‘TIME PASSING’ AND THE MEASUREMENT OF DEPLETION

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Note prepared for the London Group meeting on Environmental and Economic Accounting. Brussels, 29 September – 3 October 2008

Executive summary

1. This note is intended as a contribution to the continuing debate within London Group on the treatment of depletion of natural resource assets within the updated SEEA. It specifically addresses treatment of ‘time passing’; an element of the Net Present Valuation (NPV) method of calculating depletion of natural resource assets.

2. The discussion here is a response to the reconsideration and suggestions raised by London Group member Ole Gravgård Pedersen in a paper circulated in advance of the 2008 London Group meeting in Brussels: *Accounting for the value of time passing and the depletion of natural resources, Reconsideration and some suggestions* (Gravgård, 2008).

3. Two key points are raised in Ole’s paper. The first is that the ‘time passing’ element should not form part of the measure of depletion; instead, it should be treated as a holding gain and accounted for in the revaluation account. Secondly, that the ‘time passing’ element, while not a form of production, could nevertheless be treated as income by following a Hicksian interpretation.

4. This note provides some reasoning why the ‘time passing’ element is not a holding gain. In particular, if the price of a natural resource (or its price relativities) does not rise then there can be no holding gain. ‘Time passing’ has long been recognised as an element of SNA consumption of fixed capital and, given the conceptual similarity of depletion and consumption of fixed capital, I suggest that the ‘time passing’ element be treated consistently between the SNA and SEEA systems. It is therefore suggested that the ‘time passing’ element be off-set against resource rent in deriving and presenting depletion in SEEA.

5. A direct consequence of treating the ‘time passing’ element as a holding gain is that depletion equates to the full value of the resource rent. This would effectively leave extractive enterprises with a near-zero depletion-adjusted operating surplus. Ole’s paper circumvents this consequence by treating this ‘holding gain’ as a form of (Hicksian) income.

6. This note suggests that altering the concept of income to encompass certain holding gains is a fundamental change of principle. As such, it needs to be supported by a compelling case, rather than simply being a convenient solution to the consequences of treating ‘time passing’ as a holding gain.

Resource rent, depletion and valuation of natural resource stocks

7. This section sets out a basic understanding of the relationship between estimated resource rent, depletion and return on natural resource (natural capital) assets.

8. The unit price of an extracted natural resource contains a resource rent reflecting the value of a marginal resource unit with respect to its future extraction (Hotelling, 1931). However, resource rents are not directly observable but instead are typically derived as the difference between total revenue generated from the extraction of natural resources less costs incurred during the extraction process including the cost of produced capital (which itself includes a return to produced capital).

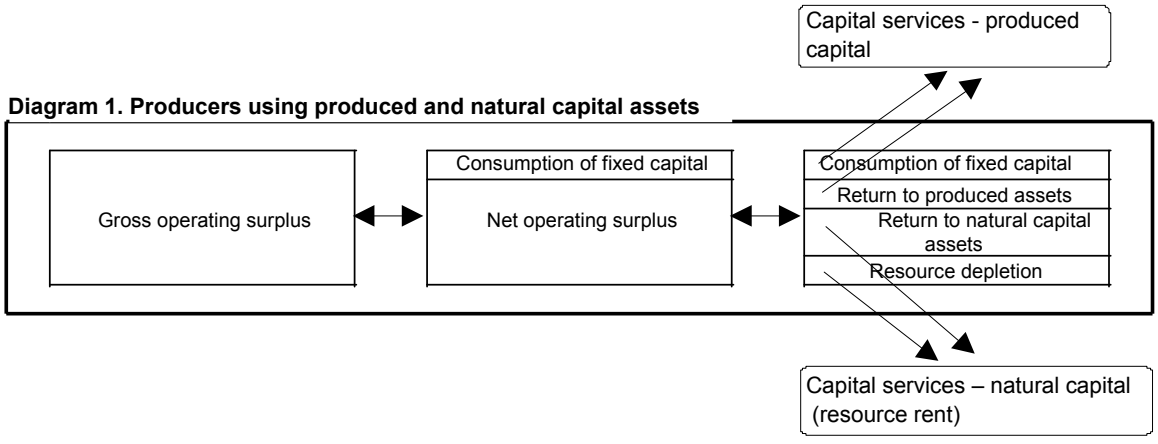
9. Or, as stated more simply in SEEA-2003:

