A COMPARISON OF DEPRECIATION METHODS UNDER CURRENT COST ACCOUNTING: A COMMENT

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Introduction

This note is intended to clarify some fundamental points which were obscured in Davey's (1979) study of depreciation. In the first case it is pointed out that, while Davey's estimates of the rate of physical decline may be reasonable, his method of calculating the money value of depreciation is not. Generally applicable depreciation estimates can be derived from Davey's estimate of R, but not by using his equations. The use of a single estimate of depreciation for years with different rates of price change is also invalid.

A further point concerns the difference between market values for surviving machines of a particular vintage and the average value of all machines of that vintage. It is the average value, including allowance for the proportion which have ceased operation, which is of relevance for tax purposes. Use of unadjusted market values would lead to underestimates of the average rate of decline for older machines. Finally, the manner in which the influence of the investment allowance was taken into account was not described. Accounting for such influence involves measurement of interaction between distributions of marginal tax rates and machinery demand. It is not so simple that it can be passed off in one sentence.

Generalised Measures of Depreciation

For simplicity, the discussion in this section is based on the assumption that a diminishing-value depreciation function is an exact description of the formation of market values. The money cost, exclusive of interest, of holding and using an asset for a period $k(X_k)$, is given by:

$$X_k = V_{k-1} - V_k, \tag{1}$$

where (V_{k-1}) is the asset value at the beginning of period k. Using Davey's definitions of the ratio of new price in period k to that in the period of purchase (I_k/I_o) and the annual rate of decline $(R/100)$, the asset value at the end of period k is given by:

$$V_k = V_{k-1}\ (I_k/I_{k-1})\ (1 - R/100), \tag{2}$$

which is Davey's equation (4). Then, from (1) and (2):

$$X_k = V_{k-1}(1 - (I_k/I_{k-1})\ (1 - R/100)). \tag{3}$$

But Davey's equation for depreciation is given by:

$$X_{kD} = V_{k-1}(I_k/I_{k-1})\ (R/100). \tag{4}$$

Clearly, equations (3) and (4) are equivalent only when $(I_k/I_{k-1}) = 1$; that is, when there is no price change.

In general $X_{kD} = X_k + ((I_k/I_{k-1}) - 1)V_{k-1}$ where $((I_k/I_{k-1}) - 1)V_{k-1}$ equals the nominal capital gain from holding the asset. Thus Davey's procedure gives consistent overestimates of depreciation when prices increase during period k. As Swan (1978) has pointed out, for a tax system based on nominal values, only a depreciation rule based on economic depreciation represented by equation (3) would be neutral. A tax system based on equation (4) would overcompensate for asset depreciation without an equivalent change in the gross income measure. The returns to investment would then be a function of investors' marginal tax rates.

Estimation

The estimation procedure used by Davey involved a search for that value of R which provided the best fit between market and book values (the subscripts b and m refer to estimated and market values, respectively) so that, from (2), expressing values in terms of purchase price V_o:

$$V_{bo}(I - R_b/100)^k(I_{bk}/I_{bo}) = V_{mo}(I - R_m/100)^k(I_{mk}/I_{mo}).$$

Provided that initial values and price changes are measured accurately, the optimal value of R_b chosen should be a reasonable estimate of R_m. The estimate of economic depreciation from equation (3) is then:

$$X_{bk} = V_{bk-1}(1 - (1 - R_b/100)\ (I_{bk}/I_{bk-1})). \tag{5}$$

If R is thought to be stable over time, equation (5) can then be used to estimate depreciation in any year simply by applying the appropriate values of (I_{bk}/I_{bk-1}). Davey, of course, used the erroneous form of equation (4) for his estimates. However, he also, inexpliciably, presented only a single estimate without indicating the value of (I_{bk}/I_{bk-1}) used. Even the equation (4) measure is a function of prices and R and thus varies from year to year.

Table 1 contains estimates of economic depreciation, for various rates of price change, for an asset with the values of V_k and R estimated by Davey. It is clear that Davey's estimates exaggerate the rate of depreciation even for a very moderate rate of price increase. It can also be seen that using single-period estimates when rates of price change vary between years can be quite misleading.

Average Depreciation and Tax Allowances

Even the use of generalised estimates taken from market values has limited relevance for taxation purposes. If such information were costless, the appropriate tax rule would be to use values for individual machines. In reality, the best available option is to aim to measure average values for each class of machine. This option at least gives equality between underestimates and overestimates. But the values observed in the market are not representative of all machines in the original stock. For any initial stock of machines, the proportion no longer usable (i.e. with zero value), P_k, increases with age. If the average market value for surviving machines is V_k, the average value of all machines of that vintage is $V_k(1 - P_k)$.

To use values unadjusted for P_k would underestimate the depreciation rate for older machines. Thus it is possible that, even if diminishing value is realistic for market values, a much steeper function, not necessarily of the same form, may be appropriate for tax purposes.

TABLE 1

Economic Depreciation using Davey's Estimates of R and V_k

Price ratio (I_k/I_{k-1})	Cost	
	Tractors	Headers
	$	$
1.00	1036	1703
1.05	746	1124
1.10	482	597
1.15	241	116
1.20	20	−325
Davey's estimate	1036	1703

Investment Allowances

The effect of an investment allowance is to reduce the realised cost of new machinery and thus to depress the prices of used machinery. Clearly the nominal price of a new machine is not the relevant starting point for depreciating the machine. Estimation of the effective price of new machines would involve accounting for the coincidence of distributions of marginal tax rates and demand curves for the whole market. The chosen starting point is obviously critical to the estimation of both the type and rate of depreciation. It seems questionable that such a major undertaking should be passed off with the simple statement that the '. . . significance of this item was also determined for the survey sample . . .' (p. 40).

Conclusions

Although the estimates of R produced by Davey may be valid, the procedure used to estimate depreciation cannot be used directly to support his arguments about tax policy. As Swan (1978) has pointed out, the use of allowances not based on the equation (3) measure of economic depreciation would not be neutral with respect to tax rates. Using either historical cost or Davey's procedure would make returns to investment a function of marginal tax rates. Whether Davey's procedure was more or less distorting than historical cost would depend, in part, on the rate of price change. Since the difference, $X_k - X_{kD}$, increases as the rate of price change increases, use of X_{kD} would be more distorting the greater was the rate of price change.

Davey's use of a single estimate of depreciation to generalise about tax rates was not internally consistent since his basic equations held depreciation to be a function of the rate of price change. Finally, although general estimates could be derived, these could not be used immediately for tax policy for two reasons. First, accurate assessment of market values must be supported with information about the survival rate of machines. Second, the method of adjustment for the investment allowance was not made clear.

References

Davey, L. E. (1979), 'A comparison of depreciation methods under current cost accounting', *Australian Journal of Agricultural Economics* 23(1), 37-47.

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