# Incorporating depletion as production cost into the national accounts

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***Disclaimer: The views expressed in this experimental work are the author's own opinions. They are not the official views of Statistics Norway and should not be interpreted as such in any sense.***

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# Preface

This paper presents an accounting framework in which the change of the natural resources (e.g., petroleum resources) between the opening and the closing accounting period, either in physical quantity or in monetary value terms, is decomposed into various components, including depletion, other changes, and revaluation. By using actual Norwegian data, this paper illustrates how to incorporate depletion as a cost of production into the sequence of the institutional sector accounts in the SNA. The impact due to the incorporation on some headline indicators is also shown.

As an early experimental exercise, the outcomes, including knowledges gained and lessons learned, can well be exploited to facilitate the implementation of the new 2025 SNA as international standards for countries worldwide, and the preparation of the subsequently revised ESA as regional standards for EU member states and other European countries.

The author wishes to make it clear that the views expressed in this paper are his own opinions. They are not the official views of Statistics Norway and should not be interpreted as such in any way.

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# Abstract

This paper presents an accounting framework in which the change of the natural resources (e.g., petroleum resources) *in situ* between the opening and the closing accounting period, either in physical or in value terms, is decomposed into various components, including depletion, other changes, and revaluation. It is fully integrated and consistent with the accounting framework as presented in a recent paper series on measuring the asset value of petroleum resources in Norway (Liu and Midttun, 2024a, 2024b, 2025).

In addition, the presented accounting framework is in line with the general capital measurement methodology as described in *Measuring Capital OECD Manuel* (Schreyer, 2009) and in Liu (2024). More importantly, the formulation as set up in this paper has removed some imprecisions as presented in the *System of Environmental-Economic Accounting 2012 – Central Framework* (United Nations *et al*., 2014a).

By using the estimated resource rent and asset value from Liu and Midttun (2025), the annual asset account of Norwegian petroleum resources and the *ex-post* depletion-adjusted resource rent or the net income over the period 1970-2021 are reported in this paper.

Using the Norwegian 2021 data, this paper illustrates how to incorporate depletion as a cost of production into the sequence of the institutional sector accounts by following the suggested split-asset approach. Finally, by using the Norwegian time series data over the period 1978-2021, the paper demonstrates the impact on some headline indictors due to the inclusion of depletion as a cost of production into the SNA.

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# 1. Introduction

Petroleum resources on the Norwegian continental shelf play a vitally important role in the Norwegian economy and are valuable for the financing of a well-functioning welfare state in Norway. For instance, the petroleum extraction industry [2] contributes, either directly or indirectly, but substantially to the entire Norwegian economy in terms of employment created, value added generated, investments conducted, export delivered, and government revenues rendered.[3]

However, petroleum resources *in situ* have not yet been registered as non-financial asset in the Norwegian National Accounts (NNA). Following the currently-applied international statistical standards, namely, the *System of National Accounts 2008* (hereafter 2008 SNA) (United Nations *et al*., 2009) and the *European System of Accounts* (hereafter ESA 2010) (Eurostat, 2013), according to which the NNA is compiled [4], petroleum resources as part of 'Mineral and energy reserves (AN.212)' should be recorded under non-produced non-financial asset (AN.2) in the balance sheet account.

In Norway, accounting for natural resources in general and petroleum resources in particular has a long history ever since 1970s, and measuring the asset value of petroleum resources as part of Norwegian national wealth has been, though not regularly, carried out in various research projects. The detailed methodologies that have been applied in these studies, however, vary to some extent.[5]

In a recent paper series (Liu and Midttun, 2024a, 2024b, 2025), effort has been made trying to measure the asset value of Norwegian petroleum resources by using the internationally recommended net present value (NPV) method. One purpose of the paper series is to set up concrete implementation procedures from an accounting perspective and to harmonize as much as possible, among others, the choice of key parameters for the measurement, with the view that the estimated results can be compared both over time and across countries.

To include natural resources as capital stock in the balance sheet account, the associated flows should also be taken into consideration in an integrated and consistent way into the whole national accounting system. One of the flows associated to natural resources is depletion, the running down of natural resources beyond its regeneration level. For non-renewable resources such as the petroleum resources, depletion in terms of physical quantity is just the extraction or production.

However, it is crucial to know that depletion in its value terms is not equal to the resource rent, let alone to the sales value of the extracted petroleum products. In the 2008 SNA and the ESA 2010, a part of the total generated resource rent is recorded as 'rent' paid by the extractor to the government, and the sales value of the extracted petroleum products are recorded as output in the production account of the extractor.

In both the 2008 SNA and the ESA 2010, depletion is treated as 'other changes', rather than 'transactions', implying that depletion does not appear in the current accounts of the SNA (i.e., the production, and the generation, allocation, redistribution, and use of income accounts), neither in the capital account. It only appears in the 'other changes in assets account'. Clearly, an important link is missing between natural resources *in situ* as a concept of stock (capital) and extraction of natural resources as a concept of flow (capital services) in the current SNA.

[2] The petroleum extraction industry is coded as '23060' in the Norwegian National Accounts, and as '06.' in the SIC 2007, the Norwegian Standard Industrial Classification 2007, which is based on NACE Rev.2.
[3] See various statistics in the Norwegian National Accounts and Government Finance Statistics published by Statistics Norway at: https://www.ssb.no/en/statbank
[4] Under the European Economic Area (EEA) Agreement, it is obligatory for Norway, though not an EU member country, to compile the NNA according to the ESA 2010 and transmit the required statistics to Eurostat, the statistical office of the EU.
[5] For a reference list of these studies, please refer to Liu and Midttun (2025).

Furthermore, some frequently used headline indicators such as the net domestic product (NDP), net national income (NNI), etc, which are derived by deducting consumption of fixed capital from the corresponding gross measures (such as GDP and GNI) in the 2008 SNA or the ESA 2010 will send wrong signals about the status of economy, because they are not genuinely 'net' indicators in the sense that depletion, which should be considered parallelly as consumption of natural capital, has not been registered as production cost and thus 'netted' out from the gross measures.

As is well known, petroleum resources are not only valuable resources but also fossil fuels, the use of which in economic activities is bound to generate greenhouse gas emissions, leading to the conundrum of global warming. To address the pending global issue, and more importantly, to help achieve environmental as well as economic sustainability, a good accounting of petroleum resources, in terms of both monetary values and physical quantities, is indispensable.

To respond to the environmental and sustainability concern, another international statistical standard, i.e., the *System of Environmental-Economic Accounting 2012 – Central Framework* (hereafter SEEA-CF) (United Nations *et al*., 2014a) was issued out which provides more concrete suggestions as regards how to measure in an integrated and consistent way the asset value of natural resources and the associated flows such as depletion in both physical and value terms.

During the course of updating the SNA, extending the 2008 SNA to incorporate aspects of the SEEA-CF is suggested by the UN Task Team, as regards accounting for economic ownership and depletion of natural resources. It is recommended, among others, to record depletion as a cost of production, to apply the SNA principles of economic ownership to natural resources by using a split-asset approach, and to put greater emphasis on net indicators rather than their gross counterparts (van de Ven and de Haan, 2021), all being accepted in the latest 2025 SNA (United Nations *et al*., 2025).

The purpose of this paper is to set up an accounting framework, feasible for incorporating depletion as production cost into the national accounts, by using Norwegian data as an example. This accounting framework is integrated and consistent with that for measuring the asset value of petroleum resources by following the NPV method as presented in Liu and Midttun (2025) and is also in accordance with the theoretical framework for general capital measurement as recommended in Schreyer (2009) and Liu (2024).

The measuring practice as documented in this paper may also be regarded as an early experimental exercise since the 2025 SNA has been adopted by United Nations Statistical Commission as the international statistical standard (United Nations *et al*., 2025). The outcomes, including knowledges gained and lessons learned, can well be exploited to facilitate the implementation of the 2025 SNA as international standards for countries worldwide, and the preparation of the subsequently revised ESA as regional standards for EU member states and other European countries.

The rest of the paper is structured as follows. Section 2 provides an overview of the present treatment of depletion as recommended by the existing international statistical standards, such as the 2008 SNA and the SEEA-CF, as well as of the suggested treatment of depletion recommended by the 2025 SNA. In Section 3, an accounting framework is presented for decomposing asset change between the closing and the opening accounting period, in both physical and value terms, into various components including depletion. Within this framework, depletion can be measured in both physical and value terms in a more consistent and sensible way than presented in the current SEEA-CF. In this Section, the *ex-post* depletion-adjusted resource rent or the net income is also defined with the estimated results being presented. Using the Norwegian 2021 data as an example, Section 4 discusses how to include depletion as production cost into the sequence of the institutional sector accounts by following the suggestions by the 2025 SNA. In Section 5, the impact on some headline indicators due to the inclusion of depletion as production cost in the NNA over the period 1978-2021 are reported. Section 6 concludes the paper with remarks.

# 2. Present and suggested treatment of depletion

## 2.1. The concept of depletion

According to an online Cambridge Dictionary [6], the meaning of *depletion* in English is '*a reduction in something*'. While used in the international statistical standards, depletion often refers to a reduction of natural resources over time due to human activities. For example, depletion is regarded in the 2008 SNA as 'the reduction in the value of deposits of subsoil assets as a result of the physical removal and using up of assets' (United Nations *et al*., 2009).

In the SEEA-CF, depletion is defined as 'the decrease in the quantity of the stock of a natural resource over an accounting period that is due to the extraction of the natural resource by economic units occurring at a level greater than that of regeneration' (United Nations *et al*., 2014a). Compared with that in the 2008 SNA, this definition is of more precision and it explicitly includes renewable resources, implying that only that part beyond the regeneration level can be considered as depletion. In addition, this definition stresses the reduction of resources in physical quantities.

Related to depletion, there is another concept called degradation and is defined in the SEEA-CF as 'changes in the capacity of environmental assets to deliver a broad range of contributions known as ecosystem services' (United Nations *et al*., 2014a). As such, depletion constitutes a subset of degradation, because depletion refers only to one type of ecosystem services, namely, the provisioning services, while degradation is linked to not only provisioning but also other ecosystem services such as regulating and cultural services (United Nations *et al*., 2014b).

In the following of this paper, unless stated otherwise, depletion refers to the annual reduction, either in physical quantities or in monetary values, of mineral and energy resources, in particular, the petroleum resources on the Norwegian continental shelf due to annual production or extraction.

## 2.2. Depletion in the 2008 SNA

Although there exists a clear relationship between the depletion as a concept of flow and the natural resources *in situ* as a concept of stock, similar to that between the consumption of fixed capital and the stock of fixed capital, the way the consumption of fixed capital is recorded is different from that for the depletion in the 2008 SNA, even if the associated natural resources are within the asset boundary as defined in the current national accounts.

In the current international statistical standards, such as the 2008 SNA or the ESA 2010, depletion is treated not as 'transactions' but as 'other changes', and therefore, it is not recorded in the current accounts of the SNA and ESA, including the production, and the generation, allocation, redistribution, and use of income accounts. Neither is it recorded in the capital account but only in the other changes in the volume of assets account.

On the contrary, consumption of fixed capital is considered as intra-unit 'transactions' and is recorded in both the current and the capital accounts in the 2008 SNA and the ESA 2010. In addition, it is clearly stressed in the 2008 SNA that 'consumption of fixed capital does not, therefore, cover the depletion or degradation of natural assets such as land, mineral or other deposits, coal, oil, or natural gas, or contracts, leases and licences' (United Nations *et al*., 2009).

[6] https://dictionary.cambridge.org/

In the 2008 SNA or the ESA 2010, the net present value (NPV) method is recommended as the last resort for measuring the asset value of mineral and energy reserves in a general sense, with no detailed and concrete implementation procedures being offered. As for the valuation of depletion, the 2008 SNA alludes to market principles for assigning a value to depletion, but detailed suggestions are unfortunately not provided either.

## 2.3. Depletion in the SEEA-CF

In general, depletion is treated with more detail and precision in the SEEA-CF than in the 2008 SNA or the ESA 2010. In addition to stressing that depletion is related to the reduction of physical quantity of natural resources, the SEEA-CF extends the definition of depletion to include not only non-renewable resources but also renewable resources and distinguishes depletion from degradation with the former being considered as a specific form of the latter (United Nations *et al*., 2014a).

The SEEA-CF provides an accounting framework with detailed assumptions and mathematical underpinnings, demonstrating how to apply the NPV method to deriving the asset value of the stock of natural resources and associated flow measures of depletion, income, as well as revaluation in a coherent and consistent accounting context. Despite a few misconceptions,[7] the accounting framework provides concrete suggestions for the application of the NPV method in practice.

The SEEA-CF explicitly considers depletion as a production cost, paralleled to consumption of fixed capital. In addition, more precision is given about how to register depletion in the institutional sector accounts. 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 contrary, the SEEA-CF recommends recording depletion in the production and generation of income accounts of the extractor as deductions from value added and operating surplus. Moreover, it recommends allocating the cost of depletion in line with the appropriation of expected incomes by the legal owner and the extractor, 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*., 2014a).[8]

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.

## 2.4. Suggestions by the SNA update Task Team and the 2025 SNA

Building partly on the work by the SEEA-CF, the UN 2008 SNA update Task Team suggests incorporating the relevant aspects of the SEEA-CF into the next SNA. It is recommended by the Task Team to record depletion of natural resources as a cost of production, paralleled to consumption of fixed capital, in the next SNA and to extend the notion of depletion to non-cultivated biological

[7] More on this in subsection 3.2.
[8] See Table 5.10 in the SEEA-CF (United Nations *et al*., 2014a).

resources, instead of restricting it to mineral and energy resources, as is presently the case in the 2008 SNA.

The Task Team also recommends applying the SNA principles of economic ownership to natural resources. Instead of assigning ownership of natural resources by convention to the legal owner (i.e. the 2008 SNA recommendation), it is proposed, when circumstances warrant such a treatment, to apply a split-asset approach and assign economic ownership to relevant institutional sectors in line with the actual distribution of resource rents and the sharing of operational risks (van de Ven and de Haan, 2021).

In addition, it is recommended by the Task Team to put greater emphasis on net indicators, as opposed to the current emphasis on gross measures, with the purpose of not only correcting the most frequently used macro-economic aggregates for the consumption of fixed capital (depreciation), but also for the running down of non-renewable natural resources, and for the non-sustainable use of non-cultivated biological resources. Finally, in the Guidance Note written by the Task Team, some numerical examples are presented, trying to include the recording of the depletion in the sequence of the institutional sector accounts (van de Ven and de Haan, 2021).

In March 2025, the United Nations Statistical Commission at its 56$^{th}$ Session adopted the 2025 SNA as the latest international statistical standard for national accounts statistics, in which the recommendations given by the Task Team as mentioned above were accepted. Presently, Eurostat is working on updating the ESA 2010 towards a new ESA in the foreseeable future.

Although conceptually clear, knowledges have so far been limited as regards whether all the recommendations by the Task Team are feasible and how to implement them in practice. Given the complexity and the potential impact on the current national accounts, and to respond to concerns expressed by countries through a global consultation on a consolidated list of recommendations by the Advisory Expert Group (AEG) on national accounts for the update of the 2008 SNA (SNA 2008 Update Project Team, 2023), more testing work by countries are encouraged.

Based on the Norwegian data, a testing work recently carried out by Statistics Norway demonstrates the feasibility of applying the split-asset approach as suggested by the Task Team for petroleum resources in Norway (Liu, 2023). In the testing study, some fictitious numerical examples are also given for illustrating the implementation of the recommendations by the Task Team, including the incorporation of depletion in the sequence of the institutional sector accounts over several years.

In this paper, by means of a coherent and consistent accounting framework that will be formulated in the next Section, the actual Norwegian data will be applied for demonstrating how to implement the recommendations by the Task Team and the 2025 SNA in practice. The use of the actual data drawn from the Norwegian institutional sector accounts makes it possible to gauge the real impact due to the inclusion of depletion as production cost into the SNA.

# 3. Measuring depletion

## 3.1. Depletion in physical and value terms

By means of the net present value (NPV) method, the asset value of one specific type of natural resources can be estimated by the following equation:

(1) $$V^{tB} = \sum_{\tau=1}^{T^{tB}}[NR^{t+\tau-1}/(1+\delta_t)^{\tau}] = \sum_{\tau=1}^{T^{tB}}[UR_N^{t+\tau-1}X^{t+\tau-1}/(1+\delta_t)^{\tau}],$$

where $V^{tB}$ is the to-be-estimated asset value at the beginning of an accounting period, such as a year *t*, $T^{tB}$ is the expected number of remaining periods of extraction. Note that both $V^{tB}$ and $T^{tB}$ are indexed by the superscript containing the capital letter 'B', simply to indicate explicitly that the expectation is formed at the *Beginning* of the year *t* (see Liu, 2024; Liu and Midttun, 2024a, 2024b, 2025).

$NR^{t+\tau-1}$ ($\tau$ = 1, 2, ..., $T^{tB}$) is the expected future nominal resource rent and is the product of a nominal unit resource rent per physical quantity unit, $UR_N^{t+\tau-1}$, and a predicted future production or extraction in physical quantity, $X^{t+\tau-1}$. $\delta_t$ is a nominal discount rate valid over time period *t*.[9]

All the three variables $NR^{t+\tau-1}$, $UR_N^{t+\tau-1}$, and $X^{t+\tau-1}$ ($\tau$ = 1, 2, ..., $T^{tB}$) are *expected* ones for the future. For example, starting from the beginning of year *t*, the first-year production is $X^t$, the second-year production is $X^{t+1}$, and so on. After the production in the last year, $X^{t+T^{tB}-1}$, is completed, the natural resources in concern will be exhausted.

Apparently, if the natural resources in concern are non-renewable resources such as the petroleum resources which is the focus of this paper, $T^{tB}$ will not be infinitive, and production is equivalent to depletion in physical terms. On the other hand, if the natural resources in concern are renewable resources such as timber resources, $T^{tB}$ could be infinitive, so long as production is not beyond the regeneration level of the renewable resources, and only that part beyond the regeneration can be considered as depletion in physical terms.

Suppose that the physical quantity of the stock of the natural resources at the beginning of the year *t*, $S^{tB}$, is known,[10] then the price of the stock in terms of per physical quantity unit can be defined as:

(2) $$P^{tB} = V^{tB}/S^{tB}.$$

Recall that the first-year production $X^t$ is a production *expected* at the beginning of the year *t*. When moving one year forward, i.e., at the end of the year *t*, or the beginning of the year *t+1*, the actual production in year *t*, $X_t$ is known. To highlight the difference, the actual production $X_t$ is indexed by *t* as the *subscript* instead of the *superscript* as for the *expected* or *ex-ante* production $X^t$.

In addition to the actual production $X_t$, there may be other physical amount reductions occurring in the first-year (such as downward appraisal, catastrophic losses, etc.), denoted as $L_t$. Equally possible, there may be physical amount additions (such as discoveries, upward appraisal, etc.), denoted as $I_t$. At the end of the year *t*, or the beginning of the year *t+1*, all the three flows just mentioned are already known.

According to the natural law, the following accounting identity should always hold:

[9] The detailed implementation methodologies at the beginning of 2021 for estimating the asset value of Norwegian petroleum resources over the period 1970-2021 are presented in Liu and Midttun (2025).
[10] The physical asset accounts for petroleum resources in Norway are compiled and reported in Liu and Midttun (2024a).

(3) $$S^{t+1B} = S^{tB} + I_t - L_t - X_t.$$

Equation (3) states that the physical stock at the beginning of the year *t+1*, or the end of the year *t*, is equal to the physical stock at the beginning of the year *t* (or the end of the year *t-1*), plus additions ($I_t$), and minus depletion ($X_t$) and other reductions ($L_t$) that have occurred during the year *t*.

Note that the actual production $X_t$ in equation (3) can be replaced by a more general definition of depletion $D_t$ which is suitable for both renewable and non-renewable resources, and is defined as:

(4) $$D_t = X_t - G_t,$$

where $G_t$ is the natural growth of the renewable resources in physical amount in year *t*, with the assumption that the natural growth is a sustainable yield, i.e., the largest amount that can be harvested for a given population size without reducing the long-term viability of the renewable resources (see United Nations *et al*., 2014a).

Clearly, for non-renewable resources such as the petroleum resources, $G_t = 0$, and the depletion $D_t$ is equivalent to the production $X_t$. Because this paper focuses on the petroleum resources on the Norwegian continental shelf, unless stated otherwise, equation (3) will be used in the following for further analysis. However, to extend the analysis to cover both non-renewable and renewable resources is obviously straightforward.

Using the same reasoning behind equation (1), the asset value at the beginning of the year *t+1* or the end of the year *t*, $V^{t+1B}$ can be estimated, then the difference between $V^{t+1B}$ and $V^{tB}$ can be written as follows:

(5) $$V^{t+1B} - V^{tB} = P^{t+1B}S^{t+1B} - P^{tB}S^{tB},$$

where the use is also made of equation (2).

