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Depreciation and Obsolescence in the Context of Natural Resource Accounting

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Abstract

Conventional national accounting practice emphasises depreciation as both a physical loss in productive capital and an economic loss due to obsolescence. This emphasis is only partially paralleled in prescriptions for natural resource accounting, where resource depletion is typically treated as "physical capital depreciation". Depreciation resulting from obsolescence—and thus relative price changes rather than physical wastage—does not feature in resource accounting. The question is, what (if anything) does a consideration of obsolescence imply for work in resource accounting? What price changes should be incorporated into revised accounts, and when are they distinct from capital gains/losses? What is the connection between obsolescence and productivity change? What "counterfactual" should apply for renewable resources? This paper contains some tentative explorations of these questions.

Depreciation and Obsolescence in Natural Resource Accounting

1. Introduction

Natural resource accounting is a broad umbrella term referring to expanding and amending the national accounts. Put as simply as possible, much of the mainstream literature on natural resource accounting is aimed at turning conventional measures of national income (based on measuring national *output*) into a better measure of something approaching "sustainable income". (See Harris and Fraser 2002.)

A standard approach in the empirical resource accounting literature is to take a capital-theoretic approach that emphasises the measurement of extended versions of the capital stock and its depreciation, resulting in a measure of net rather than gross product. The general orientation of this literature relies on the following presumptions:

- that the maintenance of an aggregate capital stock is a suitable proxy for the maintenance of consumption possibilities;
- that the appropriate measurement of the total capital stock requires an accurate measure of the depreciation of such a stock, as the depreciation of capital has implications for productivity and thus potential consumption;
- that depreciation is a physical process, i.e. it represents capital consumption based on the "using up" of capital goods. The particular types of capital goods measured in such studies include oil, fish and timber stocks, in which the depreciation is a measure of physical depletion.

What has not been dealt with in the natural resource accounting literature is that in national accounting practice, depreciation is an *economic* measure, not simply a physical one. In particular, depreciation includes obsolescence, meaning that it includes loss of capital value due to becoming outmoded, as well as due to becoming less absolutely productive from wear and tear. This has implications for the measurement of depreciation of both produced capital and "natural capital" of the types identified above. This paper discusses the implications of including obsolescence in a measure of national depreciation and in particular, the implications for treatment of (potential) obsolescence of natural capital in the accounts.

2. Obsolescence in the National Accounts

2.1 Obsolescence and Depreciation—The Conventional Approach

Standard national accounting practice does not treat depreciation as a purely physical process; or, put another way, not all revaluations are regarded as capital gains in the national accounts. *Obsolescence* is part of the standard-practice approach to depreciation in the national accounts. The logic of this is most easily seen from the perspective of business accounting, where, if depreciation is viewed as the measurement of "decline" in the value of a capital asset until it is scrapped, obsolescence due to improved alternative technologies will bring forward the "scrapping date" of the asset. Hence, from the point of view of an individual business, the amount that needs to be put aside each period to finance the replacement of the asset at the scrapping date—the depreciation allowance, in other words—increases with obsolescence.

Two questions that emerge from considerations of obsolescence in the accounts are, first, is obsolescence an important empirical magnitude in the accounts, and second, should the applications of business accounting principles with regard to obsolescence be applied to national accounting?

Two authors who argue for the relative importance of obsolescence in estimates of national depreciation are Maurice Scott and Thomas Rymes.

> "The most important reason why capital goods fall in value over time and are eventually replaced is that they are made obsolete by newer and better capital goods." (Rymes 1993, p.202)

> "(I)t is obsolescence, and not physical decay, which is the principal factor in the depreciation of those business assets that do depreciate." (Scott 1990, p.1177)

This means that the concept of depreciation used in national accounting is a broader measure than the physical measure emphasised in the natural resource accounting literature. In particular, depreciation in practice is not generally taken to be simply a monetary assessment of physical deterioration; it may have a "value change" component driven by technical progress.

