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MODERNIZATION EXPENDITURES

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Chapter 2

HOW LIBERALIZED DEPRECIATION INFLUENCES MODERNIZATION EXPENDITURES

A CHANGE in the tax laws, permitting liberalized treatment of depreciation, may contribute to capital modernization in three principal ways. (1) It may stimulate the demand for new capital equipment by its effect on rate of return, current value, and pay-back computations and by reducing risk and the length of the replacement cycle. It may also act to encourage replacement rather than the modification of existing equipment. This shall be known as the "demand effect."

(2) By reducing corporate income taxes it will increase the internal "cash flow" of the corporation for several years following any given capital expenditure, thereby providing a source of funds which may be considered less costly, more readily accessible, or less risk laden than those procured in the capital market. To the extent that this increased availability of funds results in increased expenditures there may be said to have been a "cash flow effect."

(3) It may encourage management's willingness to replace equipment or alter capital budget targets by causing the undepreciated "book value" of an asset to diminish more rapidly or by changing the rules of thumb determining the amount which management customarily spends for replacement. The first two "routes" by which liberalized depreciation tax regulations may influence modernization expenditures involve logically correct management appraisals of the returns and costs of investment op-

portunities. The third involves reactions which may not be altogether rational but nevertheless are of some importance given the existing attitudes and practices of management.

THE EFFECT OF LIBERALIZED DEPRECIATION
ON THE DEMAND FOR MODERNIZATION EXPENDITURES

Evaluation of investment projects requires that the receipts anticipated over the life of a proposed asset be compared with the costs which will be incurred. In practice such an analysis is usually carried out by computing the rate of return on the investment, the present value of anticipated future net receipts, or the number of years required to "pay-back" the initial outlay.

Computing the rate of return involves determining a single rate of discount which when applied to the anticipated net cash receipts will result in a sum of present values equal to the expected capital outlay. In applying the computation to decision making this "internal" rate of return is compared with the cost of capital (i.e., the rate which the firm sees itself as, in effect, paying for the funds it invests).

The present-value approach is to discount all anticipated net cash receipts at a discount rate equal to the firm's cost of capital. The sum of present values is then compared with the present value of all capital outlays using the cost of capital as the rate of discount. This method, though similar to the first, will not always result in candidate projects being ranked in the same order.¹⁹

The pay-back computation is quite different. Anticipated annual net cash receipts are compared directly with the capital outlay in such a way as to determine the number of years required for anticipated receipts to return the amount of the initial capital expenditure. When such a computation is used, of course, the amount of returns during the earlier years is emphasized. Projects are judged to be more or less desirable depending on the length of the period required to pay back the initial outlay. Project ranking on this basis may differ materially from those under the rate of return or current value methods, of course.

¹⁹ See Ezra Solomon, "The Arithmetic of Capital Budgeting Decisions," *The Management of Corporate Capital*, Glencoe, Ill., 1959, pp. 74-79.

Moreover, the pay-back approach will only haphazardly maximize profits or the firm's net worth.

Although depreciation *per se* is not considered as a cost in any of the above types of investment computation (the accounting charge for depreciation does not act to reduce cash receipts) it is highly relevant because tax depreciation (i.e., that depreciation authorized as a deductible expense by the Internal Revenue Service) reduces tax liabilities and thereby affects net cash returns.

Effect on Rate of Return, Current Value, and Pay-Back Computations

Liberalized depreciation alters the timing (but not the total amount) of tax reductions over the life of a single asset as compared with straight-line depreciation, increasing such reductions (and thereby increasing net cash flows) in the earlier years, decreasing them in the later ones.²⁰ This change in the time pattern of net cash flows acts to increase the present value of future cash flows because a given sum received in the near future will be assigned a higher present value than one received in the more distant future. Similarly, the change in timing increases the computed rate of return. An increase in net cash receipts in the near future at the expense of receipts in the more distant future will also reduce the computed (after-tax) pay-back period.

It is in this way—by increasing the rate of return and current value and decreasing the computed pay-back periods of proposed investment projects—that liberalized depreciation increases the *incentive* to invest.

