). In addition, the estimated resource rent accruing to the government by Definition (I) is greater than that by Definition (III). Nonetheless, the differences of the estimated resource rent accruing to the government among the four definitions are not large.

Moreover, the pattern of the estimated resource rent accruing to the government as shown in Figure 2 is quite similar with that of the estimated total resource rent as shown in Figure 1 in Section 3 and Figure A1 in Appendix A, though the magnitude is smaller in the former than in the latter.

Table 5. Correlation coefficients between total resource rent and resource rent accruing to government

	Resource rent to Government			
Estimated resource rent	Definition (I)	Definition (II)	Definition (III)	Definition (IV)
Using estimated rate of return, with specific taxes	0.987	0.990	-	-
Using estimated rate of return, without specific taxes	-	-	0.987	0.990
Using 7% as rate of return, with specific taxes	0.989	0.992	-	-
Using 7% as rate of return, without specific taxes	-	-	0.989	0.992

Source: Author's own calculation based on data from Statistics Norway.
Notes: '-' stands for 'Not defined'.

In fact, the estimated total resource and the resource rent accruing to the government are positively and highly correlated with each other. Table 5 reports the calculated correlation coefficients between the estimated resource rent by using estimated rate of return and by using 7% as rate of return, and the estimated resource rent accruing to the government by following the four definitions. Likewise, in Table A3 in Appendix A, the corresponding correlation coefficients by using 4% as rate of return are presented. As shown, all the calculated correlation coefficients are around 0.99.

5. Government share in total resource rent

With the estimated total resource rent and the resource rent accruing to the government being ready, the government share in the total resource rent can be calculated. Table 6 and Table 7 present both the annual total resource rent generated from petroleum activities and the government share in percentage over the period 1970-2021. The total resource rent in Table 6 is calculated by using estimated rate of return, while that in Table 7 is by using 7% as rate of return. In Appendix A, Table A2 presents the same information where the total resource rent is estimated by using 4% as rate of return.

In addition, some selected summary statistics (Median, Mean, Maximum, Minimum, and Standard Deviation) of the estimated time series of the government share are calculated and reported in the lower panels of Table 6 and Table 7. For doing this, three scenarios (A, B, and C) are investigated. Scenario A includes all estimated government share as shown in the upper panels of Table 6 and Table 7. Scenario B excludes six estimates (in 1970, 1971, 1972, 1973, 1974, and 1988, coloured in red in the tables) where the estimated total resource rents are negative. In Scenario C, eight estimates in total (in 1970, 1971, 1972, 1973, 1974, 1988, 1998, and 2016, with the estimates for 1998 and 2016 being coloured in blue in the tables) are excluded if all the eight excluded estimates are regarded as outliers.[23]

As shown in the lower panels of Table 6 and Table 7, the value of Median is relatively stable across the three scenarios A, B, and C, if compared with the value of Mean, and this is true for each of the estimated government share series by using the four definitions of the resource rent accruing to the government. When moving from Scenario A to Scenario B where six negative estimates are removed, the value of Mean increases without surprise, while when moving from Scenario B to Scenario C, the value of Mean decreases because two additional estimates with very large positive percentages are further removed.

In Table 6, Scenario C shows that the value of Mean is equal or slightly larger than that of Median across the four definitions, implying a slightly positively skewed distribution of the government share in total resource rent over the period 1970-2021 in this scenario. In Figure 3, the frequency distribution of the appropriation shares of the government in total resource rent for Scenario C in Table 6 is shown. As visualised, the four histograms by the four chosen definitions reveal a slightly positively skewed distribution.

Quite to the opposite, Scenario C in Table 7 shows that the value of Mean is less than the corresponding value of Median, implying a negatively skewed distribution of the government share in total resource rent over the period 1970-2021 for this scenario. Likewise, the frequency distribution of the appropriation shares of the government in total resource rent for Scenario C in Table 7 is shown in Figure 4 where the four histograms reveal a negatively skewed distribution. Similar negatively skewed distributions are found for the frequency distribution of the appropriation shares of the government in total resource rent for Scenario C in Figure A2 in Appendix A, where the total resource rent is estimated by using 4% as rate of return.

Undoubtedly, the estimated average government share in total resource rent in the long run varies, depending on the various assumptions made and the choices taken. Based on the ex-post information drawn from the Norwegian experiences over a period of slightly more than fifty years (1970-2021), and by focusing on Scenario C which is considered as a relatively more reasonable

[23] Note that in Table A2 in Appendix A, the three scenarios (A, B, and C) are slightly different from those defined in Table 6 and Table 7.

situation, a long-term average of the government share in total resource rent should lie in a range of 72% to 76% as shown in Table 6, if the total resource rent is estimated by using estimated rate of return, while the long-term average is in a range of 65% to 70% as shown in Table 7, if the total resource rent is estimated by using 7% as rate of return.[24]

Table 6. Resource rent (current prices, NOK billion) and government share in percentage, 1970-2021, using estimated rate of return

Year	Total resource rent (With specific taxes)	Government share (With specific taxes, Including Equinor dividend) Definition (I)	Government share (With specific taxes, Excluding Equinor dividend) Definition (II)	Total resource rent (Without specific taxes)	Government share (Without specific taxes, Including Equinor dividend) Definition (III)	Government share (Without specific taxes, Excluding Equinor dividend) Definition (IV)
1970	-0.14	0 %	0 %	-0.14	0 %	0 %
1971	-0.24	0 %	0 %	-0.24	0 %	0 %
1972	-0.29	-15 %	-15 %	-0.29	-15 %	-15 %
1973	-0.48	-14 %	-14 %	-0.48	-14 %	-14 %
1974	-0.81	-15 %	-15 %	-0.81	-15 %	-15 %
1975	1.31	42 %	42 %	1.31	42 %	42 %
1976	2.28	68 %	68 %	2.18	66 %	66 %
1977	1.77	80 %	80 %	1.71	79 %	79 %
1978	6.94	38 %	38 %	6.89	38 %	38 %
1979	13.53	29 %	29 %	13.47	28 %	28 %
1980	31.35	35 %	35 %	31.28	35 %	35 %
1981	36.76	37 %	37 %	36.69	36 %	36 %
1982	38.75	39 %	38 %	38.68	39 %	38 %
1983	47.62	39 %	38 %	47.54	39 %	38 %
1984	59.54	39 %	37 %	59.46	39 %	37 %
1985	60.85	45 %	44 %	60.63	45 %	44 %
1986	18.28	68 %	61 %	18.08	68 %	61 %
1987	13.22	50 %	43 %	12.98	49 %	42 %
1988	-0.51	-196 %	-196 %	-0.69	-117 %	-117 %
1989	20.59	59 %	52 %	20.37	59 %	52 %
1990	34.47	61 %	58 %	34.22	60 %	58 %
1991	32.05	72 %	67 %	30.66	71 %	66 %
1992	24.86	105 %	100 %	22.32	106 %	100 %
1993	21.12	138 %	132 %	18.29	143 %	137 %
1994	20.00	149 %	143 %	17.30	156 %	150 %
1995	23.84	136 %	129 %	20.72	142 %	134 %
1996	64.71	88 %	85 %	60.76	87 %	84 %
1997	70.06	94 %	91 %	66.40	93 %	91 %
1998	10.74	322 %	295 %	6.98	441 %	399 %
1999	52.96	101 %	100 %	49.14	101 %	100 %
2000	214.54	75 %	74 %	211.37	74 %	73 %
2001	191.13	83 %	80 %	187.28	82 %	79 %
2002	148.00	85 %	82 %	144.54	85 %	82 %
2003	151.72	87 %	84 %	148.20	87 %	83 %
2004	212.42	79 %	77 %	208.62	79 %	76 %
2005	300.28	76 %	73 %	296.70	76 %	73 %
2006	372.67	75 %	72 %	366.95	75 %	72 %
2007	327.27	76 %	71 %	322.63	75 %	71 %
2008	451.57	74 %	70 %	446.04	74 %	70 %
2009	245.92	87 %	80 %	242.19	86 %	80 %
2010	274.73	84 %	79 %	271.17	84 %	79 %
2011	390.06	74 %	71 %	386.32	74 %	71 %
2012	407.08	78 %	75 %	403.05	78 %	75 %

[24] The long-term average of the government share lies in a range of 56% to 60%, if the total resource rent is estimated by using 4% as rate of return, as shown in Table A2 in Appendix A.