> "the value of capital service flows rendered by the natural resources, or their share in gross operating surplus, is the...resource rent" (para 7.167)

10. Depletion is then derived as resource rent minus the opportunity costs of capital invested in the natural resource (SEEA-2003, para 10.30). Depletion represents the change in value of the natural resource stock due to extraction (SEEA-2003, para 7.168). This is consistent with the SNA definition of depletion.

11. For enterprises or industries using a mixture of produced and non-produced assets as capital inputs to the production process, gross operating surplus can be decomposed into consumption of fixed capital and net operating surplus. The net operating surplus can be further decomposed into a return to produced assets, a return to non-produced assets and a measure of depletion (the latter two when added together are termed *resource rent*). This decomposition of net operating surplus is typical of say a mining enterprise extracting subsoil assets, or a forestry enterprise harvesting natural forest. The relationship is depicted in diagram 1.

Diagram 1. Producers using produced and natural capital assets



12. Since market values on undeveloped natural resources are frequently unavailable, it is generally accepted that a reasonable proxy for market value is achieved by summing the (discounted) stream of future resource rents expected from developing the resource.

13. The natural resource used as an input to extractive activity is valued at its below-ground[1] price. This is the price at which the input enters the production process. Through the productive process of extraction, the resource is transformed into a different product and a different price applies. For natural resource assets, the crux of our valuation problem is that typically only output prices are observable so that in practice we are forced to deduce the price of the inputs from these observed output prices and from what we know about the proposed schedule of production.

Depletion and consumption of fixed capital

14. A natural resource asset in its natural state becomes a different product after it has been extracted. And it is the process of extraction itself that causes this change – a process that utilises natural resources below ground as an input to production and delivers the extracted resource (above ground) as an output of production. The two different products have different prices, and extraction proceeds on the assumption that a unit above ground will be worth more than a unit below ground.

15. The depletion provision can be thought of as the amount needed to be set aside from current operating surplus to allow replacement of the natural resource asset. So what price applies to the depletion provision? That is, what exactly is the depletion provision seeking to replace?

16. A central feature of the System of National Accounts (SNA) is the requirement to provide (charge) for the using up of produced capital. So, in the first instance at least, we could take our cue from SNA's treatment of consumption of fixed capital. If we consider 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).

17. This must be interpreted as recommending a charge of sufficient value to replace the capital used as an input to the production process. It is *not* saying we should enable replacement of the full value of capital services achievable from using the produced capital. Similarly for depletion, it is the value of the natural resource as an input to the extraction process that we should charge against production, not the full value of the resource rent resulting from the extractive process.

[1] The terms 'below ground' and 'above ground' are used throughout this paper to refer to, respectively, natural resources in their natural state; and the extracted product. The terms are used here to apply to all SEEA natural resource assets, even though they will not always accurately describe their physical characteristics.

18. SNA 2008 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, para 12.26).

This means that we set aside an amount that can replace the value of the natural resource as an input to production (i.e. its below ground value), *not* the value of outputs that the resource can generate. SNA2008's valuation basis is entirely appropriate and applicable to SEEA.