There are two ways to decomposing the difference between $V^{t+1B}$ and $V^{tB}$, and the first way is:

(6) $$V^{t+1B} - V^{tB} = P^{t+1B}S^{t+1B} - P^{tB}S^{tB} = P^{tB}S^{t+1B} - P^{tB}S^{tB} + P^{t+1B}S^{t+1B} - P^{tB}S^{t+1B}$$

$$= P^{tB}(S^{t+1B} - S^{tB}) + (P^{t+1B} - P^{tB})S^{t+1B},$$

and the second way is:

(7) $$V^{t+1B} - V^{tB} = P^{t+1B}S^{t+1B} - P^{tB}S^{tB} = P^{t+1B}S^{t+1B} - P^{t+1B}S^{tB} + P^{t+1B}S^{tB} - P^{tB}S^{tB}$$

$$= P^{t+1B}(S^{t+1B} - S^{tB}) + (P^{t+1B} - P^{tB})S^{tB}.$$

Since there is no *a priori* theory for discriminating either one of the two equations (6) and (7), a simple average of them will be taken. Then inserting equation (3) into the average yields:

(8) $$V^{t+1B} - V^{tB} = [(P^{tB} + P^{t+1B})/2](S^{t+1B} - S^{tB}) + (P^{t+1B} - P^{tB})[(S^{tB} + S^{t+1B})/2]$$

$$= [(P^{tB} + P^{t+1B})/2](I_t - L_t - X_t) + (P^{t+1B} - P^{tB})[(S^{tB} + S^{t+1B})/2].$$

As shown in equation (8), the difference of the estimated asset value between the two consecutive years, *t+1* and t, can be decomposed into a number of flow components, which give rise to all the entries between the opening and the closing of the accounting year *t* in an asset account for natural resources such as the petroleum resources:

(9) Opening stock (the asset value at the beginning of year *t*): $V^{tB} = P^{tB}S^{tB}$

+ Additions (e.g., discoveries): $[(P^{tB} + P^{t+1B})/2]I_t$

- Depletion: $[(P^{tB} + P^{t+1B})/2]X_t$

- Other reductions (e.g., catastrophic losses): $[(P^{tB} + P^{t+1B})/2]L_t$

+ Revaluation due to price changes: $(P^{t+1B} - P^{tB})[(S^{tB} + S^{t+1B})/2]$

= Closing stock (the asset value at the end of year *t*): $V^{t+1B} = P^{t+1B}S^{t+1B}$

## 3.2. Depletion in *ex-ante* and *ex-post* terms

It is worth mentioning that the formulation as described in the above subsection 3.1 in this paper differs from that as presented in the SEEA-CF. Apart from the differences between the notations and the associated definitions applied, the essential difference is about the treatment of depletion in *ex-ante* and *ex-post* terms.

Using the notations as employed in this paper, the SEEA-CF defines the *ex-ante* or *expected* depletion or extraction in the year *t* as (see Paragraph A5.21 in the SEEA-CF (United Nations *et al*., 2014a)):

(10) $$S^{tB} - S^{tB}_{t+1} = X^t,$$

where $S^{tB}_{t+1}$ is the *expected* or *ex-ante* physical quantity of the stock at the end of the year *t* (or the beginning of the year *t+1*, denoted by the subscript *t+1*), with the expectation being made at the beginning of the year *t*, i.e., based on the information set formed at the beginning of the year *t*. On the contrary, $S^{tB}$ is the *ex-post* (or known) physical quantity of the stock at the beginning of the year *t* (or the end of the year *t-1*).

Further, the SEEA-CF defines the difference between the *ex-post* and the *ex-ante* physical quantity of the stock as (see Paragraph A5.23 in the SEEA-CF (United Nations *et al*., 2014a)):

(11) $$S^{t+1B} - S^{tB}_{t+1} = I_t - L_t,$$

where $S^{t+1B}$ is the *ex-post* (or known) physical quantity of the stock at the beginning of the year *t+1* (or the end of the year *t*).

Subtracting equation (10) from equation (11) yields:

(12) $$S^{t+1B} = S^{tB} + I_t - L_t - X^t,$$

which is equivalent to equation (10) in Paragraph A5.30 of the SEEA-CF (United Nations *et al*., 2014a) and is different from equation (3) in this paper. As mentioned above, the essential difference lies in that in equation (3) which is our formulation in this paper, an *ex-post* or *actually realized* depletion $X_t$ is applied, while in equation (12) which is the current SEEA-CF formulation, an *ex-ante* or *expected* depletion $X^t$ is used instead.

In our opinion, the SEEA-CF formulation comes with some degree of imprecision. Because the difference between the *ex-post* and the *ex-ante* physical quantity of the stock as shown by the left hand side of equation (11), $S^{t+1B} - S^{tB}_{t+1}$, not only includes discoveries $I_t$ and catastrophic losses $L_t$, which are unforeseen at the beginning of the year *t* but become known at the end of the year *t*, but also, it should include a correction to the *ex-ante* or *expected* depletion $X^t$ which is expected at the

beginning of the year *t* but may differ from the *ex-post* or *actually realized depletion* $X_t$, the latter becomes known at the end of the year *t* or the beginning of the year *t+1*.

The correction to the *ex-ante* or *expected* depletion, $\Delta X(t)$ can be defined as the difference between the *ex-post* and the *ex-ante* depletion in the following:

(13) $$\Delta X(t) = X_t - X^t.$$

Then the corrected equation (11) should be:

(14) $$S^{t+1B} - S^{tB}_{t+1} = I_t - L_t - \Delta X(t).$$

Finally, deducting equation (10) from equation (14) and using equation (13) gives rise to:

(15) $$S^{t+1B} = S^{tB} + I_t - L_t - X_t,$$

which is exactly the same as equation (3) as described in subsection 3.1 in this paper.

Note that the *ex-ante* or *expected* depletion or extraction, denoted as $S_t$ in the SEEA-CF, is applied throughout the Annex A5.1 of the SEEA-CF, even in cases where the *ex-post* or *actually realized* depletion should have been applied instead (see United Nations *et al*., 2014a).

## 3.3. Asset account for petroleum resources

Following the methodology as just described in subsection 3.1, the asset account for Norwegian petroleum resources both in physical quantity (by using equation (3)) and in monetary value (by using equation (9)) over the period 1970-2021 is presented in Table 3.1.

Note that due to data limitations, 'Other changes' as shown in the sixth column in physical quantity ($Sm^3$ o. e. million) and in the seventh column in monetary value (in current prices, NOK million) in Table 3.1 combines both 'Additions' and 'Other reductions' as defined in equation (9), and therefore, presents the net changes except for 'Depletion' during each accounting year over the observed period 1970-2021.

The basic data on physical quantity, in both flows and stocks, are drawn from the annual petroleum resource accounts published by the Norwegian Offshore Directorate (formerly the Norwegian Petroleum Directorate) at its website.[11] For the years before 1992, except for the production (depletion), neither 'Other changes' nor stock in physical quantity is available. Therefore, by simply assuming 'Other changes' being zero, the corresponding stock in physical quantity for these years (i.e., the period 1970-1991) can be derived backward to 1970 from the relevant information known for 1992.

The asset values as reported in the third column for 'Opening stock' and in the last column for 'Closing stock' in Table 3.1 are obtained from the estimated results in Liu and Midttun (2025). They are calculated by using an estimated annual nominal rate of return to produced capital employed by the Norwegian petroleum extraction industry, and an annual real discount rate of 4%.

The estimated asset values by using 4% as annual real rate of return and 4% as annual real discount rate are presented in Table A1 in Appendix A, in which the corresponding asset account for Norwegian petroleum resources is also reported. Likewise, the estimated asset values by using 7%

[11] https://www.npd.no/en/facts/resource-accounts-and-analysis/

as annual real rate of return and 7% as annual real discount rate, and the corresponding asset account for Norwegian petroleum resources are presented in Table A2 in Appendix A.

**Table 3.1 Asset account for Norwegian petroleum resources in both quantity ($Sm^3$ o. e. million) and value (current prices, NOK million), 1970-2021**

| | Opening stock | | - Depletion | | + Other changes | | + Revaluation | = Closing stock | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Quantity | Value | Quantity | Value | Quantity | Value | Value | Quantity | Value |
| 1970 | 9041 | 303741 | 0 | 0 | 0 | 0 | 35361 | 9041 | 339102 |
| 1971 | 9041 | 339102 | 0 | 14 | 0 | 0 | 39224 | 9040 | 378311 |
| 1972 | 9040 | 378311 | 2 | 86 | 0 | 0 | 46609 | 9038 | 424835 |
| 1973 | 9038 | 424835 | 2 | 95 | 0 | 0 | 64454 | 9036 | 489194 |
| 1974 | 9036 | 489194 | 2 | 118 | 0 | 0 | 79095 | 9034 | 568171 |
| 1975 | 9034 | 568171 | 11 | 739 | 0 | 0 | 77578 | 9023 | 645010 |
| 1976 | 9023 | 645010 | 16 | 1236 | 0 | 0 | 84254 | 9007 | 728029 |
| 1977 | 9007 | 728029 | 19 | 1663 | 0 | 0 | 90958 | 8988 | 817324 |
| 1978 | 8988 | 817324 | 35 | 3343 | 0 | 0 | 68722 | 8952 | 882703 |
| 1979 | 8952 | 882703 | 45 | 4695 | 0 | 0 | 112404 | 8908 | 990412 |
| 1980 | 8908 | 990412 | 56 | 6699 | 0 | 0 | 136808 | 8851 | 1120521 |
| 1981 | 8851 | 1120521 | 55 | 7399 | 0 | 0 | 140728 | 8796 | 1253850 |
| 1982 | 8796 | 1253850 | 55 | 8215 | 0 | 0 | 123366 | 8741 | 1369001 |
| 1983 | 8741 | 1369001 | 62 | 10000 | 0 | 0 | 102461 | 8680 | 1461462 |
| 1984 | 8680 | 1461462 | 69 | 12078 | 0 | 0 | 97156 | 8611 | 1546540 |
| 1985 | 8611 | 1546540 | 73 | 13708 | 0 | 0 | 126146 | 8537 | 1658977 |
| 1986 | 8537 | 1658977 | 79 | 16306 | 0 | 0 | 212902 | 8458 | 1855573 |
| 1987 | 8458 | 1855573 | 90 | 20657 | 0 | 0 | 190903 | 8369 | 2025819 |
| 1988 | 8369 | 2025819 | 98 | 24972 | 0 | 0 | 203452 | 8271 | 2204299 |
| 1989 | 8271 | 2204299 | 120 | 33387 | 0 | 0 | 191841 | 8151 | 2362753 |
| 1990 | 8151 | 2362753 | 126 | 37825 | 0 | 0 | 182660 | 8025 | 2507587 |
| 1991 | 8025 | 2507587 | 139 | 44882 | 0 | 0 | 164653 | 7886 | 2627359 |
| 1992 | 7886 | 2627359 | 156 | 50765 | 925 | 301800 | -111229 | 8655 | 2767164 |
| 1993 | 8655 | 2767164 | 163 | 53180 | 236 | 76939 | 100092 | 8728 | 2891016 |
| 1994 | 8728 | 2891016 | 184 | 61339 | 567 | 189241 | 48378 | 9111 | 3067296 |
| 1995 | 9111 | 3067296 | 197 | 67935 | 222 | 76558 | 15039 | 9136 | 3226309 |
| 1996 | 9136 | 3226309 | 226 | 76705 | 1482 | 502507 | -275899 | 10392 | 3376211 |
| 1997 | 10392 | 3376211 | 234 | 77530 | 352 | 116672 | 142844 | 10510 | 3558199 |
| 1998 | 10510 | 3558199 | 228 | 79026 | 404 | 139964 | 162894 | 10686 | 3782031 |
| 1999 | 10686 | 3782031 | 230 | 84593 | 57 | 20934 | 297792 | 10513 | 4016163 |
| 2000 | 10513 | 4016163 | 241 | 91870 | 521 | 198498 | -25801 | 10793 | 4096990 |
| 2001 | 10793 | 4096990 | 252 | 97242 | 33 | 12798 | 146730 | 10574 | 4159276 |
| 2002 | 10574 | 4159276 | 258 | 105247 | -90 | -36562 | 293869 | 10226 | 4311336 |
| 2003 | 10226 | 4311336 | 262 | 118236 | -826 | -373150 | 585764 | 9139 | 4405715 |
| 2004 | 9139 | 4405715 | 264 | 129953 | -35 | -17089 | 176390 | 8840 | 4435062 |
| 2005 | 8840 | 4435062 | 258 | 129618 | 183 | 91912 | 26947 | 8765 | 4424303 |
| 2006 | 8765 | 4424303 | 249 | 125772 | 52 | 26285 | 1052 | 8568 | 4325868 |
| 2007 | 8568 | 4325868 | 238 | 121543 | 87 | 44284 | 114919 | 8417 | 4363527 |
| 2008 | 8417 | 4363527 | 243 | 124093 | 202 | 103154 | -129407 | 8376 | 4213181 |
| 2009 | 8376 | 4213181 | 240 | 123385 | -71 | -36488 | 181741 | 8065 | 4235049 |
| 2010 | 8065 | 4235049 | 231 | 127105 | -521 | -286967 | 399599 | 7314 | 4220576 |
| 2011 | 7314 | 4220576 | 219 | 123429 | 289 | 163032 | -184854 | 7384 | 4075324 |
| 2012 | 7384 | 4075324 | 225 | 120235 | 444 | 237447 | -250174 | 7603 | 3942362 |
| 2013 | 7603 | 3942362 | 214 | 106827 | 586 | 292800 | -290519 | 7975 | 3837817 |
| 2014 | 7975 | 3837817 | 216 | 105202 | -23 | -11158 | 78470 | 7736 | 3799926 |
| 2015 | 7736 | 3799926 | 228 | 114360 | 89 | 44721 | 164062 | 7597 | 3894349 |
| 2016 | 7597 | 3894349 | 231 | 122377 | 55 | 29195 | 269131 | 7421 | 4070298 |
| 2017 | 7421 | 4070298 | 237 | 122798 | 1325 | 687418 | -474634 | 8510 | 4160284 |
| 2018 | 8510 | 4160284 | 227 | 112067 | 21 | 10386 | 68673 | 8303 | 4127276 |
| 2019 | 8303 | 4127276 | 214 | 108298 | 99 | 50087 | 154443 | 8188 | 4223509 |
| 2020 | 8188 | 4223509 | 227 | 122163 | 29 | 15551 | 361265 | 7990 | 4478162 |
| 2021 | 7990 | 4478162 | 231 | 134625 | 89 | 51849 | 357529 | 7848 | 4752915 |

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value of petroleum resources is estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

## 3.4. Depletion and net income

Recall that the asset value at the beginning of the year *t*, $V^{tB}$ is estimated by using equation (1), based on an information set formed at that point in time.

Expanding equation (1) one year forward gives:

(16) $$V^{tB} = \sum_{\tau=1}^{T^{tB}}[NR^{t+\tau-1}/(1+\delta_t)^{\tau}] = NR^t/(1+\delta_t) + \left\{\sum_{\tau=2}^{T^{tB}}[NR^{t+\tau-1}/(1+\delta_t)^{\tau}]\right\}$$

$$= NR^t/(1+\delta_t) + \left\{\sum_{\tau^*=1}^{T^{tB}}\left[NR^{t+\tau^*}/(1+\delta_t)^{\tau^*}\right]\right\}/(1+\delta_t)$$

$$= NR^t/(1+\delta_t) + V_{t+1}^{tB}/(1+\delta_t),$$

where $V_{t+1}^{tB}$ is defined as the asset value at the beginning of the year *t+1*, but is estimated based on the information set formed at the beginning of the year *t*. On the right-hand side of the third identity in equation (16), a new time index $\tau^*$ is set as $\tau^* = \tau - 1$ in order to define $V_{t+1}^{tB}$.

Note that $V_{t+1}^{tB}$ differs from $V^{t+1B}$ as shown in equation (5) because the latter is estimated by using equation (1) based on the information set formed at the beginning of year *t+1*, or the end of year *t*, while the former is estimated based on the information set formed at the beginning of the year *t* (or the end of the year *t-1*).

As a result, the difference between $V_{t+1}^{tB}$ and $V^{tB}$ will not take unexpected changes such as discoveries and catastrophic losses into consideration. Following a similar reasoning as shown in equations (5) - (8), the difference can be decomposed as:

(17) $$V_{t+1}^{tB} - V^{tB} = -[(P^{tB} + P_{t+1}^{tB})/2]X^t + (P_{t+1}^{tB} - P^{tB})[(S^{tB} + S_{t+1}^{tB})/2],$$

where $P_{t+1}^{tB}$ and $S_{t+1}^{tB}$ are, respectively, the price and physical quantity of the stock at the beginning of the year *t+1* but are all estimated, similarly to $V_{t+1}^{tB}$, based on the information set formed at the beginning of the year *t*. Note that the depletion in equation (17), $X^t$ is also an *ex-ante* or *expected* one, rather than the *ex-post* or *actually realized* depletion $X_t$ as shown in equations (3), (8) and (9).

Reorganizing equation (16) and using equation (17) gives:

(18) $$NR^t = V^{tB}(1+\delta_t) - V_{t+1}^{tB} = \delta_t V^{tB} - (V_{t+1}^{tB} - V^{tB})$$

$$= \delta_t V^{tB} + [(P^{tB} + P_{t+1}^{tB})/2]X^t - (P_{t+1}^{tB} - P^{tB})[(S^{tB} + S_{t+1}^{tB})/2].$$

Rearranging equation (18) yields:

(19) $$NR^t - [(P^{tB} + P_{t+1}^{tB})/2]X^t = \delta_t V^{tB} - (P_{t+1}^{tB} - P^{tB})[(S^{tB} + S_{t+1}^{tB})/2].$$

As shown, the right-hand side of equation (19) consists of a nominal return to capital, $\delta_t V^{tB}$, deducted by an expected revaluation of the asset. After deduction, it can be interpreted as the expected net return from 'normal business operations' excluding holding gains or losses.

On the other hand, the left-hand side of equation (19) consists of a nominal resource rent deducted by the value of depletion, which is similar to gross operating surplus deducted by depreciation, and therefore, it can be interpreted as the net operating surplus, i.e., net income.

The net income as shown in equation (19) and derived from the theoretical setting can be interpreted as an *ex-ante* net income. In reality, it is very seldom that the NPV method is applied under conditions of perfect foresight. But anyway, with the backup of the theoretical setting as

**Table 3.2** **Annual resource rent and depletion-adjusted resource rent (net income) generated by Norwegian petroleum resources over 1970-2021 (current prices, NOK million)**

| | Estimated nr, r=4% | | rr=4%, r=4% | | rr=7%, r=7% | |
|---|---|---|---|---|---|---|
| Year | Resource rent | Net income | Resource rent | Net income | Resource rent | Net income |
| 1970 | -141 | -141 | -133 | -133 | -160 | -160 |
| 1971 | -236 | -251 | -228 | -242 | -275 | -280 |
| 1972 | -286 | -372 | -273 | -356 | -355 | -385 |
| 1973 | -481 | -576 | -446 | -538 | -562 | -596 |
| 1974 | -809 | -927 | -742 | -856 | -970 | -1013 |
| 1975 | 1309 | 570 | 1331 | 615 | 960 | 677 |
| 1976 | 2281 | 1045 | 2181 | 983 | 1600 | 1115 |
| 1977 | 1767 | 104 | 1512 | -101 | 566 | -104 |
| 1978 | 6939 | 3595 | 6412 | 3168 | 5323 | 3941 |
| 1979 | 13525 | 8830 | 12936 | 8380 | 11609 | 9634 |
| 1980 | 31347 | 24647 | 30352 | 23850 | 28599 | 25774 |
| 1981 | 36763 | 29365 | 35561 | 28380 | 33252 | 30153 |
| 1982 | 38754 | 30539 | 37362 | 29387 | 34382 | 30963 |
| 1983 | 47620 | 37620 | 46006 | 36296 | 42517 | 38385 |
| 1984 | 59543 | 47464 | 58143 | 46416 | 53951 | 49034 |
| 1985 | 60848 | 47140 | 59088 | 45779 | 53975 | 48495 |
| 1986 | 18278 | 1972 | 14989 | -855 | 9045 | 2491 |
| 1987 | 13221 | -7435 | 8156 | -11958 | 1161 | -7396 |
| 1988 | -509 | -25481 | -6353 | -30734 | -14072 | -24828 |
| 1989 | 20593 | -12794 | 15575 | -17102 | 7250 | -7665 |
| 1990 | 34473 | -3352 | 30631 | -6451 | 21900 | 4547 |
| 1991 | 32049 | -12832 | 29935 | -14107 | 20636 | -446 |
| 1992 | 24856 | -25909 | 24294 | -25536 | 14191 | -10255 |
| 1993 | 21115 | -32064 | 22928 | -29252 | 11895 | -14434 |
| 1994 | 20000 | -41339 | 22349 | -37787 | 10776 | -20446 |
| 1995 | 23836 | -44099 | 26868 | -39665 | 14763 | -20794 |
| 1996 | 64707 | -11998 | 65634 | -9421 | 52832 | 11786 |
| 1997 | 70062 | -7468 | 71447 | -4352 | 57648 | 15357 |
| 1998 | 10741 | -68285 | 11914 | -65300 | -3264 | -47508 |
| 1999 | 52961 | -31632 | 51194 | -31449 | 34988 | -13810 |
| 2000 | 214537 | 122667 | 212796 | 123074 | 195971 | 142298 |
| 2001 | 191128 | 93886 | 190885 | 96008 | 173145 | 116211 |
| 2002 | 147995 | 42749 | 147564 | 44974 | 129872 | 67727 |
| 2003 | 151720 | 33484 | 155608 | 40513 | 137237 | 66578 |
| 2004 | 212424 | 82471 | 219346 | 93148 | 200456 | 122279 |
| 2005 | 300278 | 170660 | 309220 | 183805 | 288745 | 211093 |
| 2006 | 372666 | 246894 | 381789 | 260684 | 359546 | 285469 |
| 2007 | 327270 | 205727 | 333720 | 217290 | 308840 | 238725 |
| 2008 | 451569 | 327476 | 452773 | 334504 | 424604 | 355015 |
| 2009 | 245918 | 122533 | 235989 | 118755 | 204601 | 136813 |
| 2010 | 274729 | 147624 | 272655 | 152108 | 239405 | 169874 |
| 2011 | 390062 | 266633 | 377957 | 261192 | 341591 | 275244 |
| 2012 | 407082 | 286847 | 395403 | 281954 | 355888 | 293327 |
| 2013 | 359494 | 252667 | 348186 | 247674 | 304546 | 250882 |
| 2014 | 284084 | 178882 | 271745 | 172969 | 223777 | 172197 |
| 2015 | 159957 | 45597 | 142479 | 35062 | 92077 | 35777 |
| 2016 | 71337 | -51040 | 53576 | -61707 | 3338 | -58996 |
| 2017 | 190074 | 67276 | 169996 | 53982 | 121330 | 56846 |
| 2018 | 311835 | 199768 | 286984 | 180857 | 237221 | 177848 |
| 2019 | 183896 | 75598 | 153936 | 50998 | 101949 | 43831 |
| 2020 | 48937 | -73226 | 6144 | -110863 | -48756 | -117316 |
| 2021 | 648952 | 514328 | 611463 | 481986 | 555677 | 477872 |

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: 'Estimated nr' stands for 'estimated annual nominal rate of return' and 'rr' for 'annual real rate of return' to produced capital in petroleum extraction industry; 'r' stands for 'annual real discount rate'.

described above, an *ex-post* depletion-adjusted resource rent, representing the *actually realized* net income generated by the natural resources in concern, can be defined as the following:

(20) Depletion-adjusted resource rent = $NR_t - [(P^{tB} + P^{t+1B})/2]X_t$,

where $NR_t$ and $X_t$ are *ex-post* or *actually realized* resource rent and depletion, respectively, which are different from those as shown in equation (19), with the differences being highted by the *subscript* applied for the former and the *superscript* for the latter.