Table 1 illustrates the demand effect, showing the current values and pay-back periods resulting from a change from SL to DDB depreciation and a shift from a ten-year to an eight-year service life for depreciation purposes.²¹ In the illustration, the

²⁰ It is the nature of "accelerated" depreciation techniques (double declining balance and sum-of-the-years digits being the most important) that depreciation charges are largest in the first full year and decline in each successive year.

²¹ While some of the assumptions upon which this table is based are not realistic, the table nonetheless illustrates the type of effect which depreciation liberalization has on the pay-back period and on the profitability of an investment in a depreciable asset.

use of declining balance instead of straight-line depreciation increases the present worth of after-tax savings by $3\frac{1}{2}$ per cent. With an eight-year service life and DDB depreciation the present worth is increased by 5.8 per cent.

Effect on Risk

Analogous to the effect of liberalized depreciation on pay-back periods is its effect on the degree of risk which a firm accepts when making a given capital expenditure. If we assume the dispersion of possible outcomes to increase as one looks further into the future, then clearly a short pay-back is less risky than a long one. Accordingly, accelerating depreciation, by reducing the pay-back period, reduces risk. The effect is even more dramatic, however, if we ask the question, how much of the original outlay is recouped through tax reduction in the first year? In the second year? etc. In Table 1 we see that the effect of a shift from SL to DDB is to increase the proportion of the asset's cost recovered in the first year from 20.5 to 25.5 per cent and from 39.7 to 47.7 per cent in the first two years for an asset with a ten-year service life and the given stream of gross earnings. The joint effect of a shift from SL to DDB and from ten- to eight-year service life is an increase in recovery from 20.5 to 28.0 per cent in the first year and from 39.7 to 51.5 per cent in the first two years.

In the computations which were made for current value (Table 1) more distant returns were discounted at the same interest rate as returns in the near future. It is arguable, however, that since risk increases as the projection is extended into time, anticipated returns should be discounted more severely (i.e., at higher rates) as the pay-back period lengthens, assuming this is the technique used by the taxpayer to measure risk. If this were done, the discounted values of the total stream of anticipated cash returns would be increased even more sharply by liberalized depreciation thereby increasing still further the current value of anticipated cash receipts.

Effect on Optimum Service Life and Replacement Cycle

We have seen previously that the effect of liberalized depreciation is to increase the rate of return and current value of pro-

TABLE 1. Gross Earnings Before and After Tax with Alternative Depreciation Allowances and After-Tax Rate of Return ^a

Year	Gross Earnings After Tax						
	Straight-Line Depreciation		Double Declining Balance Depreciation		Double Declining Balance Depreciation, Eight-Year Tax Life		Cumulated (7)
	Annual (2)	Cumulated (3)	Annual (4)	Cumulated (5)	Annual (6)	Annual (6)	
1	310,636	205,319	255,318	255,318	280,318	280,318	280,318
2	282,400	396,519	221,200	476,518	234,950	515,268	515,268
3	256,724	574,881	192,362	668,880	198,674	713,942	713,942
4	233,403	741,583	166,702	836,781	169,436	883,378	883,378
5	212,238	897,702	147,069	983,850	145,670	1,029,048	1,029,048
6	192,942	1,044,173	129,221	1,113,071	136,022	1,165,070	1,165,070
7	175,413	1,181,880	120,456	1,233,527	127,257	1,292,327	1,292,327
8	159,452	1,311,606	112,566	1,346,093	119,277	1,411,604	1,411,604
9	144,974	1,434,093	105,237	1,451,330	72,487	1,484,091	1,484,091
10	131,777	1,549,982	98,638	1,549,968	65,889	1,549,980	1,549,980
After-tax pay-back		5.7 years		5.1 years		4.8 years	
Present value of after-tax gross earnings (10 per cent discount rate)		1,000,000		1,035,492		1,058,442	

^a Assumptions are:

1. Facilities costing \$1 million have a ten-year life with no retirement dispersion and zero salvage value.
2. Where an eight-year service life is used for tax purposes, it is assumed the taxpayer retains the facilities in use through the tenth year.
3. Gross earnings before tax (column 1) are the annual in-

creases in the firm's revenues, net of variable costs attributable to the use of the facilities.