Coming to the second question, not all commentators approve of incorporating obsolescence into depreciation. Usher (1994, p.136) notes that this "procedure can be perverse in causing national income to fall as a consequence of beneficial technical change", while Rymes (1993, p.202) asks

"Why should we deduct from Gross Product an allowance for depreciation when all that is happening is that the value of capital goods is falling while their productive capacity may be remaining unimpaired?"

The problem here arises from the fact that accounting for business has a different purpose than accounting for the income of a nation. The former is primarily concerned with appropriate measurement of business *profit*; the latter with measurement of national *output*. To the extent that business profitability is affected by obsolescence because the scrapping date of a capital asset has been brought forward, obsolescence is a legitimate item to include in business accounts. But to the extent that the productivity of the existing capital stock is not negatively affected by the introduction of new and better capital goods, the question remains as to why measures of output should be adjusted downwards. (The implications for measurement of the income, as opposed to the output, side of the accounts shall be covered later.)

2.2 The Contra View

In the light of this, Scott, Rymes and Usher all argue for a conceptual distinction between physical change and value change (obsolescence) to be reflected in accounting practices, albeit with different authors having different suggestions as to how to implement this. Scott advocates perhaps the most radical departure from the orthodoxy, arguing that depreciation should be confined to a measure of obsolescence; that such depreciation would then be largely a transfer rather than a loss due to "capital consumption"; and that expenditures to physically maintain or restore capital assets should be labelled "maintenance" and treated as intermediate expenditures. Usher is by contrast much more conventional and in keeping with the technical natural resource

accounting literature, which, in reviewing, he states: “I think the appropriate procedure for converting gross to net national product...is to limit the measure of depreciation to the actual deterioration of the capital stock in the course of the year, ignoring obsolescence.” (Usher 1994, p.136)

3. Obsolescence, Natural Resources, Constant Capital and Reinvestment

The issue of obsolescence has almost entirely been left out of the natural resource accounting literature, in favour of treating depreciation as a consequence of physical change. As we have just seen, several commentators who have thought about obsolescence in this context have advocated maintaining a distinction between obsolescence and “wear and tear”. Scott’s approach, outlined in detail in Scott (1989), diverges from the mainstream in equating depreciation with obsolescence, and labelling expenditures on restoring the effects of “wear and tear” as maintenance. To Scott (see Scott 1990), this has two merits: it both separates physical changes from changes in the value of the capital stock which have hitherto been grouped under the label “depreciation”, *and* it also enables us to disregard the effects of obsolescence as—in his view—the depreciation of capital by obsolescence results in a transfer of wealth (to workers, in the form of real wage increases) rather than a reduction of national productivity. This latter point is quite at odds with conventional wisdom, since Scott argues that depreciation by obsolescence is, to a first approximation, zero. Just how far it is from conventional wisdom is shown by Eisner’s response (Eisner 1990) that depreciating capital would be more likely to be accompanied by real wage falls than the increases Scott claims have occurred.[1]

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[1] In Scott’s favour, Eisner appears to be instinctively thinking of depreciation in physical terms: using marginal productivity reasoning, a reduction in the quantity of capital would have such an effect. If capital is being made

However, despite Scott's apparent departure from orthodoxy, he and Usher and Rymes all seem to be fairly consistent in emphasising the need to account for physical changes (whether one labels it maintenance or depreciation), and in disregarding obsolescence. Scott (1995) discusses the application of his suggested modifications to accounting practice in terms of environmental sustainability: again the emphasis is on identifying maintenance expenditures that restore the effects of depletion/degradation of natural capital. Regardless of labelling, all three authors seem to support measuring the effects of wear and tear and (largely) ignoring the effects of obsolescence.

