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Abstract

Depreciation is difficult and expensive to measure yet central to measuring capital income. This paper considers whether measurement resources should be allocated to longer-term assets on the theory that depreciation matters more for long-term than for short-term assets. This paper argues that accuracy in depreciation is equally or more important for short-term as for long-term assets. Nevertheless, measurement costs are likely to be higher for short-term assets than for long-term assets, which means we might expect less accuracy, all else equal, for short-term assets.

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David A. Weisbach[*]

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One of the central problems in an income tax is measuring depreciation. Tax depreciation allowances in an income tax should follow the actual change in value of an asset. Tax depreciation deductions that are faster than or slower than the actual change in value of an asset result in under- or over-taxation of the income from the asset. Differential under- or over-taxation of investments creates deadweight loss as individuals shift their investments toward lower-taxed assets.

Measuring depreciation, however, is difficult and expensive. We cannot readily determine the value of a used good at each period in time. There are few secondary markets in used goods. Even where there are secondary markets, changes in value may vary by intensity of use by an individual or within an industry, so broad market values would still be inaccurate. Moreover, many daily expenses incurred by a company, such as for customer service, marketing, business planning, management, repairs and upkeep, and the other daily fare, do not produce any asset to be valued. Instead, they affect the value of the business as a whole, potentially producing some very long-term intangible benefits, some very short-term benefits, and some waste at the same time. The tax law responds to these difficulties by using crude, broad-based depreciation categories that at best only roughly correspond to actual depreciation.[1] In many cases, such as for many intangibles and everyday expenses, current law does not even try to measure depreciation, instead allowing an immediate deduction.[2]

The proper treatment of everyday expenses that lead only to intangible benefits has been a particular problem for the tax system in recent years. The problem stems from a 1992 Supreme Court decision, INDOPCO v. Commissioner.[3] In that case, the Court decided that a taxpayer had to capitalize the professional fees it paid to structure a friendly acquisition. While not a particularly remarkable holding, the standards used by the Court were quite ambiguous, creating enormous uncertainty about which of hundreds or thousands of different types of everyday business expenditures need to be capitalized.

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[1]For example, most assets are depreciated under schedules set in I.R.C. §168, which categorizes depreciable assets in the economy into just 35 classes. Similarly, I.R.C. §197 requires all intangibles acquired as part of the acquisition of a business to be depreciated over a uniform, 15 year period, regardless of their actual life. For a summary of current law depreciation rules, see Bittker and Lokken, Federal Taxation of Income, Estates, and Gifts, chapter 23 (3d ed. 1999).

[2]For example, advertising and research development expenses are immediately deductible notwithstanding the importance of these expenses to the long-term value of a company.

[3]INDOPCO v. Commissioner, 503 U.S. 79 (1992).

The case led to a profusion of audit controversies, rulings, and court decisions.[4] The Treasury has estimated that in recent years, 25 percent of exam resources for large corporations have been devoted to resolving these issues, and has recently proposed regulations on the matter.[5]

An intriguing possibility for resolving depreciation problems generally and INDOPCO-related problems in particular is that we can focus administrative resources on expenditures where depreciation matters the most. If depreciation is less important for some assets than others, we can reduce the costs of inaccuracy by focusing resources on assets where depreciation is more important. Durability conceivably fits this bill. It does not seem worthwhile to spend resources measuring depreciation rates, tracking costs, and keeping records to depreciate a three-minute, three-day or three-month asset. Instead, we can focusing on improving accuracy for longer-term assets, such as thirty-year assets.

This approach is, to some extent, reflected in current law. The INDOPCO standard is that expenses must be capitalized only if they produce a significant future benefit.[6] Interpreting this, some courts have allowed an immediate deduction for the cost of intangibles with life of less than one year.[7] Other courts have essentially allowed businesses to deduct any cost that is incurred in the ordinary course of business and that does not produce a tangible, separate, or distinct asset.[8] The recently proposed regulations have rules.[9] In addition, economists have written that such an approach makes sense.[10]

The rationale for caring less about accuracy for short-term assets is that inaccuracies will have a smaller effect on the price of short-term assets than on long-term assets. Capital income taxation reduces the return to an asset in each future time period. A change in future returns will affect the value of a short-term asset less than it will affect the value of a long-term asset. The effect is much like the effect of a change in interest rates on bond prices—long-dated bonds are more sensitive to interest rate changes than are short-dated bonds. Because of the small effect on the price of a short-term asset due to inaccuracy, one might conclude that inaccuracy matters less for short-term assets. The deadweight loss from the change in price will be smaller.

