The Taxation of Corporate Gains on Sales of Depreciable Property: An Economic Analysis

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I. INTRODUCTION

Currently, the statutory rate on corporate capital gains is equal to the statutory tax rate on ordinary corporate income, generally 35 percent for large corporations, although capital and ordinary losses are treated separately.[1] Individual capital gains taxes have received an enormous amount of attention, both in the popular media and in the academic literature. Corporate capital gains, on the other hand, have received very sparse attention. In principle, however, the distortions that arise from corporate capital gain taxation are analogous to those that might arrive from individual capital gains taxation. Corporations might face a higher user cost of capital because of this factor in the code, and they could find that their previous purchases have been "locked in" in the sense that asset sales are avoided because of their tax consequences.

As a general rule, corporate capital gains taxation has been ignored in the investment literature, and corporate capital gains tax rates have been excluded from studies that have attempted to examine the impact of taxation on firm-level investment. For example, a recent review of the literature in this area by Kevin A. Hassett and R. Glenn Hubbard does not mention a single study that addresses the theoretical or empirical impact of corporate capital gains taxation on firm behavior.[2]

More recently, a 2004 paper by Mihir A. Desai and William M. Gentry[3] and a 2006 paper by Desai[4] have begun the inquiry into the impact of the corporate capital gains taxation. They highlight a number of important findings:

1) Despite the potential for a lock-in effect, corporate capital gains still account for approximately 20 percent of corporate income in a typical tax year.[5]

2) Using Compust data, Desai estimates the value of the stock of unrealized capital gains to be, at a minimum, about $839 billion in 2004.[6] This large number suggests that the potential gains from eliminating the lock in effect could be enormous.

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[1] Section 11 imposes a 35 percent rate on corporate income in excess of $10 million. (Unless otherwise noted, section references are to the Internal Revenue Code of 1986, as currently in effect). Under section 199, 6 percent of net income from qualified production activities may be deducted in 2007 through 2009 and 9 percent may be deducted thereafter, lowering the effective tax rate to 32.9 or 31.85 percent. The only tax-rate provision for corporate capital gains is a provision in section 1201 that allows firms to choose a flat-rate 35 percent tax on their net capital gains, an option that would not lower tax liability.

As discussed in section III.B, below, some gains from the sale of depreciable property are recaptured and taxed as ordinary income rather than capital gain, but such recapture has little relevance for corporations, given the equality of the tax rates. The distinction between ordinary income and capital gains is relevant, however, for firms seeking to deduct capital losses against ordinary income.

[2] "Tax Policy and Business Investment," *Handbook of Public Economics*, v. 3, ed. Alan J. Auerbach and Martin Feldstein (Elsevier Science B.V., 2002), pp. 1293-1343.

[3] "The Character and Determinant of Corporate Capital Gains," *Tax Policy and the Economy*, v. 18, ed. James M. Poterba (MIT Press, 2004), pp. 1-36.

[4] "Taxing Corporate Capital Gains," *Tax Notes*, March 6, 2006, pp. 1079-1092.

[5] Desai and Gentry, *supra* note 3, p. 21; Desai, *supra* note 4, p. 1081.

[6] Desai, *supra* note 4, p. 1081.

3) Most countries other than the United States already either exempt corporate capital gains from taxation, or provide special treatment for such gains. For example, Hong Kong, Singapore, New Zealand, Costa Rica, Jamaica and Kenya do not tax the income at all. France exempts 95 percent of gains from taxation, and Germany does the same. Elsewhere in Europe---Sweden and the Netherlands, for example---gains are exempted from taxation if they involve at least a 5 percent share of one company in another.[7]

4)The elasticity of realizations of capital gains appears to be quite high. Using time-series regressions, Desai and Gentry estimate that it is about -1.3.[8]

5)Making conservative assumptions, Desai calculates that more than $100 billion of realizations are displaced each year because of the lock-in effect, resulting in a welfare loss to society of about $20 billion per year.[9]

This suggests that the potential consequences of a reduction in the corporate capital gains tax are significant. Indeed, Courtney Edwards, Mark H. Lang, Edward L. Madew and Douglas A. Shackelford studied a large reduction of the German corporate capital gains tax and found that it had a very large and statistically significant effect on stock prices.[10] In particular, firms with large cross holdings significantly outperformed other firms at the time of the reduction.

Perhaps because of these findings, a significant amount of attention is beginning to be paid to the corporate capital gains tax in the U.S. However, the analysis to date only looks at one piece of the puzzle. Corporate capital gains taxes certainly have a lock-in effect, but they also have the potential to increase the cost of capital as well. Because of this, a reduction in the corporate capital gains tax could have additional effects on capital investment.

The purpose of this short paper is to explore this cost-of-capital effect, and to use that exploration to provide some guidance as to potential reforms. Our discussion is limited to the taxation of gains on depreciable business property, particularly equipment and software. We do not discuss the taxation of corporate gains on financial assets.[11]

In section II, we consider a simple model with relatively specific assumptions about why sales of used capital might occur. In section III, we apply this model to the U.S. tax

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[7] Desai, *supra* note 4, pp. 1083-1084; Desai and Gentry, *supra* note 3, pp. 8-9.
[8] Desai and Gentry, *supra* note 3, p. 24.
[9] Desai, *supra* note 4, pp. 1088-1089.
[10] "Germany's Repeal of the Corporate Capital Gains Tax: The Equity Market Response," *Journal of the American Taxation Association*, winter 2004, supplement, pp. 73-97.
[11] We note, however, the strong case that Desai has made against the full taxation of capital gains received by a corporation on its holding of another corporation's stock. Section 243 provides a dividends-received deduction to mitigate "triple taxation" of inter-corporate holdings, but offers no corresponding relief for capital gains on such holdings. See Mihir A. Desai, Testimony Before the Subcommittee on Select Revenue Measures of the House Committee on Ways and Means, May 9, 2006. Also see Desai, *supra* note 4, pp. 1085-1086; Desai and Gentry, *supra* note 3, p. 16.

system. The analysis reveals that current law, in which gains on sales of used capital are taxed at ordinary tax rates and buyers are allowed to depreciate their purchase cost, raises the cost of capital because sales of used capital face a tax penalty. The tax penalty is larger for longer-lived equipment. We identify three reforms that would essentially eliminate the tax penalty in the simple model; zero taxation of capital gains with recapture of excess depreciation, zero taxation of capital gains with the seller's basis carrying over to the buyer, and reduced tax rates on capital gains. In section IV, we discuss extensions to the model and assess the strengths and weaknesses of each reform. We conclude in section V.

