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Subsoil asset accounting – the path forward

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Content

1 Introduction

Subsoil asset accounts show opening and closing stocks of subsoil assets as well as all the changes, which link the two stocks. SEEA 2003 chapters 7 and 8 describe the general principles for physical and monetary subsoil asset accounting and explain how the SEEA subsoil asset accounts relate to the SNA93. Furthermore, SEEA 2003 lists many of the theoretical and practical problems associated with the construction of the accounts. Subsoil assets are rather roughly divided into fossil fuels, metallic minerals, and non-metallic minerals.

Our purpose with this paper is first to summarise some of the outstanding problems related to physical and monetary asset accounting and its use. For most of the problems we have mentioned, more detailed descriptions can be found in SEEA 2003. In the next sections, where we summarise the problems, which meet the constructor of subsoil asset accounts, we have posed some questions. We don't expect these questions to be answered at the meeting or immediately after. Instead, we suggest that participants consider which questions they – from their actual experience - see as the most important ones to deal with in relation to subsoil asset accounting.

Secondly, we propose towards the end of the paper that one path forward with respect to subsoil asset accounting is to focus on a survey of country experiences with regard to how the countries have solved some of the problems as well as to how the accounts are used and linked to other frameworks. Also the aspect of knowledge sharing is taken up in the last section of this paper.

The content in this paper is limited to subsoil asset accounts as described in SEEA 2003 chapters 7 and 8. This means that depletion adjusted flow accounts are not dealt with. However, there is of course a link between the asset accounts and the flow accounts which must be kept in mind. Also the ongoing work by, e.g. the Canberra Group on measurements of non-financial assets and the revision of SNA93 must of course be kept in mind, when the path forward for subsoil asset accounts is addressed.

2 Physical subsoil asset accounts

A physical subsoil asset account can in principle include all resources, irrespectively of the prospects for extraction.

In practice, however, the asset accounts might be more limited in scope. Different approaches used by the national geological institutes, etc. will affect the scope of the accounts. The physical reserves are normally grouped in different categories, i.e. proven, probable, possible and potential reserves. In some cases, probabilities for extraction are used to categorize and allocate the reserves into the different categories (for instance: proven reserves as those reserves which are going to be extracted with a probability of more than 90 per cent). In other cases, an administrative approach using various types of concessions for actual extraction, planned extraction, and potential extraction is used. In addition to these reserves the stocks may also include hypothetical resources, for which the geologic and economic prospects are quite uncertain.

Would it - for assessment of the international comparability of physical subsoil asset accounts - be interesting to analyze the various approaches to delimitation of the resources and to see how the institutional conditions influence the accounting in various countries?

Can we obtain a more harmonized grouping and (more detailed) classification of subsoil assets?

To what extent is the physical accounting carried out, because it is the first step in the direction of monetary accounting, and to what extent is it an interesting accounting approach in itself?

To the extent that physical accounting is interesting in itself (irrespectively of the economic accounts), what are the actual uses of the physical accounts? Which actual indicators can be derived from the accounts and what are the uses of these?

Most work seems so far to have been performed on oil and gas. Are there any fundamental differences in the physical accounting when it comes to other kinds of subsoil assets?

3 Monetary subsoil asset accounts

3.1 Valuation of the subsoil stocks – market (SNA 93) valuation

Two groups of stock valuation methods exist: *Direct and indirect valuation.*

Direct valuation involves the use of observed market transactions in (the few) cases where those exist. The possibilities for using direct observation of market prices are limited, as there are few market transactions of subsoil assets.

Another kind of direct valuation method involves the observation of payments of specific taxes, royalties, etc. as an indicator of the resource rent obtained from the resource. There seems, however, to be quite a few examples of the use of this approach and further work is probably needed to verify whether this is a generally good approach.

Indirect valuation involves the use of some form of calculation of net present value (NPV) of future resource rent. This is the most widespread method in use. In the following sections, focus is therefore directed at problems and issues which relate to the NPV valuation method.

Apart from the technical aspects of the NPV method, it might be useful to consider and compare results of the direct and indirect methods.

Would it be possible to find or establish accounts, from which it is possible to compare the results of direct and indirect valuation methods?

In principle, the direct valuation method can include the option value of non-reserve resources (as well as a value component stemming from mineral exploration activities). If - and how – the option value component is taken into account by the NPV method seems unclear.

Can we say anything about the importance/magnitude of the option value?

