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THE IMPACT OF HIGH SALVAGE VALUE ON DOUBLE DECLINING BALANCE DEPRECIATION

ROBERT FEINSCHREIBER*

The double declining balance method of depreciation [1] produces a loss of revenue[2] to the Federal Government substantially in excess of that contemplated by Congress in the case of assets with high salvage values.[3] It is the purpose of this study to develop a method whereby this loss of revenue could be eliminated without impairing the legitimate use of double declining balance depreciation.

In order to compare the actual loss of revenue to the government (or tax savings to the taxpayers who own assets with high salvage values) with that which was intended, it is necessary first to examine the method by which double declining balance depreciation is calculated. Double declining balance depreciation is computed by applying a constant rate to a diminishing base. This depreciation base declines each year over the useful life of the asset which is being depreciated because the depreciation charge for each year is deducted from the balance at the beginning of the year to yield the base for the succeeding year.[4]

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1. Double declining balance depreciation is specifically permitted under INT. REV. CODE of 1954, § 167(2)(b).

2. The revenue loss with which we are concerned is the excess deferral of tax revenue whereby the governmnt loses the present use of these funds. *See* note 28 *infra*. This revenue loss is different in character from that which led to the enactment of INT. REV. CODE of 1954, §§ 1245 & 1250—the disposition of depreciable property at capital gains rates.

3. Assets will frequently have high salvage values. Treas. Reg. § 1.167 (a)-1(c) (1956) provides that "[i]f the taxpayer's policy is to dispose of assets which are still in good operating condition, the salvage value may represent a relatively large proportion of the original basis of the asset." In at least two cases salvage value has been found to be as high as 60 percent of cost. John W. Roddy, 20 CCH TAX CT. MEM. 1129 (1961); Catherine F. Dinkins, 45 T.C. 593 (1966), *aff'd*, 378 F.2d 825 (8th Cir. 1967).

4. Let L equal the useful life of an asset and t be any given year in the life of the asset. D is the depreciation charge for a given year and B is the undepreciated balance at the end of a given year, and base for computation of depreciation for the following year. The straight-line depreciation rate is 1/L and the double declining balance depreciation rate is therefore 2/L. The formulas below are expressed as a fraction of the basis of the asset.

$$D_1 = 2/L$$
$$B_1 = 1 - D_1 = 1 - 2/L$$
$$D_2 = (B_1)2/L = (1 - 2/L)2/L$$
$$B_2 = B_1 - D_2 = 1 - 2/L - (1 - 2/L)2/L = (1 - 2/L)^2$$

Thus, the general formulas are:

$$D_t = (1 - 2/L)^{t-1}\,(2/L)$$
$$B_t = (1 - 2/L)^t$$

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This method is called double declining balance depreciation because the base declines at twice the straight-line rate.[5] From a mathematical standpoint, this computation results in an automatic remainder which is a function of the useful life of the asset.[6] Table I provides an illustration of this remainder as a percentage of basis for selected asset lives.[7]

TABLE I

Useful Life (Years)	Remainder as a Percentage of Basis
3	3.704
4	6.250
5	7.776
6	8.779
7	9.486
8	10.011
9	10.416
10	10.737
11	10.999
12	11.216
13	11.398
14	11.554
15	11.689
16	11.807
17	11.910
18	12.002
19	12.084
20	12.158
21	12.224
22	12.284
23	12.340

5. INT. REV. CODE of 1954, § 167(b)(2) permits the use of declining balance rates which are not greater than twice the straight-line rate. The 150 percent declining balance rate was in use prior to the 1954 Internal Revenue Code.

6. The undepreciated remainder at the end of the useful life can be determined by letting t equal L in the last equation of footnote 4. Denoting the remainder by R, we have:

$$R = B_L = (1 - 2/L)^L$$

This equation was used to generate the data in Table I.

7. The maximum value for the remainder is determined by letting L approach infinity in the above equation, so that

$$\lim_{L \to \infty} (1 - 2/L)^L = e^{-2}$$

where e is the base of natural logarithms. The maximum value of the remainder is thus approximately equal to 13.534 percent of basis.