II. MODEL OF CORPORATE CAPITAL GAINS TAXATION

In subsection A, we review how the standard model of the user cost of capital works with no sales of used capital. We introduce such sales in subsection B and analyze their tax treatment in subsequent subsections.

A. Standard Framework: No Sales of Used Capital

We sketch briefly how the cost of capital is derived in the traditional framework in which depreciable property is never sold. To facilitate the numerical results presented in section III, below, we use a discrete-time framework in which production and tax payments occur at one-year intervals.

At date zero, a new unit of capital is produced, with a production cost of one consumer good. The unit produces no output at that date, but one year later, at date one, it produces C units of consumer goods. One year after that, at date two, it produces $C(1-\delta)$ units of consumer goods. It continues to produce output in every subsequent year, for all of eternity, with its real output each year equal to $(1-\delta)$ times the real output the year before. The parameter δ, which is between zero and one, is the true, or economic, depreciation rate of this capital.

Because of the specific assumptions about how capital is produced, one unit of t-year-old capital will yield exactly the same output in every future year as $(1-\delta)^t$ units of newly produced capital. Provided that old and new capital face the same tax treatment, then, a unit of t-year-old capital must sell for exactly the same amount as $(1-\delta)^t$ units of new capital. We also assume that new capital can be produced for one unit of the consumption good, so that, in the no-tax world, it would always sell for one unit of that good. We assume that firms incur no additional costs to install the capital.

In this standard framework, capital, once purchased by a firm, is always capable of producing output (of the above-described amount) in the hands of that firm. There is, then, no reason to sell the capital to another firm. To be sure, there is no particular reason not to sell, either, but such sales have no consequences in this framework and can therefore be ignored. In the real world, of course, there are many non-tax factors that may stimulate a sale, and we turn to these in subsection B, below.

Firms are willing to invest up to the point at which a new unit of capital yields an after-corporate-tax real return of *r*. In other words, the firm is indifferent between a claim on one consumer good today and a claim to 1+*r* consumer goods next year. This real return covers the compensation that households demand to supply funds to the firm (rather than consuming, investing abroad or investing in another sector of the economy), as well as any taxes that households pay on the investment.

With no taxes, what is the equilibrium level of *C*? The firm equates the present discounted value (discounted at rate *r*) of the output produced by the unit of capital to its purchase cost. To obtain the present value of the output, we sum the geometric progression for *t* equals 1 through infinity, in which each term is $C(1-\delta)^{t-1}/(1+r)^t$, obtaining $C/(r+\delta)$. Equating this present value to one, which is the production cost of the capital, yields

(1) $$C = r + \delta.$$

In economic terminology, $r+\delta$ is the *user cost of capital* in this no-tax world. The result makes intuitive sense; capital must yield a product that yields the required real return *r*, after covering depreciation δ.

With corporate taxes, the capital must generally have a higher marginal product to provide the required after-tax real return. Let τ be the corporate income tax rate, which is the same for all firms. Firms are allowed to claim depreciation deductions on their capital, which are also the same for all firms, although they generally differ across the various types of capital. Suppose that the present value of the deductions, discounted back to date zero at discount rate *r*, is *Z*.

In analyzing tax policy, the standard framework continues to ignore possible sales of used capital. Given its other assumptions, this is not surprising. We have already seen that this framework offers no non-tax reason for such sales. Assuming that the tax system does not subsidize such sales, they will also not occur with taxes. The possibility of such sales can therefore be disregarded if sales are either treated neutrally or are penalized by the tax system. Note that any tax penalty on sales is harmless in this framework, since no sales occur and none would have occurred in the absence of the penalty. (In contrast, a subsidy to sales would have important consequences, since each unit of capital would be sold by one firm to another as often as possible to claim these subsidies). Again, the framework's neglect of sales is strongly counterfactual and we will modify it in subsection B, below.

With the corporate tax in place, the present value of the after-tax cash flows is $C(1-\tau)/(r+\delta)$. But, the firm enjoys tax savings with date-zero present value τZ from claiming depreciation deductions, reducing the net purchase cost of the capital to $1-\tau Z$. The firm sets the present value of the after-tax cash flows equal to this net purchase cost, which yields

(2) $$C = \frac{(r+\delta)(1-\tau Z)}{1-\tau}.$$

With no taxes, equation (2) simplifies to equation (1). It is useful to define an effective tax rate, as follows,

(3) $$ETR = 1 - \frac{r}{C-\delta}.$$

In this expression, $C-\delta$ is the before-tax return to capital, net of depreciation, while r is (by assumption) the after-tax return, also net of depreciation.

Note than an increase in the user cost signals a reduction in investment. Such an increase means that capital investment must yield a higher before-tax return to be viable.

B. Introducing Sales of Used Capital

The standard framework's treatment of sales of used capital is clearly at odds with reality. As discussed in section I, above, firms engage in a substantial amount of sales, even though (as we shall soon see) such sales are penalized by the tax system. It is quite clear that sales take place for non-tax reasons; there must, then, be circumstances in which it is economically beneficial for capital to be held by one firm instead of another. We now introduce such sales in a specific, simple manner that illustrates the potential impact of tax policy.