Using equation (20), Table 3.2 presents the actually realized annual resource rent and the corresponding annual *ex-post* depletion-adjusted resource rent or net income in current prices (NOK million) that are generated by the Norwegian petroleum extraction activity over the period 1970-2021.

For the purpose of comparison, the estimated nominal resource rent and the depletion-adjusted resource rent are presented based on three different options for the choice of the key parameters for measuring the asset value by following the NPV method (see Liu and Midttun, 2025):

*Option 1: using estimated annual nominal rate of return to produced capital, and 4% as annual real discount rate.*

*Option 2: using 4% as annual real rate of return to produced capital, and 4% as annual real discount rate.*

*Option 3: using 7% as annual real rate of return to produced capital, and 7% as annual real discount rate.*

Note that the resource rent in Liu and Midttun (2025) is calculated by following the residual value method which estimates the resource rent by deducting all costs, including the user costs of the produced capital, from the gross operating surplus of the petroleum extraction industry.[12] As a residual measure, the calculated resource rent may contain not only the measurement errors pertaining to all the components but also returns to other unaccounted assets (Liu and Midttun, 2025).

As shown in Table 3.2, there are negative net incomes appearing in some years. In a few years, such as 1988, the estimated resource rent is negative. While in some other years, such as 1987, even if the calculated resource rent is positive, the depletion-adjusted resource rent (net income) is negative, implying that the unit resource rent (i.e., nominal resource rent divided by physical quantity of production = $NR_t/X_t$) is less than the average price of the asset *in situ* (see equation (20)).

As an *ex-post* measure, the actually realized depletion-adjusted resource rent (or net income) may contain the differences between expectation and reality. In any sense, the actually realized resource rent or the *ex-post* depletion-adjusted resource rent (or net income), like profits or losses from normal business activities, could become negative. As stated by Jorgenson *et al*. (2005), 'low or negative profits in any given year is part of the business cycle, and holding assets with an unexpected large jump in prices is entirely consistent with rational economic behaviour in the actual world'.

[12] See Table 5.5 in the SEEA-CF (United Nations *et al*., 2014a).

# 4. Including depletion in the current accounts of the SNA

The current accounts of the SNA consist of the production account, and the generation, allocation, redistribution, and use of income accounts. In the 2008 SNA or the ESA 2010, depletion is treated not as a transaction but as other volume changes, and therefore, does not appear in the current accounts of the 2008 SNA or the ESA 2010.

In this Section, using Norwegian 2021 data as an example, depletion will be taken as production cost into all the current accounts in order to show the potential impact of such an implementation. The value of the depletion is derived from the estimated asset value by using an estimated nominal rate of return to produced capital and a 4% real discount rate (see Liu and Midttun, 2025), together with the actually produced or depleted physical amount of petroleum resources during 2021 (see the number in the last row and the fifth column in Table 3.1).

Two institutional sectors, i.e., Non-financial corporations (S11) and General government (S13), together with Total economy (S1) are the focus in this Section. Ideally, the petroleum extraction industry as the extractor of Norwegian petroleum resources should be separately presented. However, due to limited information, esp. those required for constructing allocation and distribution of income accounts, the petroleum extraction industry is absorbed in Non-financial corporations (S11) in its entirety and will not be treated separately in this Section.

The starting point is the institutional sector accounts published by Table 10799 (Annual non-financial sector accounts. Income, expenditure and saving (NOK million), by transaction, contents, sector and year) at the online databank (Statbank) at Statistics Norway.[13] To highlight the differences between before and after the depletion is introduced into the relevant accounts, both values of the depletion and the depletion-adjusted indicators (together with positive or negative sign) are presented in *italic* type and coloured in *red*. For all other changes, both the values of the changes (together with positive or negative sign) and the corresponding changed/updated indictors are reported also in *italic* type but coloured in *blue*.

## 4.1. Production account

The production account for 2021 in current prices is presented in Table 4.1 for Non-financial corporations (S11), General government (S13), and Total economy (S1). As shown, the estimated value of the actual depletion in 2021 is *134625* NOK million (also see the number in the last row and the fifth column in Table 3.1).

**Table 4.1 Production account for 2021 (current prices, NOK million)**

| | | Uses | | | Resources | | |
|---|---|---|---|---|---|---|---|
| Code | Transactions and balancing items | S11 | S13 | S1 | S11 | S13 | S1 |
| P1 | Output | | | | 5138768 | 1046289 | 6983852 |
| P2 | Intermediate consumption | 2446204 | 311009 | 3089372 | | | |
| D21-D31 | Net (of subsidies) taxes on products | | | | | | 429451 |
| B1g | Value added, gross/GDP | 2692564 | 735280 | 4323931 | | | |
| P51c | Consumption of fixed capital | 443197 | 149366 | 747569 | | | |
| B1n | *Value added, net/NDP* | 2249367 | 585914 | 3576362 | | | |
| | Depletion | *134625* | | *134625* | | | |
| | *Depletion-adjusted net value added/NDP* | *2114742* | 585914 | *3441737* | | | |

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

[13] See Table 10799 at https://www.ssb.no/en/statbank/table/10799

If the depletion is taken as a charge of production cost similar to 'Consumption of fixed capital' for produced capital, as suggested by the SNA update Task Team (van de Ven and de Haan, 2021) and the 2025 SNA, the depletion-adjusted net value added for Non-financial corporations (S11) becomes *2114742* NOK million, a reduction of around 6.0%, if compared to the net value added before the adjustment.

Since General Government (S13) does not directly undertake the extraction activity and so has no operating surplus from such an activity, there is no need to register the depletion in the production account for General Government (S13). Therefore, the depletion-adjusted net value added for General Government (S13) is the same as that before the adjustment, i.e., the net value added (585914 NOK million). Such a recording practice also ensures that estimates of the government output (which are calculated based on the sum of costs) are not increased owing to the introduction of depletion.

For Total economy (S1) which includes both Non-financial corporations (S11) and General Government (S13), the Gross Domestic Product (GDP) is 4323931 NOK million, the sum of output in basic prices (6983852 NOK million) and the net (of subsidies) taxes on products (429451 NOK million), deducted by intermediate consumption (3089372 NOK million). By subtracting the total consumption of fixed capital (747569 NOK million) from the GDP, the traditional Net Domestic Product (NDP) becomes 3576362 NOK million. After further subtracting the depletion, now considered as a production cost, the depletion-adjusted NDP ends up with *3441737* NOK million, a reduction of around 3.8%, if compared to that before the adjustment of the depletion.

## 4.2. Generation of income account

The generation of income account for 2021 in current prices is presented in Table 4.2 for Non-financial corporations (S11), General government (S13), and Total economy (S1).

**Table 4.2 Generation of income account for 2021 (current prices, NOK million)**

| | | Uses | | | Resources | | |
|---|---|---|---|---|---|---|---|
| Code | Transactions and balancing items | S11 | S13 | S1 | S11 | S13 | S1 |
| B1g | Value added, gross | | | | 2692564 | 735280 | 3894480 |
| B1n | *Value added, net* | | | | 2249367 | 585914 | 3146911 |
| | *Depletion-adjusted net value added* | | | | *2114742* | 585914 | *3012286* |
| D1 | Compensation of employees | 1131728 | 585748 | 1844012 | | | |
| D29-D39 | Net (of subsidies) other taxes on production | -28416 | 166 | -39863 | | | |
| | Change due to specific taxes | *-6138* | | *-6138* | | | |
| | Updated D29-D39 | *-34554* | 166 | *-46001* | | | |
| B2g | Operating surplus, gross | 1589252 | 149366 | 2090331 | | | |
| | Updated B2g | *1595390* | 149366 | *2096469* | | | |
| B2n | *Operating surplus, net* | 1146055 | 0 | 1342762 | | | |
| | *Updated B2n* | *1152193* | 0 | *1348900* | | | |
| | *Depletion-adjusted net operating surplus* | *1017568* | 0 | *1214275* | | | |

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

As an accounting convention, the three balancing entries in Table 4.1 (i.e., B1g, B1n, and the depletion-adjusted net value added) are placed on the 'Resources' side of Table 4.2, but for Total economy (S1), only the gross (and net) value added and the depletion-adjusted net value added rather than the GDP (and NDP) and the depletion-adjusted NDP are maintained. The difference between the GDP and the value added for Total economy (S1) is just the net (of subsidies) taxes on products, which are usually estimated for the whole economy, instead of separately for different institutional sectors or industries.

On the 'Uses' side of Table 4.2, there are some new entries highlighted by the defining word 'Updated', and in particular, an entry called 'Change due to specific taxes'. In Norway, there are 'Environmental taxes' and 'Area fees' imposed on the extraction of petroleum resources. If these taxes/fees are considered as 'Specific taxes',[14] they should be reallocated from 'net (of subsidies) other taxes on production (D29-D39)' to 'Rent (D45)' as part of 'Property income (D4)' (see Table 4.3). As shown in Table 5.5 in the SEEA-CF, specific taxes should be added back to the gross operating surplus of the petroleum extraction industry for the derivation of the resource rent (United Nations *et al*., 2014a).

In 2021, the sum of 'Environmental taxes' and 'Area fees' is 6138 NOK million in current prices. Thus, this amount is deducted, as shown by the negative sign for the entry 'Change due to specific taxes' in Table 4.2, from the 'net (of subsidies) other taxes on production (D29-D39)' for Non-financial corporations (S11) (-28416 NOK million), and for Total economy (S1) (-39863 NOK million), respectively. As a result, the 'Updated D29-D39' becomes *-34554* NOK million for Non-financial corporations (S11) and *-46001* NOK million for Total economy (S1), respectively.

Accordingly, the balancing entries, i.e., the 'Operating surplus, gross (B2g)' and the 'Operating surplus, net (B2n)' in Table 4.2 are also updated by this change, as shown by the 'Updated B2g' and the 'Updated B2n', as well as the corresponding *blue* numbers in Table 4.2.

As another accounting convention, the 'Operating surplus, net (B2n)' for General Government (S13) is treated as zero, this is also true for the 'Updated B2n', because General Government (S13) is the tax receiver rather than the payer.

Starting from the 'Updated B2n', subtracting the depletion (*134625* NOK million) gives rise to the depletion-adjusted net operating surplus for Non-financial corporations (S11) as *1017568* NOK million, and for Total economy (S1) as *1214275* NOK million, respectively. If compared to B2n (Operating surplus, net), the reductions in percentage are 11.2% for Non-financial corporations (S11), and 9.6% for Total economy (S1), respectively.

## 4.3. Allocation of primary income account

The allocation of primary income account for 2021 in current prices is presented in Table 4.3 for Non-financial corporations (S11), General government (S13), and Total economy (S1).

The balancing entries as shown on the 'Uses' side of Table 4.2 are kept on the 'Resources' side of Table 4.3. On the same side, the 'Updated D2-D3' contains the 'Change due to specific taxes' as mentioned above in subsection 4.2, i.e., the reallocation of 'Environmental taxes' and 'Area fees' (6138 NOK million) from 'net (of subsidies) other taxes on production (D29-D39)' (part of D2-D3) to 'Rent (D45)' as part of 'Property income (D4)'.

Consequently, the 'net (of subsidies) taxes on production and imports' (389588 NOK million) for both General Government (S13) (as tax receiver) and Total economy (S1) are reduced with the same amount of 6138 NOK million, leading to the 'Updated D2-D3' becoming *383450* NOK million for both General government (S13) and Total economy (S1).

Because the 'Change due to specific taxes' entry reflects a reallocation from taxes to rent, it will also affect 'Rent (D45)' which is absorbed in 'Property income (D4)' in Table 4.3, but this time, with a positive effect. As shown, the amount of 6138 NOK million appears as 'Uses' for Non-financial

[14] See Liu and Midttun (2025) for more information.

corporations (S11) (as rent payer) and Total economy (S1), while as 'Resources' for General government (S13) (as rent receiver) and Total economy (S1).

In Norway, there is a special income tax imposed on the petroleum extraction industry which is levied on the profit of the industry.[15] If it is considered as part of the total resource rent generated by the petroleum extraction industry, this special income should be reallocated from income taxes (D51) to 'Rent (D45)', as part of 'Property income (D4)'.[16]

**Table 4.3 Allocation of primary income account for 2021 (current prices, NOK million)**

| | | Uses | | | Resources | | |
|---|---|---|---|---|---|---|---|
| Code | Transactions and balancing items | S11 | S13 | S1 | S11 | S13 | S1 |
| B2g | Operating surplus, gross | | | | 1589252 | 149366 | 2090331 |
| | Updated B2g | | | | *1595390* | 149366 | *2096469* |
| B2n | *Operating surplus, net* | | | | 1146055 | 0 | 1342762 |
| | *Updated B2n* | | | | *1152193* | 0 | *1348900* |
| | *Depletion-adjusted net operating surplus* | | | | *1017568* | 0 | *1214275* |
| D1 | Compensation of employees | | | | | | 1815469 |
| D2-D3 | Net (of subsidies) taxes on production and imports | | | | | 389588 | 389588 |
| | Change due to specific taxes | | | | | *-6138* | *-6138* |
| | Updated D2-D3 | | | | | *383450* | *383450* |
| D4 | Property income | 1012460 | 18816 | 1409878 | 528382 | 514181 | 1513150 |
| | Change due to specific taxes | *+6138* | | *+6138* | | *+6138* | *+6138* |
| | Change due to special income taxes | *+33728* | | *+33728* | | *+33728* | *+33728* |
| | Updated D4 | *1052326* | 18816 | *1449744* | 528382 | *554047* | *1553016* |
| | Depletion borne by government | | *+94238* | *+94238* | *+94238* | | *+94238* |
| | Adjusted by split-depletion | *1052326* | *113054* | *1543982* | *622620* | *554047* | *1647254* |
| B5g | Balance of primary income, gross / National income, gross | 1105174 | 1034319 | 4398660 | | | |
| | Updated B5g | *1071446* | *1068047* | *4398660* | | | |
| B5n | *Balance of primary income, net / National income, net* | 661977 | 884953 | 3651091 | | | |
| | *Updated B5n* | *628249* | *918681* | *3651091* | | | |
| | *Depletion-adjusted net balance of primary income* | *587862* | *824443* | *3516466* | | | |

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

In 2021, the special income tax has the value of 33728 NOK million in current prices, as shown by another new entry entitled 'Change due to special income taxes' in Table 4.3. With a positive sign, the amount of 33728 NOK million appears as 'Uses' for Non-financial corporations (S11) (as rent payer) and Total economy (S1), while as 'Resources' for General government (S13) (as rent receiver) and Total economy (S1).

Therefore, on the 'Uses' side, the new entry 'Updated D4' becomes *1052326* NOK million for Non-financial corporations (S11), and *1449744* NOK million for Total economy (S1), respectively. On the 'Resources' side, it becomes *554047* NOK million for General government (S13), and *1553016* NOK million for Total economy (S1), respectively. Note that there is no change between the original 'Property income (D4)' and the 'Updated D4' for General Government (S13) on the 'Uses' side and for Non-financial corporations (S11) on the 'Resources' side, simply because General Government (S13)

[15] In Norway. the special income 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. To compare, the ordinary company income tax rate varies across years but is in general stable with the value being around 23%.
[16] See Liu (2023) for more information.

is the tax and rent receiver rather than the payer, on the contrary, Non-financial corporations (S11) is the payer rather than the receiver.

Note that the total depletion as production cost is fully and only registered in the production account of Non-financial corporations (S11) in Table 4.1. To reflect that the resource rent received by General Government (S13) should include its share of the total depletion, a new entry, entitled 'Depletion borne by government' is, as suggested by the SEEA-CF [17], the SNA update Task Team, and the 2025 SNA [18], introduced to Table 4.3.

As for the government' share of total depletion, 70% is applied because it is a revealed long-term average over the period 1970-2021 (see Liu, 2023). In this paper, the 70% will serve as a 'distribution key' for splitting both the total depletion, resource rent, and the economic ownership of petroleum resources between General government (S13) and Non-financial corporations (S11) over the period 1970-2021. Certainly, the 'distribution key' of 70% could be updated if significant changes in extraction arrangements take place in the future.

In 2021, the 70% of the total depletion 134625 NOK million accounts for 94238 NOK million, which are 'Uses' for General government (S13) (and Total economy (S1)) but are 'Resources' for Non-financial corporations (S11) (and Total economy (S1)), as shown in Table 4.3. As a result, the final 'Property income', as shown by the entry of 'Adjusted by split-depletion', becomes *113054* NOK million for General government (S13) (and *1543982* NOK million for Total economy (S1)) on the 'Uses' side, and *622620* NOK million for Non-financial corporations (S11) (and*1647254* NOK million for Total economy (S1)) on the 'Resources' side, while there is no change for Non-financial corporations (S11) on the 'Uses' side and for General government (S13) on the 'Resources' side, if compared with those shown by the entry 'Updated D4' in Table 4.3.

By subtracting 'Uses' from 'Resources', the five balancing entries can be calculated and are listed on the 'Uses' side in the lower panel of Table 4.3. As shown, the 'Depletion-adjusted net balance of primary income' becomes *587862* NOK million for Non-financial corporations (S11), *824443* NOK million for General government (S13), and *3516466* NOK million for Total economy (S1), respectively. If compared to B5n (Balance of primary income, net / National income, net), the reductions in percentage are 11.2%, 6.8%, and 3.7%, respectively.

## 4.4. Secondary distribution of income account

The secondary distribution of income account for 2021 in current prices is presented in Table 4.4 for Non-financial corporations (S11), General government (S13), and Total economy (S1).

The balancing entries in Table 4.3 are kept on the 'Resources' side of Table 4.4. On the 'Uses' side, 'Current transfers' is the first entry. For simplicity, this entry is presented as one merging all types of current transfers, including income taxes. In addition, it is reported by the difference between the payables and the receivables.

The entry of 'Change due to special income taxes' appears also in Table 4.4. Because this special income taxes has been allocated to 'Property income (D4)' in Table 4.3, the amount of 33728 NOK million should be deducted from the paid income taxes, i.e., from the 'Uses' side of Non-financial corporations (S11). Meanwhile, the same amount should be deducted from the 'Resources' for General government (S13), but again, for simplicity, the same amount but with positive sign is shown on the 'Uses' side for General government (S13). As a result, the 'Updated current transfers' becomes

[17] See Table 5.10 in the SEEA-CF (United Nations *et al*., 2014a).
[18] In the 2025 SNA, the new entry ('Depletion borne by government') is registered as a negative value on the 'Resources' side of general government, and on the 'Uses' side of the extractor, which is different from the treatment as shown in this paper.

*355368* NOK million for Non-financial corporations (S11), and *-579153* NOK million for General government (S13), respectively.