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TABLE I (Continued)

Useful Life (Years)	Remainder as a Percentage of Basis
24	12.390
25	12.436
. .	.....
30	12.621
. .	.....
33	12.704
. .	.....
40	12.851
. .	.....
50	12.989
. .	.....
60	13.079
. .	.....
70	13.145
. .	.....
80	13.194
. .	.....
90	13.231
. .	.....
100	13.262

Unlike the other depreciation methods authorized by the Internal Revenue Code of 1954,[8] double declining balance depreciation is computed without an allowance for salvage value,[9] because Congress intended that the undepreciated balance remaining at the end of the useful life of an asset would represent the salvage value.[10]

In actuality, however, salvage value will rarely be equal to the automatic remainder. For situations in which salvage value will

8. Straight-line depreciation is specifically permitted by INT. REV. CODE of 1954, § 167(b)(1), and the sum-of-the-years-digits is specifically permitted by INT. REV. CODE of 1954, § 167(b)(3).

9. Treas. Reg. §§ 1.167(a)-1(c)(1), 1.167(b)-2(a) (1956) provide that while salvage value is not taken into account in determining annual depreciation charges under the double declining balance depreciation method, it must be determined at the time of acquisition, and the asset may not be depreciated below salvage value.

10. U. S. CODE CONG. & AD. NEWS 4185 (1954) (House Report); U.S. CODE CONG. & AD. NEWS 4836 (1954) (Senate Report); 3 P-H FED. TAXES ¶ 14,151, at 14,285.

be less than the remainder[11] Congress enacted a provision whereby a switch to the straight-line method could be made,[12] so that assets with salvage values less than their automatic remainder could be fully depreciated.[13]

Congress devoted little attention to the opposite situation, the cases in which salvage value would exceed the automatic remainder. Under the 150 percent declining balance method, which was in use at the time Congress was considering the adoption of the double declining balance method, the automatic remainder must always be at least 12.5 percent of basis, compared with 3.704 percent under the double declining balance method.[14] Thus, salvage will exceed the remainder in substantially more cases under the double declining balance method than under the 150 percent method—a fact which Congress failed to consider. It could even be argued that Congress did not contemplate that double declining balance depreciation could be used when salvage value exceeds the remainder.[15]

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11. Salvage value will frequently be less than the remainder. INT. REV. CODE of 1954, § 167(f) permits salvage value of personal property to be reduced by an amount up to ten percent of the basis of the property. Congress was concerned with the case in which salvage value is less than the remainder, but not circumstances in which salvage value was greater. The following excerpt is taken from U.S. CODE CONG. & AD. NEWS 4657 (1954) (Senate report):

> Double declining balance depreciation automatically leaves an unrecovered residual at the end of useful life which in some cases may represent an unrealistically high estimate of salvage value.
>
> The unrealistically high salvage value at the end of service life is also reflected in a relatively low level of accumulated allowances during the last third of service life. . . .
>
> This drag on cost recovery due to the automatic residual under the diminishing-balance system would partially cancel its advantages, make it unattractive to some taxpayers, and weaken its effective stimulus to investment. . . .

12. This provision was proposed by the Senate, U.S. CODE CONG. & AD. NEWS 4658 (1954), and was adopted by the House-Senate Conference as Amendment No. 51, U.S. CODE CONG. & AD. NEWS 5288 (1954). This provision is now section 167(e)(1) of the Internal Revenue Code of 1954.

13. The decision when to switch from the double declining balance depreciation method to the straight-line method is more complex than it appears. *See* Greene, *Changing from Declining Balance to Straight-Line Depreciation*, 38 ACCOUNTING REV. 355 (1963); Ricks, *Year to Switch to Straight Line Depreciation*, 39 ACCOUNTING REV. 685 (1964).

14. $\lim_{L \to 3} (1 - 1.5/L)^{L} = (\tfrac{1}{2})^3 = 12.5\%$

15. A minority in the House opposed the introduction of double declining balance depreciation for the reason that the loss of revenue would be too great. The minority illustrated the anticipated revenue loss by means of an example in which salvage value was exactly equal to the automatic remainder. Since the loss of revenue to the Federal Government would be greater when salvage values are higher, it is curious that a higher value was not selected by the minority for their illustration of revenue loss. U.S. CODE CONG. & AD. NEWS 4605 (1954). This leads to the implication that it was not within the contemplation of Congress that double declining balance depreciation could be used for assets in which the salvage value exceeds the automatic remainder.

