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Accounting for the value of time passing and the depletion of natural resources

Reconsideration and some suggestions

Ole Gravgård Pedersen

Statistics Denmark
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Content

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1. Introduction

1. The March 2007 meeting of the London Group in Johannesburg took a unanimous position on certain fundamental elements of the treatment of depletion of natural resources. This position was presented in an outcome paper (Van Halderen, 2007), which the UNCEEA agreed with at its meeting in July 2007. The UNCEEA recommended, however, the strengthening of the arguments put forward in the paper (UN 2007, p. 6).

2. Since then, work with the construction of the SEEA-Energy accounting system for stocks and flows of energy resources has made this author to doubt whether the agreed treatment of depletion is consistent with the creation of a logical accounting system with an intuitive explanation of the accounting items and the numbers recorded in the accounts.

3. The doubt is related to the interpretation of - and accounting for - the so-called time passing element. The time passing element occurs when the net present value method, NPV, is used for measuring the value of the stock of an exhaustible natural resource. The time passing element results in an increasing natural resource stock value in each and every period because future income comes closer. It is the time passing element, which leads to the possibility of calculating a cost of using up the resource, which is lower than the surplus, i.e. the resource rent, resulting from the extraction activity. This lower cost charged against the production does in turn lead to the possibility to account for a return to natural capital/income from production (equal to the time passing element), which can then be entered into the depletion adjusted income accounts.

4. This paper presents a summary of the agreed approach[1] and points at some seemingly shortcomings and illogical characteristics inherent in the approach. Furthermore, some changes to the agreed approach is proposed in order to facilitate that the treatment of the natural resources is coherent and logical across the asset accounts and the depletion adjusted income accounts. The aim is to present concepts, which are unequivocal defined and can be explained in an intuitive way based on common sense. It should be emphasised that the alternative definitions and reasoning leads to the same aggregate accounting results as the agreed approach. The difference is rather in the underlying details. Thus, the alternative approach is more an adjustment of the reasoning and practical implementation of the accounts rather than it is a totally different approach.

5. The proposed alternative approach highlights the fact that the effect of the time passing element is that it increases the resource stock value because future incomes are moving closer. This effect is seen and accounted for as holding gains instead as a result of an extraction activity[2]. In order to maintain the principal form and properties of the depletion adjusted income accounts, a wealth based argument is used for including the time passing element as income. The time passing element is seen as income because it increases the owners wealth and consumption possibili-

[1] The "agreed approach" is used throughout the paper to characterise the accounting approach following from the decision taken at the London Group meeting in Johannesburg 2006 and Rome 2007 (described in van Halderen, 2007) and the corresponding accounts in SEEA 2003. The "alternative approach" is used to describe the accounting approach, which includes the changes in definitions and reasoning proposed in this paper.

[2] This interpretation is also found in Vanoli (1999).

ties (Hicks' income concept), and not because it has lowered the costs related to the current production activity/extraction.

6. A consequence of changing to the wealth oriented reasoning is that it also facilitates the inclusion of other adjustment items, such as the natural growth of uncultivated natural resources. The growth can be included simply because it increases the wealth and consumption possibilities. Thus, there is no need to change the production boundary in order to include the uncultivated natural growth as "other non-market output" as was otherwise agreed at the London Group meeting in Rome 2007.

2. The net present value method and time passing

7. For natural resources there are normally no observable market values for the stock and it is generally necessary to use the net present value method, NPV. [3] Assuming that there are no changes in the future extraction profile and in the prices of the extracted product and the costs, etc., the net present value method gives a convenient formula for the change in stock value between opening stock in one period and the opening stock in the next period[4]:

$$V_1 - V_2 = RR - rV_1$$

where V_1 and V_2 are the opening stock value at period 1 and 2, respectively, RR is the resource rent of period 1, r is the discount rate, and rV_1 is the time passing element, which can be explained by the discounting and the fact that the future income streams have moved one period closer so that their net present value is thereby increased by the discount rate r; the overall value of that is rV_1.