We assume that, T years after each firm purchases a unit of capital, the firm loses its ability to use that unit. The firm's operations no longer "fit" the unit of capital and the unit can produce no further output in the hands of that firm. Nevertheless, the capital can still be used to produce output (in the amounts described above) if it is transferred to another firm, where it will remain operational for another T years.

In the no-tax world, the equilibrium outcome is clear. The firm that originally held the capital would sell it to another firm and such sales would be repeated every T years. The equilibrium sale price would be $(1-\delta)^t$ units of consumer goods, because that is the cost of producing $(1-\delta)^t$ units of new capital, for which this used capital is a perfect substitute. No buyer would pay more, since new capital could be purchased instead; no seller would settle for less, since even the slightest discount would draw a large number of firms eager to pay less than the cost of new capital.

Any tax penalty on sales now has real effects. To be sure, under our assumption that the capital becomes completely worthless when it is held more than T years, there is no lock-in effect (unless the tax absorbs the entire value of the capital). The firm will sell, even at a tax penalty, rather than hang on to worthless capital. Nevertheless, the anticipation of paying this tax penalty when the used capital is sold will increase the user cost and depress investment.

C. User Cost of Capital With Sales of Used Capital

We make the following general assumptions about the tax system. These general assumptions will encompass the current U.S. tax system and the reform options that we consider in section III, below. First, the sale proceeds, net of the firm's cost basis, are taxed at rate γ, which may, but need not, equal the ordinary tax rate τ. We also allow for the possibility that the firm is taxed at ordinary tax rate on a depreciation recapture amount. Third, we assume that purchasers of used capital receive the same tax treatment as purchasers of newly produced capital.[12]

The last assumption has the important implication that the real sale price of the unit of *t*-year-old capital is $(1-\delta)^T$, as it would be in the no-tax world. The unit of old capital remains a perfect substitute for that many units of newly produced capital, because it has the same future output and the same tax treatment.

At date zero, when the first firm buys the capital, it equates the present value of the after-tax output generated during its anticipated *T*-year holding period to its net cost of purchasing the unit.

To obtain the date-zero present value of the after-tax output generated by the unit of capital during the holding period, we sum the geometric progression for t equals 1 through T, in which each term is $C(1-\tau)(1-\delta)^{t-1}/(1+r)^t$, obtaining

$$C\frac{1-\tau}{r+\delta}\left\{1-\left(\frac{1-\delta}{1+r}\right)^T\right\}.$$

The firm initially spends one dollar to purchase the unit of capital, but there are four modifications to the purchase cost. First, as before, the firm enjoys tax savings from depreciation deductions. However, the date-zero present value of the tax savings is now $\tau Z(T)$ where $Z(T)$ is the present value of the cumulative depreciation deductions available to a firm that sells at date T. Second, the date-zero present value of the firm's after-capital-gains-tax sale proceeds, ignoring the basis deduction, is $(1-\gamma)\left(\frac{1-\delta}{1+r}\right)^T$. Third, the firm enjoys tax savings with a date-zero present value of $\gamma B(T)$ from the basis deduction, where $B(T)$ is the present value of the deduction allowed for a sale at date T.

[12] Generally, the tax law has provided uniform treatment to new and used capital. One historical exception is the 1962 legislation creating the investment tax credit, which generally restricted the credit to property that was constructed, or whose original use began, after December 31, 1961; each firm was, however, allowed to claim the credit on $50,000 of property that did not satisfy this requirement. See section 48 of the Internal Revenue Code of 1954, as added by section 2(b) of the Revenue Act of 1962, Public Law 87-834 (enacted October 16, 1962).

Fourth, firm pays additional tax $(\tau-\gamma)D(T)$, where $D(T)$ is the date-zero present value of the depreciation recapture amount that applies to a sale at date T.

The firm sets the after-tax cash flows equal to the net purchase cost, yielding

$$C\frac{1-\tau}{r+\delta}\left\{1-\left(\frac{1-\delta}{1+r}\right)^T\right\}=1-\tau Z(T)+(\tau-\gamma)D(T)-(1-\gamma)\left(\frac{1-\delta}{1+r}\right)^T-\gamma B(T)\text{, or}$$

$$C=\frac{r+\delta}{1-\tau}\left\{1-\left(\frac{1-\delta}{1+r}\right)^T\right\}^{-1}\left\{1-\tau Z(T)+(\tau-\gamma)D(T)-(1-\gamma)\left(\frac{1-\delta}{1+r}\right)^T-\gamma B(T)\right\}.$$

After some manipulation, this can be rewritten as

$$C=\frac{r+\delta}{1-\tau}\left\{1-\tau Z+\frac{\gamma\left[\left(\frac{1-\delta}{1+r}\right)^T-B(T)-D(T)\right]+\tau\left[\{Z-Z(T)\}+D(T)-Z\left(\frac{1-\delta}{1+r}\right)^T\right]}{1-\left(\frac{1-\delta}{1+r}\right)^T}\right\}.$$

The advantage of writing the expression in this form is that it facilitates a comparison with (3) and thereby highlights the impact of selling the capital. Specifically, selling at date T rather than holding the capital forever changes the cost of capital by

$$\text{(4)}\qquad \Delta C=\frac{r+\delta}{1-\tau}\frac{\gamma\left[\left(\frac{1-\delta}{1+r}\right)^T-B(T)-D(T)\right]+\tau\left[\{Z-Z(T)\}+D(T)-Z\left(\frac{1-\delta}{1+r}\right)^T\right]}{1-\left(\frac{1-\delta}{1+r}\right)^T}.$$

These equations generalize the results derived by Alan Auerbach in 1981, who performed a similar analysis for a specific tax system, as discussed below.[13] In drawing out the economic implications of these equations, we rely heavily upon his cogent analysis. We will also refer to work by Roger H. Gordon, James R. Hines, Jr., and Lawrence H. Summers, who performed numerical computations of this type for structures investment.[14]

[13] Alan J. Auerbach, "Inflation and the Tax Treatment of Firm Behavior," *American Economic Review*, 71(2), May 1981, pp. 419-423. Auerbach assumed that production and tax payments occur continuously, rather than at one-year intervals, but that difference has no impact on the substantive results.
[14] "Notes on the Tax Treatment of Structures," in *The Effects of Taxation on Capital Accumulation*, ed. Martin Feldstein (Chicago: University of Chicago Press, 1987), pp. 223-254.