Time passing and depletion

19. Given the available techniques of extraction, the physical characteristics of the deposit and the demand for the asset, there will emerge an optimal schedule for the extraction of the natural resource asset. If we know the physical size of the resource, and our capacity for extraction within each period, it is possible to specify this schedule as the extraction of a sequence of quantities over the expected life of the asset (n). The value of the stock of the asset below ground at the start of period t (V_1) is determined by the present value of expected receipts, less expected extraction costs, derived from the progressive extraction and sale of the natural resource throughout the expected production schedule.

$$V_t = \sum_{t=1}^{n} \frac{RR_t}{(1+r)^t} \qquad \text{[equation 1]}$$

Where: V = net present value, RR = resource rent, r = discount rate, n = asset life

20. Depletion in any one year is the change in the value of the resource between the beginning and end of the year arising purely from the extraction of the resource. By re-arranging equation 1, depletion in the year can also be shown to be equal to the year's resource rent minus a return on the natural resource asset (equation 2).

$$d = V_1 - V_2 = RR - rV_1 \qquad \text{[equation 2]}$$

Where d is depletion, 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 income component of the resource rent.

21. Depletion therefore consists of two inter-related components: the current value of the quantity extracted; and the increase in the present value of the quantities remaining in stock. It has been known for many years (see for example, Hotelling, 1925) that these two components likewise occur for produced capital in the derivation of consumption of fixed capital – i.e. consumption of fixed capital consists of the current price value of capital services used up in the course of production *less* the increase in current value of services remaining to be released by the asset over its

remnant service life. Conventional international practice is to simply net-off these two effects in the derivation of consumption of fixed capital estimates.

22. The central question we need to address is how to treat these two components of resource rent: depletion; and the item denoted by rV_1 in equation 2 (the so called 'time passing' element).

23. It is worth noting at the outset that the 'time passing' effect is not passive. Value does not simply accrue because we have taken one temporal step closer to future production. The value of the natural resource (and of the 'time passing' effect) are rooted in an expectation that the owner of the asset will use it according to an identified schedule of production, with expected output prices and production costs (among other assumptions). The calculation of asset values (and therefore depletion) is entirely based on an expectation of benefits arising from a defined schedule of extractive *activity*.

24. SNA provides a comprehensive framework to understand various possible causes of asset valuation change over time. Essentially, the change in value of an asset can be accounted for in one of three ways:

(i) Stock changes due to consumption within a production process. Or due to quantities acquired or disposed of in transactions with other economic entities. These changes are recorded in the transaction accounts (e.g. depletion is recorded in the production account);

(ii) Changes due to events not related to economic transactions, for example, catastrophic losses. Recorded in the "other changes in volume of assets account"; or

(iii) Changes may be caused by asset price changes. These holding gain/losses are recorded in the "revaluation account".

25. Depletion falls into the first category and is therefore restricted to the effect on the value of the asset solely caused by its use in production. Any effect deemed to be a holding gain/loss or an 'other change in volume' cannot be part of our measure of depletion.

26. As a way of illustrating the characteristics of depletion and of the 'time passing' element consider the following scenarios – apparently similar but with different implications for 'time passing' and therefore for measured depletion. Consider one natural resource for which extraction cannot commence immediately but which must instead wait one year to start. As production has yet to commence, we see in equation 2 that the resource rent is zero, while the rV_1 ('time passing') item is positive. As a result, our measure of the natural resource asset value has actually increased as it moves closer to the period in which it can be used. Under this scenario measured depletion is negative for the first period. Compare this scenario to one in which the schedule of production has had to be delayed for one year (say, due to the impact of a catastrophic natural event) and the whole production schedule moved back one year. Under this second scenario the resource rent is again zero but there has been no increase in the present value of the quantities remaining in stock (i.e. no 'time passing' effect) because they are no closer to being realised than they were at the start of the period. Under this second scenario there has been no increase in the value of the stock in the ground and measured depletion is zero. Therefore, simply knowing that a natural resource remains unused for one period does not, of itself, provide enough detail to understand and estimate depletion.

27. The increase in the value of the asset's unused 'natural capital services' is a part of an asset's economic characteristics and reflects the necessity of waiting to release these services in the process of production. This increase in value corresponds generally with the expected schedule of extractive activity; it does not always follow precisely. Its inevitable lack of complete precision can lead to counter-factual results (such as the negative depletion cited in the previous paragraph) and this simply reinforces the need to closely observe the assumptions, workings and outputs of the NPV technique.