8. The ***resource rent*** (RR) is the surplus resulting from extraction of the natural resource assets, i.e. the output of the extraction industry minus all costs involved in the extraction, including the costs of using fixed capital.

9. So far this is pure mathematics explaining how the change in stock value is composed. The agreed approach now goes on to introduce the following items:

> ***The value of extraction*** is used in the asset accounts as an item representing the decline in the value of the natural resource due to the extraction. The value is set equal to the resource rent (RR).
>
> ***Depletion*** (d) is (also) defined as the change in the value of the stock of the resource due to extraction. However, in contrast to the value of extraction it is measured as the total change in the net present value of the resource during the period, i.e.

[3] At the London Group meeting in South Africa 2007, the NPV method was identified as the preferred method for valuing a natural resource in the absence of observable market values. The NPV is presented in SEEA 2003, section 7.E.

[4] The formula is presented in SEEA 2003, p. 419

$d = V_1 - V_2 = RR - rV_1$

It is assumed that no other changes, besides extraction, takes place.

Return to natural capital is the remainder of the resource rent after the depletion has been subtracted, and as such it is regarded as income from the current period's extraction activity. Due to the definition of the depletion, it is always equal to the time passing element, rV_1 , when the present value method is applied (return to natural capital = RR - d = rV_1).

10. It should be noted that neither the depletion nor the return to natural capital are observable items. Thus, the split of the resource rent into these two elements is based on the specific definition (assumption) of the value of the depletion. If this value is assumed to be larger, the return to natural capital coming from the extraction activity is smaller, and if the depletion is assumed to be bigger, the return to the natural capital is smaller.

3. The asset accounts

11. When it comes to filling out the asset accounts for a non-renewable natural resource (exemplified by oil and gas), the SEEA 2003 presents an asset account, which uses the *value of extraction* (equal to the resource rent) to represent the change in the stock value due to the physical extraction of natural resources (cf. SEEA 2003, Table 7.14). The *return to natural capital* (equal to the time passing element) is shown explicitly with the additional explanation *revaluation due to time passing shown in* brackets. The SEEA 2003 account is reproduced in Table 1.

Table 1. SEEA 2003 Monetary asset account for oil and gas

Opening stock	698.8
Extractions (resource rent)	**-58.3**
Return to natural capital (revaluation due to time passing)	**28.9**
Discoveries and reappraisals	16.6
Changes in extraction path	44
Changes in the unit resource rent (nominal holding gains/losses)	-21
Closing stock	709

SEEA 2003 Table 7.14 (bold added)

12. Some points can be noted about this SEEA 2003 asset account for oil and gas:

- The account is an *adapted* account in the sense that it does *not* follow the form and style of the generic asset account presented in SEEA 2003, Chapter 7 (e.g. Table 7.3, see also Table 2 below)) or the format of the SNA asset account/balance sheets for that matter.
- The term *return to natural capital* is not used in the generic account and the correspondence between the adapted account and the generic account is indistinct.

It is not clear where the return to natural capital (the revaluation due to time passing) should be placed if the generic account were to be filled out in practice.
- Also the correspondence to the SNA asset accounts/balance sheets is indistinct.
- The time passing element is recognised as a revaluation item, although implicitly (text in brackets).
- It is the value of extractions (resource rent) and the time passing element, which are used and included separately in the adapted asset account to capture and represent the stock value changes.
- The depletion item is not used in relation to the asset accounts[5].

13. Although the depletion item is not used in the asset account it seems confusing for both compilers and users that the SEEA 2003 include two concepts (the value of extraction and the depletion) to represent the effect of the extraction on the natural resource stock value.

14. In order to make the asset accounts for the natural resources more clear and in line with the generic asset accounts an alternative approach is suggested below.