D. Economic Analysis

Expression (4) has the same sign as the following expression, which we call the *tax factor impacting sales (TFIS)*,

$$(5) \qquad TFIS \equiv \gamma\left[\left(\frac{1-\delta}{1+r}\right)^T - B(T) - D(T)\right] + \tau\left[\{Z - Z(T)\} + D(T) - Z\left(\frac{1-\delta}{1+r}\right)^T\right].$$

If *TFIS* is positive, the tax treatment of capital resale raises the user cost and thereby depresses investment; if it is negative, then the tax treatment lowers the user cost and boosts investment.

As Auerbach stressed, there are two relevant effects.[15] We will label them as follows:

- *The Capital-Gain-Tax Effect*: The sale triggers taxation at the capital gains rate on (or deduction of) the difference between sale price and basis, net of any amount that is recaptured as ordinary income. This effect is reflected by the presence of $\gamma\left[\left(\frac{1-\delta}{1+r}\right)^T - B(T) - D(T)\right]$ in (5).
- *The Depreciation-Allowance Effect*: This effect arises because the sale changes the tax depreciation allowances available on the capital. By selling the capital, the firm loses deductions with date-zero present value Z-$Z(T)$, the allowances that it has not yet had time to claim. It is also taxed on a recapture amount with date-zero present value $D(T)$. But it receives a sale price that incorporates the buyer's ability to claim depreciation deductions with date-zero present value $Z\left(\frac{1-\delta}{1+r}\right)^T$ on this capital. (Alternatively, the firm could replace the capital with that many units of new capital, on which it could claim those deductions). This effect is reflected by the presence of $\tau\left[\{Z - Z(T)\} + D(T) - Z\left(\frac{1-\delta}{1+r}\right)^T\right]$ in (5).

Without more information on the tax system, we cannot say whether either effect, let alone the combined effect, is positive or negative.

Indeed, as demonstrated in the Appendix, both effects are zero for one textbook income tax system, namely a system of true economic depreciation, involving inflation indexation for both depreciation and basis, with no depreciation recapture. Economic,

[15] Auerbach, *supra* note 13, p. 420.

inflation-indexed, depreciation results in an effective tax rate equal to the statutory tax rate with sales at any date, provided that basis is computed in a consistent inflation-indexed manner. The reason is that both of the effects vanish in this case. The capital-gain-tax effect disappears because basis is equal to sale price, so that no gain or loss occurs on the sale. The depreciation-allowance effect disappears because one unit of used capital receives the same depreciation treatment as $(1-\delta)^T$ units of new capital.

Of course, the U.S. tax system differs significantly from the above textbook system. In particular, depreciation allowances are accelerated, meaning that they are more favorable for young assets than for old ones. Due to rapid depreciation, basis is reduced below market value, a disparity that is reinforced by the tax system's failure to index basis for inflation. As a result, the capital-gain-tax effect *discourages* sales, because the sale results in a taxable capital gain. On the other hand, the depreciation-allowance effect *encourages* sales, because the used capital has very little (maybe no) depreciation allowances remaining to be claimed by the selling firm while the buying firm is allowed to depreciate its purchase cost in the same manner as if it had purchased new capital.

We now examine the net impact in the U.S. tax system.

III. APPLICATION TO U.S. TAX SYSTEM

A. Tax Penalty on Sales of Used Capital

We consider 3-year, 5-year and 7-year property, as defined in section 168(e). We use the tax depreciation schedules applicable to these types of property, which are computed in accordance with section 168 and are tabulated in recent work by Darrel S. Cohen, Dorthe-Pernille Hansen and Kevin A. Hassett (CHH).[16]

We assume that the first-year depreciation allowance is deducted at the purchase date, not one year later. For a sale at date T, the present value of depreciation allowances $Z(T)$ is the sum of the present values of the depreciation allowances for 0 through T. The nominal basis at date T is one minus the depreciation deductions claimed through T. There is no inflation indexation of basis.

We set the regular and capital-gains tax rates equal to .35, in accordance with section 11. As discussed in subsection B, below, sections 1245 and 1250 provide for recapture of some gain as ordinary income. With the two tax rates equal, however, the recapture is of no significance, so it can be disregarded for present purposes.

[16] "The Effects of Temporary Partial Expensing on Investment Incentives in the United States," *National Tax Journal*, 55(3), September 2002, pp. 457-466. The allowances, which are set forth on p. 460, are those applicable to a firm using the half-year convention, as generally permitted by section 168(d)(1). Note that firms that invest heavily in the last quarter of the tax year may be denied the use of this convention under section 168(d)(3).

Following CHH and recent work by Robert Carroll, Kevin A. Hassett and James B. Mackie III (CHM),[17],we set the inflation rate equal to .03. We set the interest rate r equal to .05, which is generally consistent with the .04 required return at the household level that CHM assume, with some markup due to household level taxes.