By subtracting 'Uses' from 'Resources', the balancing entries of different types of disposable income can be derived. As shown, there is no difference between the original B6g and the 'Updated B6g', or the original B6n and the 'Updated B6n' for Non-financial corporations (S11), General government (S13), and Total economy (S1). The reason is that the two new entries, i.e., 'Change due to specific taxes' and 'Change due to special income taxes', are just reallocation of resources between different entries before the disposable income is derived, and the net effect of the reallocation on the disposable income is zero.

**Table 4.4 Secondary distribution of income account for 2021 (current prices, NOK million)**

| | | Uses | | | Resources | | |
|---|---|---|---|---|---|---|---|
| Code | Transactions and balancing items | S11 | S13 | S1 | S11 | S13 | S1 |
| B5g | Balance of primary income, gross / National income, gross | | | | 1105174 | 1034319 | 4398660 |
| | Updated B5g | | | | *1071446* | *1068047* | *4398660* |
| B5n | *Balance of primary income, net / National income, net* | | | | 661977 | 884953 | 3651091 |
| | *Updated B5n* | | | | *628249* | *918681* | *3651091* |
| | *Depletion-adjusted net balance of primary income* | | | | *587862* | *824443* | *3516466* |
| | Current transfers | 389096 | -612881 | 67817 | | | |
| | Change due to special income taxes | *-33728* | *+33728* | | | | |
| | Updated current transfers | *355368* | *-579153* | 67817 | | | |
| B6g | Disposable income, gross | 716078 | 1647200 | 4330843 | | | |
| | Updated B6g | *716078* | *1647200* | *4330843* | | | |
| B6n | *Disposable income, net* | 272881 | 1497834 | 3583274 | | | |
| | *Updated B6n* | *272881* | *1497834* | *3583274* | | | |
| | *Depletion-adjusted net disposable income* | *232494* | *1403596* | *3448649* | | | |

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate. Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

Therefore, the 'Depletion-adjusted net disposable income' becomes *232494* NOK million for Non-financial corporations (S11), *1403596* NOK million for General government (S13), and *3448649* NOK million for Total economy (S1). If compared to the net disposable income (B6n), the reduction is *40387* NOK million (or 14.8%) for Non-financial corporations (S11), *94238* NOK million (or 6.3%) for General government (S13), and *134625* NOK million (or 3.8%) for Total economy (S1).

Clearly, the distribution of the total depletion *134625* NOK million for Total economy (S1) among the two institutional sectors, i.e., Non-financial corporations (S11) and General government (S13) is that 30% (i.e., *40387* NOK million) is allocated to the former, and 70% (i.e., *94238* NOK million) is to the latter.

There is an alternative way to register the Norwegian special income taxes in the allocation of primary income account and the secondary distribution of income account. At times, for policy-making purposes, emphasis may be placed on that the Norwegian special income taxes should be maintained in the national accounts as they are, simply to reflect that the total resource rents generated by extraction activity are distributed to General government (S13) through two different channels: one paid as other (net of subsidies) taxes on production and another paid as rent through the first distribution of income channel, and the other as paid income taxes through the secondary distribution channel.

Using this alternative way for registration of the Norwegian special income taxes, the allocation of primary income account and the secondary distribution of income account are presented in Table B1 and Table B2 in Appendix B, respectively. As shown, only the entry of 'Change due to specific

taxes' is presented in Table B1 and no entry of 'Change due to income taxes' appearing because the special income taxes are contained in the entry of 'Current transfers' in Table B2 with no distinction being made.

As a result, the balancing entries in Table 4.3 differ from those in Table B1, but in Table B1, there are no differences between B5g (gross balance of primary income or national income) and the 'Updated B5g', or between B5n (net balance of primary income or national income) and the 'Updated B5n'. In addition, the balancing entries in Table 4.4 are the same as those in Table B2.

To sum up, if compared to the way the Norwegian special income taxes are registered as described in the main text, the alternative way does not affect the balancing entries in the secondary distribution of income account. As for the allocation of primary income account, the impact is reflected by the different distribution of primary income between the two institutional sectors, i.e., Non-financial corporations (S11) and General government (S13). For Total economy (S1), however, the alternative way for registration has no impact on the national income as a balancing entry.

## 4.5. Use of disposable income account

The use of disposable income account for 2021 in current prices is presented in Table 4.5 for Non-financial corporations (S11), General government (S13), and Total economy (S1).

**Table 4.5 Use of disposable income account for 2021 (current prices, NOK million)**

| | | Uses | | | Resources | | |
|---|---|---|---|---|---|---|---|
| Code | Transactions and balancing items | S11 | S13 | S1 | S11 | S13 | S1 |
| B6g | Disposable income, gross | | | | 716078 | 1647200 | 4330843 |
| B6n | *Disposable income, net* | | | | 272881 | 1497834 | 3583274 |
| | *Depletion-adjusted net disposable income* | | | | *232494* | *1403596* | *3448649* |
| P3 | Final consumption expenditure | 0 | 970694 | 2597042 | | | |
| D8 | Adjustment for the change in pension entitlements | | | 5376 | | | |
| B8g | Saving, gross | 716078 | 676506 | 1728425 | | | |
| B8n | *Saving, net* | 272881 | 527140 | 980856 | | | |
| | *Depletion-adjusted net saving* | *232494* | *432902* | *846231* | | | |

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

Since there is no difference between B6 and the updated one, only three balancing entries, i.e., B6g, B6n and the 'Depletion-adjusted net disposable income' are kept on the 'Resources' side of Table 4.5.

After deducting 'Final consumption expenditure (P3)' and 'Adjustment for the change in pension entitlements (D8)', the balancing entries for the use of disposable income account are reported on the 'Uses' side of Table 4.5.

Both the gross saving (B8g) and the net saving (B8n) are the same as the original ones, and in particular, B8g and B8n are the same as B6g (gross disposable income) and B6n (net disposable income) respectively, for Non-financial corporations (S11), simply because there is no final consumption incurred in this institutional sector.

The 'Depletion-adjusted net saving' becomes *232494* NOK million for Non-financial corporations (S11), *432902* NOK million for General government (S13), and *846231* NOK million for Total economy (S1). If compared to the net saving (B8n), the reduction is *40387* NOK million (or 14.8%) for Non-financial corporations (S11), *94238* NOK million (or 17.9%) for General government (S13), and *134625* NOK million (or 13.7%) for Total economy (S1).

# 5. Including depletion in the accumulation accounts of the SNA

The accumulation accounts of the SNA show all changes between two balance sheets and they comprise the capital account, the financial account, and the other changes in assets accounts. The last 'other changes in assets accounts' consist of the other changes in the volume of assets account and the revaluation account.

For our purpose, the financial account will not be discussed in the paper, and the other changes in assets accounts will be briefly discussed because the relevant entries related to petroleum resources in the other changes in assets accounts are already presented in subsection 3.1.

## 5.1. Capital account

The capital account for 2021 in current prices is presented in Table 5.1 for Non-financial corporations (S11), General government (S13), and Total economy (S1).

**Table 5.1 The capital account for 2021 (current prices, NOK million)**

| | | Changes in assets | | | Changes in liabilities and net worth | | |
|---|---|---|---|---|---|---|---|
| Code | Transactions and balancing items | S11 | S13 | S1 | S11 | S13 | S1 |
| B8n | *Saving, net* | | | | 272881 | 527140 | 980856 |
| | *Depletion-adjusted net saving* | | | | *232494* | *432902* | *846231* |
| P5g | Gross capital formation | 615881 | 220457 | 1084790 | | | |
| P51c | Consumption of fixed capital | -443197 | -149366 | -747569 | | | |
| NP | Acquisitions less disposals of non-produced assets | -2761 | -476 | -164 | | | |
| | Depletion | *-40387* | *-94238* | *-134625* | | | |
| D9 | Capital transfers, net | | | | 10925 | -11768 | -1191 |
| B9 | *Net lending (+)/borrowing (-)* | 113883 | 444757 | 642608 | | | |
| | *Depletion-adjusted net lending (+)/borrowing (-)* | *113883* | *444757* | *642608* | | | |

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

The balancing entries in Table 4.5, i.e., 'Net saving (B8n)' and 'Depletion-adjusted net saving' provide the link between the current accounts of the SNA and the subsequent accumulation accounts, and therefore, are presented on the 'Changes in liabilities and net worth' side in Table 5.1.

Since savings are in net terms, 'Gross capital formation (B5g)' on the 'Changes in assets' side have to deduct 'Consumption of fixed capital (B51c)' to become comparable. In addition, if depletion is considered as a cost of production, it should be presented alongside with 'Consumption of fixed capital (B51c)'. As shown in Table 5.1, the total depletion in 2021 (*134625* NOK million) is allocated as follows: 70% (*94238* NOK million) to General government (S13) and 30% (*40387* NOK million) to Non-financial corporations (S11).

After taking into consideration both 'Acquisitions less disposals of non-produced assets (NP)' and 'Capital transfers, net (D9)', the balancing item does not change due to the inclusion of the depletion, i.e., 'Depletion-adjusted net lending (+)/borrowing (-)' is the same as 'Net lending (+)/borrowing (-) (B9)' for Non-financial corporations (S11), General government (S13), and Total economy (S1).

## 5.2. Other changes accounts

As known, the other changes in assets accounts are divided into two accounts: the first is the other changes in the volume of assets account, and the second is the revaluation account.

As mentioned in Section 2, according to the existing 2008 SNA or the ESA 2010, depletion and other changes (such as discoveries and catastrophic losses) of the petroleum resources are recorded in

the other changes in the volume of assets account, but in the current NNA, there is no depletion and other changes related to petroleum resources being recorded simply because the petroleum resources has not yet been registered as non-financial asset in the balance sheet account. Likewise, there is no relevant entry linked to the petroleum resources being recorded in the revaluation account either.

If the depletion is to be incorporated as production cost into the national accounts, no depletion but only other changes related to petroleum resources as estimated and shown in Table 3.1 should be registered in the other changes in the volume of assets accounts in the NNA. Of course, if a country has already registered depletion in the other changes in the volume of assets account, the entry of depletion has to be removed. On the other hand, the revaluation entry associated with the petroleum resources as shown in Table 3.1 should be added to the revaluation account in the NNA.

As for the distribution of the total value of other changes as well as revaluation between Non-financial corporations (S11) and General government (S13), following the principle of the suggested split-asset approach, the distribution key is set as follows: 30% and 70% of the total value are allocated to Non-financial corporations (S11) and General government (S13), respectively.

In Liu and Midttun (2025), the asset value of Norwegian petroleum resources are measured for the period 1970-2021, with the value of 2021 being estimated by expected future resource rents, while those during the period 1970-2020 being estimated by using both *ex-post* or actually realized resource rents for the period 1970-2020 together with the expected future resource rents. Note that the estimation work is carried out at the beginning of 2021 with all information available up to that point of time.

Suppose that incorporating depletion as production cost into the national accounts as presented in this paper is also undertaken at the beginning of 2021. For 2021, the incorporation has been shown in all tables in Section 4 and in Section 5 up to now. As for the period of 1970-2020, a simple method may be conducted for each and every year: the same distribution key is applied to both depletion, other changes, and revaluation as estimated and shown in Table 3.1, i.e., 30% and 70% of the total value (either depletion or other changes or revaluation) are allocated to Non-financial corporations (S11) and General government (S13), respectively.

It is possible that there might exist a short period before the petroleum extraction activity took place on the Norwegian continental shelf, and during that period, it is natural to consider the government as the sole owner of the whole petroleum resources found up to that time. Then a capita transfer from General government (S13) to Non-financial corporations (S11) should be registered sometime in later period when it did happen.

However, since the petroleum resources have never been registered in the balance sheet account in the NNA, it may not be worth making things unnecessarily complicated. Thus a simple assumption is made in this paper that from 1970, the value of asset, depletion, other changes, and revaluation of Norwegian petroleum resources is split based on a long-term average of 30% vs. 70% between Non-financial corporations (S11) and General government (S13), and the split is implemented at the beginning of 2021, with all information available up to that point of time.

Note that the distribution key is a long-term average over the period 1970-2021 found by a testing work that is carried out at Statistics Norway (see Liu, 2023). When the accounting year moves forward, say, at the beginning of 2022, the suggestion is to keep using the same distribution key of 30% vs. 70% until significant changes in extraction arrangements take place. Once the split ratio is changed to e.g., 25% vs. 75%, then the value of asset, depletion, other changes, and revaluation will be split by using this new ratio. However, the historical data by using the previous split ratio are not suggested to be revised.

# 6. Impact on some headline indicators over 1978-2021

Incorporating depletion into the existing national accounts will certainly have impact on the relevant accounts and the associated statistical indicators, and in particular, on the balancing items, such as some headline indicators. In general, the impacts can be reflected by the reductions on the headline indicators due to the adjustment made by the depletion, although the detailed impacts may vary.

In this paper, the impact on headline indicators are defined as:

(21) Impact (in percentage) = (original indicator - depletion-adjusted indicator)/original indicator,

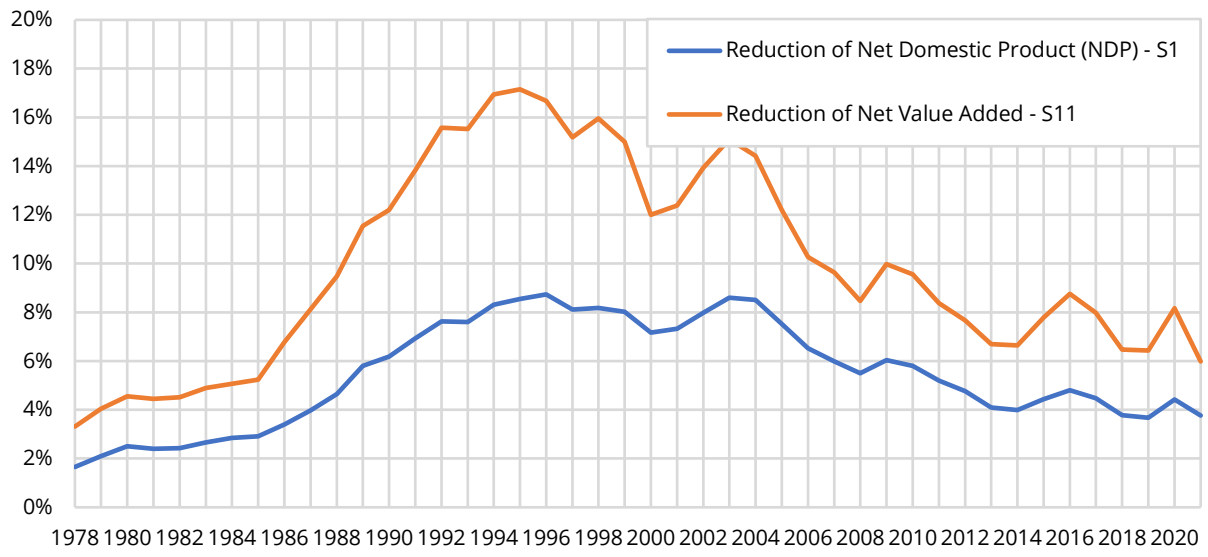
where the original indicator is obtained directly from the institutional sector accounts, published by Table 10799 at Statistics Norway,[19] and the depletion-adjusted indicator is the new balancing entry introduced in the relevant accounts, as described and shown in Section 4 and Section 5 for 2021 with the value of them being coloured in italic *red*.

Note that the value of depletion as applied in this section for measuring the impact is estimated by using an estimated nominal annual rate of return to produced capital employed by the petroleum extraction industry and an annual real discount rate of 4% (see the fifth column in Table 3.1). The corresponding impacts due to the introduction of the depletion that is estimated based on different assumptions are presented in Appendix C and Appendix D. In Appendix C, the annual real rate of return and the annual real discount rate are set equal to 4% and 4% respectively, while in Appendix D, they are assumed to be 7% and 7%, respectively.

## 6.1. Net valued added and net domestic product (NDP)

Figure 6.1 displays the impact in percentage on the Net Domestic Product (NDP) for Total economy (S1) and on the net value added for Non-financial corporations (S11) over the period 1978-2021, due to the inclusion of the depletion as production cost.

**Figure 6.1 Impact on net value added and net domestic product (NDP) (%), 1978-2021**




Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

[19] See Table 10799 at https://www.ssb.no/en/statbank/table/10799 in which the starting year is 1978.

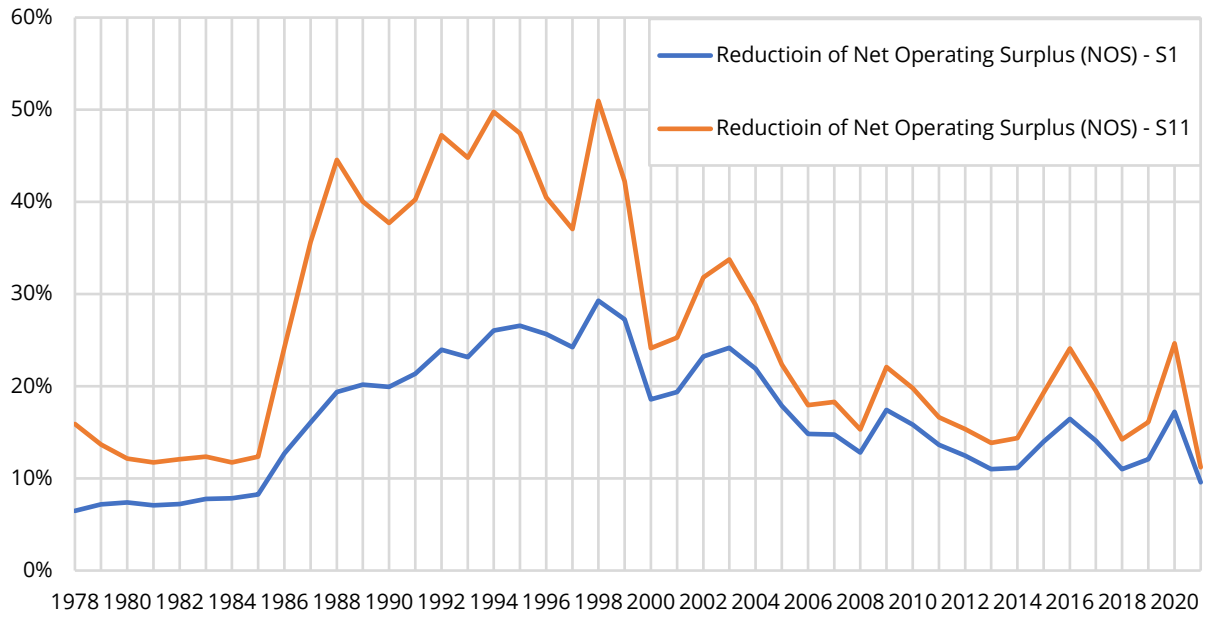
In general, the reduction of both NDP and the net value added for Non-financial corporations (S11) has been increasing since 1978, after reaching the top around 1995/1996, it has been decreasing. In particular, the reduction of NDP is under 9% over the whole observed period, while that of the net value added for Non-financial corporations (S11) is lower than 10% after 2009.

Note that there is no impact on the net value added for General government (S13) due to the inclusion of the depletion since the whole value of the depletion is recorded as production cost for petroleum extraction activity only (see Table 4.1).

## 6.2. Net operating surplus (NOS)

Figure 6.2 displays the impact in percentage on the net operating surplus (NOS) for Total economy (S1) and Non-financial corporations (S11) over the period 1978-2021.

**Figure 6.2 Impact on net operating surplus (%), 1978-2021**




Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

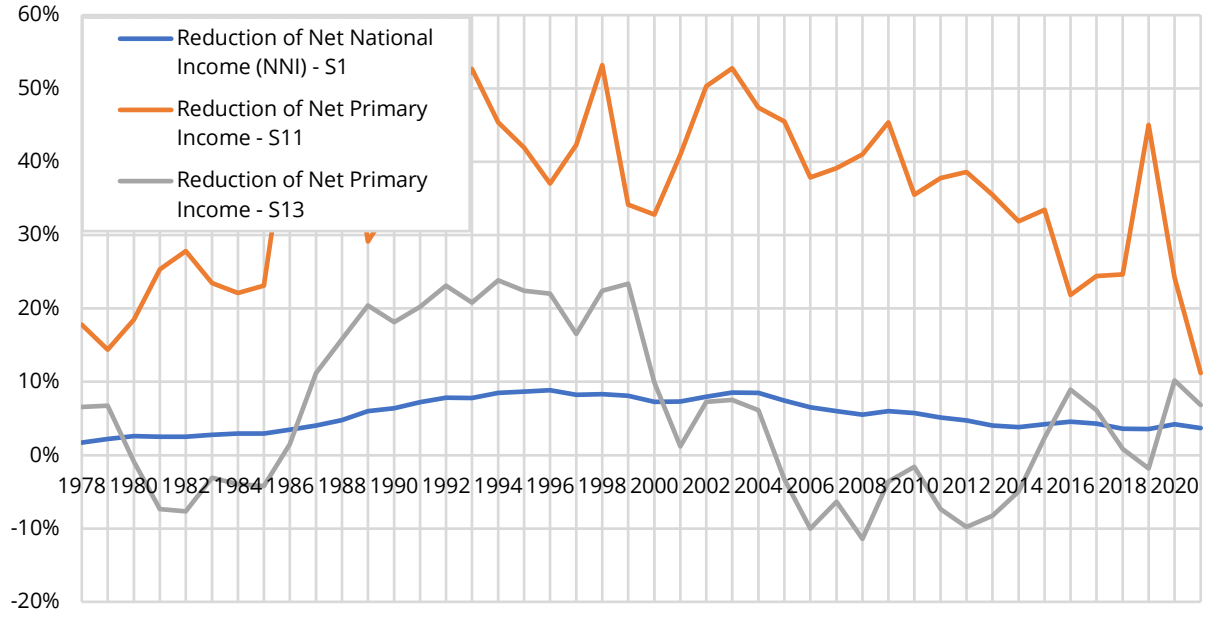
As shown, the general pattern of the reduction of net operating surplus (NOS) for both Total economy (S1) and Non-financial corporations (S11) is approximately concave, i.e., the reduction climbs up to the top in 1998 and then decreases, although with ups and downs. The large drop for Non-financial corporations (S11) after 1998 is mainly due to that the original net operating surplus jumps significantly to a new level since then.