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[4]For a summary of these issues, see, Thomas Evans and Gregory Gallagher, INDOPCO–The Treasury Final Acts, 80 Taxes 47 (2002); Glenn Carrington, Capitalization after *INDOPCO* and into the New Millennium __ Tax Notes 813 (2001).

[5]Prop. Reg. §1.263(a)-4.

[6]See INDOPCO v. Commissioner, 503 U.S. 79 (1992).

[7]See USFreightways v. Commissioner, 270 F.3d 1137 (7th Cir. 2001); Zaninovich v. Commissioner, 616 F.2d 429 (9th Cir. 1980).

[8]See Wells Fargo v. Commissioner, 224 F.3d 874 (8th Cir. 2000).

[9]Prop. Reg. §1.263(a)-4(f).

[10]See, for example, Jane Gravelle, Whither Depreciation?, 54 National Tax Journal 513 (2001). Other commentators, however, have implicitly taken the contrary position. See, for example, Dale Jorgenson & Kun-Young Yun, tax Reform and the Cost of Capital (1991), and Don Fullerton & Andrew Lyon, Tax Neutrality and Intangible Capital, in Tax Policy and the Economy (Lawrence Summers, ed. 1988).

I will argue here that as a matter of the pure economics of taxation, accuracy is as important, if not more important, for short-term assets as long-term assets. We should care as much about depreciation for a three-day asset as for a thirty-year asset. There may be good reason to treat short-term assets differently than long-term assets, but these relate to the relative administrative costs of capitalization.

The argument is based on a two decade old arguments about investment incentives in an income tax, with its best known statement by Alan Auerbach.[11] Roughly, the argument is that taxation of capital income should be production efficient, and production efficiency must be based on a pattern of usage or consumption over time. When considering equivalent consumption patterns over time, the difference between long-term and short-term assets disappears. Choosing a short term investment means that more of the return from the asset must be reinvested because of its rapid depreciation. The net value available for consumption will be the same regardless of the durability chosen. Inaccuracies in measurement of depreciation, it turns out, affect this net value roughly equally for all assets.

This conclusion is bad news for tax administration. It means that the strategy of focusing measurement and administrative costs on long-term assets may not be promising. In addition, it is very hard to measure the life of short-term assets. Theoretically, we must distinguish between one-day and two-day assets. The two-day asset has twice the life of the one-day asset and failing to distinguish them can lead to errors of similar magnitude as to failing to distinguish 10 and 20 year assets. The administrative costs of such precision would be prohibitive. It is this factor, that the costs of accuracy differ for short-term and long-term assets, that should drive the allocation of measurement costs.

Section I of the paper briefly reviews the measurement problem for capitalization and depreciation. The key problem is that we cannot determine actual asset values at any given point in time, nor can we make accurate estimates of future asset values. Many of the current law capitalization and depreciation rules can be seen as responses to these measurement costs. Section II gives a simple numerical example showing why accuracy is as important for short-term as for long-term assets. Section III gives a more general mathematical version of the argument.

Section IV discusses the special measurement and administrative problems with taxing short-term assets. There are three key problems. First, measuring the lives of short-

[11]See Alan Auerbach, Tax Neutrality and the Social Discount Rate 17 J. Public Economics 355 (1982). Others arguing for a similar approach include David Bradford, Tax Neutrality and the Investment Tax Credit, in the Economics of Taxation (H. Aaron and M. Boskin, eds. 1980), Arnold Harberger Tax Neutrality in Investment Incentives, in The Economics of Taxation, (H. Aaron and M. Boskin, eds. 1980), and Jane Gravelle, Effects of the 1981 Depreciation Revisions on the Taxation of Income from Business Capital, 35 National Tax Journal 1 (1981).

term assets with reasonable accuracy is particularly difficult. Second, the pattern of measurement error is asymmetrical. The shortest possible asset life is zero, while the longest possible asset life can be many multiples of the actual life. The potential wedge between pre-tax and after-tax returns can be much greater on the high side than on the low side. Third, any system of capitalizing short-term assets would have to be coordinated with the accounting periods of existing law. The problem is that reasonably long accounting periods—one year under current law—are thought to improve the tax system on a number of boundaries but it is very difficult to capitalize and depreciate assets whose life is shorter than the accounting period. The conclusion is that the rules that seem to allow great inaccuracy for short-term assets may be justified because of the relative administrative costs of accuracy for these assets.