Suggestion for an alternative approach to the asset accounts for non-renewable natural assets

15. The "reduction in the value of a sub-soil asset as a result of the physical removal and using up of the asset" should be unambiguously defined, and only one value should be attributed to this.

16. The "reduction in the value of a sub-soil asset as a result of the physical removal and using up of the asset" is called depletion in the SNA and it is appropriate to use this term correspondingly in the SEEA.

17. When it comes to the valuation of the depletion it seems most appropriate to use the resource rent directly, and thus *not* to deduct the time passing element. The following reasons can be mentioned (Further reasons are given in Section 4, Para 32 and 33):

- The time passing element (rV_1) is determined by the discount rent (r) and the total stock value only. It is independent of the amount of natural resources extracted and the extraction process. Even if no extraction takes place in a specific period the time passing element will add to the stock value. The time passing element relates to the fact that future incomes come closer, and it has as such nothing to do with the effect of the current extraction activity.

- Subtracting the time passing element (rV_1) from the resource rent when depletion is calculated (i.e. depletion = $V_2 - V_1 = RR - rV_1$) might lead to counter-intuitive results. The resource rent might be less than the time passing element if, for instance, no - or only a small - extraction takes place in the period and/or the coun-

[5] However, the depletion is shown in the capital account part of the illustration of depletion-adjusted flow accounts, cf. SEEA 2003 Table 10.4.

try has huge deposits of natural resources. In that case the stock value will still increase. While the physical account then shows a zero or positive extraction, the corresponding monetary account shows that the depletion has a negative value, which is subtracted from the opening stock. Thus, the depletion *increases* the resource value.

- In practice the calculation of depletion is more complicated than the simple formula above seems to indicate. The depletion can in practice not be calculated as the difference between the ordinary opening and closing stock values (=RR-rV_1) since these refer to the beginning of period prices. Instead the calculation must be based on the average price of the period, and it is therefore necessary to carry out an alternative set of net present value estimates of the stock values (V_1' and V_2', where ' indicate that the net present value is based on the average of the resource rents of period 1 and 2). In order to fulfil the accounting identity of the asset account it is subsequently necessary to account for the difference (V_2-V_1)-(V_2'-V_1') as a revaluation in the asset account). Although, this is, of course, not an insurmountable problem it adds extra work to the accounting, and – more importantly - it makes some of the accounting items less recognisable for the users.

18. If the time passing element is not included in the calculation of the depletion it has to be included under another accounting item. Due to the systemic character of SEEA (and SNA) it seems appropriate to include it under one of the regular accounting items in the generic asset accounts, instead as a separate and special item. It is suggested that it is explicitly recognised that the time passing (due to the assumptions and the NPV valuation method) increases the value of the resource, and, thus, that it is in fact a revaluation, which logically belongs to the SNA revaluation account. Therefore, it should be accounted for explicitly as *capital/holding gains*[6]. The term *return to capital* need not - and should not - be used in the asset account.

19. The suggested alternative to the SEEA 2003 adapted asset account for a non-renewable natural resource (Table 1) is shown in table 2. All elements that change the value of the resource, but are not related to a change in the total physical stock of the natural resource are recorded under the item for revaluation/holding gains and losses. These items are: Revaluation due to time passing, revaluation due to changing extraction path, and revaluation due to changing the resource rent. The "reduction in the value of a sub-soil asset as a result of the physical removal and using up of the asset" is called depletion and is valued by the resource rent.

[6]Another possibility is to see the increase in value as a kind of volume change reflecting that the quantity is the same but the quality higher because the future extraction comes closer. The increase can then be accounted for as *an other changes in volume change* on the asset account.

