Foreseen Obsolescence and Depreciation

By Peter Hill

Reading Barbara Fraumeni’s very helpful comments I realised that there may still be two different schools of thought who may not see eye to eye on depreciation. Call them the ‘productivity school’ and the ‘accounting school’. I found Barbara’s statement that the “notion that depreciation should include expected obsolescence need(s) further explanation” rather surprising. I take it for granted that depreciation over time includes expected obsolescence and there is some economics (not national accounts) literature that I cite below to support this view. In any case, the differences between the two schools can be fully reconciled, as my paper on Capital stocks, Capital Services and Depreciation tries to show.

The ‘productivity school’ concept of depreciation, as exemplified by Jorgensen’s definition in terms of the mortality distribution is of course correct in the context in which it is used. However, there is another approach to depreciation which is concerned with the ageing of an asset over time and not the differences between assets of different ages at the same point of time. Moreover, I contend that this inter-temporal concept of depreciation is the main stream economic concept of depreciation which can be traced back at least to Hotelling (1925).

The definition of economic depreciation with which I have always been familiar is \( d_t = v_t - v_{t+1} \) where \( v_t \) is the value of the asset at the start of period \( t \). As it involves the value of the same asset at two different points of time, \( t \) and \( t+1 \), call it the inter-temporal formula to distinguish it from productivity formula used by Jorgensen and many others. When \( v_t \) is given by the present value of the remaining services provided by the asset, this definition translates into the following.

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    d_t = s_t - rv_t
\]

where \( s_t \) is the value of the capital services in period and \( r \) is the rate of interest. This formula has a long history going back to Canning (1929) and Hotelling (1925), and possibly earlier. Erwin Diewert has said that it is to be found in Walras, while Hartwick and Hageman (1993) jokingly suggest that the formula is so pervasive it must be found somewhere in the writings of Aristotle. When I produced this formula in my paper for the first meeting of the Canberra group I was therefore surprised that some participants actually queried it, which is indicative of the gap between the two different schools.$^1$

On the other hand, the relationship between the inter-temporal and the productivity formulae has never been spelled out. As a result, it looks as if there is a conflict between two competing formulae when, in fact, there is no conflict. The missing

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1 I used this formula extensively myself in my 1979 OECD monograph on Profits and Rates of Return in which I explained the functional forms that the sequences of service values need to take in order to yield straight-line and geometric depreciation. I also gave the depreciation formula associated with the one-hoss shay case.
link is foreseen obsolescence. This (rightly) plays no part in the productivity formula which defines depreciation as the difference between the values of different vintages at the same point of time. The inter-temporal measure, on the other hand, includes not only the productivity measure of depreciation but an additional term measuring the effect of foreseen obsolescence. The inter-temporal formula reduces to the productivity one in the special case in which the (real) price of the services provided by an asset remains constant over time. This is all explained in my paper which I do not intend to repeat here.

I would, however, like to place these issues in a broader context as they have been debated extensively in economic literature in the past, although without the algebraic formulae with which we are now familiar. In particular, I should like to refer back to the debate in *Economica* on maintaining capital intact between Pigou (1942) and Hayek (1942) in which Hicks (1942) also intervened. Pigou was essentially advocating a productivity approach to maintaining capital intact. Hayek countered by saying that “what is meant by ‘maintaining capital intact’ [according to Pigou] consists in effect of the suggestion that for this purpose we should disregard obsolescence and require merely that such losses of value of the existing stock of capital goods be made good as are due to physical wear and tear.” Hayek went on to invoke the example of a manufacturer of fashion goods who installs special machinery whose efficiency may be undiminished by the end of the year but which he knows in advance that he will have to scrap at the end of the year because there is no longer any demand for the good it produces. He then argues that foreseen obsolescence of this kind must be treated in the same way as wear and tear. He goes on: “The manufacturer of wireless sets, for example, who expects this year’s model to be superseded in a year’s time by technical improvements would certainly have to restrict investment and output so as to keep prices high enough to enable him to write off obsolescing equipment in the course of the year.” Hayek notes, however, that unforeseen obsolescence must be treated as a capital loss and not as depreciation (which has always been accepted by everyone so far as I know). Hayek continues “the real problem of maintaining capital intact arises not after such losses have been made, but when the entrepreneur plans his investment. The question is what allowance for amortization he ought to make in his calculations so that, in view of all the circumstances known to him, he can expect to be able to earn the same income in the future.”