I. The Problem of Measuring Asset Values

The problems of measuring asset values in the tax system should be familiar to most readers. It is worth, however, briefly reemphasizing the extent of the problem. The most obvious and important example of measurement problems is the realization requirement. A tax system which perfectly measured income, often called a Haig-Simons system, would impose a tax on the change in value of all assets in each time period. This would require measuring asset values each period. Under realization rule, we do not try to measure asset values at the end of each period. Instead, we wait until a sale of the asset and take income or loss into account at that point. This produces a tax system that deviates from Haig-Simons income—the deferral of the taxation of gain and loss until realization reduces the effective tax rate. Moreover, realization gives the taxpayer the option of when to pay tax or claim losses, creating an incentive to defer taxation of appreciated assets (lock-in) and accelerate losses on depreciated assets (lock-out) and, therefore, distorting patterns of asset ownership. The benefits of lower measurement costs of realization are thought to outweigh these costs.[12]

The depreciation system of current law builds on the realization system. We require ex ante estimates of asset price paths and allow deductions for these expected rather than actual losses.[13] Using ex ante estimates means we do not have to attempt to measure asset values at each point in time. Predicting asset price paths, however, is difficult for the same reasons Haig-Simons taxation is difficult—there are no secondary markets in many assets so there is little historical data with which to predict the future. Some items, such as goodwill or other intangibles, are almost never bought or sold as separate items, and data for setting the expected price paths is extremely crude or entirely unavailable. In addition, even if data were available, future price paths may not reflect data from prior years. Finally, even if we could accurately predict expected future prices, future price are stochastic, so even good estimates of expected future price will have

[12] See Michael Graetz and Deborah Schenk, Federal Income Taxation: Principles and Policies (2001) at 142 for a summary of issues relating to the realization requirement.

[13] See Michael Graetz and Deborah Schenk, Federal Income Taxation: Principles and Policies (2001) at 289 for a summary of issues relating to depreciation.

error.[14]

Within the depreciation system, we use crude categories rather than case-by-case estimates. That is, we group together large classes of assets, such as all cars or all machines of a certain type or used in a certain industry, and give them all the same depreciation schedule, set by the government in advance.[15] This categorization is intended to reduce the costs of making estimates. It also reduces disputes over estimates compared to the case where taxpayers make individualized estimates that can be challenged by the government.

Individual assets within these crude categories are often further aggregated by taxpayers into asset accounts.[16] Roughly, in an asset account system, all assets of a taxpayer of a particular type are put into a single account and depreciated as a single asset. This saves administrative costs but reduces accuracy because the accounts do not take into account facts specific to particular assets, such as retirements.

There are a large number of studies of the accuracy of the current system. Some of the inaccuracy of current law is intentional (e.g., subsidies given through accelerated depreciation) and some comes from non-measurement related policies such as the double taxation of corporate equity. Other inaccuracies relate to the imputed income from consumer durables, which, while measurement related, present different issues from those discussed here. Much of the inaccuracy, however, comes from difficulty in measurement of depreciation.

The most recent large scale study of the depreciation system is by the Treasury Department, completed in 2000.[17] While the Treasury is careful to avoid drawing broad conclusions, the data shows that alternative investments are taxed at "widely differing marginal effective tax rates." (p. 38). Perhaps more important, the Treasury finds that "comprehensive overhaul of depreciation to reflect more accurately economic depreciation would be difficult and costly," primarily because "we do not know with any degree of certainty what economic depreciation rates should be, even on average, for aggregated classes of investments." (p. 44) That is, the depreciation system is inaccurate but measurement costs are too great to develop a more accurate system. Intangibles are highlighted as a particular problem in the Treasury study. The marginal effective tax rate on intangibles is calculated to be only 3.8%, compared to the economy wide average

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[14]See Jeff Strnad, Depreciation and Risk, 52 SMU L. Rev. 547 (1999) for a discussion of how risk affects depreciation policy.