Table 2. Suggested SEEA (generic) monetary asset account for oil and gas with link to SNA 2008 account

SNA 2008 code	SEEA generic account	SNA 2008	
LS	Opening stock levels	Opening stock	698,8
	Changes due to transaction[1)]		
NP1	*Acquisitions less disposals*	*Acquisitions less disposals*	
K1	Increases in stocks	Economic appearance	16,6
	Discoveries		
	Reappraisals		
K2=K21+K22	Decreases in stocks	Economic disappearance	
K21	*Depletion*	*Depletion*	-58,3
K22	*Reappraisals*	*Other economic disappearance*	
	Other changes in stock levels[1)]		
K3+K4	*Catastrophic losses and uncompensated seizures*	*Catastrophic losses and uncompensated seizures*	
K6 = K61+K62	*Changes in classifications and structure*	*Changes in classification*	
K7	*Valuation changes (capital gains and losses)*	*Nominal holding gains and losses*	51,9
	of which due to time passing		*28,9*
	changes in extraction path		*44,0*
	changes in unit ressource rent		*-21,0*
LE	Closing stock levels	Closing stocks	709,0

20. By introducing these changes, confusion about what is the value of extraction/depletion is avoided and the generic SEEA asset account can be used directly. Furthermore, an immediate correspondence to the SNA 2008 balance sheets/accumulation accounts is introduced.

21. With regard to the correspondence to the SNA accounts and the valuation of depletion it should be noted that the SNA 2008 does not distinguish between *value of extraction* and *depletion*, and the SNA 2008 does not say anything about how the valuation of the depletion of natural resources should be done. The SNA 2008 only states that: *The depletion of natural resources covers the reduction in the value of deposits of sub-soil assets as a result of the physical removal and using up of the assets (SNA 2008, 12.26).* The SNA text is sometimes interpreted as saying that the time passing element should be subtracted when depletion is calculated (e.g. SEEA 2003, 10.32), but this interpretation seems in fact not presented or hinted at in the SEEA 2008.

4. The current accounts

22. In relation to the standard SNA current accounts (production account, generation and distribution of income) the time passing element and the depletion measure are of no interest since they are not presented in any of the accounts.

23. However, according to the agreed approach, the so-called *depletion adjusted generation of income accounts (cf. SEEA 2008, Chapter 10)* both the reduction in the value of a sub-soil asset as a result of the extraction value (-58.3) and the time passing element (28.9) are included explicitly. The former element subtracts value (costs of extraction) from the net operating surplus, and the latter adds value (return to capital/income).

24. SEEA 2003 Para 10.38 and Table 10.4 present the depletion adjusted operating surplus according to the agreed approach. Part of the account and the numerical example is reproduced in Table 3.

25. In contrast to SEEA 2003 Table 10.4, the discoveries of natural resources have here been excluded from the adjusted income account in Table 3. An agreement to exclude discoveries from the adjusted accounts seems not to have been expressed explicitly by the London Group, but it is seems, however, to be a logical consequence of the decisions taken to separate mineral exploration from the value of the discoveries based on the argument that the discoveries are not a result of a production activity (the argument is referred to in e.g. Van Halderen (2007), Para. 36-40).

Table 3. Agreed depletion adjusted generation of income accounts

Gross operating surplus	104.1
Less consumption of fixed capital	24.9
Equals net operating surplus	79.2
Less extraction of natural resources	-58.3
Plus returns to natural resources	28.9
Equals operating surplus adjusted for the depletion of natural resources	49.8

Based on SEEA 2003 Para. 10.38 and Table 10.4

26. It is seen that the adjustment items correspond to (some of) the items in the asset accounts (Table 1). Just as is the case for the SEEA 2003 asset accounts, the *depletion* item does not directly show up in relation to the calculation of the depletion adjusted operating surplus[7]. Again it is the individual elements – the resource rent and the time passing element – i.e. the constituents of the depletion - that is shown in the account. The decline in the stock value due to extraction is again represented by the resource rent.