28. When extractive activity takes place and is expected to follow a schedule of production into the future, what happens as we move forward one period? A certain amount of the natural resource is used up in extraction, causing a decline in the value of the asset (depletion). In the absence of readily available market values, we cannot observe the precise value of this depletion. It must be *inferred* from the resource rent; which is itself inferred from observed values of operating surplus.

29. But we know that the value of the resource rent derives from above-ground prices achieved on sales of the extracted resource. The depletion value is based on below ground prices. We therefore generally expect the value of resource rent to exceed that of the depletion, though in concept (as well as in practice) this is not necessary. The difference between resource rent and depletion is income and is the return to the extractor for undertaking extractive activity. The 'time passing' effect relates directly to this income component. It is the release of one year of this income from the stock of future expected resource rents embodied in the value of the natural resource asset.

30. Typically, as we move forward one period, resource rent arises from production and the entire quantum of this resource rent enters the accounts as a part of operating surplus. We do not need to adjust any 'extra' income into the accounts. However, we do need to add a charge for depletion. If the natural resource asset is valued by NPV approach, depletion must be modelled and the primary observation we work with is resource rent – the NPV model is essentially built around the observed resource rent and a range of assumptions and expectations. One of the assumptions underlying the model is that resource rent is comprised of income and depletion components. If we were to assume, for example, that depletion is equal to the entire amount of resource rent, our model would operate differently.

31. Our charge for depletion is estimated from our model i.e. it appears as part of the 'unwinding' of value from the natural resource asset according to our expected production schedule. Resource rent is already included in the production and income accounts, as is the income component of resource rent. Neither of these items is needed for our depletion adjustment, the only component required is the depletion measure.

32. If the objective of our exercise is to derive the depletion measure, why also explicitly record the measures of resource rent and income? Why mislead users by labelling resource rent as 'depletion'? It means that we need to 'correct' this mislabelling with a contra-item called 'time passing' (or similar). Neither the balance sheet nor the flow accounts benefit from this presentation. Why not simply record what we want to record; the decline in asset value due to its physical removal and using up i.e. depletion? In the SNA, a similar NPV exercise is used in deriving consumption of fixed capital – where it is well known that the time passing effect also occurs. Its meaning, treatment and presentation has been debated in SNA-related forums and it is now standard practice to simply net-off the capital services and time

passing effects in the derivation of consumption of fixed capital. This treatment is now a relatively uncontroversial part of SNA principles and practice.

Implications of treating 'time passing' as a holding gain

33. Assume, however that we were to accept that the effect of 'time passing' on natural resource asset values is a holding gain, what is the impact on SEEA aggregates?

34. The most important change is that depletion would equate to the entire value of the resource rent. Therefore, in deriving depletion-adjusted measures of production and income, the full amount of the resource rent would need to be deducted from current production. That is, we would deduct not only the decline in value of the natural resource caused by its extraction, but also that part of operating surplus generated from using the natural resource. In practice, it would remove much of the operating surplus of extractive industries and, for economies with significant extractive activity it would have a significant downward impact on measures of adjusted GDP. An analyst examining these accounts would be unclear as to why anybody would engage in extractive activity.

35. Integrated Economic and Environmental accounts will gain quicker and more complete acceptance if they reflect the realities of interactions between environment and economy. Based on current experience in Australia, acceptance of these accounts requires recognition that the using up of natural resources incurs a cost to the nation. Equally, though, there needs to be continuing recognition that the extraction of natural resources generates income. For example, Australia recently announced an intention to create a 'Building Australia Fund' to finance future infrastructure development. This initiative is largely being funded by taxation receipts related to the current resources boom and is recognition that eventually natural capital will need to be replaced by other means of generating income. It is a reality that business receipts (and government revenue) are boosted by extractive activity. Treating 'time passing' as a holding gain in the accounts means that these receipts are effectively removed from SEEA's production and income accounts. Income received from extractive activity would remain more or less unaffected throughout cycles of natural resource 'boom' and 'bust'.