[15]See IRC section 168. See also, Department of the Treasury, Report to the Congress on Depreciation Recovery Periods and Methods (July 2000) for a recent summary of the depreciation system.

[16]See Treas. Reg. §1.168(i)-1. For a detailed description of group accounting, see Jeff Strnad, Tax Depreciation and Risk, 52 SMU L. Rev. 547 612 (1999).

[17]See Department of the Treasury, Report to the Congress on Depreciation Recovery Periods and Methods (July 2000). For a summary of this study, see Davd W. Brazell and Jame B. Mackie III, Depreciation Lives and Methods, Current Issues in the U.S. Capital Cost Recovery System, 53 National Tax Journal 531 (2000).

(which includes intangibles) of 21.5%. Other studies have drawn similar conclusions.[18]

As noted above, the most visible set of controversies over depreciation in recent years involves everyday business expenses that do not create an identifiable asset. The INDOPCO decision created uncertainty about which of these expenses should be capitalized and significant resources are now devoted to the issue. The number of potential factual issues that must be resolved is vast. Intangibles can be created through research, through marketing, or merely through the daily operations of a business, such as customer service. Research expenditures can be wasted or lead to a variety of different products that last for a variety of different time periods. Marketing, customer service, management, planning, and the like, can lead to a mix of long-term, short-term benefits, and waste. Systems designed to track these costs and assign them depreciable lives are complex and expensive. The question addressed in the following sections of this paper is whether one approach to resolving depreciation issues generally and INDOPCO issues in particular is to focus measurement resources on long-lived assets.

II. The Problem of Durability: A Simple Example

The question is whether measurement resources should be allocated based on durability. As noted, current law roughly reflects this approach, allowing immediate deductions for many short-term expenses. I will argue that as a matter of the pure economics of taxation, this approach is wrong. Accuracy matters as much or more for short-term assets as for long-term assets. This section uses a simple example to develop the intuition. I will divide the argument into three steps. First, I will show that changes in effective tax rates (defined below) matter equally for short-term and long-term assets. Second, I will show that equal percentage mismeasurements produce roughly equal changes in effective tax rates, regardless of durability. Finally, I will discuss what happens when the strict assumptions in the example are relaxed. The next section gives a more general and formal model of the problem.

Suppose an individual has $1,000 and wants use this money to finance a level pattern of consumption over time. The individual has two investment choices.[21] He can buy a perpetuity that pays him $100 per year every year indefinitely. In a world without taxes and with a 10% interest rate, the perpetuity will cost $1,000. Alternatively, the individual can purchase a one-year, zero-coupon bond for $1,000 that pays $1,100 next year. The individual can consume $100 of the proceeds and purchase another one-year

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[18]See, for example, James B. Mackie III, Unfinished Business of the 1986 Tax Reform Act: An Effective Tax Rate Analysis of Current Issues in the Taxation of Capital Income, 55 National Tax Journal 293 (2002); Jane Gravelle, The Economics Effects of Taxing Capital Income, at p. 53 (1994); Dale Jorgenson and Kim-Young Yun, Tax Reform and the Cost of Capital at 147 (1991); Dale Jorgenson and Kun-Young Yun, Investment Vol. 3, Lifting the Burden: Tax Reform, The Cost of Capital, and U.S. Economic Growth (2001).

[21]The choices are framed in terms of financial assets. The taxation of financial assets, however, raises a number of issues outside of the topics discussed here. I use financial terms merely for convenience and the examples should be thought of as representing investments in real assets.

zero for $1,000 next year. The following year, the zero will produce $1,100 and the individual can once again consume $100 and reinvest the remaining $1,000. This pattern continues indefinitely. In a world without taxes, the individual would be indifferent between these two sets of investments.[22] In each case, the cost is $1,000 and the investment finances $100/year of consumption forever.