27. While the *depletion* item, does not play any role in relation to filling out the asset or current accounts in SEEA 2003, the background for introducing and defining depletion as the resource rent minus the time passing element should instead be seen in relation to the argument for including an income /return to natural capital element (equal to the time passing element) in the

[7] However, the depletion element is shown explicitly in the adjusted capital account; cf. SEEA 2003, Table 10.4.

adjusted income accounts. By defining the effect on the stock value of the extraction as the resource rent minus the time passing element, the extraction activity does per definition leave a surplus equal to the time passing element, rV_1, which then without any further argumentation can be included in the depletion adjusted income account as income from the current production/extraction, exactly because, in the accounts, it appears as a surplus created by the production activity.

28. A further advantage of the agreed approach is that a correspondence between the using up of the natural resources and consumption of fixed capital (machinery, buildings, etc.) is obtained: The depletion is parallel to consumption of fixed capital and the return to natural capital (the time passing element) is parallel to the return to fixed capital.

29. By defining depletion as the total change in the value of the asset, i.e. including the effect of the time passing, depletion is in principle measured in exactly the same way as consumption of fixed capital. This follows from the characterisation of the measurement of consumption of fixed capital and by the description of the capital service theory presented in SNA 2008 Chapter 6 and 20, respectively.

> … Consumption of fixed capital is measured by the decrease, between the beginning and the end of the current accounting period, in the present value of the remaining sequence of expected future benefits. The extent of the decrease will be influenced not only by the amount by which the efficiency of the asset may have declined during the current period but also by the shortening of its service life and the rate at which its economic efficiency declines over its remaining service life. The decease is expressed in the average prices of the current period for an asset of exactly the same quality and should exclude holding gains and losses.
>
> (SNA 2008 6.246)

30. This procedure for the measurement of fixed capital does in fact also lead to an inclusion in the production accounts of income streams which are not related to the current periods' production[8]. It seems to be in conflict with the traditional SNA way of thinking, but it is perhaps accepted because in practice the effect is invisible or non-existent due to the fact that the net present value method for calculating consumption of fixed capital is seldom used in practice. In stead, the stocks of fixed assets, such as buildings and machinery, is in practice valued either from observed market prices or from estimates based on the accumulation of previous periods' investments taking into account, among other things, how much of this that has survived to the present period.

31. However, when the NPV method is used in practice to calculate the stock values and changes in stock values, the characteristics of the time passing element might very well become obvious and lead to results which most probably will seem counterintuitive and of little relevance to the users if they are not accounted for in an appropriate way.

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[8] This specification of how to measure consumption of fixed capital is an extension of the overall SNA 2008 definition of consumption of fixed capital: ***Consumption of fixed capital is the decline, during the course of the accounting period, in the current value of the stock of fixed assets owned and used by a producer as a result of physical deterioration, normal obsolescence or normal accidental damage.*** (SNA 2008, 6.240).

32. Leaving the net present value behind us for a moment, it can be noted that the purpose of recording consumption of fixed capital is to introduce a measure of the cost of using up the capital. Another way to look at this is to say that the amount of consumption of fixed capital charged as a cost of production should be sufficient to enable the assets to be replaced, if desired (cf. SNA 2008, 1.67). Transferring this to the depletion of a natural resource, it would, based on common sense, probably be appropriate to use the resource rent as a proxy for the cost of buying a similar deposit (quantity) of the natural resource, and not expect that the market price would be lowered by the time passing element corresponding to the parts of the reserves, which are not extracted now, but will be so only in the future. Thus, from a common sense point of view, the resource rent seems to be a good proxy for the costs related to the current extraction.

33. Further, it is standard procedure in natural resource economics to argue that the cost of using the natural resource in the present period is the present value of the future losses due to a decrease in the future extraction. It is then further deducted that this loss in future income is exactly equal to the present period's resource rent (if the future loss is bigger than the resource rent, current extraction should be decreased; and if the future loss is less than current resource rent, the resource rent should be increased). Hartwick (2000, p.86) puts - with reference to Samuelson and Hicks - this into a theoretical national accounting framework and deducts what he calls the fundamental depreciation result for the decline in asset value from the optimal use of the asset: The asset value "shrinks by resource rents" and "What we observe is that the decline in value is indeed physical shrinkage valued at the net price of a unit of stock".