Following CHH, we take the economic depreciation rates are taken to be the reciprocal of the tax lives; .333 for three-year property, .2 for five-year property, and .143 for seven-year property. Under these assumptions, the present value of depreciation deductions, Z, equals .930 for three-year property, .874 for five-year property, and .825 for seven-year property.

For these benchmark parameters, we display effective tax rates for different holding periods T in Table 1:

TABLE 1: EFFECTIVE TAX RATES ON SOFTWARE AND EQUIPMENT (percent)

	No Sale	10	5	3	2	1
Three-year	22.5	22.7	24.5	28.1	31.3	36.2
Five-year	25.3	26.6	31.3	35.2	37.6	40.5
Seven-year	26.7	29.5	35.1	38.2	40.0	42.2

Allowing for the sale of used capital can significantly increase the effective tax rate, depending on the frequency of sale. For any given holding period, the effects are larger for longer-lived equipment. The reason is that the depreciation-allowance effect, which works to reduce the tax penalty, is smaller for longer-lived equipment, since depreciation allowances are claimed more slowly on such equipment.

With sales every 10 years, for example, the effective tax rate rises by 0.2 percentage points for three-year property, 1.3 points for five-year property and 2.8 points for seven-year property. With sales every five years, the increases are 2.0, 6.0, and 8.4 percentage points.

Not only does the tax penalty on sales discourage investment, it is also likely to distort the allocation of investment. As noted above, for any given holding period, the tax penalty is larger on the longer-lived equipment, which already faces slightly higher effective tax rates even in the standard framework. Of course, different types of property may also face different tax penalties because they have different holding periods, another source of distortion in the allocation of investment.

The tax penalty on sales is larger (smaller) with higher (lower) inflation, because basis is lower (higher) relative to sale price. As shown in the Appendix, however, the impact is relatively modest. By the same token, inflation-indexation of basis would have little effect, as also shown in the Appendix.

[17] "The Effect of Dividend Tax Relief on Investment Incentives," *National Tax Journal*, 56(3), September 2003, pp. 629-651.

The impact of the tax penalty on investment may be substantial. If sales occur every five years, then the tax penalty on sales increases the user cost of capital (not shown) by 0.4 percent for three-year property, 2.2 percent for five-year property, and 4.2 percent for seven-year property. CHH report that roughly 20 percent of equipment and software spending goes to three-year property and roughly 40 percent each to the other two categories.[18] The weighted percentage increase in user cost is then 5.2 percent.

In their survey of the literature, Hassett and Hubbard state, "Recent empirical studies appear to have reached a consensus that the elasticity of investment with respect to the tax-adjusted user cost of capital is between -0.5 and -1.0."[19] That result suggests a 2.6 to 5.2 percent reduction in equipment and software gross investment. Since such investment is about $1 trillion annually, these results suggest a $25 to $50 billion reduction in annual gross investment.

Of course, the impact is sensitive to the holding period. With a holding period of 10 years, the weighted increase in the user cost falls dramatically, to 0.7 percent. But, even this number is significant.

To provide some perspective, it should be noted that CHH found a weighted reduction of 3.1 percent for the section 168(k) temporary partial-expensing provision.[20] Under the five-year holding period assumption, the impact of the tax penalty on sales of used capital is actually larger than this provision. Even under the 10-year assumption, the effect of the tax penalty is one-quarter the size of the effect of what was generally considered a powerful investment incentive.

We now identify and discuss three reforms that would, exactly or approximately, eliminate the tax penalty on sales in the current framework.

B. Zero Capital Gains Tax, with Recapture of Excess Depreciation

Under the first policy, the capital gains tax rate γ is set to zero, eliminating the capital-gains-tax effect while the depreciation-allowance effect is negated through a recapture provision. The desired policy sets the date-zero present value of the recapture amount equal to

(6) $$D(T) = Z(T) - Z + Z\left(\frac{1-\delta}{1+r}\right)^T,$$

which results in a zero value for the depreciation-allowance effect in equation (5). Accordingly, the effective tax rate is independent of the holding period:

TABLE 2: EFFECTIVE TAX RATES ON SOFTWARE AND EQUIPMENT (percent)
(Zero Capital Gains Rate, Recapture of Excess Depreciation)

[18] Cohen, Hansen and Hassett, *supra* note 16, p. 460.
[19] Hassett and Hubbard, *supra* note 2, p. 1325.
[20] Cohen, Hansen and Hassett, *supra* note 16, p. 463, Table 3. The results are taken from the "new law" column of the table and from the intermediate-adjustment-cost assumption that omega is .5.

	No Sale	10	5	3	2	1
Three-year	22.5	22.5	22.5	22.5	22.5	22.5
Five-year	25.3	25.3	25.3	25.3	25.3	25.3
Seven-year	26.7	26.7	26.7	26.7	26.7	26.7

Since $D(T)$ is the date-zero present value of the recapture amount, its actual date-T value is $(1+r)^T$ times larger and can be written as $Z(1-\delta)^T - (1+r)^T\{Z - Z(T)\}$. The two terms in this expression have intuitive interpretations:

- The first term, $Z(1-\delta)^T$, is the date-T present value of the depreciation that would still be left to claim *if the depreciation allowances had been allocated across years in proportion to the depreciation that actually occurred in each year*. With this uniform allocation, the value of remaining depreciation allowances would always be Z times the market value of the capital.
- The second term, $(1+r)^T\{Z - Z(T)\}$, is, by definition, the date-T present value of the depreciation allowances actually remaining to be claimed.

If the latter term is smaller, as it is in the U.S. tax system, it indicates that too little of the lifetime depreciation allowance is still unclaimed, which means that too much has already been claimed. That excess is recaptured as ordinary income.