When salvage value does exceed the remainder, the salvage value, rather than the remainder sets the upper limit for depreciation, and the asset may not be depreciated below the salvage value.[16] Thus, depreciation terminates prior to the end of the useful life of the asset.[17] For assets with high salvage values, then, the impact of the salvage value is to reduce depreciation charges only in the last years of life, rather than proportionately throughout the life of the asset, as is the case with the other depreciation methods authorized by the Internal Revenue Code of 1954.[18] As we shall see, this produces loss of revenue to the Government (and savings to taxpayers who own assets with high salvage) which is in excess of what Congress had contemplated.[19]

Congress anticipated that the double declining balance method would write off approximately forty percent of the cost of an asset during the first quarter of its service life, and two-thirds of the cost during the first half of service life.[20] These objectives are realized for assets with a zero salvage value, as Table II indicates.

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16. Treas. Reg. § 1.167 (a)-1 (c) (1) (1956).

17. For an illustrated presentation of this point, see Myers, *Influence of Salvage Value Upon Choice of Tax Depreciation Methods,* 35 ACCOUNTING REV. 598 (1960).

18. Under these other depreciation methods, the depreciation charge for each year is computed on basis less salvage value. Thus salvage value reduces the depreciation proportionately for each year over the useful life of the asset.

19. An important showing of the intent of Congress "to prevent unrealistic deductions and resulting tax avoidance" is Technical Amendment (c) in the Senate Report, U.S. CODE CONG. & AD. NEWS 4659 (1954), which limited double declining balance to assets with a useful life of three years or longer. If this method could be used when the service life was only two years, the entire amount could be depreciated during the first year. This provision was adopted by the House-Senate Conference as Amendment 50. U.S. CODE CONG. & AD. NEWS 5288 (1954).

20. U.S. CODE CONG. & AD. NEWS 4047 (1954) (House Report); U.S. CODE CONG. & AD. NEWS 4605 (1954) (House Report—Minority Views); U.S. CODE CONG. & AD. NEWS 4655 (1954) (Senate Report).

TABLE II

Asset Life (Years)	Percent of Cost Depreciated During First Quarter of Life[21]	Percent of Cost Depreciated During First Half of Life[22]
4	50.00	75.00
8	43.75	68.36
12	42.13	66.51
16	41.38	65.64
20	40.95	65.13
24	40.67	64.80
40	40.13	64.15
60	39.86	63.83
80	39.73	63.68
100	39.65	63.58
∞	39.35	63.21

When the salvage value is greater than zero, the amount depreciable is correspondingly less.[23] Because the higher salvage value does not diminish the depreciation charges in the early years of life, a higher amount will be charged off in the first quarter and

21. The general formula for the total depreciation over the first quarter of life is

$$\sum_{t=1}^{L/4} (2/L)(1 - 2/L)^{t-1} = (2/L) \sum_{t=1}^{L/4} (1 - 2/L)^{t-1}$$

Applying the formula for the sum of a finite geometric series, the above formula becomes

$$(2/L) \cdot \frac{1 - (1 - 2/L)^{L/4}}{1 - (1 - 2/L)} = (2/L) \cdot \frac{1 - (1 - 2/L)^{L/4}}{2/L} = 1 - (1 + 2/L)^{L/4}$$

Consequently, the minimum value for the total depreciation in the first quarter of life is

$$\lim_{L \to \infty} 1 - (1 - 2/L)^{L/4} = \lim_{L \to \infty} 1 - (1 - \frac{1/2}{L/4})^{L/4} = 1 - e^{-1/2}$$

which is approximately equal to 39.35 percent.

22. The general formula for the total depreciation over the first half of life is

$$\sum_{t=1}^{L/2} (2/L)(1 - 2/L)^{t-1} = (2/L) \sum_{t=1}^{L/2} (1 - 2/L)^{t-1}$$

Applying the formula for the sum of a finite geometric series, the formula for the total depreciation over the first half of life becomes

$$(2/L) \cdot \frac{1 - (1 - 2/L)^{L/2}}{1 - (1 - 2/L)} = (2/L) \cdot \frac{1 - (1 - 2/L)^{L/2}}{2/L} = 1 - (1 - 2/L)^{L/2}$$

Consequently the minimum value for the total depreciation in the first half of life is

$$\lim_{L \to \infty} 1 - (1 - 2/L)^{L/2} = \lim_{L \to \infty} 1 - (1 - \frac{1}{L/2})^{L/2} = 1 - e^{-1}$$

which is approximately equal to 63.21 per cent.

23. The amount depreciable is basis minus salvage value.

first half of the life of the asset (and thus produce greater tax savings in that period) than had been anticipated by Congress,[24] as Table III and Table IV indicate.