3.1.1 Value of stock calculated by NPV of future resource rent – general principle

The NPV method, calculates the market value as the sum of discounted expected future resource rents. The method involves estimation in physical terms of a future profile for the extraction of the asset and a monetary value for the resource rent per unit. The present value of the future resource rents are calculated by using a discount rate.

3.1.2 Delimitation of the physical stock, which is going to be valued

In principle, all resources over which ownership rights can be enforced and from which economic benefits may be derived, should be included in an asset account based on market valuation. SNA93 recommends that *proven* reserves are included, but actual examples indicate that *probable* or *possible* reserves could be included as well (in some cases weighted with the probability for extraction). This is probably in line with the fact that the non-proven part of the resources do have some market value, if not for any other reason than that the market does attach some option value to the resource. However, no uniform agreed approach on how to treat non-proven resources in relation to valuation seems to exist.

To what extent and how is the resource rent of non-proven resources calculated by different countries?

3.1.3 Resource rent calculation – PIM or capital service method

A standard method for the calculation of the resource rent is what SEEA 2003 calls the PIM-method:

Gross operating surplus
- consumption of fixed capital
- return to fixed capital
= resource rent

This method is for instance used in the Eurostat guidelines for a set of standard tables for subsoil assets (Eurostat, 1993).

When the PIM method is used, a precise estimate of the value of the stock of fixed capital is important since this determines the return to fixed capital. Also the choice of rate, which is used for calculating the return to fixed capital, is of course important.

Most countries use the net capital stock (net of accumulated consumption of fixed capital) valued at current market value of the capital stock.

However, there might be a problem with estimation of the capital stock by the PIM method. It may not be adjusted adequately for the fluctuations in the actual amount of capital used. Consequently, when mines close, the capital stock figures may become too high and this could reduce the rent of the

resource to a negative value. This has been the case for gold-mines in Canada where the rent is negative for many years.

An alternative way of applying the PIM method is the so-called capital service method:

Gross operating surplus
- capital services of produced assets
= resource rent

Whether the contribution to gross operating surplus from fixed capital is calculated by the PIM method or the capital service method is a question of what national accounts data are available, and as such the question can be regarded as a technical national accounting issue, which is treated by, e.g. the Canberra Group. In practice, those working with subsoil resource rent calculations have to consult their fixed capital experts to see what data are available and appropriate.

However, the London group might wish to look at actual calculations in order to see whether the data create problems for the resource rent calculations. Are there, for instance, other countries than Canada facing the problem with negative resource (see also section 3.1.8)?

3.1.4 Fixed capital and mineral exploration

According to SNA93 mineral exploration is regarded as part of fixed capital. This means that the value of mineral exploration is excluded from the resource rent and the value of the subsoil asset when the NPV method is used for valuation.

Alternatively, the value of the mineral exploration can be regarded as part of – or an input into - a developed and discovered natural asset (a produced asset), which includes the value of mineral exploration as well as the value of the subsoil asset itself. In this case, the value of the (developed) subsoil asset is higher and correspondingly no separate asset of "mineral exploration" exists.

The treatment of the mineral exploration is linked to the view on what constitutes the asset and what determines its value. Furthermore, it has implications for the accounting entries in the current and asset accounts.

It seems as if the SNA93 view (mineral exploration as a separate fixed asset) dominates, but since the discussion of alternatives still continues in, e.g. the Canberra Group*, the London group might wish to follow the discussion. If that is the case, it could be suggested to look at the results of the alternative accounting approaches, to compare those and to see what advantages and disadvantages these lead to*.

3.1.5 Decommissioning

Decommissioning costs (scrapping of oil rigs, etc.) can in principle be included as future costs in the NPV calculation. Inclusion of such costs will lower the resource rent and the total value of the stock of subsoil assets. SEEA

2003 recommends that the decommissioning costs are anticipated in terms of consumption of fixed capital over the whole time period and that the actual decommissioning costs are treated as fixed capital formation when they actually occur. Other possibilities are to make an immediate write-off in the consumption of fixed capital for the year in which the costs occurred or to treat the costs as intermediate consumption for the year in which these costs actually occurred.

Decommissioning costs seem to be an important economic aspect, which should be taken into account in one way or other.

Is there any country that has practical experiences with calculations for decommissioning costs?