Year	Total resource rent (With specific taxes)	Government share (With specific taxes, Including Equinor dividend) Definition (I)	Government share (With specific taxes, Excluding Equinor dividend) Definition (II)	Total resource rent (Without specific taxes)	Government share (Without specific taxes, Including Equinor dividend) Definition (III)	Government share (Without specific taxes, Excluding Equinor dividend) Definition (IV)
2013	359.49	75 %	71 %	354.56	75 %	71 %
2014	284.08	87 %	79 %	277.97	86 %	78 %
2015	159.96	105 %	95 %	153.47	105 %	95 %
2016	71.34	165 %	150 %	64.82	172 %	155 %
2017	190.07	86 %	81 %	183.95	85 %	81 %
2018	311.84	75 %	70 %	304.86	75 %	70 %
2019	183.90	111 %	100 %	177.02	112 %	100 %
2020	48.94	88 %	57 %	41.92	86 %	50 %
2021	560.65	72 %	70 %	554.51	72 %	70 %
			Summary statistics (A) [1]			
Median		75 %	71 %		75 %	71 %
Mean		69 %	65 %		73 %	68 %
Maximum		322 %	295 %		441 %	399 %
Minimum		-196 %	-196 %		-117 %	-117 %
SD [2]		64 %	60 %		70 %	65 %
			Summary statistics (B) [3]			
Median		76 %	73 %		75 %	72 %
Mean		83 %	78 %		86 %	81 %
Maximum		322 %	295 %		441 %	399 %
Minimum		29 %	29 %		28 %	28 %
SD [2]		47 %	43 %		62 %	56 %
			Summary statistics (C) [4]			
Median		76 %	72 %		75 %	71 %
Mean		76 %	72 %		76 %	72 %
Maximum		149 %	143 %		156 %	150 %
Minimum		29 %	29 %		28 %	28 %
SD [2]		27 %	26 %		28 %	27 %

Source: Author's own calculation based on data from Statistics Norway

Notes:

1. Summary statistics A are calculated with all estimates included.
2. SD stands for 'Standard Deviation'.
3. Summary statistics B are calculated with six estimates (in 1970, 1971, 1972, 1973, 1974, and 1988) being excluded, given that the calculated annual total resource rent in each year is negative.
4. Summary statistics C are calculated with eight estimates (in 1970, 1971, 1972, 1973, 1974, 1988, 1998, and 2016) being excluded, if all the eight estimates are regarded as outliers.

Both the level of the resource rent and the size of the government share depend on the definitions used, and how the measurement is carried out. Nonetheless, it seems safe to say that more than half of the total resource rent from oil and gas is appropriated by the government, and the rest part remains with the oil and gas sector in the long run.

One should also bear in mind that there are other mechanisms that ensure the government receives revenue from petroleum activities. As shown in Table 3, total government revenue from petroleum activities includes 'Ordinary taxes' which have been excluded from the resource rent.

Table 8 presents the ratio of total government revenue from petroleum activities (including 'Ordinary taxes') to the total generated resource rent over the period 1970-2021, where the total resource rent is estimated by using estimated rate of return, and by using 7% as rate of return, respectively. The similar information is provided in Table A4 in Appendix A where the total resource rent is estimated by using 4% as rate of return. and on whether specific taxes are included in the

resource rent accruing to the government.[25] A tentative conclusion could be that the government revenue from petroleum activities is therefore somewhat around 100% of the total resource rent from a long-term perspective.

The three scenarios (A, B, and C) are the same as applied in Table 6 and Table 7. By focusing on Scenario C, the value of Mean as shown in the lower panel of Table 8 indicates that the long-term average of the ratio of the government revenue from petroleum activities to the total resource rent is in a range of 98% to 111%, depending on the choice of rate of return for resource rent estimation

Table 7. Resource rent (current prices, NOK billion) and government share in percentage, 1970-2021, using 7% as rate of return

Year	Total resource rent (With specific taxes)	Government share (With specific taxes, Including Equinor dividend) Definition (I)	Government share (With specific taxes, Excluding Equinor dividend) Definition (II)	Total resource rent (Without specific taxes)	Government share (Without specific taxes, Including Equinor dividend) Definition (III)	Government share (Without specific taxes, Excluding Equinor dividend) Definition (IV)
1970	-0.12	0 %	0 %	-0.12	0 %	0 %
1971	-0.20	0 %	0 %	-0.20	0 %	0 %
1972	-0.22	-19 %	-19 %	-0.22	-19 %	-19 %
1973	-0.38	-18 %	-18 %	-0.38	-18 %	-18 %
1974	-0.60	-20 %	-20 %	-0.60	-20 %	-20 %
1975	1.55	35 %	35 %	1.55	35 %	35 %
1976	2.53	61 %	61 %	2.43	60 %	60 %
1977	2.08	68 %	68 %	2.02	67 %	67 %
1978	7.07	37 %	37 %	7.01	37 %	37 %
1979	13.73	28 %	28 %	13.68	28 %	28 %
1980	31.41	35 %	35 %	31.34	35 %	35 %
1981	36.95	36 %	36 %	36.88	36 %	36 %
1982	39.15	39 %	38 %	39.08	39 %	38 %
1983	48.10	39 %	38 %	48.03	39 %	38 %
1984	60.66	38 %	37 %	60.58	38 %	37 %
1985	62.16	44 %	43 %	61.94	44 %	43 %
1986	18.56	67 %	60 %	18.36	67 %	60 %
1987	12.36	53 %	46 %	12.12	52 %	45 %
1988	-1.72	-58 %	-58 %	-1.90	-43 %	-43 %
1989	20.58	59 %	52 %	20.35	59 %	52 %
1990	35.88	58 %	56 %	35.62	58 %	56 %
1991	35.52	65 %	61 %	34.13	64 %	59 %
1992	30.36	86 %	82 %	27.83	85 %	80 %
1993	29.56	98 %	94 %	26.73	98 %	93 %
1994	29.30	101 %	98 %	26.60	102 %	97 %
1995	34.14	95 %	90 %	31.03	95 %	89 %
1996	73.32	78 %	75 %	69.38	77 %	74 %
1997	79.74	82 %	80 %	76.08	82 %	79 %
1998	21.03	164 %	150 %	17.27	178 %	161 %
1999	60.93	87 %	87 %	57.11	87 %	86 %
2000	222.90	72 %	71 %	219.73	71 %	71 %
2001	201.54	78 %	76 %	197.70	78 %	75 %
2002	158.19	80 %	77 %	154.73	79 %	76 %
2003	166.64	79 %	76 %	163.13	79 %	76 %
2004	230.69	73 %	71 %	226.89	73 %	70 %
2005	321.52	71 %	68 %	317.94	70 %	68 %
2006	395.15	71 %	68 %	389.44	71 %	67 %
2007	348.66	71 %	67 %	344.02	71 %	67 %
2008	469.69	71 %	68 %	464.17	71 %	67 %

[25] The long-term average of the ratio of the government revenue from petroleum activities to the total resource rent is in a range of 83% to 85%, where the total resource rent is estimated by using 4% as rate of return, as shown in Table A4 in Appendix A.