Hicks (1942) comments: “Obsolescence of the kind described in Professor Hayek’s example is *true depreciation on our* [i.e., Hicks] test; the fashion firm scraps its machinery in accordance with anticipations; it is not a failure of foresight which makes the end-value less than the beginning-value.” [Emphasis added] In 1956, Kaldor commented as follows. “From the point of view of the individual owner of resources *expected* diminutions in the market value of resources have the same significance whether they are due to physical depreciation or depletion, technical obsolescence or foreseen changes in demand.” [Emphasis in original] In more recent jargon, it is immaterial whether the decline in the present value of the remaining services is due to factors which affect the expected quantities of the services or their expected prices. The decline counts as depreciation in both cases.
Depreciation is widely understood by economists, and also by accountants, as the decline in the value of an individual asset over time. It is inherently a temporal phenomenon. Hotelling defined depreciation as “the rate of decrease of value” with respect to time: specifically as $-dV(t)/Dt$. Defined in this way depreciation must include foreseen obsolescence and this has always been stated explicitly in national accounts. For example, the 1954 edition of the methodology of the US National Income accounts states: “Capital consumption allowances consist of depreciation proper .. and accidental damage. The first of these items measures wear and tear and obsolescence …” The 1968 SNA states that consumption of fixed capital is equal to “the value … of the … fixed assets … used up during a period … as a result of normal wear and tear, foreseen obsolescence and the normal rate of accidental damage.” There is a subtle improvement in the 1993 SNA whereby consumption of fixed capital is no longer the value of the assets “used up” but “the decline in … the current value of …the assets … as a result of physical deterioration, normal obsolescence or normal accidental damage.” (It is unfortunate that the word “foreseen” in the 1968 SNA definition was inadvertently changed to “normal”.) Subsequent text in the 1993 SNA noted that “the value of assets may decline not merely because they deteriorate physically but because of a decrease in the demand for their services as a result of technical progress and the appearance of new substitutes for them. In practice, many structures including roads and railway tracks, are scrapped or demolished because they have become obsolete.” Eventually, it is clarified that although depreciation “includes reductions in the value of fixed assets resulting from normal, expected rates of obsolescence, it should not include losses due unexpected technological developments …”

The concept of depreciation adopted by the productivity school is not the Hotelling concept. According to the productivity school, depreciation is not the decline in the value of an asset over time but the difference between the values of assets of different ages at the same point of time. Hulten and Wycoff (1996) are very clear on this point stating that economic depreciation is defined as “the percentage difference in the price of capital between two successive ages in the same year” (their emphasis). They add subsequently that: “Economic depreciation is, by definition, the decline in price along the age dimension, i.e., the partial derivative of $p_{t,s}$ with respect to age $s$ ….” It is a partial derivative which holds time constant and allows the value of the asset to vary with its age at that point of time.

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2 Hotelling, incidentally, remarked that “Obsolescence is a risk of essentially the same nature as fire, earthquake or burglary … to be relegated, with insurance, to the category of operating expenses.” He was clearly thinking of unforeseen obsolescence.

3 Although a marginal digression, it is also worth noting that para. 6.181 in the chapter on the Production Account of the 1993 SNA discusses both actual and imputed rentals on fixed assets and their relationship to depreciation, or consumption of fixed capital. It states: “Whether owned or rented, the full cost of using the fixed asset in production is measured by the actual or imputed rental on the asset and not by consumption of fixed capital alone. When the asset is actually rented under an operating lease … the rental is recorded under intermediate consumption as the purchase of a service…. When the user and the owner are one and the same unit, consumption of fixed capital represents only part of the cost of using the asset.” The recent proposals by myself and Anne Harrison to record the full cost explicitly in the production account of the SNA is not so radical.
Now while that this may be the appropriate definition of depreciation for purposes of the productivity school, it cannot be claimed that this is the economic concept of depreciation. The productivity school have redefined the concept to suit their own requirements. By eliminating the time dimension they have thrown out what has traditionally been regarded as the essential element in depreciation, namely the decline in the value of the same asset over time.

I conclude that are two concepts of depreciation now in circulation both of which are valid and appropriate for their own purposes. There should be no argument about which is the right one. Both are needed. There is no disputing the validity of either measure in its context. But the inter-temporal measure is the more comprehensive one and the also the one in the main stream of economics.

Finally, both measures are needed in the Manual. The inter-temporal concept is the appropriate one for the Production and Capital Accounts of the SNA. The productivity concept is the appropriate one for the perpetual inventory method that is concerned with the aggregation of different vintages of assets at some point of time. As I see it, the main challenge now is how to present these complex issues in the Manual in a simple way to compilers and users of national accounts -- no easy task.

REFERENCES