The recapture amount can be expressed relatively simply for a sale that occurs after the tax life of the property has ended, when $Z(T)$ is equal to Z. Then, the recapture amount is $Z(1-\delta)^T$. Note that $(1-\delta)^T$ is the sale price and, since basis is zero, is also the gain. Under this policy, therefore, for sales that occur after the tax life has ended, a fraction Z of the gain is taxed as ordinary income at rate τ and the remainder is tax-exempt. So, 93 percent of the gain is recaptured for three-year property, 87 percent for five-year property, and 82 percent for seven-year property. A simplified version of the recapture rule would always set the recapture amount at the fraction Z of the taxable gain, even for sales within the tax lifetime. The implications of this approximate rule are discussed in subsection D, below.

The recapture rule discussed here should be compared to the current-law recapture rules. As noted above, recapture is unimportant for corporations under current law, since the tax rates are equal, although it can affect the ability to deduct capital losses. For equipment and other personal property, all nominal depreciation allowances (up to the amount of the taxable nominal gain) are recaptured as ordinary income under section 1245; only the excess, if any, of the sale price over the original nominal purchase price is treated as capital gain. (Section 1250 prescribes more lenient treatment for structures). The recapture rule described above is less severe than section 1245, because only some of the depreciation allowances are recaptured.

If this recapture tax is imposed, there should be no capital gains tax, not even one at a preferential rate. With a positive capital gains tax and recapture, a tax penalty on sales remains. Table 3 displays the impact of a 15 percent capital gains tax, with the above-described recapture provision.

TABLE 3: EFFECTIVE TAX RATES ON SOFTWARE AND EQUIPMENT (percent)
(15 Percent Capital Gains Rate, Recapture of Excess Depreciation)

	No Sale	10	5	3	2	1
Three-year	22.5	22.6	23.4	25.0	26.5	29.1
Five-year	25.3	25.9	28.0	29.9	31.1	32.7
Seven-year	26.7	27.9	30.6	32.1	33.1	34.3

This policy removes four-sevenths of the tax penalty on sales, but leaves a significant penalty in place.[21]

The analysis of the depreciation-recapture policy suggests another policy that would yield similar results in this framework.

C. Zero Capital Gains Tax, with Basis Carryover for Seller

This policy sets the capital gains rate to zero, without imposing any recapture obligation on the seller, but requires the buyer to depreciate the capital in the same manner and to the same extent that it would have been depreciated by the buyer. If the buyer must follow exactly the same rules as the seller, this effectively places the obligation to pay the recapture tax on the buyer rather than the seller.

Under the maintained assumption in this framework that all firms have the same tax rates, it makes no difference which firm bears the obligation. The sale price simply declines to reflect the buyer's obligation. Of course, for any sale that occurred after the tax life had ended, the buyer would take the seller's zero basis and would have nothing to depreciate.

As with the rule discussed in subsection B, above, there should be no capital gains taxation under this policy, not even at a preferential rate.

This policy has little precedent in the current Code. An unrelated buyer is rarely, if ever, required to carry over the seller's basis. The Code does contain provisions, such as sections 1031 and 1033, pertaining to like-kind exchanges and certain rollovers, under which capital gains tax is not imposed on the seller and the *seller* takes a carryover basis in the replacement property. Sections 362 and 723 sometimes require a corporation or

[21] The current-law policy described in Table 1 can be viewed as implementing the recapture policy with gains taxed at 35 percent. (With the gains rate and the ordinary rate equal, we can view any amount, or none, as recaptured.) The policy in Table 3 is therefore four-sevenths of the way from Table 1 to Table 2 and the reduction in the user cost of capital, not shown, is four-sevenths as great. The pattern does not hold exactly for the effective tax rates shown in the tables, because the effective tax rate depends upon the user cost in a non-linear manner, as indicated by equation (3).

partnership to which a taxpayer contributes property (without payment of capital gains tax) to take a carryover basis in the property.

D. Reduced Capital Gains Rates

Another way to eliminate the tax penalty is to lower the capital gains tax rate, with no depreciation recapture or basis carryover.

In his 1981 analysis, Alan Auerbach derived a particularly simple and striking result for certain tax systems. He concluded that the capital-gains-tax effect and the depreciation-allowance effect are offsetting, so that there is no penalty on or subsidy to sales, if γ is equal to τZ.[22] Although Auerbach restricted his analysis to the case in which nominal depreciation allowances decay at rate δ, the result generalizes to any tax system in which depreciation allowances follow a geometric schedule and are not indexed for inflation, as shown in the Appendix. Of course, even that general case does not describe the U.S. tax system.

The Auerbach result also holds, however, in another case that is more relevant for the U.S. tax system; for any sale after the tax lifetime, setting γ equal to τZ results in tax neutrality toward sales. This can be confirmed from equation (6), using the fact that $B(T)$ is zero and $Z(T)$ is Z. It also follows straightforwardly from the discussion in subsection B, above. There, we saw that neutrality was achieved, for sales that occur after the tax life has ended, by taxing a fraction Z of the gain at the ordinary tax rate τ and exempting the remainder. The same outcome can obviously be achieved by taxing the entire gain at rate τZ.

Using the values of Z previously reported, this policy involves reducing the capital gains tax rate to 32.53 percent for three-year property, 30.60 percent for five-year property, and 28.87 percent for seven-year property. The following effective tax rates would then emerge if these rates are applied to all sales, including those that occur within the tax life:

TABLE 4: EFFECTIVE TAX RATES ON SOFTWARE AND EQUIPMENT (percent)
(Capital Gains Tax Rates of 32.53, 30.60 and 28.87 Percent; No Recapture)

	No Sale	10	5	3	2	1
Three-year	22.5	22.5	22.5	22.5	22.4	18.4
Five-year	25.3	25.3	25.3	26.3	24.9	18.7
Seven-year	26.7	26.7	27.9	27.5	25.9	19.0

In general, the tax penalty on sales is essentially negated for holding periods within the tax life, as well as later sales, except for sales at date one. It would, of course, be possible to specify different tax rates for each holding period and there is certainly precedent for

[22] Auerbach, *supra* note 13, p. 420.
[24] Gordon, Hines, and Summers, *supra* note 14.

varying capital gains tax rates by holding period. The exercise would essentially be the same as that involved in setting the recapture amount in subsection B, which varies by holding period. With a precisely calibrated capital gains tax rate for each holding period, the outcomes listed in Table 3 would emerge.