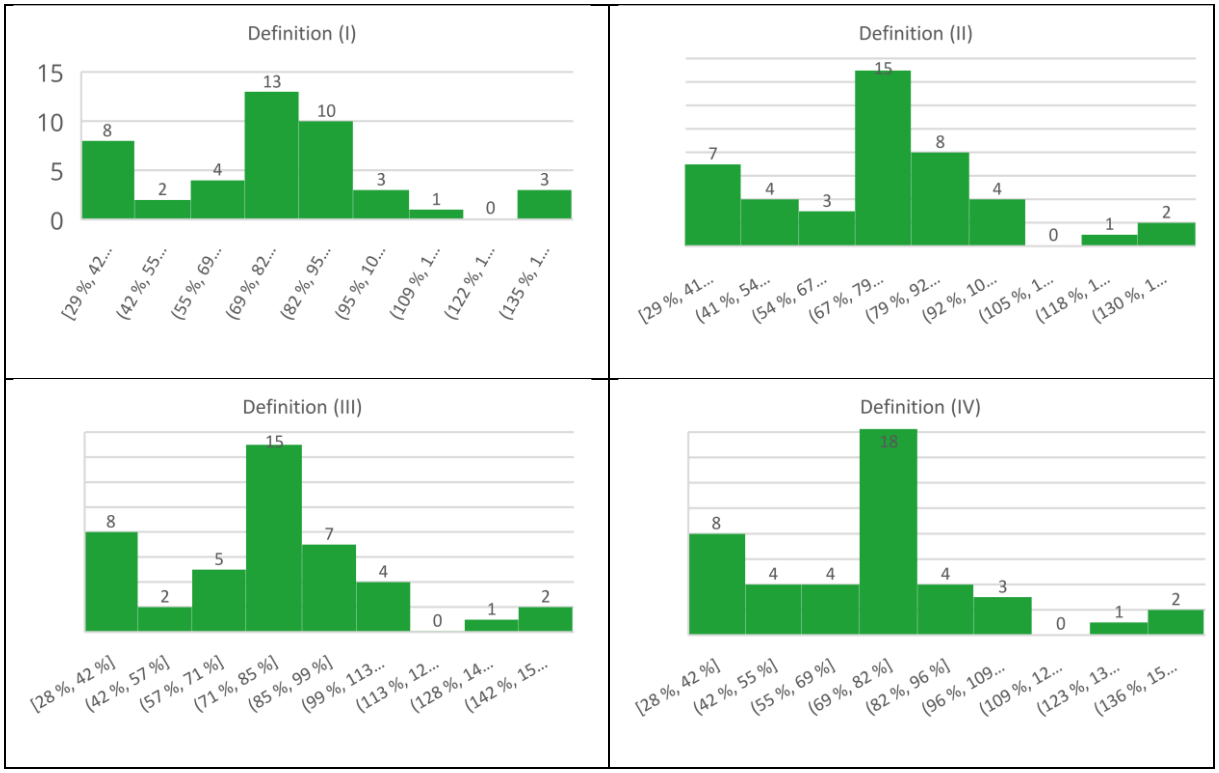
Year	Total resource rent (With specific taxes)	Government share (With specific taxes, Including Equinor dividend) Definition (I)	Government share (With specific taxes, Excluding Equinor dividend) Definition (II)	Total resource rent (Without specific taxes)	Government share (Without specific taxes, Including Equinor dividend) Definition (III)	Government share (Without specific taxes, Excluding Equinor dividend) Definition (IV)
2009	254.84	84 %	78 %	251.11	83 %	77 %
2010	292.63	79 %	75 %	289.07	79 %	74 %
2011	399.80	72 %	69 %	396.06	72 %	69 %
2012	419.14	76 %	73 %	415.10	76 %	72 %
2013	374.40	72 %	68 %	369.47	72 %	68 %
2014	300.56	82 %	74 %	294.44	81 %	74 %
2015	172.75	97 %	88 %	166.27	97 %	88 %
2016	83.75	141 %	128 %	77.24	144 %	130 %
2017	199.23	82 %	77 %	193.10	81 %	77 %
2018	316.87	74 %	69 %	309.90	74 %	69 %
2019	185.16	110 %	100 %	178.28	111 %	100 %
2020	39.12	110 %	71 %	32.10	112 %	65 %
2021	546.35	74 %	72 %	540.21	73 %	72 %
			Summary statistics (A) [1]			
Median		72 %	68 %		71 %	68 %
Mean		63 %	59 %		63 %	59 %
Maximum		164 %	150 %		178 %	161 %
Minimum		-58 %	-58 %		-43 %	-43 %
SD [2]		40 %	37 %		40 %	36 %
			Summary statistics (B) [3]			
Median		73 %	70 %		72 %	69 %
Mean		73 %	69 %		73 %	69 %
Maximum		164 %	150 %		178 %	161 %
Minimum		28 %	28 %		28 %	28 %
SD [2]		27 %	24 %		28 %	25 %
			Summary statistics (C) [4]			
Median		72 %	69 %		72 %	68 %
Mean		70 %	66 %		69 %	65 %
Maximum		110 %	100 %		112 %	100 %
Minimum		28 %	28 %		28 %	28 %
SD [2]		21 %	18 %		21 %	18 %

Source: Author's own calculation based on data from Statistics Norway

Notes:

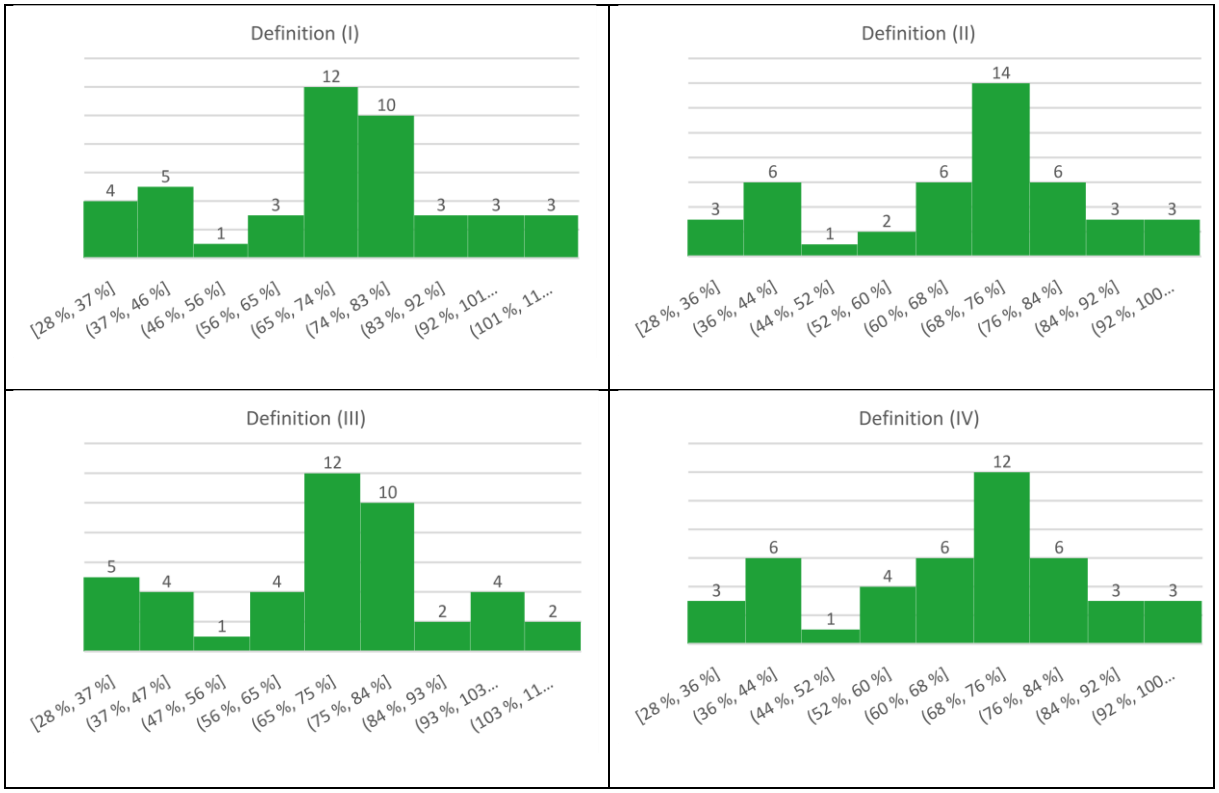
1. Summary statistics A are calculated with all estimates included.
2. SD stands for 'Standard Deviation'.
3. Summary statistics B are calculated with six estimates (in 1970, 1971, 1972, 1973, 1974, and 1988) being excluded, given that the calculated annual total resource rent in each year is negative.
4. Summary statistics C are calculated with eight estimates (in 1970, 1971, 1972, 1973, 1974, 1988, 1998, and 2016) being excluded, if all the eight estimates are regarded as outliers.

Figure 3. Frequency distribution of government share in total resource rent estimated by using estimated rate of return, Scenario C



Source: Author's own calculation based on data from Statistics Norway.
Note: Estimates of the share of the government in 1970, 1971, 1972, 1973, 1974, 1988, 1998, and 2016 are excluded.

Figure 4. Frequency distribution of government share in total resource rent estimated by using 7% as rate of return, Scenario C



Source: Author's own calculation based on data from Statistics Norway.
Note: Estimates of the share of the government in 1970, 1971, 1972, 1973, 1974, 1988, 1998, and 2016 are excluded.

At first glance, the finding that only more than half of the total resource rent was distributed to the government seems to be conflicting with that the total government revenue from oil and gas was around 100% of the total resource rent. As a matter of fact, the two findings are conceptually different, with the former 'more than half of the total resource rent' being a concept of cost, while the latter '100% of the total resource rent' being a concept of revenue. Government revenue from oil and gas production includes ordinary taxes, and the petroleum industry is very capital intensive. When calculating the resource rent (see Section 3), the normal return on capital is excluded. However, this normal return is part of net profits at the oil companies, which in turn is subject to ordinary taxes paid to government.