An efficient tax system should not alter this choice or the choice between this pair of investments and all other possibilities. The tax system that does not alter these choices is said to be neutral because it does not directly influence the composition of the capital stock.[23] Optimal tax theories may indicate that some deviation from neutrality is desirable but the size of the adjustments tends to be sufficiently small and of uncertain direction, and the benefits sufficiently minimal that most economists assume neutrality is best.[24]

For the tax system not to alter the choice between assets, the after-tax cash flows on the assets must remain in parity. Suppose, for example, $100 of income from the perpetuity is perfectly measured and taxed at a 30% tax rate. The individual will then have $70 per year after taxes to consume if he buys the perpetuity. To keep the choice between the two instruments the same, the tax system has to give the bond holder $70 per year after taxes. To do this, the system would accurately measure the net income from the bond, allowing a $1,000 deduction from the $1,100 amount received on the bond, and giving the individual $100 of taxable income and $70 after tax.

We can think about the tax system as creating a wedge between pre-tax and after-tax returns. The wedge in this case is $30. The wedge represents the difference between social and private rates of return on investments. The social rate of return is the pre-tax rate of return—society gets the full benefit of the return from the asset either through returns to its owner or through taxes. The private rate of return is the net of tax return that accrues to the owner of the asset. Private rates of return will equilibrate to be the same on all assets. In an efficient system, social rates of return should be equal on all assets. Therefore, in an efficient tax system, the wedge between private and social rates of return must be equal.

If we express the wedge between pre-tax and after-tax returns as a percent of pre-tax returns, we get what is known as the marginal effective tax rate or ETR.[25] Marginal

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[22] The two choices might impose different interest rate risk on the taxpayer. As is customary in the literature on depreciation, I will ignore risk here. The effect of risk on taxation is complex and it is not clear that it affects after tax proceeds very much, if at all. For a general study of risk and taxation, see David Weisbach, Taxation and Risk-Taking: The Case of Multiple Tax Rates, Chicago Law and Economics Working Paper No. __ (2d Series) and the sources cited therein. See Jeff Strnad, Tax Depreciation and Risk, 52 SMU L. Rev. 547 (1999) for a study of the effect of risk on depreciation.

[23] The tax system may influence the capital stock indirectly by reducing savings or changing the interest rate.

[24] See, e.g., Alan J. Auerbach, The Deadweight Loss from 'Non-Neutral' Capital Income Taxation, 40 J. Public Econ 1 (1989); Jane Gravelle, The Economic Effects of Taxing Capital Income (1994) at 61-62.

[25] Ths measure was first developed in Alan J. Auerbach and Dale Jorgenson, Inflation-Proof Depreciation

effective tax rates have some very convenient features. With perfectly measured incomes, the ETR is equal to the nominal tax rate. In the example, the nominal rate is 30% and the effective tax rate is 30% because income was perfectly measured. If income is imperfectly measured, the ETR is equivalent to the hypothetical nominal rate applied to perfectly measured income that is equal to the combination of the actual tax rate and the mismeasurement. That is we can translate any mismeasurement into an ETR.

Suppose, now, that the two choices are taxed imperfectly. The case I have in mind in studying inaccuracies in depreciation is that basis recovery is not correct, but the inaccuracy could be in any aspect of the taxation of the investments. Regardless of the cause for inaccuracy, we can translate it into an ETR. (I will discuss below the central question of how inaccuracies in depreciation for different types of assets translate into different effective tax rates.)

The tax system will now distort asset choice. The composition of the capital stock will not be the same as in a no-tax world. The question is which distortion in capital stocks for a similar size measurement error causes a lower loss of welfare-mistaxation of the perpetuity (the long duration asset) or mistaxation of the one-year bond (the short duration asset).

Consider the consequence of imposing an effective tax rate of only 20% on the perpetuity and, alternatively, on the one-year bond. Lower taxation of either asset will cause individuals to shift to that asset until its price adjusts to equilibrate after-tax returns. In our example, the after-tax return is 7%, so the price of the assets will increase until the after-tax return is this amount.

In the case of the perpetuity, if the effective tax rate is 20%, the taxpayer will receive $80 each year. If this amount is capitalized at the after-tax interest rate of 7%, the price will increase to $1,143. This price increase gives us a rough idea of the size of the distortion in asset allocation because of the mistaxation. Standard deadweight loss triangles for capital income taxation measure the change in capital stocks for the tax-induced change in prices. The price change gives the height of the triangle.