Conversely, the results in Table 4 would be replicated under the recapture policy if the recapture amount was set at the fixed fraction *Z* of the gain, rather than using the precise formula presented in subsection B, above.

Too large of a rate reduction encourages sales, because the capital-gains-tax effect becomes smaller than the depreciation-allowance effect. Consider, for example, the consequences of reducing the rate to 20 percent, with no depreciation recapture:

TABLE 5: EFFECTIVE TAX RATES ON SOFTWARE AND EQUIPMENT (percent)
(Capital Gains Tax Rate of 20 Percent; No Recapture)

	No sale	10	5	3	2	1
Three-year	22.5	21.6	10.8	-27.8	-123.5	*
Five-year	25.3	21.9	5.4	-9.9	-46.6	-613.0
Seven-year	26.7	22.1	14.0	3.6	-12.7	-93.0

* Effective tax rate is not meaningful, because before-tax net-of-depreciation marginal product is negative.

This tax rate results in a tax subsidy to sales, pushing the effective tax rate lower than in the no-sale case. Indeed, the rates become negative (often extremely negative) for short holding periods, indicating that the before-tax net-of-depreciation marginal product is lower than *r*.

In the absence of other constraints, firms would engage in tax-motivated sales and every unit of capital would be turned over every year. Anti-abuse rules could try to prevent sales that were purely tax motivated with no business purpose. But, even the sales that have some business purpose should not be artificially encouraged. Although subsidizing such sales lowers the cost of capital, it is a distortionary way of doing so, relative to a policy that is neutral toward sales.

Gordon, Hines and Summers concluded that individuals, but not corporations, had an incentive to churn structures under the laws in place prior to the Tax Reform Act of 1986. For individuals, the 20 percent top tax rate on long-term capital gains was far below the 50 percent top ordinary tax rate and there was no depreciation recapture for individuals who had used the straight-line method of depreciation.[24]

IV. EXTENSIONS

The basic conclusions from section III hold in a more general context, but some complexities are introduced.

A. Introducing a Lock-In Effect

The simplest modification is to assume that capital does not become worthless after it has been held for T years, but instead simply becomes somewhat less productive. This has little real impact on the analysis. A tax penalty on sales remains undesirable, but the form of the inefficiency changes to some extent and its magnitude becomes smaller. In some cases, with a sufficiently small tax penalty on sales, the tax will cause the capital to not be sold. This is the familiar lock-in effect.

The tax penalty on sales of used capital always continues to raise the user cost of capital, however, because the penalty results in either a tax payment on sale or in the inefficient retention of less productive capital, either of which reduces the profitability of the initial investment. When the capital is retained, it must be less burdensome than the tax payment (or it would not have been chosen), so the availability of this option does reduce the initial burden on investment. Note, however, that since no revenue is collected from the capital gains tax in that case, the burden rises as a fraction of revenue.

All of the key results still apply with this modification. It is still desirable to eliminate the tax penalty on sales of used capital, regardless of the exact form or mix of distortions that are caused by such a penalty. Furthermore, if the other assumptions of the above model are retained, any of the three reforms described above would eliminate the tax penalty.

Things become more complicated, though, if we move to a more general model of the economy.

B. More General Model

To begin, there are many ways to model the determinants of sales. The motivation for sale might be the same as we have assumed, but the sale price may be higher or lower than modeled, because the production cost of the substitutable new capital may have changed. Or, it is possible that the used capital remains fully productive for the selling firm, but that it has acquired "extra" value for the buying firm. (For this story to work, some restriction must be imposed on why perfectly substitutable capital cannot be produced at the same cost, but such restrictions may well be plausible.) Also, capital may not depreciate in the smooth geometric manner that we have assumed.

Another complication is that firms may not face the same tax rates. Some may be pass-through entities rather than C corporations, some may be subject to the corporate alternative minimum tax, and some may be in loss-carryforward situations.

Of course, the general principle that the tax system should neither subsidize nor penalize sales of used capital remains valid. None of the three reforms described in section III work perfectly in this framework, however, and each reform has strengths and weaknesses.

A zero capital gains tax rate with depreciation recapture has drawbacks if the sale price deviates from $(1-\delta)^T$ due to any of the factors mentioned above. In that case, tax neutrality generally does not hold at the time of sale. If the price exceeds that value, the sale is subsidized, because the seller pays no tax on the additional gain (the seller's only tax liability is the depreciation recapture) but the buyer is allowed to depreciate the higher amount. Conversely, if the price is lower than that value, the sale is penalized, because the seller's tax liability does not fall, but the buyer is limited to depreciating the sale price. (In principle, the seller should pay tax on the full recapture amount, even if it exceeds the taxable gain, contrary to the approach now taken by sections 1245 and 1250). Resale decisions would, therefore, be affected by the tax system. There may also be a perceived inequity if gains are not taxed and losses are not deducted.

On the other hand, the initial ex ante user cost of capital is largely unaffected, if δ (as used to compute the recapture amount) is set at the *expected* rate of depreciation. Depending upon future developments, sales of used capital may be either penalized or subsidized, but firms do not know which will occur when the capital is initially produced.

The recapture formula is non-intuitive, particularly if it requires recapture of an amount greater than the full gain. The exact formula is a complicated function of both δ and T, but it can be simplified by recapturing a fixed fraction Z of the gain. The idea of depreciation recapture already exists in sections 1245 and 1250.