As suggested by the SEEA-CF, the total resource rent should be recorded as 'Depletion of natural resources' in 'Production and generation of income account' of the oil and gas sector. If say, 70% of the total resource rent is paid to the government, an entry called 'Depletion borne by government' (with value equal to 70% of the total resource rent but with negative sign) is registered in 'Allocation of primary income account', reflecting that the rent received by the government includes its share, i.e., 70% of the total depletion cost. Accordingly, about 30% of the total resource rent remained is the depletion cost borne by the oil and gas sector. On the other hand, 'Ordinary taxes' are registered in 'Secondary distribution of income account' of the oil and gas sector as 'Current taxes on income' paid to the government as revenue, they differ from the cost incurred for extracting oil and gas.[26]

Table 8. Ratio of the government revenue from petroleum activities to total resource rent, 1970-2021

	Ratio to total resource rent estimated by using estimated rate of return		Ratio to total resource rent estimated by using 7% as rate of return	
Year	With specific taxes	Without specific taxes	With specific taxes	Without specific taxes
1970	0 %	0 %	0 %	0 %
1971	0 %	0 %	0 %	0 %
1972	-15 %	-15 %	-19 %	-19 %
1973	-14 %	-14 %	-18 %	-18 %
1974	-15 %	-15 %	-20 %	-20 %
1975	103 %	103 %	86 %	86 %
1976	140 %	146 %	126 %	131 %
1977	186 %	192 %	158 %	163 %
1978	87 %	87 %	85 %	86 %
1979	73 %	73 %	72 %	72 %
1980	73 %	73 %	73 %	73 %
1981	71 %	71 %	71 %	71 %
1982	76 %	76 %	75 %	75 %
1983	73 %	74 %	73 %	73 %
1984	72 %	72 %	71 %	71 %
1985	84 %	85 %	83 %	83 %
1986	108 %	109 %	106 %	107 %
1987	94 %	95 %	100 %	102 %
1988	-909 %	-667 %	-269 %	-243 %
1989	97 %	98 %	97 %	98 %
1990	98 %	99 %	94 %	95 %
1991	111 %	116 %	100 %	104 %
1992	133 %	148 %	109 %	119 %
1993	168 %	194 %	120 %	133 %
1994	187 %	216 %	128 %	140 %
1995	173 %	199 %	121 %	133 %
1996	110 %	117 %	97 %	102 %
1997	112 %	119 %	99 %	103 %
1998	368 %	566 %	188 %	229 %
1999	121 %	131 %	106 %	113 %
2000	91 %	93 %	88 %	89 %

[26] Also see the numerical accounting example in Appendix B in this paper.

	Ratio to total resource rent estimated by using estimated rate of return		Ratio to total resource rent estimated by using 7% as rate of return	
Year	With specific taxes	Without specific taxes	With specific taxes	Without specific taxes
2001	102 %	104 %	97 %	99 %
2002	109 %	112 %	102 %	104 %
2003	112 %	114 %	102 %	104 %
2004	103 %	105 %	95 %	96 %
2005	99 %	100 %	92 %	93 %
2006	97 %	98 %	91 %	93 %
2007	96 %	97 %	90 %	91 %
2008	94 %	95 %	90 %	91 %
2009	107 %	109 %	103 %	105 %
2010	106 %	108 %	100 %	101 %
2011	95 %	96 %	92 %	93 %
2012	98 %	99 %	95 %	96 %
2013	93 %	94 %	89 %	90 %
2014	102 %	104 %	97 %	99 %
2015	116 %	121 %	107 %	112 %
2016	173 %	191 %	148 %	160 %
2017	95 %	98 %	90 %	93 %
2018	90 %	92 %	88 %	90 %
2019	130 %	135 %	129 %	134 %
2020	122 %	142 %	153 %	186 %
2021	89 %	90 %	91 %	92 %
		Summary statistics (A) [1]		
Median	98 %	99 %	95 %	95 %
Mean	82 %	95 %	83 %	88 %
Maximum	368 %	566 %	188 %	229 %
Minimum	-909 %	-667 %	-269 %	-243 %
SD [2]	152 %	135 %	64 %	65 %
		Summary statistics (B) [3]		
Median	102 %	104 %	97 %	98 %
Mean	114 %	123 %	101 %	106 %
Maximum	368 %	566 %	188 %	229 %
Minimum	71 %	71 %	71 %	71 %
SD [2]	48 %	76 %	24 %	31 %
		Summary statistics (C) [4]		
Median	100 %	101 %	96 %	97 %
Mean	107 %	111 %	98 %	102 %
Maximum	187 %	216 %	158 %	186 %
Minimum	71 %	71 %	71 %	71 %
SD [2]	28 %	34 %	19 %	24 %

Source: Author's own calculation based on data from Statistics Norway

Notes:

1. Summary statistics A are calculated with all estimates included.
2. SD stands for 'Standard Deviation'.
3. Summary statistics B are calculated with six estimates (in 1970, 1971, 1972, 1973, 1974, and 1988) being excluded, given that the calculated annual total resource rent in each year is negative.
4. Summary statistics C are calculated with eight estimates (in 1970, 1971, 1972, 1973, 1974, 1988, 1998, and 2016) being excluded, if all the eight estimates are regarded as outliers.

As well known, one necessary condition for a weak sustainability criterion for a country is that total stock of national wealth does not decrease over the years if substitution between different types of national assets is allowed.[27] In this sense, transferring the revenue which is somewhat around 100% of the generated oil and gas resource rents into financial asset (such as the GPFG fund) will ensure

[27] Strictly speaking, the necessary condition for a weak sustainability is a non-decreasing total national wealth *per capita* over the years (e.g., Arrow *et al*., 2012, 2013). Here, population dimension is ignored for ease of discussion. Nonetheless, given that population in Norway has been increasing over the years (see Table 05810 at Statbank of Statistics Norway), a non-decreasing total national wealth still serves as a basic necessary condition.

that the total national wealth is well preserved in the long run, which is exactly the original intention for setting up the GPFG fund in Norway.

Therefore, the precautionary measure undertaken by the Norwegian government by allocating the total government revenue from petroleum activities to the GPFG as part of the whole regulatory framework for petroleum activities, so that a type of non-renewable natural resource, when running down, is entirely converted to a type of financial asset in value, is a thoughtful policy and a sensible practice, as far as sustainability is concerned.

6. Splitting economic ownership in practice

The basic idea behind the split-asset approach is to assign the economic ownership of natural resources to relevant institutional sectors in line with the actual distribution of resource rents and the sharing of operational risks, with the purpose to restore the missing link between depletion borne by relevant institutional sectors and the corresponding capital stock in use.

In an example illustrated in van de Ven and de Haan (2021), the feasibility of applying the split-asset approach for allocating natural gas asset between Dutch state and non-financial corporations in the Netherlands was demonstrated by using only one year (2017) data. However, when having time series data over a period as presented in this paper for the Norwegian case, things become more complicated, and accordingly more detailed guidance is needed.

There are at least three different options for the Norwegian case that can be undertaken for implementing the split-asset approach and for recording the flows of resource rent between the government and the extractor in practice.

Option 1:

- *Use the annual realised distribution of resource rent to split the economic ownership in each year.*
- *Record the actual flows of resource rent from the government to the extractor in each year.*

This option is a natural extension of the Dutch one-year example as presented in van de Ven and de Haan (2021) directly to a time series situation without any change. An obvious advantage of this option is that the restored link between capital used in production and related gross income derived from it is an exact proportionate mapping in each year. However, given the revealed extreme volatility of oil and gas prices, the business cycle effect, and many other factors involved, both the estimated annual resource rent and its apportioning in each year between the government and the extractor has been volatile over the observed period 1971-2021, as shown in Table 3 for the Norwegian case.

Using the volatile annual distribution information to spit the economic ownership in each year may frequently send wrong signals to data users since some sharp changes of natural resources owned by the government (or by the extractor) between years may be primarily due to the technical reallocation (capital transfers) resulted from the application of the split-asset approach, rather than to an actual run-down (due to depletion) or build-up (due to new discoveries or revaluations) of the natural resources in concern. In some years, a beyond 100% share of the resource rent by the government makes the split-asset approach simply impractical.

Moreover, applying the split-asset approach requires a recording in capital account of 'Capital transfer received' (as resources) and 'Acquisition of assets' (as uses) by the extractor, and the corresponding entries by the government with the same value but negative sign.[28] Implementing such a recording in each and every year makes accounting unduly sophisticated for data compilers in annual national accounts, let alone in quarterly or even monthly national accounts with higher frequency sub-annual data. In addition, an ever-changing ownership share between the government and the extractor may not be very convincing for data users either.

[28] Please refer to Example D in van de Ven and de Haan (2021).

Option 2:

- *Use an average distribution of resource rent observed over a long period to split the economic ownership in the year when extracting activities start, and no further splitting is needed in other years until significant changes in extraction arrangements occur.*
- *Use the same average distribution to record the flows of resource rent from the government to the extractor in each year.*

Recognizing the tremendous volatility related to oil and gas as mentioned in Option 1, a long-term perspective is arguably of essential importance when trying to split the economic ownership between the government and the extractor in practice. Because only over a long period, can it be possible to identify a relatively stable relationship in which the split asset could be approximately in proportion to the averaged distribution of resource rents.

The long-term perspective is also consistent with the practice undertaken by the Norwegian government when setting a fiscal rule where only 4% of the GPFG can be used for government budget each year, and the 4% refers to an expected *long-term* real rate of return to the GPFG.

Option 2 suggests splitting the economic ownership only in the year when extracting activities start by the extractor, and therefore, the apportioning of the resource between the government and the extractor becomes much easier. Before the starting year, the whole ownership is implicitly assumed to stay with the government as a legal owner. No further split is needed so long as no significant changes related to extraction arrangements, either legally or economically, come about. If significant changes do take place after some years, the previously applied average distribution information should be re-assessed and updated if necessary.