As shown in Table 4.2, the depletion is suggested not to have any impact on the net operating surplus (NOS) for General government (S13).

## 6.3. Net primary income and net national income (NNI)

Figure 6.3a displays the impact in percentage on the net national income (NNI) for Total economy (S1), and that on the net primary income for both Non-financial corporations (S11) and General government (S13) over the period 1978-2021.

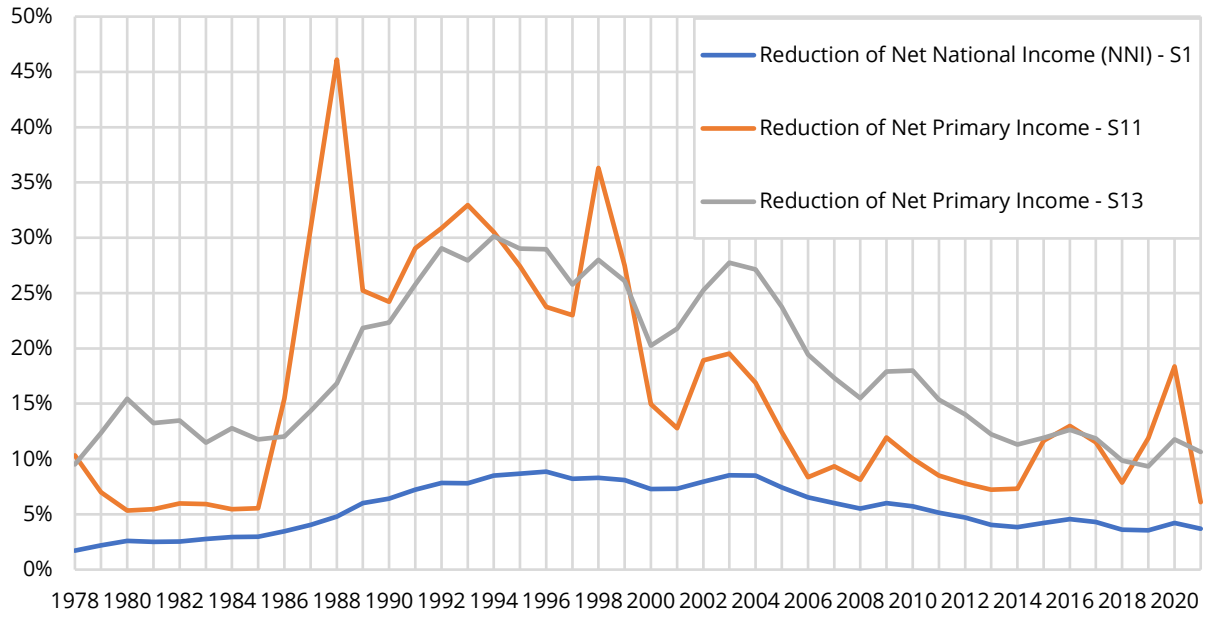
**Figure 6.3a Impact on net primary income and net national income (NNI) (%), 1978-2021**




Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

Over the observed period 1978-2021, the reduction of the net national income (NNI) for Total economy (S1) is under 9%. The reduction of the net primary income for General government (S13) is lower than that for Non-financial corporations (S11) over the entire period. Moreover, in some years, such as those from 2005 to 2014, the reduction for General government (S13) is negative, implying that the changes have led to an increased depletion-adjusted net primary income for General government (S13), if compared to the original net measure.

**Figure 6.3b Impact on net primary income and net national income (NNI) (%), 1978-2021, using alternative way for registering special income taxes**




Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

This is due to, among others, the reallocation of the special income taxes from current transfers to property income and in some years the special income taxes are larger than the depletion part borne by the government.

In subsection 4.4, an alternative way for registering the special income taxes is discussed. In other words, the special income taxes are still recorded as current transfers in the secondary distribution of income account as they are in the current NNA.

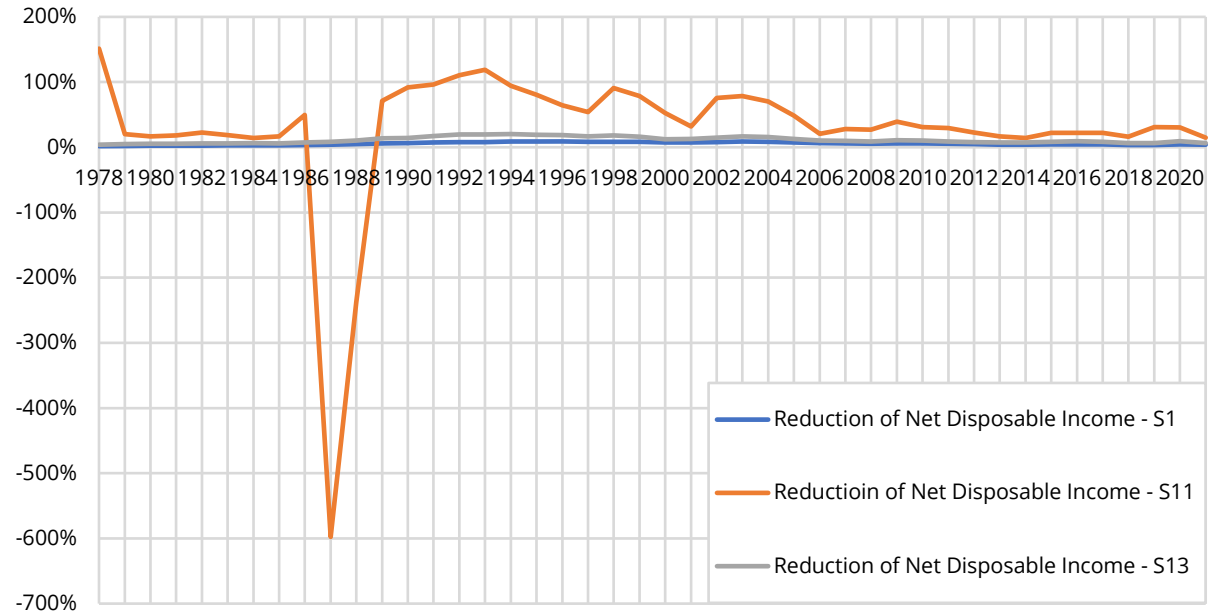
By using the alternative way for registering the special income taxes, Figure 6.3b displays the impact in percentage on the net national income (NNI) for Total economy (S1), and that on the net primary income for both Non-financial corporations (S11) and General government (S13) over the period 1978-2021.

As revealed, the reduction of net primary income for General government (S13) becomes positive over the entire period 1978-2021, and in some years, the reduction is even larger than that for Non-financial corporations (S11). There is no change for the reduction of net national income (NNI) for Total economy (S1) between Figure 6.3a and Figure 6.3b.

## 6.4. Net disposable income

Figure 6.4a displays the impact in percentage on the net disposable income for Total economy (S1), Non-financial corporations (S11), and General government (S13) over the period 1978-2021.

**Figure 6.4a Impact on net disposable income (4%), 1978-2021**



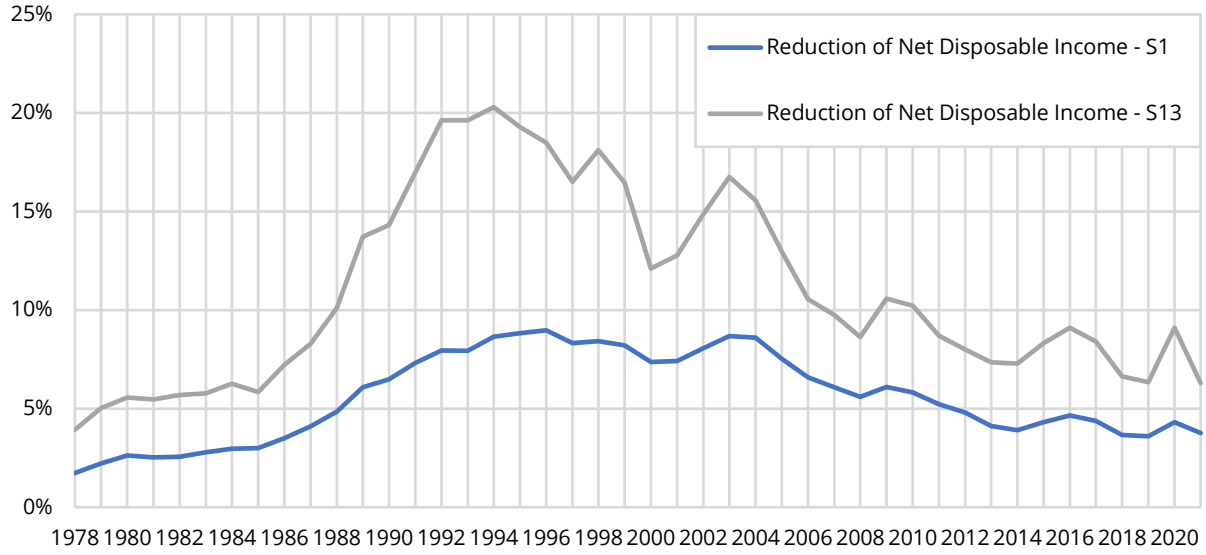

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

As for the reduction of net disposable income for Non-financial corporations (S11), there appear two outstanding observations for 1987 and 1988, because these are the only two years over the entire period 1978-2021 when the original net disposable income is negative.

By removing the reduction of net disposable income for Non-financial corporations (S11), Figure 6.4b presents the impact on net disposable income for Total economy (S1) and General government (S13) only. As shown, the general pattern for both is roughly concave, with the top being reached in

1994 for General government (S13) and in 1996 for Total economy (S1), respectively. Over the whole period 1978-2021, the reduction for Total economy (S1) is under 9%.

**Figure 6.4b Impact on net disposable income (4%), 1978-2021**

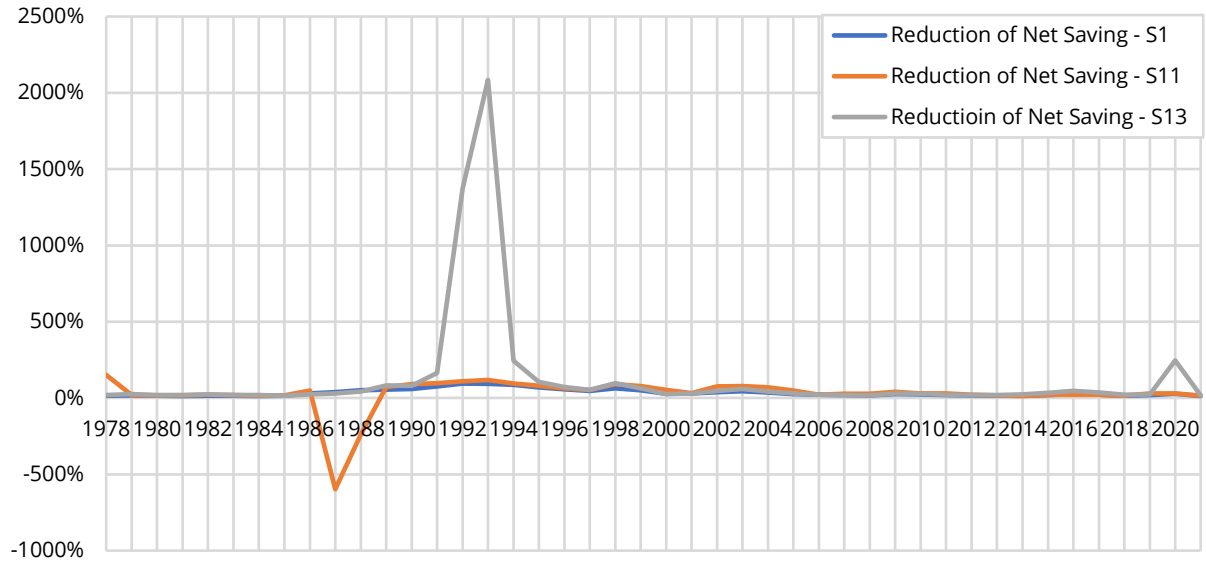



Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

## 6.5. Net saving

Figure 6.5a displays the impact in percentage on the net saving for Total economy (S1), Non-financial corporations (S11), and General government (S13) over the period 1978-2021.

**Figure 6.5a Impact on net saving (4%), 1978-2021**

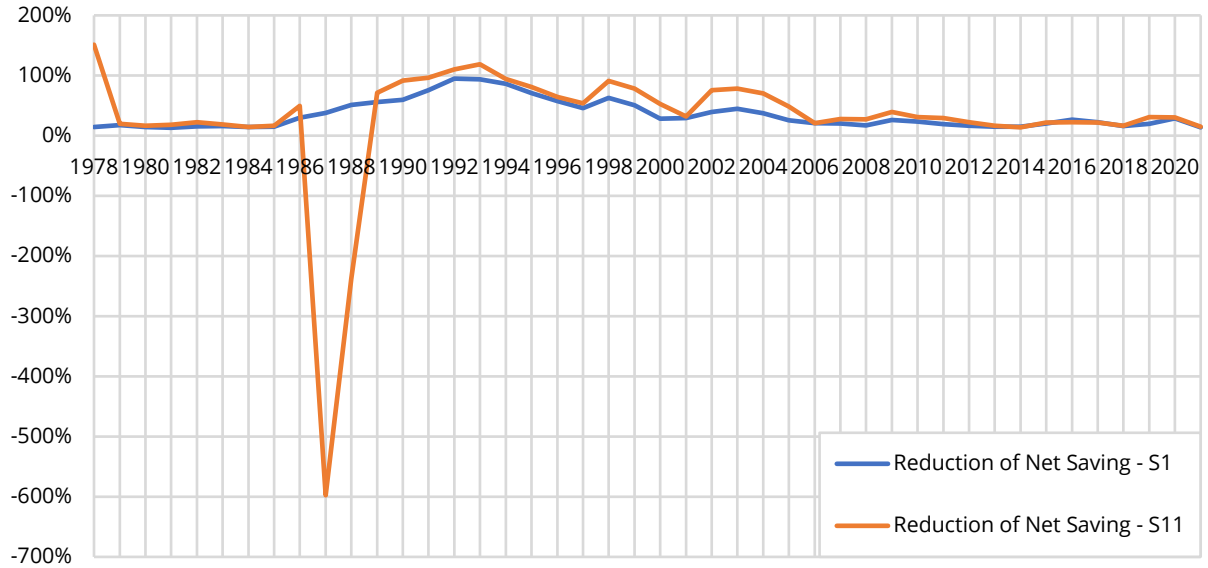



Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

Regarding the reduction of net saving for General government (S13), there are two outstanding observations for 1992 and 1993, when the original net saving is extremely low. For other years over

the period 1978-2021, the reduction of the net saving is comparable to those for both Total economy (S1) and Non-financial corporations (S11).

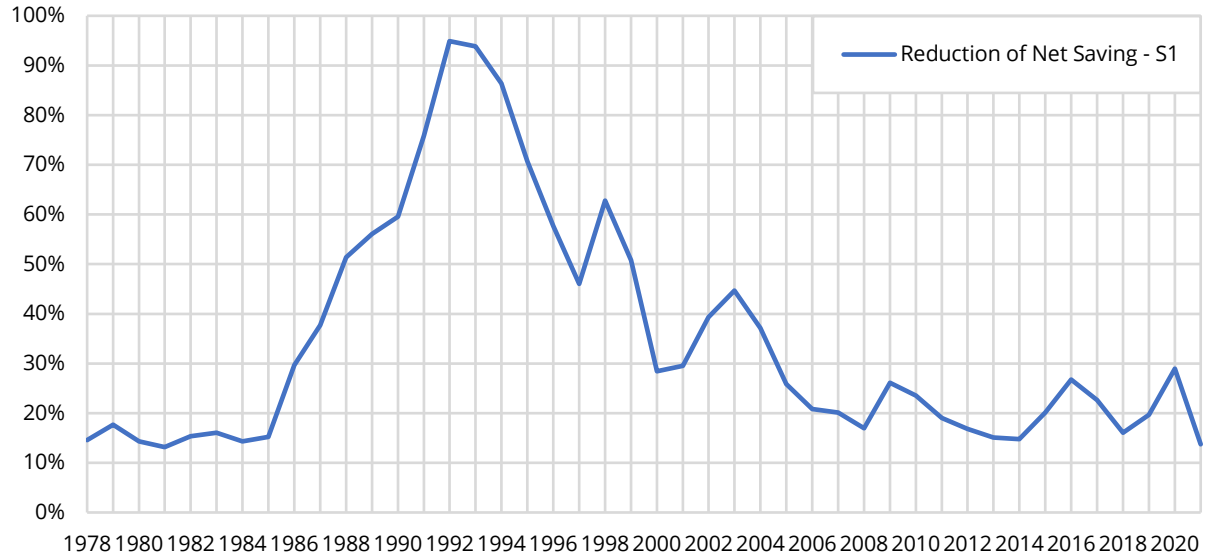
**Figure 6.5b Impact on net saving (4%), 1978-2021**




Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

By removing the reduction of net saving for General government (S13), Figure 6.5b presents the impact on net saving for Total economy (S1) and Non-financial corporations (S11) only.

**Figure 6.5c Impact on net saving (4%), 1978-2021**




Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

Since there is no final consumption for Non-financial corporations (S11), the reduction of net saving is the same as that of net disposable income for this institutional sector. By further removing the reduction for Non-financial corporations (S11) from Figure 6.5b, Figure 6.5c presents the reduction of net saving for Total economy (S1), which is roughly concave and has been under 30% since 2005.

# 7. Concluding remarks

Depletion is regarded as the running down of natural resources beyond its regeneration level. As for petroleum resources which is the focus of this paper, depletion refers to the reduction in both the quantity and the value of petroleum resources *in situ* as a result of extraction activities.

In the currently applied international statistical standards, such as the 2008 SNA and the ESA 2010, depletion is treated as 'other changes' rather than 'transactions', although it shares a common character with consumption of fixed capital, a production cost due to the use of fixed capital in production. As a result, depletion does not appear in the current accounts and the capital account of the 2008 SNA or the ESA 2010 (United Nations *et al*., 2009; Eurostat, 2013).

To improve the treatment of depletion, the SEEA-CF suggests treating depletion as a cost of production (United Nations *et al*., 2014a). In addition to this suggestion, the recent 2008 SNA update Task Team and later the adopted 2025 SNA recommend applying a split-asset approach and assigning economic ownership to relevant institutional sectors in line with the actual distribution of resource rents and the sharing of operational risks (van de Ven and de Haan, 2021; United Nations *et al*., 2025).

In this paper, a coherent and consistent accounting framework is presented in which the change of the asset between the opening and the closing accounting period, either in physical or in value terms, is decomposed into various components, including depletion, other changes, and revaluation. The accounting framework in this paper is fully integrated and consistent with that as presented in a recent paper series on measuring the asset value of petroleum resources in Norway (Liu and Midttun, 2024a, 2024b, 2025).

In addition, the coherent and consistent accounting framework as reported in this paper is also in line with the general capital measurement framework as described in *Measuring Capital OECD Manuel* (Schreyer, 2009) and in Liu (2024). More importantly, the formulation as set up in this paper has removed some imprecisions as presented in the current SEEA-CF.

With the backup of the capital theory, this paper defines an *ex-post* depletion-adjusted resource rent or the net income. By using the estimated resource rent and asset value (see Liu and Midttun, 2025) and other Norwegian data, the annual asset account of Norwegian petroleum resources and the calculated depletion-adjusted resource rent or the net income over the period 1970-2021 are reported in this paper.

Using the Norwegian 2021 data, this paper illustrates how to incorporate depletion as production cost into the sequence of the institutional sector accounts by following the suggested split-asset approach. Finally, by using the time series data over the period 1978-2021 drawn from the Norwegian institutional sector accounts, the paper also demonstrates the impact on some headline indictors due to the inclusion of depletion as a cost of production.