The basis carryover approach is superior in a number of respects. It does not require a complicated formula. More important, it can handle fluctuations in the sale price. So long as the buyer and the seller face the same tax rate, neutrality is preserved. No tax is imposed on any gain, but the buyer gets no depreciation benefit, since depreciable basis is carried over from the seller. Similarly, no loss is deducted, but there is no reduction in depreciation deductions. Everything continues as if the capital had never changed hands.

Of course, the approach breaks down, at least to some extent, if the buyer and seller are in different tax brackets. To be sure, differences in tax treatment already cause some problems under current law.

The approach is also likely to seem counter-intuitive. Why should a buyer who pays real money to acquire used capital be denied depreciation deductions, simply because the capital has already been fully depreciated by the seller? The fact that the seller received a price reduction to compensate for this disability may not be seen as a compelling response. As noted above, there is little or no precedent for this approach.

Preferential rates on capital gains with no depreciation recapture are relatively simple to implement. To be sure, separate rates must be specified for each type of capital, although the information needed to do so can be inferred from the tax depreciation schedules and the firm's discount rate. This approach also handles the case in which the sale price deviates from $(1-\delta)^T$; the excess or shortfall results in a change in the seller's tax liability that offsets the impact on depreciation allowances. Preferential rates for capital gains are also familiar from current and past law. There may still be an incentive, however, for capital to move between firms with different tax rates.

V. CONCLUSION

The taxation of corporate capital gains is an important topic that has received little attention in the literature. Our analysis reveals that current law, in which gains on sales of used capital are taxed at ordinary tax rates and buyers are allowed to depreciate their purchase cost, raises the cost of capital. We identify three policies that would essentially eliminate the impact on user cost in a simple model; a zero tax rate on capital gains with recapture of excess depreciation allowances at ordinary tax rates, zero taxation of capital gains with the seller's basis carrying over to the buyer, and reduced tax rates on capital gains. The basic results hold in more general models, although each of the three reforms has strengths and weaknesses.

APPENDIX

No Tax Penalty on Sales With Economic Depreciation

Under such system, the depreciation allowance at each date *t* has *real* value $\delta(1-\delta)^{t-1}$ and date-zero present value $\delta(1-\delta)^{t-1}/(1+r)^t$. Summing these present values for *t* from 1 through *T* reveals that *Z*(*T*) is $\frac{\delta}{r+\delta}\left\{1-\left(\frac{1-\delta}{1+r}\right)^T\right\}$, so that *Z* is $\frac{\delta}{r+\delta}$. Also, the basis remaining at date *T*, after claiming the date-*T* depreciation allowance, has real value $(1-\delta)^T$ and date-zero present value *B*(*T*) of $\left(\frac{1-\delta}{1+r}\right)^T$. Substituting these values into equation (6) reveals that *TFIS* equals zero for all values of *τ* and *γ*. Alternatively, substituting these values into equation (4) reveals that $C=\frac{r}{1-\tau}+\delta$ and $ETR=\tau$, which is the same values yielded by equations (3) and (4).

Sensitivity to Inflation and to Basis Indexation

Tables A1 and A2 show the tax penalties on sales with 6 percent inflation and zero inflation, respectively. Inflation only affects the tax penalty for sales within the tax lifetime; for sales at later dates, the basis is zero and inflation has no impact. (Of course, the effective tax rates are influenced by inflation, which affects the real value of the fixed nominal depreciation allowances.)

TABLE A1: EFFECTIVE TAX RATES ON SOFTWARE AND EQUIPMENT (percent) (6 Percent Inflation)

	No Sale	10	5	3	2	1
Three-year	28.0	28.2	30.2	34.3	37.8	43.4
Five-year	30.8	32.2	37.4	41.8	44.5	47.9
Seven-year	32.0	35.2	41.4	44.9	47.1	49.6

TABLE A2: EFFECTIVE TAX RATES ON SOFTWARE AND EQUIPMENT (percent) (Zero Inflation)

	No Sale	10	5	3	2	1
Three-year	15.7	15.8	17.2	20.0	22.4	26.4
Five-year	18.0	19.1	22.8	25.9	27.8	30.1
Seven-year	19.4	21.7	26.2	28.5	29.9	31.6

One proposal to mitigate capital gains taxation is to index basis to inflation. (H.R. 1261, which was introduced in the House on March 1, 2007 and now has 40 sponsors, would allow inflation indexation of basis for certain capital gains realized by individuals; it would not apply, however, to corporate capital gains.) The effects of basis indexation are also quite modest; they apply, of course, only to sales during the tax life of the property, when basis is still positive:

TABLE A3: EFFECTIVE TAX RATES ON SOFTWARE AND EQUIPMENT (percent)
(3 Percent Inflation, Indexed Basis)

	No Sale	10	5	3	2	1
Three-year	22.5	22.7	24.5	28.1	30.0	33.2
Five-year	25.3	26.6	31.3	32.5	33.6	34.7
Seven-year	26.7	29.5	33.1	33.9	34.5	35.0

Generalizing Auerbach Result to Any Geometric Nominal Tax Depreciation Rate

With tax depreciation rate *d* and inflation rate *π*, the depreciation allowance at date *T* has date-zero present value of $d(1-d)^{T-1}/(1+i)^T$, where $(1+i)\equiv(1+r)(1+\pi)$, resulting in $Z(T)=\frac{d}{i+d}\left\{1-\left(\frac{1-d}{1-i}\right)^T\right\}$, $Z=\frac{d}{i+d}$, and $B(T)=\left(\frac{1-d}{1-i}\right)^T$. Substituting into (6) yields $TFIS=(\gamma-\tau Z)\frac{(1-\delta)^T(1+\pi)^T-(1-d)^T}{(1+i)^T}$.