By removing short-term volatility, this option allows a relatively stable relationship to be used as a 'distribution key' for splitting the economic ownership between the government and the extractor. On the other hand, this option requires to use the same average distribution to record the actual flows of resource rents from the government to the extractor in each year. This is not appropriate because all these flows have been already recorded in, e.g., the NNA and the GFS. Redefining some of the registered transactions, e.g., from 'Environmental taxes' to 'Resource rent' may take place, but the actual values of these flows in each year as recorded in the NNA and the GFS should better not be changed.

Option 3:

- *Use an average distribution of resource rent observed over a long period to split the economic ownership in the year when extracting activities start, and no further splitting is needed in other years until significant changes in extraction arrangements occur.*
- *Record the actual flows of resource rent from the government to the extractor in each year.*

This option consists of the second clause of Option 1 and the first clause of Option 2. Consequently, compared to Options 1 and 2 *per se*, this option is regarded as a more practical approach because it uses the revealed long-run average of the distribution of resource rent to spit the asset economic ownership and keeps the actual annual flows of the resource rent from the government to the extractor as recorded in both the NNA and the GFS unchanged.

Based on the Norwegian experiences as described in this paper, Option 3 seems to be the best choice if the split asset approach were to be adopted. Formally, the recordings for the Norwegian case would be as follows: in the capital account, use the ex-post information drawn from a long-term average distribution of the resource rent (e.g., 75% vs. 25% between the government and the

oil and gas sector) to split the economic ownership in the year when extracting production started, while in the current account, record the actual flows of the resource rent from the government to the extractor in both the NNA and the GFS in each year. As for 'Other changes in volume' and 'Revaluation', the same average distribution applied in the capital account is used to spilt them in the other changes in volume account and the revaluation account, respectively. In addition, the split is suggested to be carried out in all the year(s) when 'Other changes in volume' or 'Revaluation' does appear.

With the purpose of facilitating further illustration and understanding of the recommended recordings, a fictitious numerical accounting example, specifically designed to be suitable not only for the Norwegian case but also for more general cases as well, is presented in Appendix C for elaborating on how to implement the split-asset approach in practice, and how to record various transactions in the detailed accounts of both the government and the extractor in each year, when a time series data instead of only one-year data is in use.

7. Conclusions

The estimation of both the resource rent and its part that is appropriated by the government hinges upon a variety of assumptions and choices. With the sound assumptions made and reasonable choices taken, the Norwegian experiences indicate that more than half of the generated resource rent is apportioned to the government while the rest remains with the oil and gas sector from a long-term perspective, despite the observed volatility of these shares over the years.

The long-term average pattern can serve as a 'distribution key' to split the economic ownership of oil and gas between the government and the oil and gas sector. Therefore, splitting the economic ownership for petroleum resources between the government and the oil and gas sector in Norway is feasible, with its practical implementation conditional on the final decision as regards the definition and estimation of the resource rent due to petroleum activities, as well as those of the value of petroleum resources.

The splitting is suggested to be carried out in the year when extracting activities start and no further splitting is needed for the following years until significant changes in extraction arrangements take place. When arrangements have changed, investigation should be undertaken to check whether the changes warrant using different splits and/or for different sectors.

In addition, the actual flows of the resource rent as recorded in both the NNA and the GFS between the government and the extractor in each year are suggested not to be changed. Although the restored link between oil and gas asset used in production and related depletion cost is not an exact proportionate mapping in each year, it is in the long run.

The analysis of the resource rent from Norway's oil and gas production reveals a key challenge of the split asset approach: the distribution of the resource rent varies significantly from year to year, and there may be periods of several years with deviations of several percentage points from the long-term average. A possible solution is indicated in this paper, but there are two important caveats. First, data availability may hamper similar analysis in other cases. Moreover, it is not certain that one can always identify a stable pattern of distribution for all natural resources in all countries, at least not without long time series. Second, the need for accuracy depends on how the data are to be used. The more data are considered over short time horizons, or are used directly for policy formulation, the higher the requirement for accuracy. As part of the work towards the update of the SNA standard, these caveats need to be addressed.

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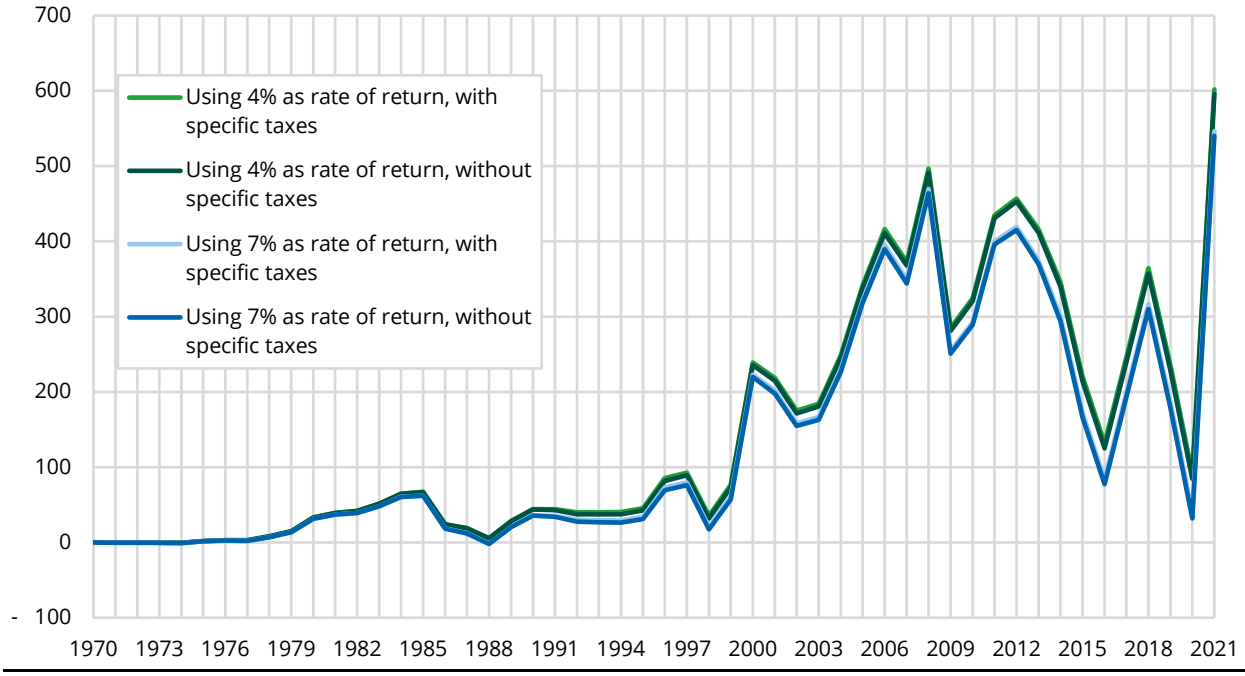
Appendix A: Some results by using 4% as fixed rate of return

Table A1. Total resource rent in current prices (NOK billion), 1970-2021

	Using 4% as rate of return		Using 7% as rate of return	
Year	With specific taxes	Without specific taxes	With specific taxes	Without specific taxes
1970	-0.09	-0.09	-0.12	-0.12
1971	-0.16	-0.16	-0.20	-0.20
1972	-0.14	-0.14	-0.22	-0.22
1973	-0.27	-0.27	-0.38	-0.38
1974	-0.39	-0.39	-0.60	-0.60
1975	1.91	1.91	1.55	1.55
1976	3.09	2.99	2.53	2.43
1977	2.98	2.93	2.08	2.02
1978	8.10	8.05	7.07	7.01
1979	15.00	14.95	13.73	13.68
1980	33.08	33.02	31.41	31.34
1981	39.15	39.08	36.95	36.88
1982	42.00	41.92	39.15	39.08
1983	51.43	51.36	48.10	48.03
1984	64.66	64.58	60.66	60.58
1985	67.04	66.82	62.16	61.94
1986	24.24	24.04	18.56	18.36
1987	19.04	18.80	12.36	12.12
1988	5.66	5.47	-1.72	-1.90
1989	28.53	28.30	20.58	20.35
1990	44.21	43.96	35.88	35.62
1991	44.40	43.01	35.52	34.13
1992	40.01	37.48	30.36	27.83
1993	40.09	37.27	29.56	26.73
1994	40.35	37.66	29.30	26.60
1995	45.70	42.59	34.14	31.03
1996	85.55	81.60	73.32	69.38
1997	92.91	89.25	79.74	76.08
1998	35.53	31.77	21.03	17.27
1999	76.41	72.58	60.93	57.11
2000	238.97	235.80	222.90	219.73
2001	218.48	214.64	201.54	197.70
2002	175.09	171.63	158.19	154.73
2003	184.19	180.67	166.64	163.13
2004	248.73	244.93	230.69	226.89
2005	341.07	337.50	321.52	317.94
2006	416.39	410.68	395.15	389.44
2007	372.43	367.79	348.66	344.02
2008	496.60	491.07	469.69	464.17
2009	284.82	281.09	254.84	251.11
2010	324.38	320.83	292.63	289.07
2011	434.53	430.79	399.80	396.06
2012	456.88	452.84	419.14	415.10
2013	416.08	411.15	374.40	369.47
2014	346.37	340.26	300.56	294.44
2015	220.89	214.41	172.75	166.27
2016	131.73	125.22	83.75	77.24
2017	245.71	239.58	199.23	193.10
2018	364.40	357.43	316.87	309.90
2019	234.82	227.94	185.16	178.28
2020	91.56	84.54	39.12	32.10
2021	601.81	595.68	546.35	540.21