4. The income tax rate is 50 per cent.

5. The discount rate used by the firm is 10 per cent.

6. The facilities are installed at the beginning of year 1. All earnings are realized and depreciation allowed at the end of each year.

posed investments and to reduce their pay-back periods. A slightly different point is that a change to liberalized depreciation shortens the optimum life and replacement cycle in an industry from the time of initiation of the tax depreciation change, and thereby encourages replacement. Of course, replacement may occur without modernization and the equipment installed need not incorporate technological improvements. But in practice the new equipment usually incorporates such improvements and modernization does take place.

The theoretical conditions supporting the effect have been set forth by Edgar O. Edwards.²² Essentially the argument is that when a firm contemplates replacing an existing asset it must first consider the value of that asset's quasi rent, i.e., the excess of its gross revenues over all variable costs attributable to it. To justify continuing use of the asset over the coming time period this quasi rent must exceed (1) the interest on its salvage which is sacrificed by not replacing, (2) the decline in its disposal value which will also be lost to the firm over the coming period by failure to replace, and (3) the net returns which would have been derived from the replacement asset had replacement taken place.²³ Replacement will take place when the quasi rent from the existing machine falls below the sum of these three amounts.

The effect of liberalized depreciation on the replacement cycle derives from its effect on the time pattern of these quasi rents and is twofold. First of all, since it causes tax reductions for a given asset to be larger in the earlier years and decline as time passes, the decline of (after-tax) quasi rents on an existing facility is accelerated. Secondly, by the same process, the net return from the replacement machinery (point three) is increased.²⁴

²² Edgar O. Edwards, "Depreciation and the Maintenance of Real Capital," in J. L. Meij (ed.), *Depreciation and Replacement Policy*, Amsterdam, 1961, pp. 46-54.

²³ Net return is defined as the interest on the excess of the present value of successive quasi rents and disposal value associated with the new machine over its cost. For a firm with no finite limit on its time horizon the third point should be stated in the form: quasi rent from the existing machine must exceed the interest on the capitalized value of the excess of quasi rents and scrap values over costs of acquisition of an infinite succession of replacements. *Ibid.*, pp. 52-54 and Ture, *Accelerated Depreciation*, pp. 20-21.

²⁴ In discussing this, Norman Ture has pointed out that while the firm's replace-

Effect on the Choice Between Replacement and Modification

In many instances (especially in the industry under study) the alternative to replacing a facility is modernization through modification, i.e., rebuilding. Where tax depreciation provisions are conservative, the decision to modify rather than replace would be influenced by the possibility of deducting a large part of the modification expenses, in the form of labor costs, as annual maintenance expenses.

By improving the anticipated rate of return, discounted cash flow, or pay-back from a new asset, depreciation liberalization will, clearly, render the option of replacement more attractive than previously was the case.

Importance of the Demand Effect

The importance of liberalized depreciation as it acts upon the demand side of the investment decision depends upon several factors. First of all, management must recognize the after-tax advantage of the depreciation liberalization. Some firms make use of pay-back computations on a before-tax basis. If no after-tax computation is made of the savings due to depreciation, liberalization will not be recognized. Projects will be evaluated by management on the basis of the same pay-back periods as though there had been no liberalization. There is no additional *incentive* to spend for a given candidate modernization project.

The size of the change in the effective demand for modernization expenditures resulting from liberalization will depend upon the extent of the change in the after-tax return on investment or pay-back, and the elasticity of demand for modernization projects. Liberalized depreciation will have its principal effect on marginal investment decisions. Where the investment proposal is extremely attractive (e.g., pay-back in two years) or where it is absolutely essential for the continued operation of the business

ment cycle will be shortened this need not hold for the economy at large since replaced equipment may be resold in a used equipment market. Whether the point is significant or not will depend on the extent to which a used equipment market develops and on the tax depreciation provisions which apply to used equipment. See Ture, *Accelerated Depreciation*, pp. 20-21.

(e.g., shift in customers' requirements makes new equipment necessary) even though pay-back cannot be computed, the firm will somehow manage the financing and make the expenditure regardless of tax considerations.²⁵ The effectiveness of the tax change depends upon the quantity of projects which lie at the threshold of decision and which become economically desirable in view of the increase in their prospective effective yields or decrease in expected after-tax pay-back.