These recommendations also seem consistent with some of the sustainability prescriptions emerging from the natural resource accounting literature, such as Hartwick's Rule prescribing the reinvestment of resource rents into produced capital (see Hartwick 1977, Solow 1986, 1991). Note that Scott does not explicitly outline any Hartwick-type reinvestment rule: he just stresses the need for identifying what he labels maintenance expenditure generally. Presumably in Scott's schema, reinvestment according to Hartwick's Rule would be labelled required maintenance expenditures, since Scott seems to regard maintenance as being those expenditures required to restore the capital stock and maintain consumption possibilities (along Hicksian lines). So far, nothing, bar the labelling, seems out of the ordinary. It is worth noting, though, that Scott disavows any explicit references to a "constant capital" rule. "(I)n my preceding discussion, I did

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obsolescent but *not losing actual productivity*, there is no reason to expect that wages will fall as more productive capital items come onto the market causing existing ones to lose value.

not need to mention any aggregate capital stock, let alone a 'natural' one. Even when the concept of economic development is widened, that does not seem necessary." (Scott 1995, p.87.)[2]

There are unanswered questions remaining however. The first relates conceptually to the question of optimal resource usage, and particularly applies to (for example) renewable resources. Take the case of agricultural land ("soil"). Soil is both a renewable resource, and one that has a quality as well as a quantity dimension. There remains a debate in the natural resource accounting literature—and the more general literature on sustainability—as to how to best account for changes in the quantity and/or quality of the soil stock due to agricultural production (see Harris and Fraser 2002). Some approaches—including the UN SEEA[3]—recommend a disaggregated capital maintenance rule that would regard the benchmark against which depreciation (or "maintenance") should be measured as being *constant* soil quality/quantity. This contrasts with an economic efficiency criterion; that is, a present-value maximisation rule under which there is an implicit "optimal path" of soil usage (which may involve "mining" the soil over some time frame) that would be the benchmark against which depreciation in the stock of soil would be assessed.[4] Using the conventional terminology, this affects any calculations of depreciation of such natural resources. In Scott's terminology, it affects the boundary where maintenance ends

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[2] Whether this is simply a pragmatic position—one need not attempt to measure the value of the underlying stock as long as one accounts appropriately for the periodic flows—is not clear, but seems likely. Scott, like many other authors, seems to work with at least an implicit constant capital rule, even if he states his belief that actually measuring it is an unworthwhile endeavour.

[3] United Nations' System of Integrated Economic and Environmental Accounts (United Nations 1993).

[4] This is an example of a more general point that is important for natural resource accounting. Welfare and sustainability are two obvious benchmarks (fitting our second and third concepts of income earlier) for assessing what income is meant to measure and how well it performs. However, welfare maximising trajectories may violate sustainability conditions (such as non-declining consumption) and vice versa. Measures of depreciation are often conditional upon counterfactuals or ideals: it is thus important to be explicit about the counterfactual/benchmark and to note that alternatives are possible and that they may be incompatible.

and investment begins. Scott's approach appears consistent with that of the UN, in that any loss of productivity should be matched by equivalent restorative expenditures, labelled maintenance. The contra view, put here by Eisner (1990, p.1182), is that "The conventional measure of depreciation, though, is the derivative of the value of an asset with respect to time on the assumption not that maintenance prevents all loss of value due to depreciation but rather that maintenance expenditures are such as to maximize the present value of expected returns net of those maintenance expenditures."[5]

This does leave unanswered the issue of how to account for changes in the value of a resource stock due to what might be thought of as obsolescence. For example, development of alternative energy sources would be likely to reduce the value of a stock of oil in a way that suggests increased "obsolescence". Modifying the accounting rules (in particular, the depreciation charges) in the light of such possibilities has received little attention.[6] Scott (1990) notes that obsolescence cannot be counted as a simple within-nation transfer when trade exists, and thus terms-of-trade effects matter. For the sorts of resource-dependent economies under discussion here, such effects are likely to be important.

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[5] With regard to soil issues, Kirby and Blyth (1987) advocate the "efficiency" approach, while Young (1997) advocates the "sustainability" framework.