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# Appendix A: Asset accounts based on different assumptions

**Table A1.** **Asset account for Norwegian petroleum resources in both quantity ($Sm^3$ o. e. million) and value (current prices, NOK million) (estimated by using 4% as annual real rate of return to produced capital and 4% as annual real discount rate), 1970-2021**

| | Opening stock | | - Depletion | | + Other changes | | + Revaluation | = Closing stock | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Quantity | Value | Quantity | Value | Quantity | Value | Value | Quantity | Value |
| 1970 | 9041 | 294594 | 0 | 0 | 0 | 0 | 34292 | 9041 | 328886 |
| 1971 | 9041 | 328886 | 0 | 14 | 0 | 0 | 38041 | 9040 | 366913 |
| 1972 | 9040 | 366913 | 2 | 83 | 0 | 0 | 45200 | 9038 | 412030 |
| 1973 | 9038 | 412030 | 2 | 92 | 0 | 0 | 62488 | 9036 | 474426 |
| 1974 | 9036 | 474426 | 2 | 114 | 0 | 0 | 76659 | 9034 | 550971 |
| 1975 | 9034 | 550971 | 11 | 717 | 0 | 0 | 75162 | 9023 | 625417 |
| 1976 | 9023 | 625417 | 16 | 1198 | 0 | 0 | 81728 | 9007 | 705947 |
| 1977 | 9007 | 705947 | 19 | 1612 | 0 | 0 | 88418 | 8988 | 792752 |
| 1978 | 8988 | 792752 | 35 | 3244 | 0 | 0 | 66990 | 8952 | 856498 |
| 1979 | 8952 | 856498 | 45 | 4556 | 0 | 0 | 109273 | 8908 | 961215 |
| 1980 | 8908 | 961215 | 56 | 6502 | 0 | 0 | 132854 | 8851 | 1087567 |
| 1981 | 8851 | 1087567 | 55 | 7181 | 0 | 0 | 136724 | 8796 | 1217110 |
| 1982 | 8796 | 1217110 | 55 | 7975 | 0 | 0 | 120029 | 8741 | 1329164 |
| 1983 | 8741 | 1329164 | 62 | 9710 | 0 | 0 | 99722 | 8680 | 1419177 |
| 1984 | 8680 | 1419177 | 69 | 11728 | 0 | 0 | 94002 | 8611 | 1501451 |
| 1985 | 8611 | 1501451 | 73 | 13309 | 0 | 0 | 122454 | 8537 | 1610596 |
| 1986 | 8537 | 1610596 | 79 | 15844 | 0 | 0 | 209702 | 8458 | 1804453 |
| 1987 | 8458 | 1804453 | 90 | 20114 | 0 | 0 | 190639 | 8369 | 1974978 |
| 1988 | 8369 | 1974978 | 98 | 24381 | 0 | 0 | 204508 | 8271 | 2155105 |
| 1989 | 8271 | 2155105 | 120 | 32677 | 0 | 0 | 192336 | 8151 | 2314763 |
| 1990 | 8151 | 2314763 | 126 | 37082 | 0 | 0 | 182227 | 8025 | 2459908 |
| 1991 | 8025 | 2459908 | 139 | 44042 | 0 | 0 | 163070 | 7886 | 2578937 |
| 1992 | 7886 | 2578937 | 156 | 49831 | 925 | 296243 | -109078 | 8655 | 2716271 |
| 1993 | 8655 | 2716271 | 163 | 52181 | 236 | 75494 | 96033 | 8728 | 2835618 |
| 1994 | 8728 | 2835618 | 184 | 60136 | 567 | 185527 | 44705 | 9111 | 3005715 |
| 1995 | 9111 | 3005715 | 197 | 66533 | 222 | 74977 | 143799 | 9136 | 3157958 |
| 1996 | 9136 | 3157958 | 226 | 75055 | 1482 | 491693 | -272269 | 10392 | 3302327 |
| 1997 | 10392 | 3302327 | 234 | 75799 | 352 | 114069 | 136718 | 10510 | 3477314 |
| 1998 | 10510 | 3477314 | 228 | 77214 | 404 | 136754 | 157750 | 10686 | 3694605 |
| 1999 | 10686 | 3694605 | 230 | 82644 | 57 | 20451 | 291474 | 10513 | 3923887 |
| 2000 | 10513 | 3923887 | 241 | 89722 | 521 | 193857 | -28462 | 10793 | 3999560 |
| 2001 | 10793 | 3999560 | 252 | 94877 | 33 | 12487 | 138798 | 10574 | 4055967 |
| 2002 | 10574 | 4055967 | 258 | 102590 | -90 | -35639 | 283164 | 10226 | 4200902 |
| 2003 | 10226 | 4200902 | 262 | 115094 | -826 | -363234 | 562383 | 9139 | 4284957 |
| 2004 | 9139 | 4284957 | 264 | 126198 | -35 | -16595 | 158401 | 8840 | 4300565 |
| 2005 | 8840 | 4300565 | 258 | 125415 | 183 | 88932 | 7533 | 8765 | 4271615 |
| 2006 | 8765 | 4271615 | 249 | 121105 | 52 | 25309 | -21732 | 8568 | 4154087 |
| 2007 | 8568 | 4154087 | 238 | 116430 | 87 | 42420 | 89833 | 8417 | 4169911 |
| 2008 | 8417 | 4169911 | 243 | 118269 | 202 | 98313 | -145618 | 8376 | 4004337 |
| 2009 | 8376 | 4004337 | 240 | 117234 | -71 | -34669 | 170372 | 8065 | 4022806 |
| 2010 | 8065 | 4022806 | 231 | 120547 | -521 | -272160 | 367008 | 7314 | 3997107 |
| 2011 | 7314 | 3997107 | 219 | 116765 | 289 | 154229 | -183736 | 7384 | 3850835 |
| 2012 | 7384 | 3850835 | 225 | 113449 | 444 | 224044 | -247291 | 7603 | 3714140 |
| 2013 | 7603 | 3714140 | 214 | 100512 | 586 | 275492 | -283223 | 7975 | 3605897 |
| 2014 | 7975 | 3605897 | 216 | 98776 | -23 | -10476 | 68703 | 7736 | 3565347 |
| 2015 | 7736 | 3565347 | 228 | 107418 | 89 | 42006 | 161814 | 7597 | 3661750 |
| 2016 | 7597 | 3661750 | 231 | 115283 | 55 | 27503 | 267031 | 7421 | 3841001 |
| 2017 | 7421 | 3841001 | 237 | 116014 | 1325 | 649444 | -438871 | 8510 | 3935559 |
| 2018 | 8510 | 3935559 | 227 | 106126 | 21 | 9836 | 73297 | 8303 | 3912566 |
| 2019 | 8303 | 3912566 | 214 | 102938 | 99 | 47608 | 167520 | 8188 | 4024756 |
| 2020 | 8188 | 4024756 | 227 | 117007 | 29 | 14894 | 386527 | 7990 | 4309170 |
| 2021 | 7990 | 4309170 | 231 | 129477 | 89 | 49867 | 339448 | 7848 | 4569007 |

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value of petroleum resources is estimated by using 4% as annual real rate of return to produced capital and 4% as annual real discount rate (see Liu and Midttun, 2025).

**Table A2. Asset account for Norwegian petroleum resources in both quantity ($Sm^3$ o. e. million) and value (current prices, NOK million) (estimated by using 7% as annual real rate of return to produced capital and 7% as annual real discount rate), 1970-2021**

| | Opening stock | | - Depletion | | + Other changes | | + Revaluation | = Closing stock | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Quantity | Value | Quantity | Value | Quantity | Value | Value | Quantity | Value |
| 1970 | 9041 | 98260 | 0 | 0 | 0 | 0 | 14725 | 9041 | 112985 |
| 1971 | 9041 | 112985 | 0 | 5 | 0 | 0 | 16913 | 9040 | 129893 |
| 1972 | 9040 | 129893 | 2 | 30 | 0 | 0 | 20485 | 9038 | 150348 |
| 1973 | 9038 | 150348 | 2 | 34 | 0 | 0 | 28232 | 9036 | 178546 |
| 1974 | 9036 | 178546 | 2 | 44 | 0 | 0 | 35593 | 9034 | 214096 |
| 1975 | 9034 | 214096 | 11 | 282 | 0 | 0 | 35753 | 9023 | 249566 |
| 1976 | 9023 | 249566 | 16 | 485 | 0 | 0 | 39978 | 9007 | 289060 |
| 1977 | 9007 | 289060 | 19 | 670 | 0 | 0 | 45654 | 8988 | 334043 |
| 1978 | 8988 | 334043 | 35 | 1382 | 0 | 0 | 35991 | 8952 | 368652 |
| 1979 | 8952 | 368652 | 45 | 1975 | 0 | 0 | 52542 | 8908 | 419220 |
| 1980 | 8908 | 419220 | 56 | 2826 | 0 | 0 | 54808 | 8851 | 471201 |
| 1981 | 8851 | 471201 | 55 | 3099 | 0 | 0 | 55105 | 8796 | 523207 |
| 1982 | 8796 | 523207 | 55 | 3419 | 0 | 0 | 48749 | 8741 | 568537 |
| 1983 | 8741 | 568537 | 62 | 4131 | 0 | 0 | 36493 | 8680 | 600898 |
| 1984 | 8680 | 600898 | 69 | 4917 | 0 | 0 | 27780 | 8611 | 623761 |
| 1985 | 8611 | 623761 | 73 | 5480 | 0 | 0 | 39337 | 8537 | 657618 |
| 1986 | 8537 | 657618 | 79 | 6555 | 0 | 0 | 103973 | 8458 | 755037 |
| 1987 | 8458 | 755037 | 90 | 8557 | 0 | 0 | 106232 | 8369 | 852712 |
| 1988 | 8369 | 852712 | 98 | 10756 | 0 | 0 | 127136 | 8271 | 969092 |
| 1989 | 8271 | 969092 | 120 | 14915 | 0 | 0 | 116688 | 8151 | 1070866 |
| 1990 | 8151 | 1070866 | 126 | 17353 | 0 | 0 | 109751 | 8025 | 1163264 |
| 1991 | 8025 | 1163264 | 139 | 21082 | 0 | 0 | 106356 | 7886 | 1248538 |
| 1992 | 7886 | 1248538 | 156 | 24446 | 925 | 145332 | -18601 | 8655 | 1350822 |
| 1993 | 8655 | 1350822 | 163 | 26329 | 236 | 38092 | 88101 | 8728 | 1450686 |
| 1994 | 8728 | 1450686 | 184 | 31222 | 567 | 96326 | 67288 | 9111 | 1583078 |
| 1995 | 9111 | 1583078 | 197 | 35557 | 222 | 40070 | 123443 | 9136 | 1711034 |
| 1996 | 9136 | 1711034 | 226 | 41046 | 1482 | 268900 | -114686 | 10392 | 1824201 |
| 1997 | 10392 | 1824201 | 234 | 42292 | 352 | 63644 | 113098 | 10510 | 1958651 |
| 1998 | 10510 | 1958651 | 228 | 44244 | 404 | 78362 | 158727 | 10686 | 2151496 |
| 1999 | 10686 | 2151496 | 230 | 48798 | 57 | 12076 | 231687 | 10513 | 2346461 |
| 2000 | 10513 | 2346461 | 241 | 53673 | 521 | 115967 | -15312 | 10793 | 2393444 |
| 2001 | 10793 | 2393444 | 252 | 56934 | 33 | 7493 | 96369 | 10574 | 2440373 |
| 2002 | 10574 | 2440373 | 258 | 62145 | -90 | -21589 | 204090 | 10226 | 2560729 |
| 2003 | 10226 | 2560729 | 262 | 70659 | -826 | -222998 | 379917 | 9139 | 2646989 |
| 2004 | 9139 | 2646989 | 264 | 78177 | -35 | -10280 | 112768 | 8840 | 2671300 |
| 2005 | 8840 | 2671300 | 258 | 77653 | 183 | 55064 | -12357 | 8765 | 2636354 |
| 2006 | 8765 | 2636354 | 249 | 74077 | 52 | 15481 | -59794 | 8568 | 2517964 |
| 2007 | 8568 | 2517964 | 238 | 70115 | 87 | 25546 | 21714 | 8417 | 2495109 |
| 2008 | 8417 | 2495109 | 243 | 69589 | 202 | 57846 | -168604 | 8376 | 2314763 |
| 2009 | 8376 | 2314763 | 240 | 67788 | -71 | -20047 | 99800 | 8065 | 2326729 |
| 2010 | 8065 | 2326729 | 231 | 69531 | -521 | -156980 | 199481 | 7314 | 2299699 |
| 2011 | 7314 | 2299699 | 219 | 66348 | 289 | 87636 | -161638 | 7384 | 2159350 |
| 2012 | 7384 | 2159350 | 225 | 62561 | 444 | 123549 | -209038 | 7603 | 2011300 |
| 2013 | 7603 | 2011300 | 214 | 53665 | 586 | 147089 | -209143 | 7975 | 1895580 |
| 2014 | 7975 | 1895580 | 216 | 51580 | -23 | -5471 | 11077 | 7736 | 1849606 |
| 2015 | 7736 | 1849606 | 228 | 56300 | 89 | 22017 | 122628 | 7597 | 1937950 |
| 2016 | 7597 | 1937950 | 231 | 62334 | 55 | 14871 | 227398 | 7421 | 2117885 |
| 2017 | 7421 | 2117885 | 237 | 64483 | 1325 | 360976 | -207371 | 8510 | 2207006 |
| 2018 | 8510 | 2207006 | 227 | 59372 | 21 | 5503 | 30619 | 8303 | 2183756 |
| 2019 | 8303 | 2183756 | 214 | 58118 | 99 | 26879 | 144723 | 8188 | 2297240 |
| 2020 | 8188 | 2297240 | 227 | 68560 | 29 | 8727 | 347106 | 7990 | 2584514 |
| 2021 | 7990 | 2584514 | 231 | 77805 | 89 | 29966 | 213748 | 7848 | 2750423 |

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value of petroleum resources is estimated by using 7% as annual real rate of return to produced capital and 7% as annual real discount rate (see Liu and Midttun, 2025).

# Appendix B: Alternative way for registering the Norwegian special income taxes

**Table B1. Allocation of primary income account for 2021 (current prices, NOK million) – using alternative way for registering the Norwegian special income taxes**

| | | Uses | | | Resources | | |
|---|---|---|---|---|---|---|---|
| Code | Transactions and balancing items | S11 | S13 | S1 | S11 | S13 | S1 |
| B2g | Operating surplus, gross | | | | 1589252 | 149366 | 2090331 |
| | Updated B2g | | | | *1595390* | 149366 | *2096469* |
| B2n | *Operating surplus, net* | | | | 1146055 | 0 | 1342762 |
| | *Updated B2n* | | | | *1152193* | 0 | *1348900* |
| | *Depletion-adjusted net operating surplus* | | | | *1017568* | 0 | *1214275* |
| D1 | Compensation of employees | | | | | | 1815469 |
| D2-D3 | Net (of subsidies) taxes on production and imports | | | | | 389588 | 389588 |
| | Change due to specific taxes | | | | | *-6138* | *-6138* |
| | Updated D2-D3 | | | | | *383450* | *383450* |
| D4 | Property income | 1012460 | 18816 | 1409878 | 528382 | 514181 | 1513150 |
| | Change due to specific taxes | *+6138* | | *+6138* | | *+6138* | *+6138* |
| | Updated D4 | *1018598* | 18816 | *1416016* | 528382 | *520319* | *1519288* |
| | Depletion borne by government | | *+94238* | *+94238* | *+94238* | | *+94238* |
| | Adjusted by split-depletion | *1018598* | *113054* | *1510254* | *622620* | *520319* | *1613526* |
| B5g | Balance of primary income, gross / National income, gross | 1105174 | 1034319 | 4398660 | | | |
| | Updated B5g | *1105174* | *1034319* | *4398660* | | | |
| B5n | *Balance of primary income, net / National income, net* | 661977 | 884953 | 3651091 | | | |
| | *Updated B5n* | *661977* | *884953* | *3651091* | | | |
| | *Depletion-adjusted net balance of primary income* | *621590* | *790715* | *3516466* | | | |

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

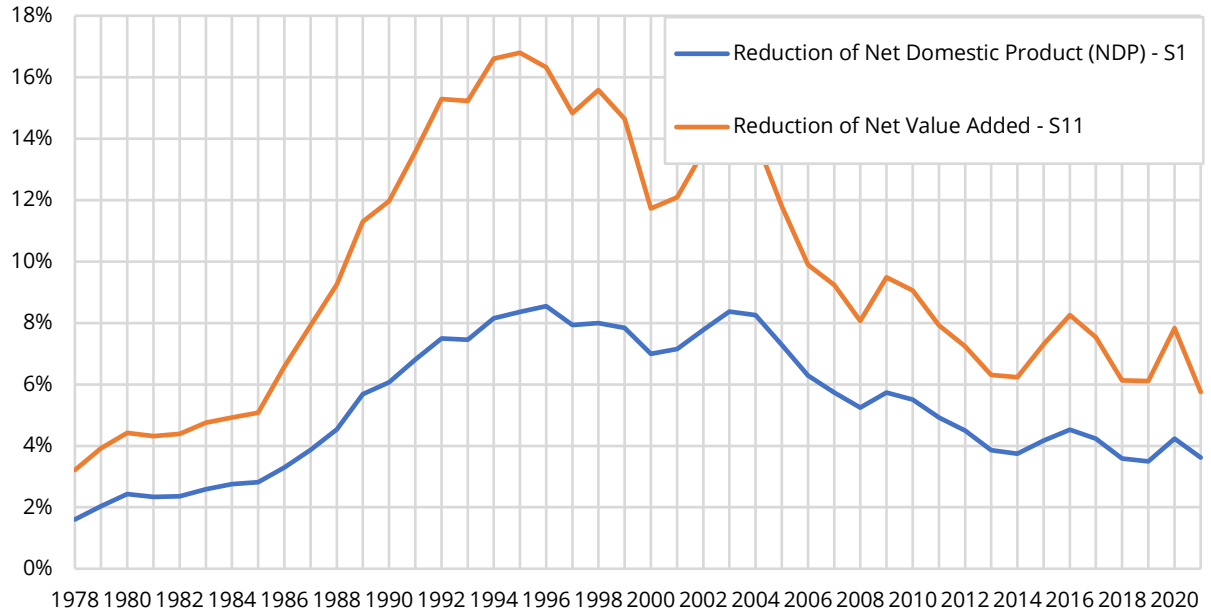
**Table B2. Secondary distribution of income account for 2021 (current prices, NOK million) – using alternative way for registering the Norwegian special income taxes**

| | | Uses | | | Resources | | |
|---|---|---|---|---|---|---|---|
| Code | Transactions and balancing items | S11 | S13 | S1 | S11 | S13 | S1 |
| B5g | Balance of primary income, gross / National income, gross | | | | 1105174 | 1034319 | 4398660 |
| B5n | *Balance of primary income, net / National income, net* | | | | 661977 | 884953 | 3651091 |
| | *Depletion-adjusted net balance of primary income* | | | | *621590* | *790715* | *3516466* |
| | Current transfers | 389096 | -612881 | 67817 | | | |
| B6g | Disposable income, gross | 716078 | 1647200 | 4330843 | | | |
| B6n | *Disposable income, net* | 272881 | 1497834 | 3583274 | | | |
| | *Depletion-adjusted net disposable income* | *232494* | *1403596* | *3448649* | | | |

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using an estimated annual nominal rate of return to produced capital and an annual real discount rate of 4% (see Liu and Midttun, 2025).