Turn to the one-year bond. If taxed at a 20% tax rate, an initial calculation might conclude that its price would adjust less. The after-tax payment in one year would be $1,080 and its present value at a 7% discount rate is $1,009 rather than the $1,143 calculated for the perpetuity. With this smaller price adjustment, the deadweight loss triangle is likely to be smaller. Therefore, the mistaxation of the one-year bond might seem to matter less. But this calculation is misleading.

The individual in our example has chosen a level pattern of consumption. If the individual chooses to buy the one-year bond, he will reinvest enough to fund

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of Assets, 58 Harvard Business Review 113 (1980).

consumption in future years. If the taxpayer is willing to pay $1,143 to get $80 per year indefinitely for the perpetuity, he must be willing to pay the same amount to get an identical flow from a series of one year bonds. The price adjustment has to be the same.

The error in simple present value computation is that it views the bond as a single asset funding consumption only in the next period rather than a series of short-duration assets funding consumption over time. Looking only at next period makes the value of the lower tax rate seem smaller than the value of the lower tax rate for the perpetuity because in the case of the one-year bond, the benefit from the lower tax rate is counted only for the one period. The lower tax rate for the perpetuity is counted for the indefinite future. If the lower tax rate applies to both assets for equal time periods, the price adjustments have to be identical and the distortion in asset choice is similarly the same.

One way to restate the argument is to compare the internal rate of return criteria to the net present value criteria. The net present value criteria assumes that any cash flows are reinvested at a zero rate of return. Internal rates of return assume that any cash flows are reinvested at the project rate.[26] If the one-year bond is mismeasured in each period and the individual reinvests in that bond, internal rates of return give the proper measurement because it assumes continued mismeasurement. Effective tax rates rely on internal rates of return—they are a measurement of the wedge between pre-tax and post-tax internal rates of return—and therefore properly take reinvestment into account. Net present values are misleading because they fail to take into account future mismeasurements. Effectively, the net present value calculation assumes that the zero coupon bond is perfectly taxed starting in one year while it assumes that the perpetuity stays under-taxed indefinitely.[27]

The key to the argument was comparison of consumption patterns over equivalent time periods. Other common measures of the efficiency of capital income taxation do not share this feature. The most prominent measurement is known as the rental price of capital. The rental price of capital is the amount an individual would receive for leasing a unit of capital for one period. In a world without taxes, the rental price, usually denominated c, is equal to r + d, where r is the interest rate and d is the percent depreciation on the asset during the period. The reason is that the renter must pay enough to compensate the owner for the time value of money during the period of use and to allow the owner to recover any depreciation in the asset. The one-year rental price of the perpetuity is $100. There is no depreciation for the perpetuity so an owner would be happy to lend it to someone for the time value component of $100. The rental price of the bond is $1,100, which is the time value return of $100 plus the $1,000 depreciation.

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[26] See Brealey and Myers, Principles of Corporate Finance, 7th ed. (2002) at 101-104.

[27] The discussion in the text suggests that there may be political reasons for caring less about accuracy for short-term assets. Suppose that changes to tax policy only apply prospectively because of some exogenous political constraint. Then, if there is a chance of improving accuracy in the future because we will have more information, short-term assets may be likely to be taxed more accurately over time than long-term assets because the retroactivity restriction has less effect.

Rental prices have to be adjusted for taxes. The rental price in a world with taxes is the cash flow that would compensate the owner for the use of the asset, given that the owner will pay tax on that cash but also get the benefit of the tax depreciation deductions that come with owning the asset. Effectively, the rental price in a world with taxes is the rental price absent taxes increased because of the tax on the gross cash flow and decreased because of the benefit of tax depreciation.

If income is measured perfectly, the rental prices after-taxes for both assets in the example are unchanged. The key is to note that taxes reduce the rate of return demanded by investors from 10% to 7%. For the perpetuity, a $100 payment per period leaves the owner with $70 after taxes. At a 7% rate of return, this amount is sufficient to compensate him at the after-tax rate of return on his $1,000 investment. For the one-year bond, the owner must receive $1,100, which is sufficient to compensate him after taxes at a 7% rate of return on his $1,000 assuming the owner is allowed to receive his $1,000 investment back tax free.