3.1.6 Taxes/subsidies

If consumption of fixed capital is subtracted from gross operating surplus, net operating surplus is obtained, and the resource rent calculation of SEEA 2003 can be expressed as

Net operating surplus (NOS)
- return to produced assets
= resource rent

When the NOS is calculated, specific taxes on products and production are deducted. This means that the resource rent is lowered by the same amount.

The Eurostat guideline for subsoil asset accounts (Eurostat, 1993) mentions explicitly that specific taxes are considered as part of the resource rent (appropriated by government) and these taxes must therefore be added when the resource rent is calculated:

Net operating surplus (NOS)
+ specific taxes less subsidies on products
+ other specific taxes less subsidies on production
- return to produced assets
= resource rent

The treatment of the specific taxes in relation the valuation of the stock of subsoil assets is related to the distribution of the resource rent between owner and extractor and from which point of view the market value is regarded.

To what extent do countries treat specific taxes differently in relation to the resource rent calculations?

Would taxes and subsidies on subsoil asset be interesting in itself to make more explicit accounts for?

3.1.7 The discount rate

When the present value of a future income stream is calculated, the choice of discount rate has a major impact on the result.

As long as the valuation of subsoil assets are going to reflect market prices, market conditions and mainstream economic reasoning must be applied to the discount rate. However, the choice can be influenced by whether a business or government view is taken. A government or social discount rate is usually lower than a private business discount rate. For instance, the Eurostat guidelines for subsoil asset accounting (Eurostat, 1993) recommend that the discount rate should be a social rate of discount and state that a level of 4 percent is regarded as acceptable.

It would be interesting to compare which discount rates are used for NPV subsoil asset market valuation in various countries, and to try to assess the underlying arguments for the discount rate?

To what extent has sensibility analysis of the importance of the discount rate been carried out in connection with actual subsoil accounts?

3.1.8 Yearly fluctuations of the resource rent

Energy and mineral prices show yearly fluctuations that are much larger than the fluctuations in costs for intermediate consumption and capital use. Thus, rather large fluctuations in the current prices resource rent are normal from year to year. Problems with the volatility of prices can be mitigated by using fixed prices or resource rents averaged over a few years (e.g. three years average or weighted average).

In certain years a negative resource rents might also occur. One reason for a negative resource rent is that costs are fixed in the short run, while the energy or mineral prices are determined by world market prices. Alternatively, negative resource rent can indicate that the rate of return on fixed capital used in the estimates is too high or that the extraction industry receives subsidies or other kinds of government support. Also an inappropriate division of extraction costs between different subsoil assets (e.g. oil and gas), in the case of joint production (see next section), can in theory result in negative resource rents.

How are the fluctuations in resource rents and negative resource rents treated by countries? Can any recommendations be agreed upon concerning this issue?

3.1.9 Allocation of resource rents on products in the case of joint production

When two or more products are extracted from the same subsoil deposit by joint production, normally no separate data on the extraction costs for each product exist. Thus, assumptions on the allocation of costs or resource rents for each product have to be made.

How is the division of costs or resource rents by products best carried out? Is it appropriate or possible to harmonize the methods? The problem exists for oil and gas. Are there similar problems with mineral extraction?

3.1.10 Reserve/resource heterogeneity

In relation to the NPV-method it is normally assumed that all reserves are homogeneous in quality and costs. Thus, the future resource rent is calculated by multiplying the actual average unit resource rent by the expected extraction. However, for most sub-soil assets, the lowest costs and highest value resources are extracted first.

The heterogeneity problem can be overcome by calculating reserve values for each reserve class and then aggregating across reserve class, but this method is rather costly and the necessary data may not be available for reserves that have not yet been exploited.

How big is the problem with heterogeneity of resources? Do we have – or can we make - actual calculations showing the importance of using detailed calculations taking the variations in reserve quality and costs into account?

3.1.11 Valuation of the flows of subsoil assets

The changes in value between opening stock and closing stock are made up, first of all, by the values of discoveries, extraction, changes in extraction rate, as well as holding gains and losses. Based on the stock estimates, resource rent, physical stocks, the discount rate, etc. formulas for the value of these various flow components can be given. (cf. formulas in SEEA 2003, box 7.3 and Eurostat, 1993. p. 12). In other words, the change over a year can be decomposed into the effects of the various flows.

SEEA 2003 states that the"... decomposition is dependent on the order in which the effect of the changes in parameters are evaluated. A different ordering will give somewhat different results." (SEEA 2003 p. 287).