34. Now, let's look at the practical implementation aspects of the agreed approach. For fixed assets it is normally quite easy to determine the scope of the assets which are used in the production process. The assets owned by a producer are used as the basis for the calculation of the consumption of fixed capital. In the case of a natural resource, e.g. an energy reserve, it is less obvious how to determine which part of a country's total reserves of natural resources that is used in the production process. The SNA 2008 states that the ownership should be attributed to the legal owner. It can be argued, however, that in some cases the (economic) ownership should be shared between the extractor and the government, e.g. based on who obtains the resource rents during the whole extraction periods (cf. Comisari, 2007).

35. Both the SNA 2008 position and the shared ownership position seems to lead to an asymmetry in the accounts if the return to natural capital is seen as a result of the extraction activity and part of the resource rent. In fact it leads to a recording of a return to extractor's natural capital, which is larger than what could be expected.

36. In the example shown in Table 4 below (where the depletion element is shown explicitly) the effect of defining depletion as the resource rent minus the time passing element or - in other words - to allocate the whole time passing element to the extraction activity leads to a rate of return (9.4 percent, last row) on the natural capital owned by the extractor, which is out of proportion with the discount rate (4 per cent), at least if the extractor does not own the whole natural resource. In addition, the (other) resource owner (government) has a zero return to his natural capital. This seems to be a counterintuitive accounting result, which is not in line with what

should be expected. In addition, the attribution of the whole time passing element to the extractor makes it difficult to determine and explain the development of the owner's stock value.

Table 4. Agreed approach: Asset and adjusted income accounts with split ownership and return to natural capital attributed to the extractor

	Total resource	Owner (Government)	Extractor
Asset account			
Opening stock	698.8	400	298.8
- depletion	-29.4	0	-29.4
= value of extraction	-58.3	0	-58.3
- return to income	28.9	0	28.9
Closing stock	669.4	400	269.4
Adjusted income account			
Net operating surplus	79.2	0	79.2
less extraction of natural resources	-58.3	0	-58.3
Plus returns to natural resources	28.9	0	28.9
equals operating surplus adjusted for the depletion of natural resources	49.8	0	49.8
Rate of return to natural capital (per cent)	4	0	9.7

Note: Compared to the asset accounts shown in Table 2 the accounting items for changes in resource rent, discoveries and change in extraction profile have been left out.

37. Obviously, another counterintuitive accounting result appears when no extraction takes place in the current period, but future extraction is still envisaged. In that case the accounts presents a negative depletion (in Table 4 it would correspond to an addition to stock value for depletion of 28.9 for the extractor and the total economy instead of an subtraction for depletion of 29.4) and a corresponding positive income from the extraction activity although no extraction activity takes place.

Suggestion for an alternative approach to the depletion adjusted income accounts

38. Two solutions to the seemingly counterintuitive results of the agreed approach can be considered. One is that the total resource is attributed to the extractor and none to the other owner/Government. This, however, is neither in accordance with the SNA 2008, nor what is suggested in Comisari (2007) and discussed and supported by the London Group meeting in Rome 2007.

39. The other solution is that the return to capital (the time passing element) is split in proportion to ownership shares of the opening stock as shown in Table 5. The asset account part and the valuation of the depletion are consistent with the suggested (generic) asset account presented in Table 2 above. In both the asset and the adjusted income account the depletion (measured as resource rent) is charged against the extractor, but the return to natural capital is divided according to the ownership of the natural resources. This means that the government gets its share of income/return to capital although it does not carry out any extraction activity in the current period. Similarly, the extractor does only get an income corresponding to his share. In the case of no extraction activity, no negative depletion charge (i.e. surplus) will be recorded for the extractor, but he will still get a return due to the holding gains.