If income is not perfectly measured, rental prices will change. For example, suppose that the cost of the bond is immediately deducted (similar to the way that the cost of many short-term investments is deducted). The rental price will go down to $1,070. The reason is that the immediate deduction effectively exempts the return on the bond from taxation which means that the owner will only require cash equal to the after-tax return of 7% plus the depreciation. If the cost of the perpetuity is immediately deducted, the rental cost goes down to $70 for similar reasons.

The proportionate change for the perpetuity is much higher than it is for the one-year bond. The rental price changed by 30% for the perpetuity compared with 2.73% for the one-year bond. One might conclude from this that mistaxation has a greater effect on long-duration assets and we should, therefore, care more about accuracy for long-duration assets.

Empirical studies of the deadweight loss from capital income taxation commonly use changes in rental prices. In particular, the rental price is the most commonly used criteria to estimate the reduction in aggregate investment due to taxes on capital. Because of the importance of this question, there is a cottage industry focused on it and the rental price is the standard tool.[28] Estimates of deadweight loss from the misallocation of capital due to differential taxation are more schizophrenic, sometimes using the effective tax rate

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[28]The literature is large. For surveys, see Ernst R. Berndt, The Practice of Econometrics (chapter 6) (1991); Kevin Hassett and R Glenn Hubbard, Tax Policy and Business Investment, in Handbook of Public Economics (Alan J. Auerbach and Martin Feldstein, eds. 2002); Robert S. Chirinko, Business Fixed Investment Spending: Modeling Strategies, Empirical Results, and Policy Implications, 31 J. Economic Literature 1875 (1993). Problems with the rental cost formulation unrelated to those discussed here have led to the use of other criteria such as Tobin's *q*.

criteria and sometimes using the rental price criteria.[29]

Rental prices may have their uses, but they are not sufficient for thinking about the relative cost of mismeasurement of long and short-term assets. They have the same flaw as the present value calculation. (In fact, the next section will show that the two criteria are identical.) Rental prices do not allow comparison of equivalent consumption flows over time because they are gross of depreciation. Equivalent consumption flows for assets of different durations require reinvestment of some or all depreciation in each period. Rental prices are useful only if rental prices are calculated net of reinvestment and, as shown in the next section, rental prices net of reinvestment are equivalent to the effective tax rate criteria. For example, the rental prices net of reinvestment for the two assets discussed here if they are taxed perfectly are $70. In the case where the assets are taxed at a 20% rate, the rental prices net of reinvestment are $80. The effect of mistaxation on the net of reinvestment rental prices is the same.

To summarize the argument so far, I have argued that in the simple example considered here, we should care equally about deviations in effective tax rates from neutrality for both long and short-term assets. It remains to be shown how effective tax rates for long and short-term assets are affected by measurement error and whether the argument holds for more complex examples. Consider first the effect of mismeasurement of depreciation on effective tax rates.

To examine the effect of mismeasurement on effective tax rates we can no longer use the simple case of the perpetuity. The reason is that it is impossible to mismeasure the life of the perpetuity as too long—we cannot have a useful life longer than infinite. The example must be changed.

The calculation is also somewhat more complex. The reason is that the price of the asset depends on any tax benefits or costs from mismeasurement and the tax benefits or costs from mismeasurement depend on the price. For example, if there is extra basis recovery, the price will reflect this tax benefit and the tax benefit will be based on the price (because price determines basis). Solving for price in this situation is not difficult but takes a step or two.