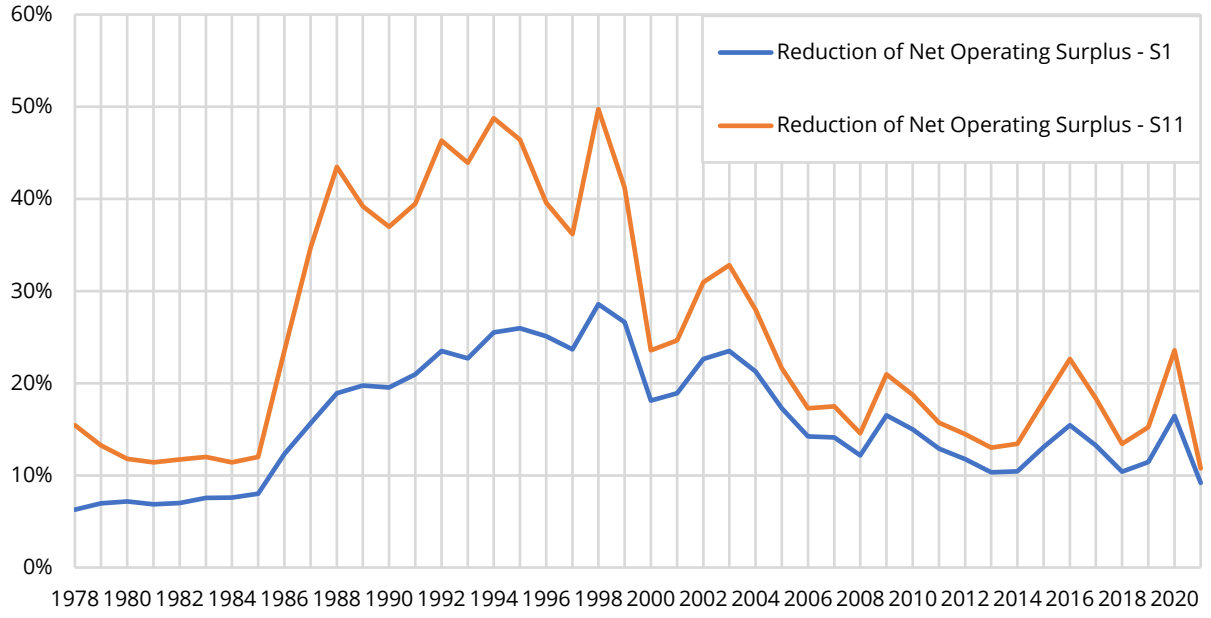
# Appendix C: Impact on headline indicators (rr=4%, r=4%)

**Figure C1. Impact on net value added and net domestic product (NDP) (%), 1978-2021**



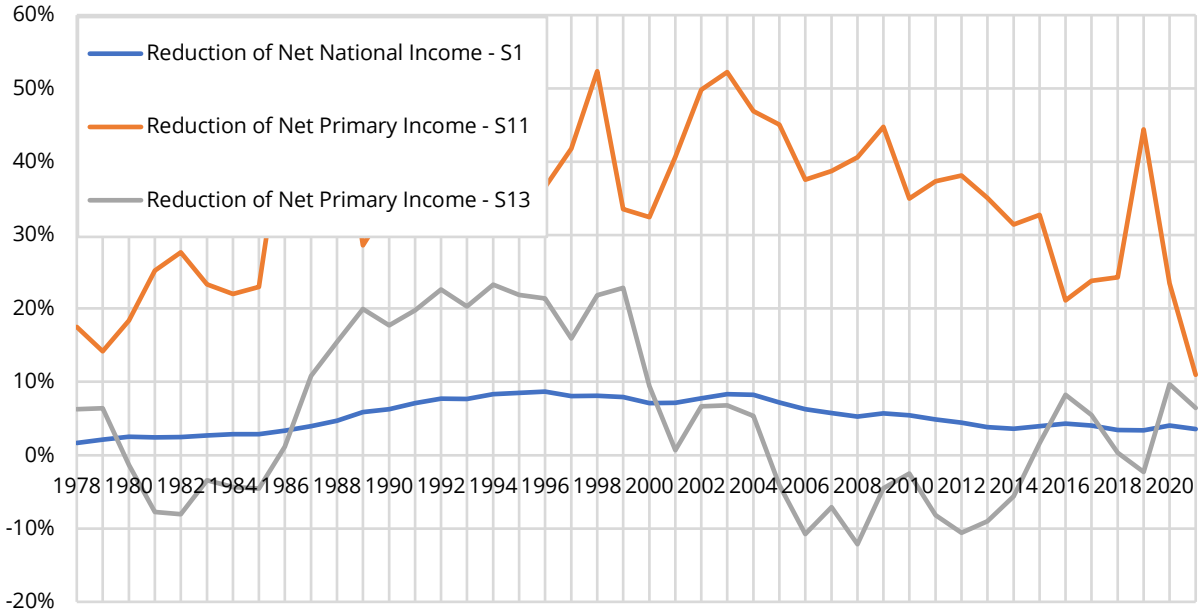

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 4% as annual real rate of return to produced capital and 4% as annual real discount rate (see Liu and Midttun, 2025).

**Figure C2. Impact on net operating surplus (NOS) (%), 1978-2021**



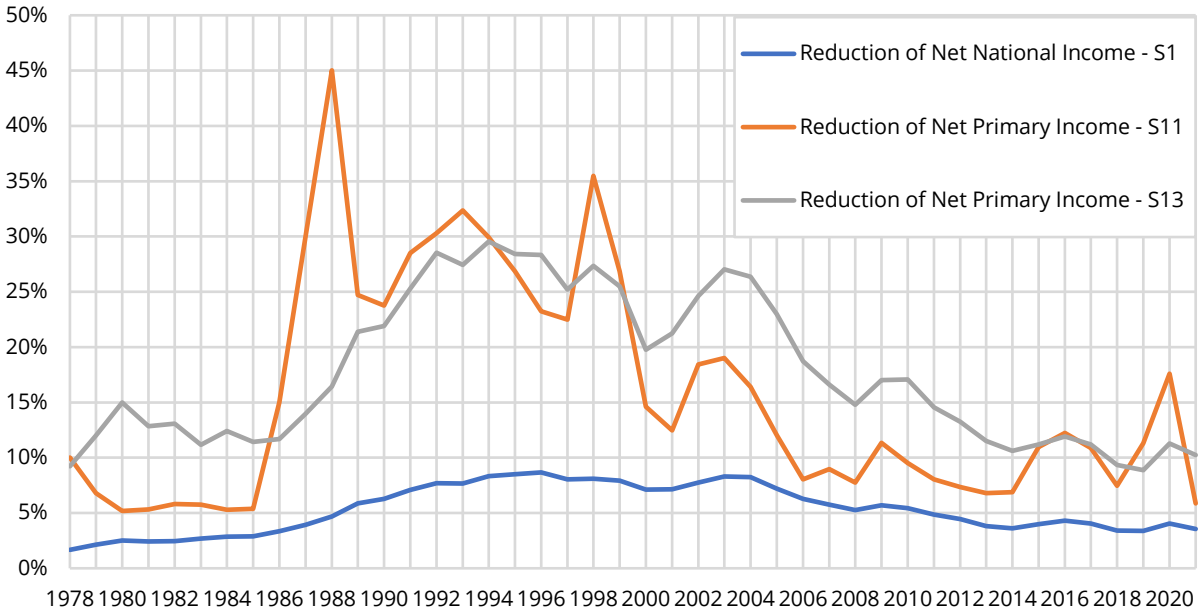

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 4% as annual real rate of return to produced capital and 4% as annual real discount rate (see Liu and Midttun, 2025).

**Figure C3a. Impact on net primary income and net national income (NNI) (%), 1978-2021**



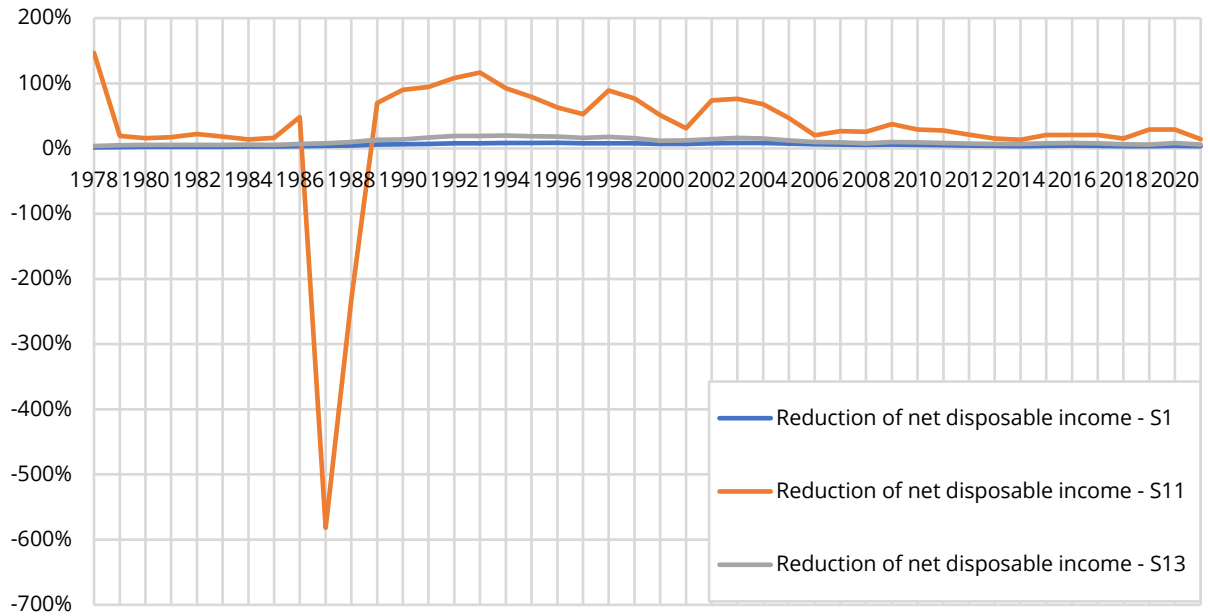

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 4% as annual real rate of return to produced capital and 4% as annual real discount rate (see Liu and Midttun, 2025).

**Figure C3b. Impact on net primary income and net national income (NNI) (%), 1978-2021, using alternative way for registering special income taxes**



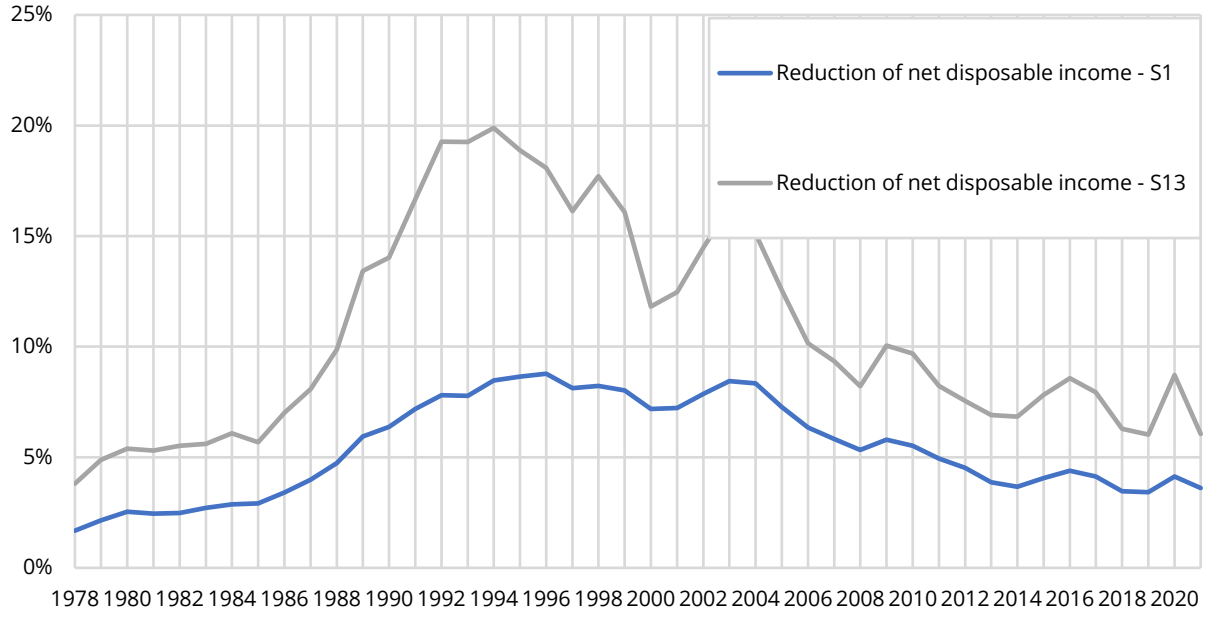

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 4% as annual real rate of return to produced capital and 4% as annual real discount rate (see Liu and Midttun, 2025).

**Figure C4a. Impact on net disposable income (%), 1978-2021**



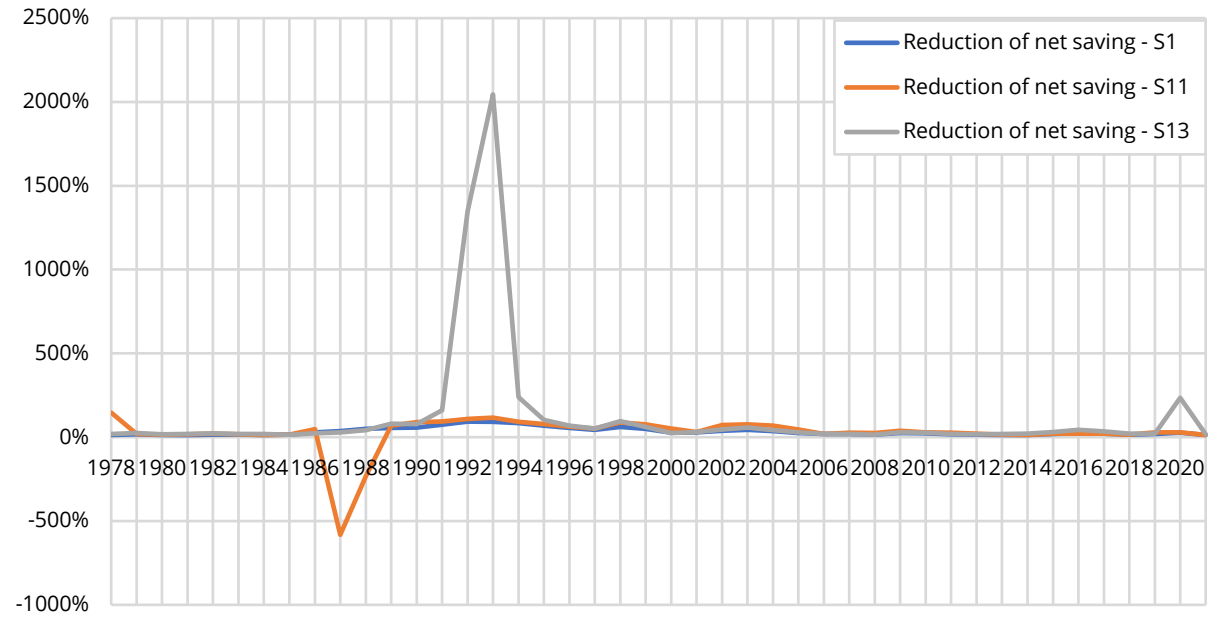

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 4% as annual real rate of return to produced capital and 4% as annual real discount rate (see Liu and Midttun, 2025).

**Figure C4b. Impact on net disposable income (%), 1978-2021**



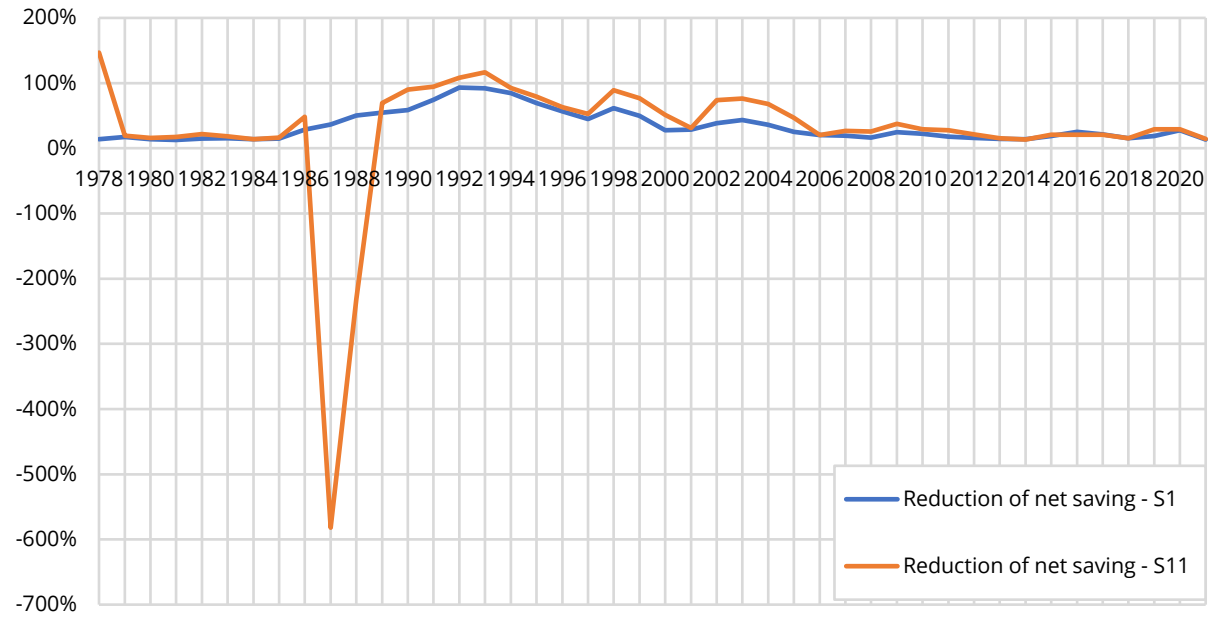

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 4% as annual real rate of return to produced capital and 4% as annual real discount rate (see Liu and Midttun, 2025).

**Figure C5a. Impact on net saving (%), 1978-2021**



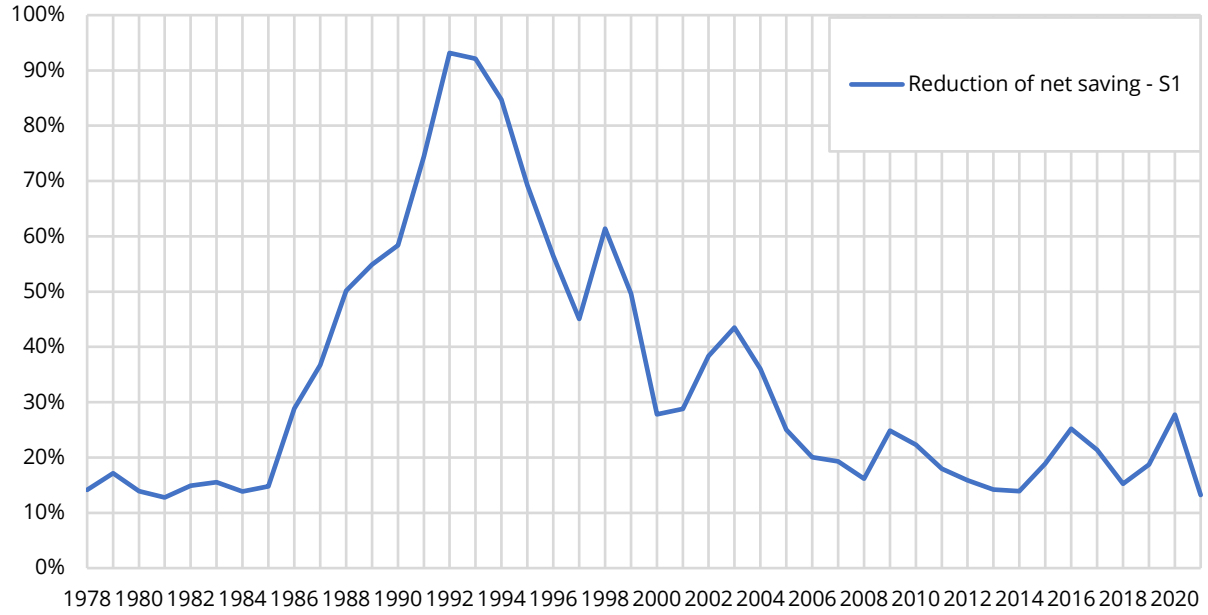

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 4% as annual real rate of return to produced capital and 4% as annual real discount rate (see Liu and Midttun, 2025).

**Figure C5b. Impact on net saving (%), 1978-2021**




Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 4% as annual real rate of return to produced capital and 4% as annual real discount rate (see Liu and Midttun, 2025).

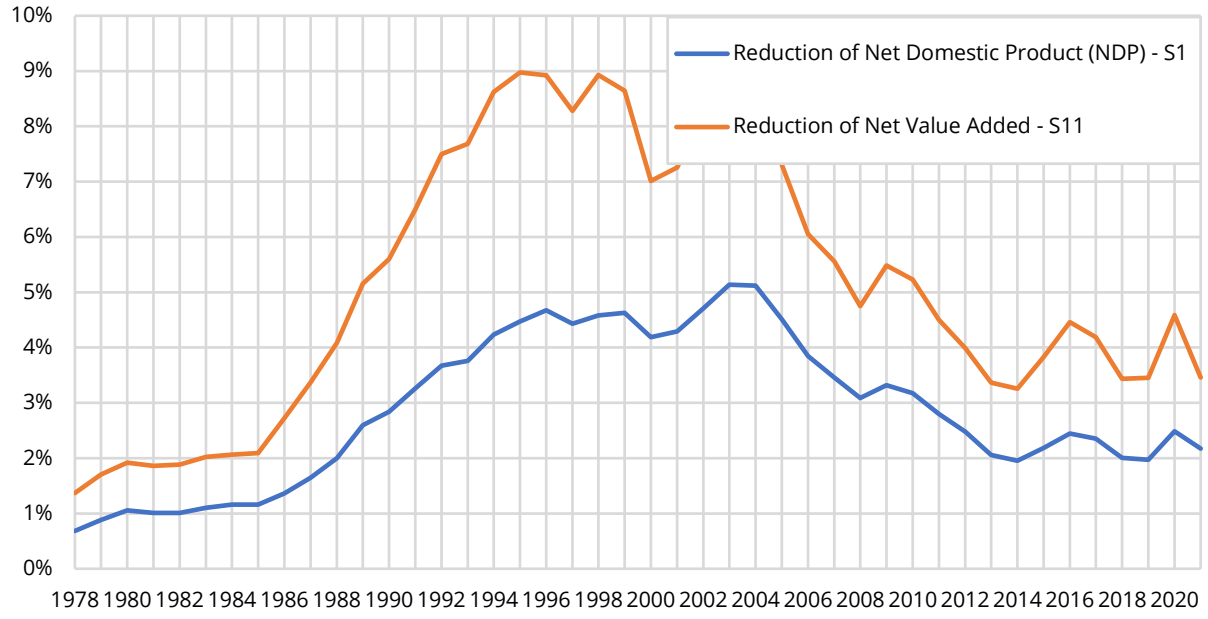
**Figure C5c. Impact on net saving (%), 1978-2021**




Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 4% as annual real rate of return to produced capital and 4% as annual real discount rate (see Liu and Midttun, 2025).