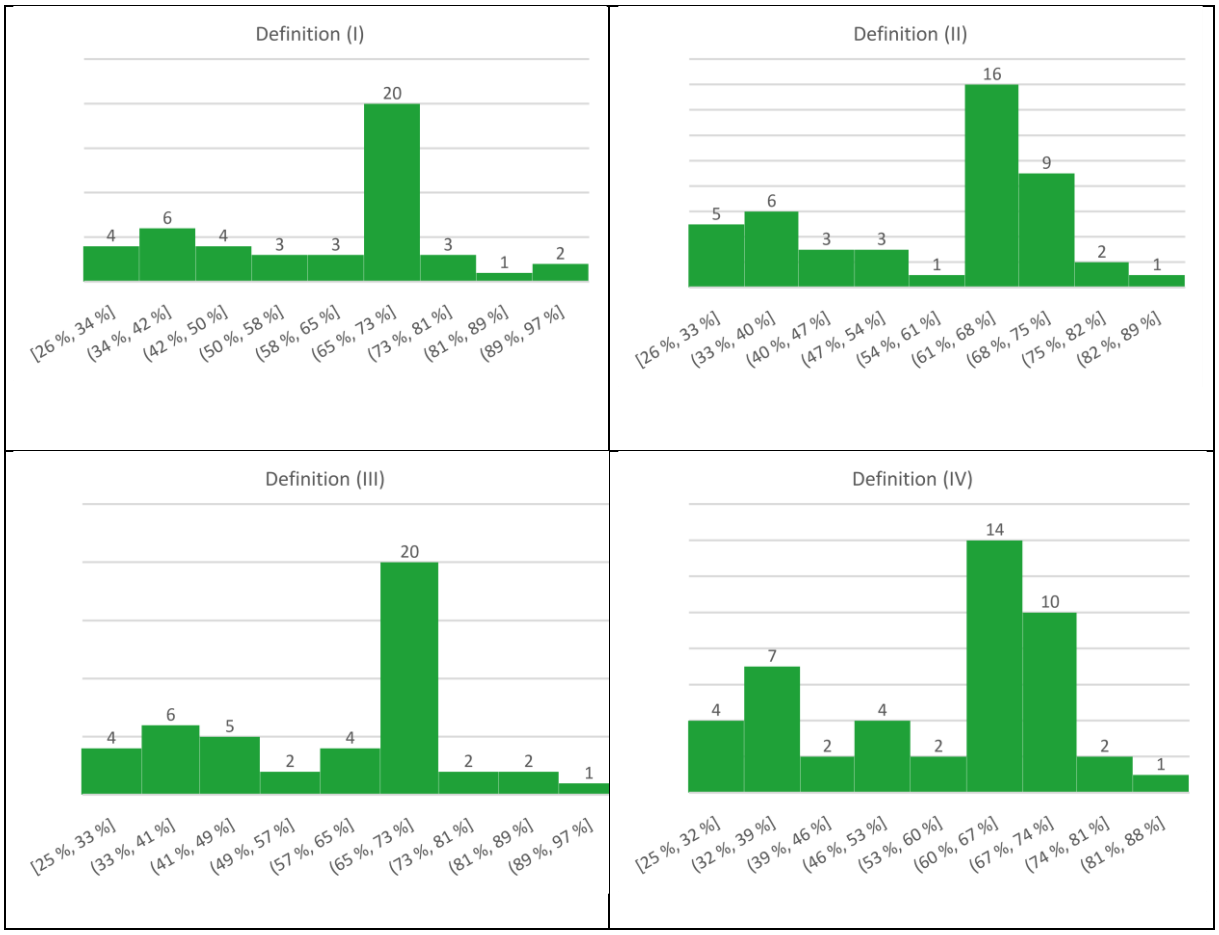
Source: Author's own calculation based on data from Statistics Norway.

Figure A1. Estimated resource rent from petroleum activities in Norway (current prices, NOK billion), using fixed rate of return (4% and 7%, respectively)



Source: Author's own calculation based on data from Statistics Norway.

Figure A2. Frequency distribution of government share in total resource rent estimated by using 4% as rate of return, Scenario C



Source: Author's own calculation based on data from Statistics Norway.
Note: Estimates of the share of the government in 1970, 1971, 1972, 1973, 1974, and 1988 are excluded.

Table A2. Resource rent (current prices, NOK billion) and government share in percentage, 1970-2021, using 4% as rate of return

Year	Total resource rent (With specific taxes)	Government share (With specific taxes, Including Equinor dividend) Definition (I)	Government share (With specific taxes, Excluding Equinor dividend) Definition (II)	Total resource rent (Without specific taxes)	Government share (Without specific taxes, Including Equinor dividend) Definition (III)	Government share (Without specific taxes, Excluding Equinor dividend) Definition (IV)
1970	-0.09	0 %	0 %	-0.09	0 %	0 %
1971	-0.16	0 %	0 %	-0.16	0 %	0 %
1972	-0.14	-29 %	-29 %	-0.14	-29 %	-29 %
1973	-0.27	-26 %	-26 %	-0.27	-26 %	-26 %
1974	-0.39	-31 %	-31 %	-0.39	-31 %	-31 %
1975	1.91	28 %	28 %	1.91	28 %	28 %
1976	3.09	50 %	50 %	2.99	48 %	48 %
1977	2.98	47 %	47 %	2.93	46 %	46 %
1978	8.10	33 %	33 %	8.05	32 %	32 %
1979	15.00	26 %	26 %	14.95	25 %	25 %
1980	33.08	33 %	33 %	33.02	33 %	33 %
1981	39.15	34 %	34 %	39.08	34 %	34 %
1982	42.00	36 %	35 %	41.92	36 %	35 %
1983	51.43	36 %	35 %	51.36	36 %	35 %
1984	64.66	36 %	34 %	64.58	36 %	34 %
1985	67.04	41 %	40 %	66.82	41 %	40 %
1986	24.24	51 %	46 %	24.04	51 %	46 %
1987	19.04	35 %	30 %	18.80	34 %	29 %
1988	5.66	18 %	18 %	5.47	15 %	15 %
1989	28.53	43 %	38 %	28.30	42 %	37 %
1990	44.21	47 %	45 %	43.96	47 %	45 %
1991	44.40	52 %	49 %	43.01	50 %	47 %
1992	40.01	65 %	62 %	37.48	63 %	59 %
1993	40.09	72 %	69 %	37.27	70 %	67 %
1994	40.35	74 %	71 %	37.66	72 %	69 %
1995	45.70	71 %	68 %	42.59	69 %	65 %
1996	85.55	67 %	65 %	81.60	65 %	63 %
1997	92.91	71 %	69 %	89.25	70 %	68 %
1998	35.53	97 %	89 %	31.77	97 %	88 %
1999	76.41	70 %	70 %	72.58	68 %	68 %
2000	238.97	67 %	66 %	235.80	67 %	66 %
2001	218.48	72 %	70 %	214.64	72 %	69 %
2002	175.09	72 %	69 %	171.63	72 %	69 %
2003	184.19	72 %	69 %	180.67	71 %	68 %
2004	248.73	68 %	66 %	244.93	67 %	65 %
2005	341.07	67 %	64 %	337.50	66 %	64 %
2006	416.39	68 %	64 %	410.68	67 %	64 %
2007	372.43	66 %	63 %	367.79	66 %	62 %
2008	496.60	67 %	64 %	491.07	67 %	64 %
2009	284.82	75 %	69 %	281.09	74 %	69 %
2010	324.38	71 %	67 %	320.83	71 %	67 %
2011	434.53	67 %	64 %	430.79	66 %	63 %
2012	456.88	70 %	67 %	452.84	69 %	66 %
2013	416.08	65 %	61 %	411.15	64 %	61 %
2014	346.37	71 %	64 %	340.26	71 %	64 %
2015	220.89	76 %	69 %	214.41	75 %	68 %
2016	131.73	90 %	81 %	125.22	89 %	80 %
2017	245.71	66 %	63 %	239.58	65 %	62 %
2018	364.40	64 %	60 %	357.43	64 %	60 %
2019	234.82	87 %	79 %	227.94	87 %	78 %
2020	91.56	47 %	30 %	84.54	42 %	25 %
2021	601.81	67 %	65 %	595.68	67 %	65 %
Summary statistics (A) [1]						