36. It has been suggested however that the 'time passing' element, if treated as a holding gain, could nevertheless be reclaimed as income using Hicksian logic. In this way, resource rent would be split into depletion and (redefined, Hicksian) income components. This would effectively restore the SEEA measure of depletion to equate with resource rent less the 'time passing' element, thereby placating the concerns raised in the preceding paragraphs.

'Time passing' redefined as (Hicksian) income

37. Two fundamental SNA principles are: that income derives from production; and holding gains on assets do not of themselves constitute production. So, for example, a share price increase (holding gain) is not production since no good or service has been produced. The increase in the share price is not SNA income.

38. Treating the 'time passing' effect as a holding gain represents a fundamental change of concept with significant implications for key SEEA aggregates. If we propose to treat certain holding gains as income, this needs to be done because there are compelling reasons to do so. We should not recommend treating the 'time passing' effect as income simply as a way of achieving the 'right' measure of depletion.

39. It's generally agreed that SEEA and SNA both benefit from a consistency in the basic conceptual underpinnings of their economic measures. Concepts of economics are well established in the SNA through comprehensive processes of consultation and review, therefore, proposals to change these concepts need to be convincing. If the arguments are, at best, mildly appealing then why create a series of fundamental inconsistencies in the integrated environmental and economic accounts?

40. The proposal creates counter-intuitive results. It would deliver different economic treatments to growth in non-renewable natural resources subject to identical natural processes. For example, tree growth in a plantation forest would be treated as a form of production leading to income, while the corresponding process in a natural forest would also generate income, but without any production occurring. Imagine there was a community decision to convert a commercial forest plantation into a natural forest. This would lead to; no change in environmentally-adjusted national income; but a fall in environmentally adjusted GDP. The approach agreed to at the December 2007 meeting of London Group would result in no change to either environmentally-adjusted national income or environmentally adjusted GDP because it applies consistent treatment of tree growth across both natural and plantation forests.

41. The 'time passing' element *must* be calculated using NPV methodology. For those natural resources yet to commence production, the passage of time will not of itself lead to a real-world price change and therefore no holding gain is discernable from observed market prices. In this unique situation the 'holding gain' is a 'phantom' gain – it cannot be observed in the real world. Estimation of the 'time passing' effect would be a unique case where we *cannot* use market prices but instead *must* use an NPV approach.

Comments on the practice of estimating depletion of natural resource assets

42. It is worth making a number of observations on the practice of estimating natural resource asset values and related depletion. The following comments are drawn from the experience of the Australian Bureau of Statistics (ABS).

43. In estimating natural resource asset values, resource rent and depletion, close scrutiny must be paid to results generated. Any problems in the underlying measures of gross operating surplus, consumption of fixed capital or estimates of return to produced capital will impact on our estimate of resource rent. For example, while it is possible to generate negative resource rents, we would not expect this to continue for an extended period of time. It might be necessary, for example, to reassess estimates of capital services on produced capital used in the extractive process.

44. Estimation of the depletion and income components of resource rent also tends to be an iterative process. For example, negative depletion should not be

allowed to occur; in practical terms, its existence indicates a problem with one or more of the data inputs or assumptions used. It might be necessary, for instance, to reassess and adjust the discount rate used.

45. The 'time passing' element is not separately identifiable in the Australian accounts. It is combined with the resource rent to generate depletion of natural resource assets. In this respect it is consistent with the presentation used for consumption of fixed capital in the SNA and the Australian national accounts.

46. In the Australian balance sheets, holding gains on natural resources are dealt with as a separate exercise to the NPV calculation of asset values and depletion. Holding gains can be derived by applying pure (observed) price changes to the balance sheet. They can also be derived residually if the balance sheet open and close positions and transactions and other volume changes are known. Unit prices of natural resources used in NPV estimation must be consistent with the index used to derive the holding gains.

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