[6] There is a further practical difficulty to be confronted here too. Capital gains and losses (changes in the value of capital assets) are traditionally excluded from national income. There has been attention paid in the natural resource accounting literature to when it might be appropriate to include capital gains (in particular, when capital gains represent capitalised increases in future consumption possibilities: see e.g. Asheim 1996, and Hartwick 2000), but this then requires analysts to be able to distinguish between those changes in the value of capital assets that have no real effects on productivity (and hence on consumption possibilities) and those that *do* have implications for future consumption.

Some work has been done (e.g. Weitzman 1997) on the topic of technical progress in the formal Hamiltonian framework for green accounting: however, this is mostly aimed at restoring the welfare-interpretation of greened income, rather than determining specific accounting procedures for individual items in response to such technical advances. Moreover, as a standard neoclassical growth model that distinguishes between (exogenous) technical progress and conventional capital accumulation, it does not explicitly address the issue of obsolescence or its relationship to productivity change.

It may be the case that obsolescence matters with respect to resources and energy, beyond whether the "capital stock" (the natural resource) becomes less valuable through the discovery of substitutes. Fraumeni (1997, p.8) noted that "obsolescence has played a big part in the debate about the impact of the oil embargo on productivity." In particular, Baily (1981) argued that rapid oil price increases led to obsolescence of particular specific assets, with a consequent decline in the rate of productivity change. A counter-argument has been put by Hulten, Robertson and Wykoff (1989).

Fraumeni (1997) also notes that with respect to the American NIPAs (National Income and Product Accounts), the Bureau of Economic Analysis is moving towards estimating measures of depreciation that separate the effects of obsolescence from those of physical deterioration.

4. Conclusions

The curious reader might wonder that this paper has been devoted to a non-problem: that first I claim that the NRA literature has avoided reference to depreciation by obsolescence (as opposed

to depreciation by physical change), and then I claim that those analysts who have paid attention to this issue have advocated against any measurement of depreciation-by-obsolescence anyway, preferring to confine their attention to depreciation-by-physical-change.

To respond, the first counter-argument is that depreciation-by-obsolescence is a standard part of national accounting practice and at some stage needs to be explicitly addressed in the literature, even if only to be dismissed. Including obsolescence in depreciation measures is sensible as business practice as it brings forward the date at which it is economic to scrap (and replace) an existing asset. However, as obsolescence at the national level ought to have (to a first approximation) no negative effect on national productivity—in fact it should have the reverse effect by dint of the new technologies which render the old ones less valuable!—it is easy to see why Rymes and Usher advocate confining economic depreciation to changes in productivity induced by wear and tear, broadly defined. (And why Scott, in similar spirit but utilising different classifications and terminology, advocates distinguishing between investment and maintenance.)

The issue of what to measure and what to include is one of determining what the aggregate index is intended to measure. A forward-looking income measure that attempts to provide information on long-term consumption prospects is unlikely to be improved by including obsolescence in its depreciation estimates—and a concern for alerting ourselves to possible "limits to growth" suggests the importance of maintaining a focus on the physical where natural resource endowments are concerned—but in turn this requires attention to be paid to the potential "upside" of technological improvements that move us away from reliance on (for example) exhaustible fossil fuels. Rendering those fuels cheaper through technical advance does not lead to the

conclusion that we have impoverished ourselves (albeit that it might make individual oil-rich countries less wealthy).

The ever-present tension between what accountants are trying to measure—how much has the economy produced this year and how much income has been generated by that production?—and what economists would like to infer from such measures—for example, are we better off this year than last year; by how much; and how are we affecting our long term prospects?—looms large in consideration of these issues.

If a consensus on a "sustainable consumption" kind of measure is reached, then some authors have argued there is a case for inclusion of some revaluations (capital gains) in such a measure. This is in contrast with national accounting practice where capital gains are conventionally regarded as not part of national income. Here we have also seen that some revaluations (due to obsolescence) *are* considered part of national income, but by contrast, a number of authors make the case for *exclusion* of such revaluations. National accountants and economists working on the theory of national income and design of national accounts are offered this as a suggestion of areas deserving further attention.

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