TABLE III

Salvage Value Equals 25% of Basis

Asset Life (Years)	% of Amount Depreciable During First Quarter of Life	% of Amount Depreciable Depreciated During First Half of Life
4	66.67	100.00
8	58.33	91.15
12	56.17	88.68
16	55.17	87.52
20	54.60	86.84
24	54.23	86.40
40	53.50	85.53
60	53.15	85.11
80	52.97	84.90
100	52.87	84.78
∞	52.47	84.28

TABLE IV

Salvage Value Equals 50% of Basis

Asset Life (Years)	% of Amount Depreciable During First Quarter of Life	% of Amount Depreciable Depreciated During First Half of Life
4	100.00	100.00
8	83.50	100.00
12	84.26	100.00
16	82.76	100.00
20	81.90	100.00
24	81.34	100.00
40	80.26	100.00
60	79.72	100.00
80	79.46	100.00
100	79.30	100.00
∞	78.70	100.00

24. Was Congress concerned with the percentage of cost which would be written off, or the percentage of the amount depreciable which would be written off? Congress uses the word "cost," but its concern was probably the amount depreciable. *See* materials cited note 20 *supra*. Congress most likely did not contemplate a problem arising from the use of double declining balance depreciation in the case of assets with high salvage and for this reason was less precise in its terminology than it might have been. *See* notes 14 & 15 *supra*. Further, in the case of assets with high salvage values it would not be possible to depreciate two-thirds of the cost in the first half of life because of the requirement that the asset not be depreciated below salvage value. Thus, it appears fairly certain that Congress had "depreciable balance" in mind when it used the word "cost."

The above tables indicate that when salvage value is high the double declining balance method will write off a higher percentage of the basis in the early years of life than Congress had anticipated.

An objective of Congress in instituting the double declining balance depreciation method was to make tax depreciation "more in accord with the actual pattern of loss of economic usefulness."[25] When salvage values are high, this objective is undoubtedly not realized. For example, when an asset with a three year life has a salvage value of one-third of its basis, two-thirds of the basis will be depreciated during the first year under the double declining balance method, at which point depreciation will cease because salvage value has been reached. Thus there will be no depreciation for tax purposes in the last two years of service life. Similarly, when an asset with a useful life of four years has a salvage value equal to one-quarter of the basis, half the basis will be depreciated in the first year and one-quarter in the second year, but after that point no further depreciation can be taken because the asset has been depreciated down to salvage value. Thus, no depreciation can be taken for tax purposes in the last two years of useful life of the asset.

A further objective of Congress was that double declining balance depreciation conform to sound accounting principles.[26] Generally accepted accounting principles require the cost of an asset to be

> spread over the expected useful life of the facility in such a way as to allocate it as equitably as possible to the periods during which services are obtained from the use of the facility ... in a systematic and rational manner.[27]

As the previous examples illustrate, this objective may not be realized under the double declining balance method when salvage value is a high percentage of the basis of an asset.

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25. U.S. CODE CONG. & AD. NEWS 4048 (1954) (House Report); U.S. CODE CONG. & AD. NEWS 4656 (1954) (Senate Report).

26. Materials cited note 25 *supra.*

27. AICPA ACCOUNTING RESEARCH BULL., No. 43, at 76 (1953).

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How will this overly-rapid write-off of assets with high salvage values under the double declining balance method affect federal revenue? Because the depreciation charges in later years will be lower as a result of higher depreciation charges in earlier years, it might at first glance seem that no loss in tax revenue would result. This argument is specious, however, because it ignores the time value of money, that a dollar of tax revenue today is worth more than a dollar of tax revenue some time in the future.[28] Moreover, in a growth economy there are more new assets for which depreciation is just beginning than there are assets near the completion of their service life. As a result, the lower depreciation charged to assets in the latter part of their service life will not offset the higher depreciation charged to assets in the early part of their service life. Thus, while the economy continues to grow, the loss of tax revenue will persist.

As we have seen, the double declining balance depreciation method permits a higher percentage of the amount depreciable to be written off in the early years of useful life of an asset with a high salvage value, and that this extra-rapid write-off is not in accord with economic reality, generally accepted accounting principles, or the intent of Congress.