To what extent are the techniques for actual decomposing of the stock changes i.e. the valuation of the flows firmly established? And what are the techniques used and problems encountered by countries in actual estimation of these flows?

A special case in connection with the valuation of changes in subsoil assets is the treatment of depletion, i.e. the treatment of the decline in the value of the resource in connection with the income accounts in the SNA and satellite accounts. SEEA 2003 (chapter 10) touches on this issue, but does not come up with a clear solution. Examples of actual accounts do exist by now (see e.g. ABS (2002) and Hamilton (2003)).

Should the London Group have an input on the treatment of depletion in relation the upcoming process to revise the SNA?

3.2 Non-market valuation and sustainability

In principle, option values, bequest values and existence values could be included in a SEEA account in addition to the normal use values captured by NPV valuation. As mentioned, some – but probably not all - of these values might be captured by direct valuation of the assets. A first impression would be that the non-market values are marginal compared to the market values,

but it is a field in which not much research has been conducted, and thus some caution is appropriate before the issue is totally neglected.

When it comes to sustainability issues, it is very unclear if and how this could be reflected in the monetary asset (and flow) accounts. Traditionally, the issue is taken up in connection with the discussion of the choice of discount rate used for the NPV-valuation. From a sustainability point of view it is often argued that a lower discount rate compared with a market based discount rate should be used. Even a zero discount rate is sometimes suggested. This is a discussion which goes far beyond the subsoil asset accounts, and no consensus and obvious solution exist.

At the moment, the general (stronger) sustainability issues are probably most conveniently dealt with through the physical accounts showing the developments (and maybe including quality aspects) in asset stocks.

What possibilities are there for using the subsoil asset accounts for sustainability analysis? Do countries have experiences/examples of such use of the accounts?

What demands do sustainability analysis raise in relation to the accounts?

Related to this is the question of the link to the depletion adjusted flow accounts (cf. SEEA 2003, chapter 10), which by some are regarded as a step towards (weak) sustainability indicators.

How will the development and decisions taken on the depletion adjusted accounts affect the demands toward the subsoil asset accounts?

4 Ideas for path forward

Both physical and monetary subsoil asset accounts seem to be well-developed when it comes to their general form and the general methods to be used for estimating the various accounting items. A rather high number of countries have implemented subsoil asset accounts. However, when it comes to some of the practical problems associated with the implementation and estimation it seems as though somewhat different solutions have been used in different countries. Moreover, when it comes to the choice of, e.g. discount rate, rate of return to capital, delimitation of the resource and the other factors mentioned above, it seems as though practices vary between countries. There are probably good reasons for these deviations between countries – either because conditions differ or because the view on what the accounts should be used for varies.

We think that most of the problems are well-known. Therefore, the work with subsoil asset accounts is at a point, when it is time to closely **compare the different country approaches to problem-solving from a practical point of view**. *What choices have been made in different countries? What are the arguments behind the choices made? What is the effect of the choices made?* And probably most important of all: *What does it mean for the actual or potential use of the accounts?*

To the extent possible such a comparison should include results from sensibility analysis carried out in the countries concerning the importance of various parameters.

Such a comparison would serve at least two purposes: one is to bring us closer to a practical solution and pragmatic approach to the many questions raised in the previous sections. The other is to give us an idea of the state of art when it comes to present international comparability of existing accounts. Such a comparison might also give ideas to whether it is appropriate to work in the direction of a more detailed and harmonized classification of subsoil assets.

Furthermore, we feel that **systemised knowledge sharing** should be an issue. From practical experience we know that it is rather confusing to start constructing a subsoil asset account for the first time, because of the many choices that must be made. One element in the work with surveying country experiences could be to produce an overview end maybe even recommendations for practical solutions to the many questions encountered by the constructor of subsoil asset accounts. Elements from the Eurostat guidelines (Eurostat, 1993) and the SEEA Operational Manual (UN, 2000) can serve as important input to such a work.

Furthermore, an important point for future work is the **use and analysis of the subsoil asset accounts**. It is important to observe user needs, whether these are by colleagues, who use parts of the assets accounts for the construction of flow account or by researchers, analysts or officials who uses the information directly. In relation to this, the question thus arising is how the gap between accounts and indicators can best be bridged. Furthermore, the issue of how the asset accounts can be combined with other accounts and information (e.g. other asset accounts, tax payments) could be interesting to look at.

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