THE CASH FLOW EFFECT OF LIBERALIZED DEPRECIATION

Under modern accounting practice an attempt is made to allocate the cost of a capital asset over the period during which it contributes to production of income by recording a depreciation charge each fiscal period until the accumulation of such charges is equal to the cost of the asset. Although not necessarily an accurate reflection of wear and obsolescence in any given period, the charge does serve to prevent the reporting of excessive profits over the life of the asset. Under accepted management practice the contribution to internal cash flow made by depreciation charges is neither placed in a sinking fund nor earmarked for replacement of the asset in question. Rather, it is regarded, along with retained earnings, as available for any legitimate business use. Thus depreciation funds provide an important source of corporate finance. Indeed, they have constituted an increasing source of corporate funds throughout the postwar period. Since 1955, for example, capital consumption allowances have risen from 32 per cent of total sources to 40 per cent in 1966.²⁶

How Increased Cash Flow May Act to Increase Spending

The management of many firms apparently believes that financing must be almost entirely out of depreciation-generated

²⁵ In the latter case the return on investment may be regarded as the entire net income of the business which has been placed in jeopardy plus any losses that would occur if the expenditure were not made.

²⁶ For nonfarm, nonfinancial corporations, cf. the "1967 Annual Report of the Council of Economic Advisers," *Economic Report of the President*, p. 294.

funds and retained earnings.²⁷ Such firms apparently have judged that the cost of issuing new equity is prohibitive (i.e., their stock sells at such a low figure in the market relative to earnings that to sell additional shares to finance capital projects at hand is considered as "diluting" stockholders' equity). Moreover, they find debt financing very expensive (if they are relatively small, the sale of bonds may be impossible and long-term borrowing from such institutions as insurance companies expensive and difficult to arrange) and the imputed cost of uncertainty prohibitive. Such firms are frequently said to have an "aversion to debt." They may fear that the contractual burden of interest payments may force the firm into bankruptcy and for this reason they may prefer to avoid debt financing altogether or to use it in very limited amounts for unusually rewarding projects or those necessary to preserve the competitive position of the firm.

Liberalization of tax depreciation results in immediate increases in depreciation-generated funds, funds deemed to have the lowest capital cost of all sources available to the corporation and which are likely to be channelled into additional capital expenditures.

In essence, what takes place is that the supply curve for investible funds is shifted to the right.²⁸ For firms which are en-

²⁷ Despite management's belief that internally generated funds cost less than funds derived externally, widespread doubts exist among economists. For example, Ezra Solomon has pointed out that unless the corporation is one in which the assets are static or shrinking it will be investing new equity funds. Under such conditions "the cutoff point for new investment proposals will be determined, on the supply side, by the cost of other kinds of equity capital that are used to finance the expansion of assets." Ezra Solomon, *The Management of Corporate Capital*, Glencoe, Ill., 1959, p. 134.

²⁸ This shift is illustrated in Figure 1, p. 69. A more detailed delineation of this view of the role of cash flow changes will be presented in Chapter 5, pp. 68-70. The points of issue concerning the costs of funds from alternative sources is the subject of an extensive literature. See, for example, F. Modigliani and M. H. Miller, "The Cost of Capital, Corporation Finance, and the Theory of Investment," *American Economic Review*, XLVIII, No. 3 (1958), 261-297; David Durand, "The Cost of Capital in an Imperfect Market: A Reply to Modigliani and Miller," *American Economic Review*, XLIX, No. 4 (1959), 646-655; F. Modigliani and M. H. Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment: Reply," *American Economic Review*, XLIX, No. 4 (1959), 657; F. Modigliani and M. H. Miller, "Some Estimates of the Cost of Capital to the

tirely dependent on internally generated funds the supply curve of funds for the purchase of capital goods and plant may be viewed as positively sloped through the range representing the extent of depreciation generated funds plus retained earnings, rising vertically at the point where the full amount of internal funds is allocated to capital additions. For firms which make use of both internal and external funds and which regard the latter as more costly than the former, the supply curve will kink at the full amount of internal funds, rising vertically to meet the upward sloping external funds supply curve. In either case, the rightward shift of the supply curve may be expected to increase capital expenditures unless there are no eligible investment projects lying at the margin.