Let us propose a modified method of double declining balance depreciation. Rather than using the basis of the asset as the base upon which double declining balance depreciation is computed, we will use a depreciation base which includes a number of factors: the salvage value of the asset, the automatic remainder, and the basis of the asset. The depreciation rate remains at twice the straight-line rate.

The application of this modified double declining balance depreciation method is simple. Salvage value is subtracted from the basis, as is now done with the straight-line and sum-of-the-years-digits depreciation methods. This quantity is then multiplied by the applicable "multiplier," as shown by Table V.[29]

28. This difference in relative worth to the government can be measured by the interest rate which the government must pay to secure borrowed funds in place of the tax revenue, which has been deferred because of the extra-rapid depreciation deductions permitted.

29. If an asset is depreciated down to the automatic double declining balance remainder, the total amount of depreciation taken at the end of the useful life of the asset is given by the formula.

$$\sum_{t=1}^{L} (B)(2/L)(1-2/L)^{t-1} = (B)(2/L)\sum_{t=1}^{L}(1-2/L)^{t-1} =$$

$$B\ (2/L)\left\{\frac{1-(1-2/L)^{L}}{1-(1-2/L)}\right\} = \frac{B\ (2/L)\ [1-(1-2/L)^{L}]}{1-(1+2/L)} = B\ [1-(1-2/L)^{L}]$$

As can be seen above, the formula for the total amount of depreciation is ob-

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TABLE V

Useful Life (Years)	Multiplier
3	1.038
4	1.067
5	1.084
6	1.096
7	1.105
8	1.111
9	1.116
10	1.120
11	1.123
12	1.126
13	1.128
14	1.130
15	1.132
16	1.133
17	1.135
18	1.136
19	1.137
20	1.138
21	1.139
22	1.140
23	1.140
24	1.141
25	1.142
. .	.....
30	1.144
. .	.....
33	1.146
. .	.....
40	1.147
. .	.....

tained through the use of the formula for the sum of a finite geometric series. If the asset is to be fully depreciated, the total depreciation would have to be equal to B, the original basis of the asset. Our objective is to find the quantity which when multiplied by $B[1 - (1 - 2/L)^L]$ will yield B. This quantity, called the "multiplier" can be expressed by the formula

$$\frac{1}{1-(1-2/L)^L} \text{ since } B[1-(1-2/L)^L] \cdot \frac{1}{1-(1-2/L)^L} = B.$$

Thus, the multiplier eliminates the "remainder" aspect of double declining balance depreciation, and with it the justification for not deducting salvage value at the outset. The maximum value for the multiplier is

$$\lim_{L \to \infty} \frac{1}{1-(1-2/L)^L} = \frac{e^2}{e^2-1} \text{ or approximately } 1.157.$$

TABLE V (Continued)

Useful Life (Years)	Multiplier
50	1.149
. .	.....
60	1.150
. .	.....
70	1.151
. .	.....
80	1.151
. .	.....
90	1.152
. .	.....
100	1.152

To see how this modified method of double declining balance depreciation could be employed, consider the example of an asset with a cost basis of $2000, a useful life of four years, and a salvage value of $500 (25 percent of the basis). Under the present double declining balance depreciation method, $1000 would be depreciated the first year and $500 would be depreciated the second year. At that point the asset would be fully depreciated down to salvage value, and no depreciation could be charged during the third and fourth years.

Under the modified method of double declining balance depreciation, salvage value ($500) is subtracted from the basis ($2000). The resulting quantity ($1500) is then multiplied by the "multiplier" for an asset with a useful life of four years (1.067) to get the new depreciable base ($1600). The double declining balance method is then applied to this new base: $800 would be charged off for depreciation in the first year, $400 in the second year, $200 in the third year and $100 in the fourth year. At the end of the fourth year, when the expected useful life of the asset has ended, the asset is fully depreciated. Depreciation of $1500 has been taken, and this is equal to the amount depreciable (basis less salvage value).

Under this proposed method, the asset will be fully depreciated regardless of how high or low the salvage value may be. The amount which is depreciable will be depreciated over the entire useful life of the asset, in a systematic and rational manner, which is more in accord with the actual loss of economic usefulness and with generally accepted accounting principles than is the current double declining balance depreciation method. More-

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over, this proposed method will eliminate much of the unintended loss of tax revenue,[30] yet preserve the features of double declining balance depreciation which had been intended by Congress.

30. The depreciation charges will be lower in the initial years of service life, and the tax loss will therefore be correspondingly lower. See notes 2 and 28 *supra*.