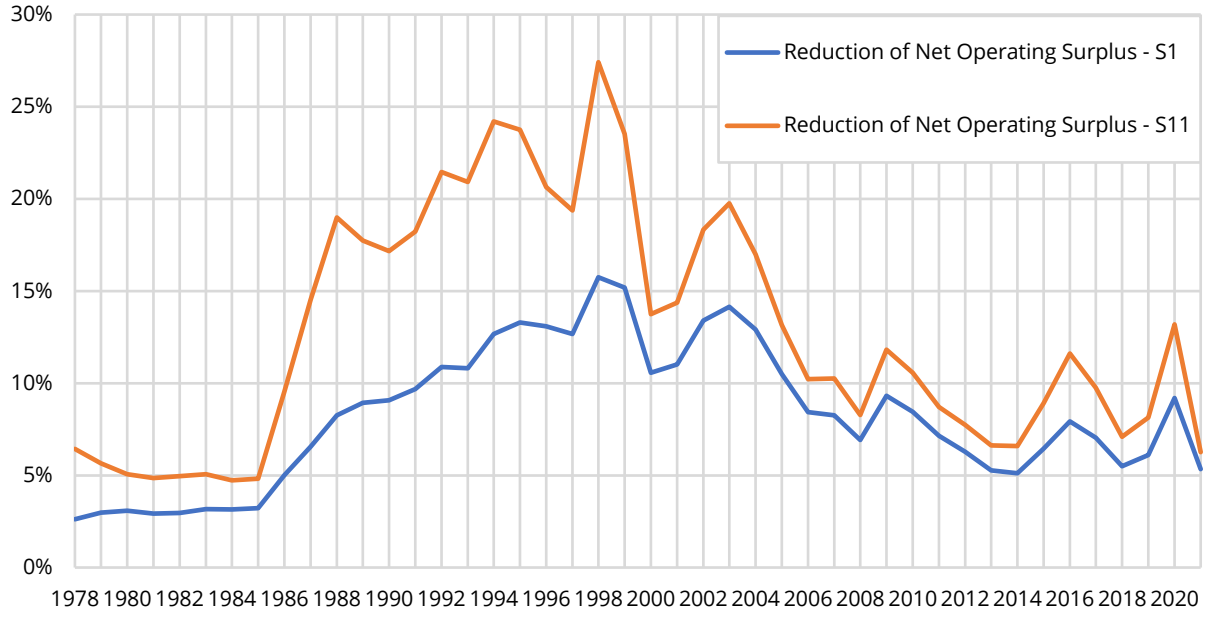
# Appendix D: Impact on headline indicators (rr=7%, r=7%)

**Figure D1. Impact on net value added and net domestic product (NDP) (%), 1978-2021**



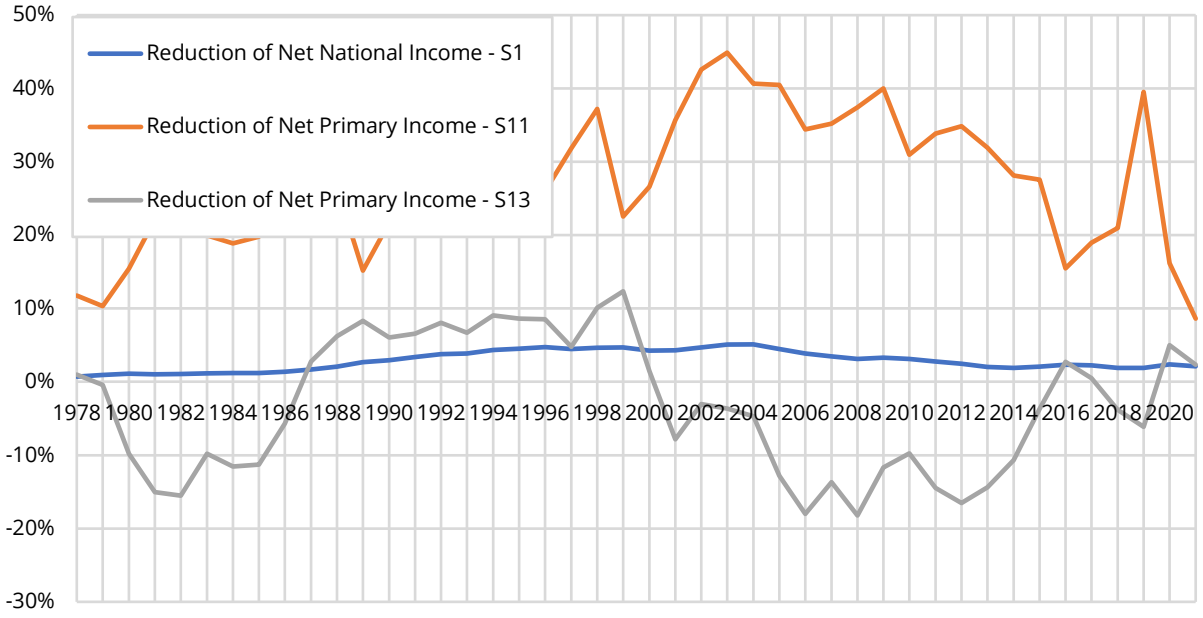

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 7% as annual real rate of return to produced capital and 7% as annual real discount rate (see Liu and Midttun, 2025).

**Figure D2. Impact on net operating surplus (NOS) (%), 1978-2021**



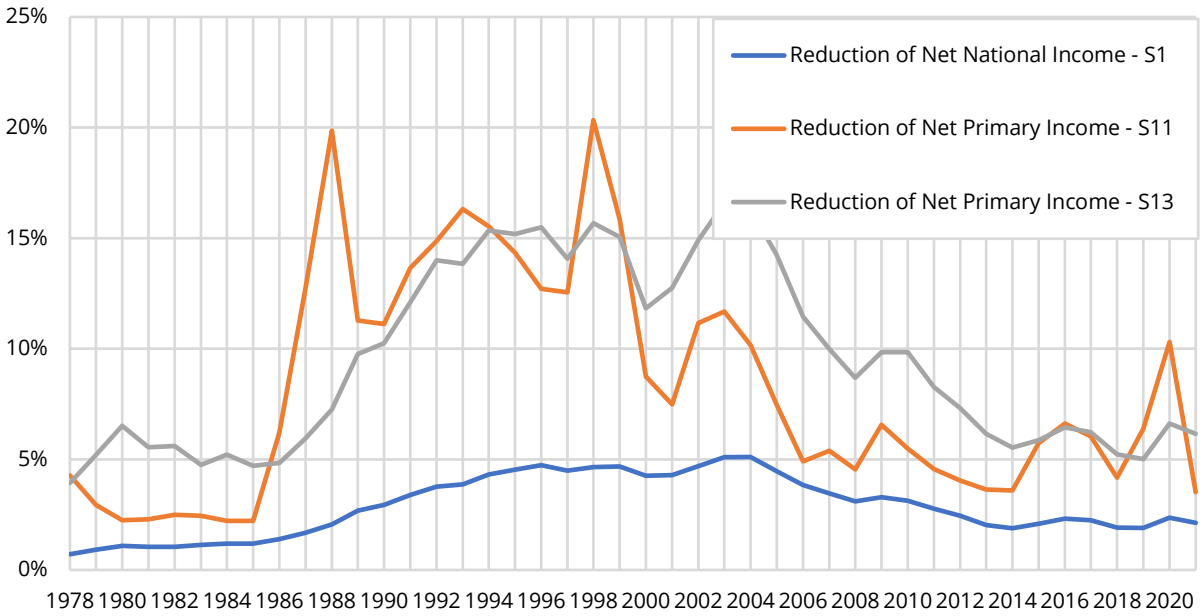

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 7% as annual real rate of return to produced capital and 7% as annual real discount rate (see Liu and Midttun, 2025).

**Figure D3a. Impact on net primary income and net national income (NNI) (%), 1978-2021**



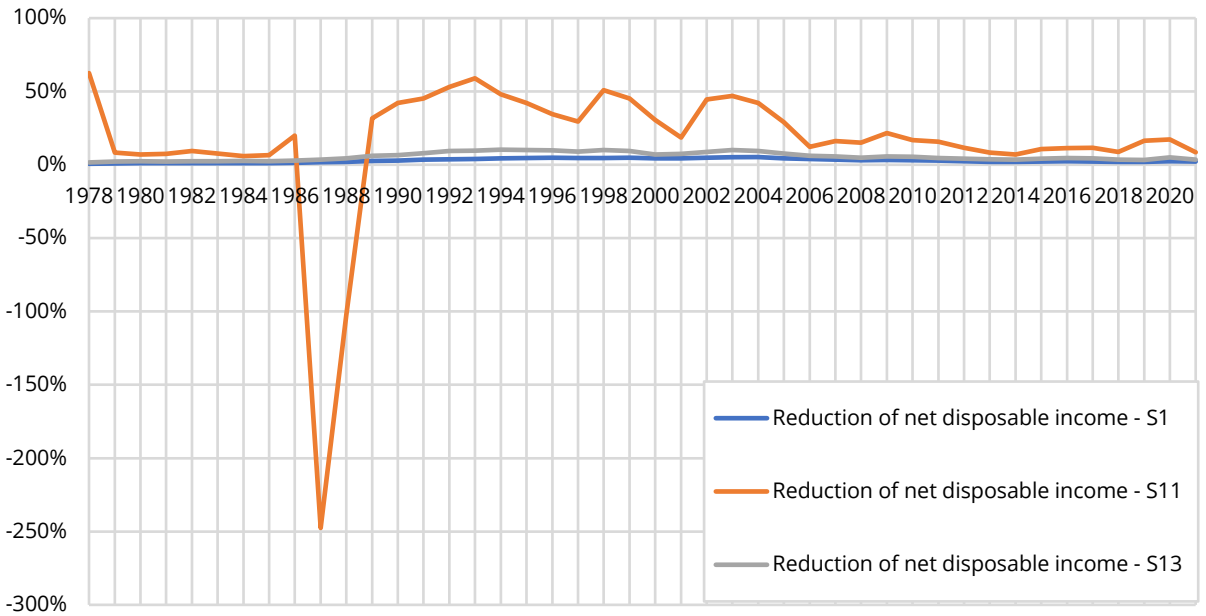

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 7% as annual real rate of return to produced capital and 7% as annual real discount rate (see Liu and Midttun, 2025).

**Figure D3b. Impact on net primary income and net national income (NNI) (%), 1978-2021, using alternative way for registering special income taxes**



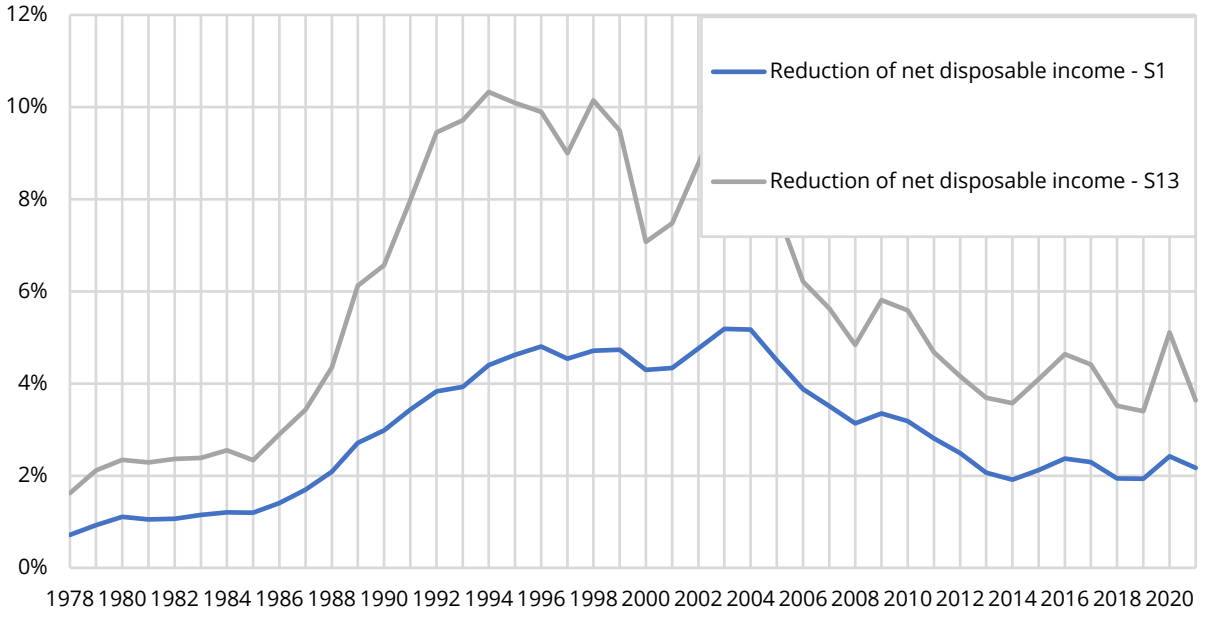

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 7% as annual real rate of return to produced capital and 7% as annual real discount rate (see Liu and Midttun, 2025).

**Figure D4a. Impact on net disposable income (%), 1978-2021**



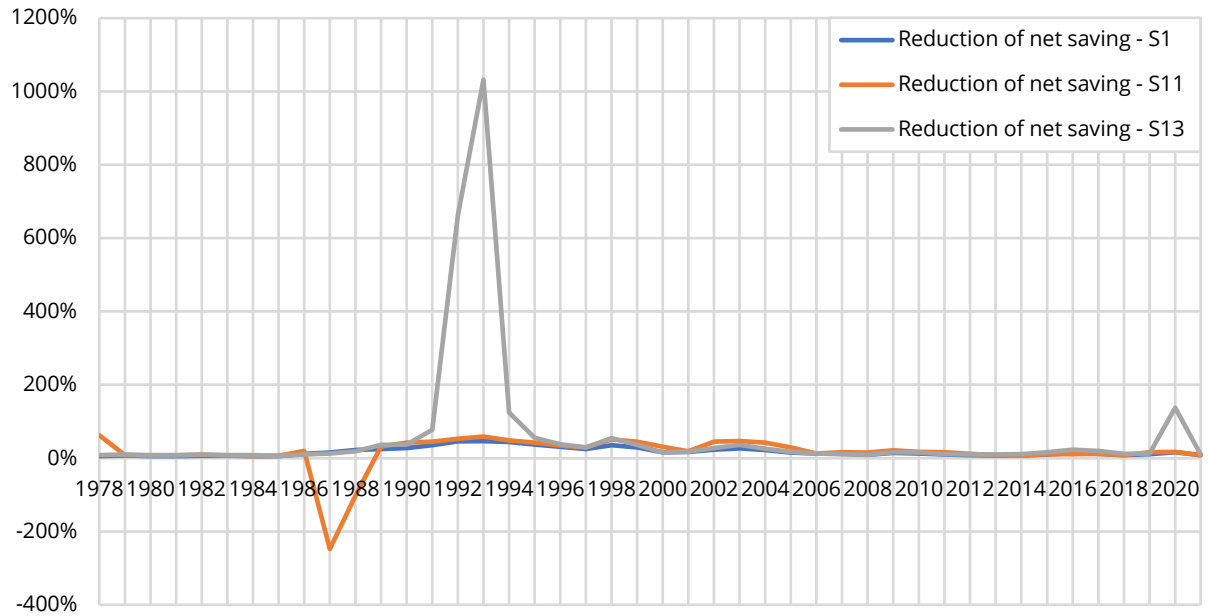

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 7% as annual real rate of return to produced capital and 7% as annual real discount rate (see Liu and Midttun, 2025).

**Figure D4b. Impact on net disposable income (%), 1978-2021**



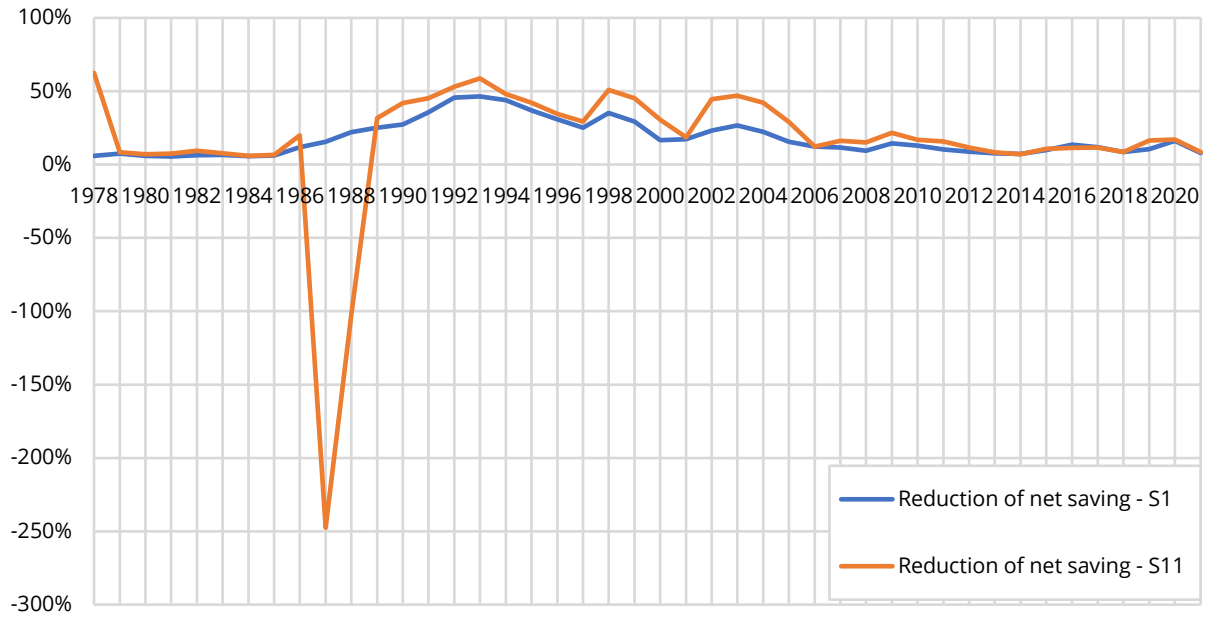

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 7% as annual real rate of return to produced capital and 7% as annual real discount rate (see Liu and Midttun, 2025).

**Figure D5a. Impact on net saving (%), 1978-2021**



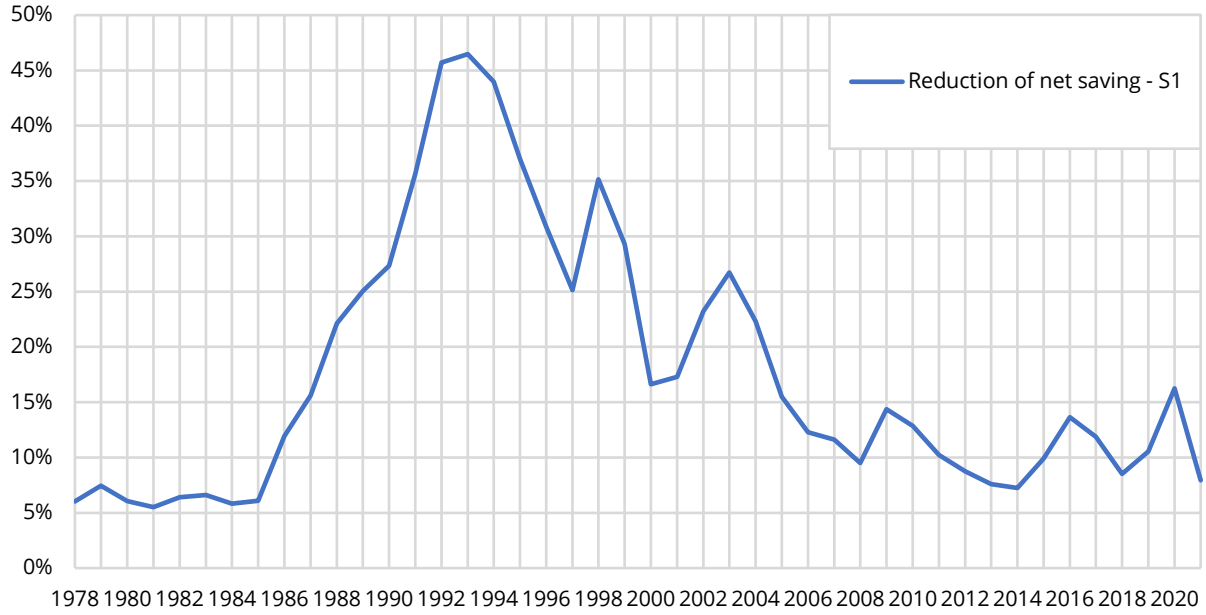

Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 7% as annual real rate of return to produced capital and 7% as annual real discount rate (see Liu and Midttun, 2025).

**Figure D5b. Impact on net saving (%), 1978-2021**




Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 7% as annual real rate of return to produced capital and 7% as annual real discount rate (see Liu and Midttun, 2025).

**Figure D5c. Impact on net saving (%), 1978-2021**




Source: Authors' own calculation based on data from Statistics Norway and the Norwegian Offshore Directorate.
Note: The asset value and depletion of petroleum resources are estimated by using 7% as annual real rate of return to produced capital and 7% as annual real discount rate (see Liu and Midttun, 2025).