Year	Total resource rent (With specific taxes)	Government share (With specific taxes, Including Equinor dividend) Definition (I)	Government share (With specific taxes, Excluding Equinor dividend) Definition (II)	Total resource rent (Without specific taxes)	Government share (Without specific taxes, Including Equinor dividend) Definition (III)	Government share (Without specific taxes, Excluding Equinor dividend) Definition (IV)
Median		66 %	62 %		65 %	61 %
Mean		52 %	49 %		51 %	48 %
Maximum		97 %	89 %		97 %	88 %
Minimum		-31 %	-31 %		-31 %	-31 %
SD [2]		29 %	27 %		29 %	27 %
Summary statistics (B) [3]						
Median		67 %	64 %		66 %	63 %
Mean		59 %	56 %		58 %	55 %
Maximum		97 %	89 %		97 %	88 %
Minimum		18 %	18 %		15 %	15 %
SD [2]		18 %	17 %		18 %	17 %
Summary statistics (C) [4]						
Median		67 %	64 %		66 %	63 %
Mean		60 %	57 %		59 %	56 %
Maximum		97 %	89 %		97 %	88 %
Minimum		26 %	26 %		25 %	25 %
SD [2]		17 %	16 %		17 %	16 %

Source: Author's own calculation based on data from Statistics Norway
Notes:

1. Summary statistics A are calculated with all estimates included.
2. SD stands for 'Standard Deviation'.
3. Summary statistics B are calculated with five estimates (in 1970, 1971, 1972, 1973, and 1974) being excluded, given that the calculated annual total resource rent in each year is negative.
4. Summary statistics C are calculated with six estimates (in 1970, 1971, 1972, 1973, 1974, and 1988) being excluded, if all the six estimates are regarded as outliers.

Table A3. Correlation coefficients between total resource rent and resource rent accruing to government

Estimated resource rent	Resource rent to Government Definition (I)	Definition (II)	Definition (III)	Definition (IV)
Using 4% as rate of return, with specific taxes	0.995	0.996	-	-
Using 4% as rate of return, without specific taxes	-	-	0.995	0.996

Source: Author's own calculation based on data from Statistics Norway.
Notes: '-' stands for 'Not defined'.

Table A4. Ratio of the government revenue from petroleum activities to total resource rent, 1970-2021

Year	Ratio to total resource rent estimated by using 4% as rate of return: With specific taxes	Without specific taxes
1970	0 %	0 %
1971	0 %	0 %
1972	-29 %	-29 %
1973	-26 %	-26 %
1974	-31 %	-31 %
1975	70 %	70 %
1976	104 %	107 %
1977	110 %	112 %
1978	74 %	75 %
1979	66 %	66 %
1980	69 %	70 %
1981	67 %	67 %
1982	70 %	70 %
1983	68 %	68 %
1984	66 %	67 %
1985	77 %	77 %
1986	81 %	82 %
1987	65 %	66 %
1988	82 %	84 %

	Ratio to total resource rent estimated by using 4% as rate of return	
Year	With specific taxes	Without specific taxes
1989	70 %	71 %
1990	77 %	77 %
1991	80 %	82 %
1992	82 %	88 %
1993	88 %	95 %
1994	93 %	99 %
1995	90 %	97 %
1996	83 %	87 %
1997	85 %	88 %
1998	111 %	125 %
1999	84 %	89 %
2000	82 %	83 %
2001	90 %	91 %
2002	92 %	94 %
2003	92 %	94 %
2004	88 %	89 %
2005	87 %	88 %
2006	87 %	88 %
2007	84 %	85 %
2008	85 %	86 %
2009	92 %	94 %
2010	90 %	91 %
2011	85 %	86 %
2012	87 %	88 %
2013	80 %	81 %
2014	84 %	85 %
2015	84 %	86 %
2016	94 %	99 %
2017	73 %	75 %
2018	77 %	78 %
2019	102 %	105 %
2020	65 %	71 %
2021	83 %	84 %
	Summary statistics (A) [1]	
Median	83 %	85 %
Mean	73 %	75 %
Maximum	111 %	125 %
Minimum	-31 %	-31 %
SD [2]	32 %	33 %
	Summary statistics (B) [3]	
Median	84 %	86 %
Mean	83 %	85 %
Maximum	111 %	125 %
Minimum	65 %	66 %
SD [2]	11 %	13 %
	Summary statistics (C) 4	
Median	84 %	86 %
Mean	83 %	85 %
Maximum	111 %	125 %
Minimum	65 %	66 %
SD [2]	11 %	13 %

Source: Author's own calculation based on data from Statistics Norway

Notes:

1. Summary statistics A are calculated with all estimates included.
2. SD stands for 'Standard Deviation'.
3. Summary statistics B are calculated with five estimates (in 1970, 1971, 1972, 1973, and 1974) being excluded, given that the calculated annual total resource rent in each year is negative.
4. Summary statistics C are calculated with six estimates (in 1970, 1971, 1972, 1973, 1974, and 1988) being excluded, if all the six estimates are regarded as outliers.

Table A5. Realised government cash flow from petroleum activities in Norway, 1970-2021 (current prices, NOK billion)

Year	Ordinary taxes (1)	Special taxes (2)	Environmental taxes (3)	Area fees (4)	Royalties (5)	Net cash flow from SDFI (6)	Equinor dividend (7)	Net government cash flow (8) = (1) + (2) + (3) + (4) + (5) + (6) + (7)
1970	-	-	-	-	-	-	-	-
1971	-	-	-	-	-	-	-	-
1972	-	-	-	-	0.04	-	-	0.04
1973	-	-	-	-	0.07	-	-	0.07
1974	-	-	-	-	0.12	-	-	0.12
1975	-	-	-	-	0.21	-	-	0.21
1976	1.14	0.00	-	0.10	0.71	-	-	1.96
1977	1.69	0.73	-	0.06	0.65	-	-	3.12
1978	1.83	0.73	-	0.05	1.21	-	-	3.82
1979	3.40	1.49	-	0.05	1.61	-	-	6.55
1980	9.91	4.96	-	0.06	3.64	-	-	18.57
1981	13.80	8.06	-	0.07	5.31	-	-	27.24
1982	15.04	9.01	-	0.08	5.76	-	0.37	30.25
1983	14.23	8.87	-	0.08	7.66	-	0.35	31.19
1984	18.33	11.08	-	0.08	9.72	-	0.80	40.02
1985	21.81	13.01	-	0.22	11.63	-8.34	0.72	39.04
1986	17.31	10.00	-	0.20	8.17	-11.96	1.25	24.96
1987	7.14	3.18	-	0.24	7.52	-10.71	0.89	8.26
1988	5.13	1.07	-	0.18	5.48	-9.13	0.00	2.73
1989	4.83	1.55	-	0.22	7.29	0.76	1.48	16.12
1990	12.37	4.96	-	0.26	8.47	7.34	0.80	34.20
1991	15.02	6.74	0.81	0.58	8.94	5.88	1.50	39.47
1992	7.56	7.27	1.92	0.62	8.13	3.62	1.40	30.51
1993	6.41	9.53	2.27	0.55	7.85	0.16	1.25	28.02
1994	6.24	8.97	2.56	0.14	6.60	0.00	1.08	25.58
1995	7.85	10.79	2.56	0.55	5.88	9.26	1.61	38.51
1996	9.94	12.89	2.79	1.16	6.30	34.96	1.85	69.89
1997	15.49	19.53	3.04	0.62	6.22	40.31	1.60	86.81
1998	9.09	11.00	3.23	0.53	3.76	14.50	2.94	45.04
1999	5.54	6.15	3.26	0.56	3.22	25.76	0.14	44.63
2000	21.92	32.90	3.05	0.12	3.46	98.22	1.70	161.37
2001	41.46	64.32	2.86	0.98	2.48	125.38	5.75	243.24
2002	32.51	52.41	3.01	0.45	1.32	74.49	5.05	169.23
2003	36.82	60.28	3.06	0.46	0.77	67.15	5.13	173.66
2004	43.18	70.44	3.31	0.50	0.72	80.04	5.22	203.41
2005	61.59	103.29	3.35	0.22	0.36	98.59	8.14	275.54
2006	78.02	133.49	3.41	2.31	0.04	125.52	12.59	355.38
2007	70.28	116.23	3.88	0.76	-	111.23	14.01	316.39
2008	88.80	150.84	3.68	1.84	-	153.76	16.94	415.87
2009	61.50	103.73	2.26	1.47	-	95.34	15.49	279.79
2010	58.83	96.78	2.19	1.37	-	103.97	12.82	275.96
2011	78.24	127.69	2.23	1.52	-	127.77	13.35	350.80
2012	85.80	142.87	2.26	1.78	-	148.89	13.89	395.48
2013	76.12	125.39	3.23	1.70	-	124.29	14.42	345.15
2014	64.21	105.84	4.58	1.54	-	112.86	22.65	311.67
2015	39.48	64.20	4.93	1.55	-	92.72	15.38	218.26
2016	16.03	25.06	5.11	1.40	-	66.46	10.72	124.78
2017	23.69	41.36	5.19	0.94	-	88.27	8.40	167.85
2018	38.54	71.77	5.19	1.78	-	118.69	14.98	250.96
2019	43.01	90.49	5.37	1.51	-	96.48	20.06	256.91
2020	16.73	11.66	5.60	1.42	-	56.39	15.03	106.83
2021	51.98	33.73	5.20	0.94	-	185.17	10.49	287.51

Source: Statistics Norway

Notes: '-' stands for 'Not available' and is treated as nil in computation in this paper. 'Ordinary taxes' and 'Special taxes' are calculated on cash payment basis.