It may be objected that having shown that liberalized depreciation may stimulate investment by altering the after-tax rate of return (the demand effect), one is not entitled to say that the increase in the flow of internal funds resulting from more liberal depreciation of a given piece of capital equipment is an *additional* route by which capital expenditures may be stimulated. But such is not the case; in this analytical context, depreciation liberalization may affect the demand for capital goods both by increasing the present value of their after-tax income stream and by reducing the apparent cost of acquiring them.

It is quite possible, of course, that the increased cash flow from liberalized depreciation may not result in additional investment. If the firm has previously made use of the capital funds market under relatively favorable terms, the liberalized depreciation may merely offer it an alternative source of funds under conditions it considers only slightly more favorable. It may happen that no additional acceptable investment opportunities lie at the threshold. In such a case the additional supply of funds will, of course, pose problems to management, which may then find it necessary to allow liquidity to be permanently increased, revise its capital structure, pay out funds in the form of divi-

Electric Utility Industry, 1954-57," *American Economic Review*, XVI, No. 3 (1966), 333-387. A. A. Robichek and S. C. Myers, *Optimal Financing Decisions*, Englewood Cliffs, N.J., 1965, pp. 21 ff; J. S. Duesenberry, *Business Cycles and Economic Growth*, New York, 1958, pp. 96-97.

dends, or use these funds to move the firm into a new type of economic activity (e.g., to diversify its product line).

Clearly, the effectiveness of the cash flow route will be dependent on the attitude of management toward the use of external funds (whether it regards additional internal funds as opening up new opportunities for expenditures or merely as substitutes for external financing which otherwise would have been used) as well as the abundance of expenditure projects which meet management's investment criteria.

The Reinvestment Cycle

We have seen previously that for a single asset liberalized depreciation acts to increase depreciation charges in the early years and to reduce them in the later ones. When replacement of assets is continuous and the quantity of assets is held constant, depreciation charges will rise with a shift from SL to DDB or SYD but will eventually return to the level of SL depreciation.²⁹ Where the stock of capital is growing, depreciation charges under DDB and SYD will continue to exceed those which would have been made with SL provisions. If there is an irregular growth in assets DDB and SYD depreciation allowances may fall below SL allowances in any one year but total accumulated allowances will exceed those under SL arrangement. For a growing concern, therefore, any use of liberalized depreciation results in increases in total cash flow over time.

If all additional internal funds are spent for additional capital items, liberalization of tax depreciation will result in an immediate increase in expenditure and will set up a stream of additional expenditures through time, since liberalized depreciation immediately results in a larger stream of cash due to tax savings and such funds are in turn spent for new equipment or plant. The new expenditure may generate, through increased earnings, an additional cash flow which can in turn be spent for additional equipment (again assuming an acceptable rate of return) and so on.

²⁹ This discussion follows closely that of Norman Ture, *Accelerated Depreciation*, pp. 18-19.

A further point needs to be made in connection with the re-investment cycle generated by a pure cash flow reinvestment effect: its maximum effect comes about when increased cash flow is invested promptly. If there are delays in reinvestment or interruptions in the investment spending due, say, to business cycle recessions the effect is substantially dissipated.

THE EFFECT OF LIBERALIZED DEPRECIATION
ON MANAGEMENT'S ATTITUDES

A third route by which liberalized depreciation may act is by influencing management's attitudes about spending for modernization: determining whether or not to replace equipment, or determining the amount of funds to be allocated to the modernization budget in contrast to other uses. This route must not be confused with either the demand or cash flow effects discussed previously. The influence referred to here is not related to the tax reduction *per se* but instead to the role played by enlarged depreciation charges made within the *bookkeeping system* in affecting managerial judgment. For such an influence to make itself felt there must be a change in depreciation accounting practices for financial and general administrative purposes along with a change for tax purposes. Moreover, management must hold concepts regarding depreciation charges that will lead to the practices described.

Of course, firms are not required to treat depreciation for ordinary management purposes in the same way that they treat such charges for tax purposes (management may keep "two sets of books") and it is only when tax and book depreciation are treated alike that it is possible for the effects on management attitudes under discussion to take place.