Table 5. Alternative asset and adjusted income accounts with split ownership and return to natural capital attributed according to ownership shares

	Total economy	Owner (Government)	Extractor
Asset account			
Opening stock	698.8	400	298.8
- depletion (=resource rent)	-58.3	0	-58.3
+ Holding gains (due to time passing)	28.9	16.5	12.4
Closing stock	669.4	416.5	252.9
Adjusted income account			
Net operating surplus	79.2	0	79.2
less depletion	-58.3	0	-58.3
Plus returns to natural resources (=holding gains from time passing)	28.9	16.5	12.4
equals operating surplus adjusted for the depletion of natural resources	49.8	16.5	33.3
Rate of return to natural capital (per cent)	4	4	4

Note: Compared to the asset accounts shown in Table 2 the accounting items for changes in resource rent, discoveries and change in extraction profile have been left out.

40. This solution does however require a somewhat different argument for the deduction of the depletion and the addition of the return to capital/income. Depletion (now equal to the resource rent) can still be subtracted because it is a cost of production, but instead of arguing that the income results from the production i.e. that it is related the current extraction activity the income is seen as a result of the revaluation of the asset due to the time passing element. Thus, emphasis is put on the wealth aspect instead of the production aspect, and the income concept corresponds to the so-called Hicks' income concept, which is also related to the concept of sustainability: The income is what we can use during the period and be as well of at the end as in the beginning of

the period. We now include the increase in the value of the asset stemming from the time passing element, not because we have put a lower value on the depletion, and therefore get a surplus from the extraction activity, but because our wealth has gone up due to the revaluation[9]. In a broader theoretical framework, Hartwick (2000, Chapter 4) gives a formal deduction of national accounting matrices, which include the expected capital gains as part of the net national product or net national income[10].

41. Changing the argumentation and the definition of depletion means that the immediate parallel between the perception and calculation of consumption of fixed capital and depletion disappears[11]. While it might be useful for certain analytical purposes to draw a parallel between the using up of natural resources and the consumption of fixed assets, and while it does give an argument for including a return on capital (the time passing element) as income from production in the adjusted income accounts there is however *a priori* no reason to assume that the role in the production process of a natural resource and a fixed assets is exactly the same and that that they should be treated in exactly the same way in the accounts. In fact this has been questioned by some (cf. Vanoli, 2007). Looking at the institutional arrangements around many natural resources and how they are managed in practice does in fact indicate that it is not market-oriented economic behaviour and assessments that necessarily determine their overall use and management.

42. As shown, the assumption that "the role in the production process of natural resources is the same as fixed capital" is not necessary for establishing the adjusted income accounts and obtaining the same aggregate adjusted income measures. Furthermore, since all elements are shown explicitly in the accounts it is immediately possible to calculate the difference between the resource rent/depletion and the time passing element and compare that to the consumption of fixed

[9] An intermediate position could also be considered: For the natural resources actually extracted (or owned) by the corresponding time passing element could be attributed to the current extraction activity (i.e. deducted when depletion is calculated), while the time passing element related to resources owned by a "non-extractor" (e.g. the government) could be recorded as holding gains. However, it is not clear why the time passing element should be treated differently for an extractor and a non-extractor.

[10] Hartwick does calculate an extended depreciation measure (different from the fundamental depreciation measure, i.e. the resource rent) by subtracting all capital gains from the resource rent. He explains this by "one is forced to incorporate anticipated capital gains on natural stocks into the accounts through the depreciation terms" (Hartwick 2000 p. 83).

[11] It can be noted, however, that although focus in relation to the calculation of consumption of fixed capital and the application of capital service theory is on the production activity in Chapter 20 of the SNA 2008 on the capital service theory, it seems in fact also to be Hicks' income concept, which to some extent lies behind this. SNA 2008 Para. 20.12 and 20.34 says about the return to fixed capital and the use of natural resources, respectively:

" .. this amount satisfies the criterion for income that it is the amount that can be spent and still be as well off at the end of the period as at the beginning".