Appendix B: A numerical example in a time-series situation

Table B1. Assumptions about the extractor

	Year 1	Year 2	Year 3
1. Output	100	100	100
2. Compensation of employees	35	35	35
3. Consumption of fixed capital	20	20	20
4. Resource rent (= 1 - 2 - 3)	45	45	45
5. Rents paid to government	36	15	39
6. Current taxes on income paid to government	9	30	6
7. Stock of fixed assets at the beginning of year	200	180	160
8. Stock of fixed assets at the end of year	180	160	140
9. Cash flow (= 1 - 2- 5 - 6)	20	20	20

Table B2. Assumptions about the legal owner (i.e., government)

	Year 1	Year 2	Year 3
1. Rents received from extractor	36	15	39
2. Current taxes on income received from extractor	9	30	6
3. Depletion of natural resources	45	45	45
4. Stock of natural resources at the beginning of year	750	735	720
5. Other changes in volume	15	15	15
6. Revaluations	15	15	15
7. Stock of natural resources at the end of year	735	720	705
8. Cash flow (= 1 + 2)	45	45	45

Notes:
The return on either fixed assets or natural resources is set equal to zero.
Annual resource rent derived from extracting activities is assumed to be constant (45 units), while its distribution between the government and the extractor varies across years.
Over the three years, the government appropriates 2/3 (30 units = (36 + 15 + 39)/3), while the extractor appropriates 1/3 (15 units = (9 + 30 + 6)/3) of the resource rent on average.
The sum of 'Current taxes on income paid to government' and 'Rents paid to government' is assumed to be equal to the resource rent generated in each year (45 units).[29]
Both 'Other changes in volume' and 'Revaluations' are assumed to be constant (15 units) over the three years. They will be allocated to the government and the extractor by using the same 'distribution key', i.e., 2/3 to the government and 1/3 to the extractor.

In the elaboration of the recommended recordings below, both the accounts of the extractor and those of the legal owner (i.e., government) are shown consecutively for Year 1, Year 2, and Year 3. The 'distribution key' (i.e., 2/3 to government and 1/3 to the extractor) is used to split the economic ownership of natural resources between the government and the extractor only in Year 1 when production is assumed to start, and to split 'Other changes in volume' and 'Revaluations' in each year. The actual distribution of resource rent in each year, as shown in Table C1 and Table C2, is suggested not to be changed, which significantly simplifies the recording of natural resources in the SNA by following the split-asset approach in a time series situation. In addition, such a recording practice ensures that the consistency with the GFS is maintained.

[29] This assumption is made so that the hypothetical situation is similar to a case where the sum of 'Ordinary taxes' and the resource rent accruing to the government is about 100% of the total resource rent in the long run.

Year 1: Accounts for the extractor

Production and generation of income account

Compensation of employees	35	Output	100
Consumption of fixed capital	20		
Depletion of natural resources	45		
Net operating surplus	0		

Distribution of income account

Rent on natural resources	36	Net operating surplus	0
Depletion borne by government	-36		
Current taxes on income	9		
Net saving	-9		

Capital account

Acquisition of assets	250	Net saving	-9
Consumption of fixed capital	-20	Net capital transfers received	250
Depletion of natural resources	-9		
Net lending/borrowing	20	Changes in NW due to saving and CT	241

Financial account

Cash	20	Net lending/borrowing	20

Other changes in the volume of assets account

Other changes in volume	5	Changes in NW due to other changes in assets	5

Revaluation account

Revaluations	5	Changes in NW due to revaluation	5

Balance sheet

Cash	0	20	Net worth	200	451
Fixed capital	200	180			
Natural resources		251			
Total	200	451	Total	200	451

Year 1: Accounts for the government

Production and generation of income account

Compensation of employees	0	Output	0
Consumption of fixed capital	0		
Net operating surplus	0		

Distribution of income account

		Net operating surplus	0
		Rent on natural resources	36
		Depletion borne by government	-36
		Current taxes on income	9
Net saving	9		

Capital account

Acquisition of assets	-250	Net saving	9
Consumption of fixed capital	0	Net capital transfers received	-250
Depletion of natural resources	-36		
Net lending/borrowing	45	Changes in NW due to saving and CT	-241

Financial account

Cash	45	Net lending/borrowing	45

Other changes in the volume of assets account

Other changes in volume	10	Changes in NW due to other changes in assets	10

Revaluation account

Revaluations	10	Changes in NW due to revaluation	10

Balance sheet

Cash	0	45	Net worth	750	529
Fixed capital	0	0			
Natural resources	750	484			
Total	750	529	Total	750	529

Year 2: Accounts for the extractor

Production and generation of income account

Compensation of employees	35	Output	100
Consumption of fixed capital	20		
Depletion of natural resources	45		
Net operating surplus	0		

Distribution of income account

Rent on natural resources	15	Net operating surplus	0
Depletion borne by government	-15		
Current taxes on income	30		
Net saving	-30		

Capital account

Acquisition of assets	0	Net saving	-30
Consumption of fixed capital	-20	Net capital transfers received	0
Depletion of natural resources	-30		
Net lending/borrowing	20	Changes in NW due to saving and CT	-30

Financial account

Cash	20	Net lending/borrowing	20

Other changes in the volume of assets account

Other changes in volume	5	Changes in NW due to other changes in assets	5

Revaluation account

Revaluations	5	Changes in NW due to revaluation	5

Balance sheet

Cash	20	40	Net worth	451	431
Fixed capital	180	160			
Natural resources	251	231			
Total	451	431	Total	451	431

Year 2: Accounts for the government

Production and generation of income account

Compensation of employees	0	Output	0
Consumption of fixed capital	0		
Net operating surplus	0		

Distribution of income account

		Net operating surplus	0
		Rent on natural resources	15
		Depletion borne by government	-15
		Current taxes on income	30
Net saving	30		

Capital account

Acquisition of assets	0	Net saving	30
Consumption of fixed capital	0	Net capital transfers received	0
Depletion of natural resources	-15		
Net lending/borrowing	45	Changes in NW due to saving and CT	30

Financial account

Cash	45	Net lending/borrowing	45

Other changes in the volume of assets account

Other changes in volume	10	Changes in NW due to other changes in assets	10

Revaluation account

Revaluations	10	Changes in NW due to revaluation	10

Balance sheet

Cash	45	90	Net worth	529	579
Fixed capital	0	0			
Natural resources	484	489			
Total	529	579	Total	529	579

Year 3: Accounts for the extractor

Production and generation of income account

Compensation of employees	35	Output	100
Consumption of fixed capital	20		
Depletion of natural resources	45		
Net operating surplus	0		

Distribution of income account

Rent on natural resources	39	Net operating surplus	0
Depletion borne by government	-39		
Current taxes on income	6		
Net saving	-6		

Capital account

Acquisition of assets	0	Net saving	-6
Consumption of fixed capital	-20	Net capital transfers received	0
Depletion of natural resources	-6		
Net lending/borrowing	20	Changes in NW due to saving and CT	-6

Financial account

Cash	20	Net lending/borrowing	20

Other changes in the volume of assets account

Other changes in volume	5	Changes in NW due to other changes in assets	5

Revaluation account

Revaluations	5	Changes in NW due to revaluation	5

Balance sheet

Cash	40	60	Net worth	431	435
Fixed capital	160	140			
Natural resources	231	235			
Total	431	435	Total	431	435

Year 3: Accounts for the government

Production and generation of income account

Compensation of employees	0	Output	0
Consumption of fixed capital	0		
Net operating surplus	0		

Distribution of income account

		Net operating surplus	0
		Rent on natural resources	39
		Depletion borne by government	-39
		Current taxes on income	6
Net saving	6		

Capital account

Acquisition of assets	0	Net saving	6
Consumption of fixed capital	0	Net capital transfers received	0
Depletion of natural resources	-39		
Net lending/borrowing	45	Changes in NW due to saving and CT	6

Financial account

Cash	45	Net lending/borrowing	45

Other changes in the volume of assets account

Other changes in volume	10	Changes in NW due to other changes in assets	10

Revaluation account

Revaluations	10	Changes in NW due to revaluation	10

Balance sheet

Cash	90	135	Net worth	579	605
Fixed capital	0	0			
Natural resources	489	470			
Total	579	605	Total	579	605