In strict logic it is irrelevant to the decision to replace a physical asset whether or not the existing asset has been fully depreciated on the books of the company.³⁰ What is important is

³⁰ It is true, of course, that undepreciated value is more or less a measure of salvage and sales value. Replacement decisions do involve consideration of salvage value of the old asset.

whether or not the increased net revenues over and above maintenance and operating costs will be sufficient to pay for the new asset in the course of its expected life and to provide an acceptable return on its purchase price.³¹

Yet there is often a reluctance to part with an asset that has not lived out its "full life" according to accounting records. In part, this is emotional, stemming from reluctance to admit what may be regarded as past errors. But it may also stem from the fact that executives operate in a world of imperfect knowledge. Top management is constantly beset by requests to spend money. At the same time it regards the maintenance of the firm as a going concern to be a fundamental responsibility.

Lower management is anxious to improve efficiency and may be given to optimism in projecting operating advantages of proposed new equipment. Accordingly, top management may be tempted to use existing book value as a defensive rule of thumb or as an additional criterion when it feels unsure of what the future holds or of the claims submitted.

Of course, modern management practice does not include the amount of undepreciated book value as an acceptable investment criterion. Management may adjust for lack of confidence in the future by setting higher requirements for rates of return or pay-back but it should ignore book value of the old asset.³² Nevertheless, scientific procedures are not always followed, and management does not always ignore the size of undepreciated asset values in making replacement decisions.

Another way in which liberalized depreciation affects capital expenditures is through its effect on the modernization expenditures budget. In practice management may have difficulty determining how much to allocate for modernization. Not only do some firms face competing demands for modernization, expansion, and additional working capital, but they also face competing demands upon managerial time and energy (modernization proj-

³¹ Where management uses pay-back criteria this statement should be rephrased in terms of increased net revenues paying back the purchased price within an acceptable period.

³² It should not, however, ignore salvage value.

ects make considerable demands on both). In addition, the extent to which quality erodes and maintenance and operating costs mount with the increasing age of equipment is often difficult to ascertain, and precise computations of savings from more modern equipment are difficult to make. Under such conditions, as is so often the case in running a complex business, management may make use of rather crude rules of thumb to assist in making business judgments. One such rule of thumb is that depreciation charges constitute a target, perhaps a minimum target, for replacement expenditure if the firm is to remain competitive. Such a rule may be used loosely to determine whether or not an amount equal to accumulated depreciation has been spent over a period of years, or it may be applied as an annual minimum. Liberalized depreciation may serve to raise this capital budgetary target.

MODERNIZATION VERSUS CAPITAL EXPANSION

In Chapter I it was noted that modernization outlays can be defined as those made to *replace* existing facilities with new ones which will afford reductions in variable unit costs at the same level of output. Such outlays may be contrasted, on one hand, with outlays for facilities to be used for increasing total output without reduction of unit costs and, on the other, with simple replacement affording no production economies.³³

The preceding sections have outlined routes by which liberalized depreciation may influence modernization expenditures, the type of capital expenditure of major concern to this study. Yet it must be noted that for several reasons it may sometimes be difficult if not impossible to distinguish between modernization expenditures and expansion type expenditures. One reason for this difficulty is that an expenditure may serve both to replace existing equipment and increase output because of the increased pro-

³³ We noted in Chapter I, pages 8-9, that in practice replacement expenditures are likely to involve modernization. This merging of pure replacement and pure modernization expenditures would seem to impose no conceptual difficulties in the present chapter.

ductivity of the newer equipment or plant. Another is that both modernization and capacity expansion are, in general, responsive to the same factors. As we have seen, liberalized depreciation acts to make replacement more attractive and shortens the replacement cycle. But it also increases the marginal efficiency of capital invested in expansion projects. Similarly, the cash flow effect of liberalized depreciation may influence replacement and expansion projects alike.

Throughout this study we shall emphasize the role of liberalized depreciation in influencing modernization. To the extent that it is possible, influences on modernization will be isolated. It must be recognized, however, that much that will be said will often be applicable for capital expenditures other than modernization.