"Because the residual amount is consistent with the idea of maintaining the level of wealth intact, it can be regarded as income.

capital for specific analysis or uses. This difference could – but need not – be introduced in the SEEA as a memorandum item called e.g. *depletion, net (of revaluation/holding gains due to time passing)* or, perhaps better, *depreciation of natural capital*. The analysts can then decide whether he or she wants to draw the parallel and make analysis based on the data in the accounts.

43. Using the wealth argument (Hicks' income) for the depletion adjusted accounts makes a short-circuit in the sense that it introduces the adjustment items directly in the adjusted accounts without going through the production accounts. This can be seen as an advantage in relation to other adjustments as well.

44. For instance, it was agreed at the London Group meting in Rome 2007 that the growth of uncultivated natural resources (e.g. forests) should be regarded as "other non-market output". By changing the SNA boundary and including the natural growth of uncultivated natural resources, the value of the growth will end up as a positive contribution to the operating surplus adjusted for depletion.

45. Now, alternatively, by using the wealth argument, it is quite simple to add the natural growth to the adjustments simply because the growth adds to our wealth and in that sense it is income.

46. Inclusion of other items in the adjusted income accounts can be considered as well. For instance, it could be considered to supplement the "normal return" (rV_1) on the natural resource by other revaluation effects. If for example all expected extraction is postponed one period, this will off-set the expected "normal" return to capital, and give a total contribution to income and savings of zero. Also new discoveries of e.g. energy deposits could be added as income based on the wealth arguments, even if the discoveries as such are not regarded as being produced.

47. The challenge with respect to introducing adjustments based on the wealth arguments is that it opens up for a lot of adjustments, and there will of course be a need to decide which adjustments should be introduced, and which not. This, however, is not different from the approach which uses the "detour" around the production account in order to introduce the items as income, but for the users the wealth-reasoning will probably be clearer than a reasoning focusing on adjustment of the SNA production boundary.

5. Questions for the London Group.

Questions related to the asset accounts:

Q.1 Do you agree that the "reduction in the value of a sub-soil asset as a result of the physical removal and using up of the asset" should be unambiguously defined, and that only one concept and value should be attributed to this?

Q.2 Do you agree that the generic asset accounting format (Table 2) should be used in stead of the adapted form (Table 1) when accounting for natural resources – or at least that it should be possible and clear how to use the generic format ?

Q.3 If the answer is yes to Q.1 and Q.2: Should the value of the "reduction in the value of a sub-soil asset as a result of the physical removal and using up of the asset" be valued as

a) Equal to the resource rent, while the time passing element is recorded as holding gains in the generic asset accounts?

or

b) Equal to the resource rent minus the time passing element (accepting that the "reduction" in value can be either negative or positive)?

Questions related to the adjusted income accounts:

Q.4 If "the agreed approach" is used to account for the a split ownership (or pure legal ownership) situation, the extractor seems to get a disproportionate big return to his natural capital, and the (other) owner a zero return (cf. Table 4).

Do you agree that an accounting which attributes the time passing element (return to natural capital) according to the owners' share of the natural resource stock value (Table 5) seems more appropriate and in line with common sense than an approach which attributes the whole time passing element to the extraction activity (Table 4)?

Q.5 The agreed approach to income adjustments is based on the premises that "depletion is parallel to consumption of fixed capital" and that "uncultivated natural growth it's a result of production". The alternative approach presented in this paper avoids these changes of the SNA production boundary. Instead, it makes a short-circuit and use the argument that the time passing element is a holding gain, since it is not related to any physical changes in the period, but entirely to a change of the resource value. This holding gain is then regarded as income because it increases the wealth (Hicks' income). Similarly, the growth of an uncultivated natural resource can be seen as income because it increases our wealth and consumption possibilities.

What is your view on the alternative approach?

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