The key is to note that the effect of mismeasurement of depreciation for an asset purchased at $x is the same as $x multiplied by the effect of mismeasurement for an asset that costs $1. This allows us to solve for the purchase price, $x. To so, set the price $x, equal to the present value of the gross cash flows less taxes on those flows and then add back in the tax benefit of depreciation. Letting t be the tax rate, we get

[29] For example, Jane Gravelle, Effects of the 1981 Depreciation Revisions on the Taxation of Income from Business Capital, 35 National Tax Journal 1 (1981), (Equation 11) measures deadweight loss gross of depreciation while Don Fullerton & Andrew Lyon, Tax Neutrality and Intangible Capital, in Tax Policy and the Economy (Lawrence Summers, ed. 1988) (Equation 2) measure deadweight loss net of depreciation.

$$\$x = PV(cash\ flows)\ (1\text{-}t) + \$xtPV(depreciation\ on\ \$1) \qquad \textbf{(1)}$$

Solving for $x:

$$\$x = [PV(cash\ flows)\ (1\text{-}t)] \,/\, [1\text{-}tPV(depreciation\ on\ \$1)] \qquad \textbf{(2)}$$

Given this formula, we can solve for effective tax rates in four steps. First, we must determine the pattern of depreciation allowed on the investment and determine its present value. I have assumed straight line depreciation on assets with a fixed cash flow each year of $100. This depreciation is not accurate but serves our purposes well enough. (The depreciation schedule is systematically too fast, which means effective tax rates are lower than the nominal rate even if the life is correct.) Second, given this depreciation, we can calculate a price for the asset. Third, given this price, we can calculate a pre-tax internal rate of return based on the price and the $100/year cash flows. Finally, we can convert this into an effective tax rate. The table below gives the conclusions for five and ten year assets, using various depreciable lives.[30]

Five Year Actual Life ($100/year for five years)

Depreciable Life		4	5	6	
ETR		25.7%	28.8%	31.6%	

Ten Year Actual Life ($100/year for ten years)

Depreciable Life	8	9	10	11	12
ETR	24.7%	26.3%	27.7%	29.0%	30.3%

The tables show up to 20% deviations from actual lives. For the five year asset, this means measuring the life within one year of its actual life. For the ten year asset, this means measuring the life within two years of its actual life. As can be seen, there are roughly equal swings of just under six percentage points in effective tax rates for equal percentage deviations in life. (The five year life actually has a slightly greater deviation for equal percent mismeasurement. The next section shows this to be true for geometric depreciation as well.) Because we care about deviations of effective tax rates from neutrality, we should try to create roughly equal percentage measurement errors regardless of durability, which completes the argument.[31]

Note that equal percent deviations from actual life demands greater and greater

[30]Details of the calculation are available from the author.

[31]Of course, we do not know true lives so there measurement errors cannot be estimated as in the text. Instead, we should invest in enough information to believe that the error is within a given amount for each type of asset.

precision in absolute terms as the actual life gets shorter. In the example, the five year asset has to be measured to within one year of actual life to get the same inaccuracy as measuring the ten year asset within two years of actual life. The effect gets more pronounced as lives get shorter. Five day assets must be measured within one day and five minute assets must be measured within one minute to get the same percentage errors as shown here. As discussed in Section IV below and as should be relatively clear, the costs of the necessary accuracy will go up as lives get shorter, dramatically so for very short-lived assets. Because the costs of accuracy go up as asset life gets shorter but the benefits of accuracy stay the same, we should expect less accuracy for short-term assets.

The examples used in this section were dependent on a series of assumptions, but the conclusions generally do not change when the assumptions are relaxed. It should be relatively clear that the assumption of a level consumption pattern does not change the conclusions – the argument would work for any pattern of consumption over time with the only change being that the math would be more complicated. The same is true for the choice of assets. Limiting the choice to two assets and to those two assets had no effect except to keep the math simple. The calculation of the effect of mismeasurement on effect tax rates may depend on the level cash flow assumption and the assumption of straight-line depreciation. The next section shows that the result holds for geometric depreciation, which is thought to be a decent surrogate for actual depreciation for many assets. Other depreciation patterns (both tax and economic), however, may create difficult results.

III. The Problem of Asset Durability: A Model

This section extends the example discussed above, more formally modeling the terms used. The argument is broken into three steps. First, I define the various tests for neutrality and following closely the discussion found in Auerbach,[32] argue that depreciation schedules should be set so that effective tax rates are equal. Second, the argument is then extended to the case of mismeasurements. The argument is that we should care about the extent to which mismeasurements cause unequal effective tax rates, not unequal changes in rental prices. Finally, I argue that equal percentage mismeasurements of useful lives or depreciation schedules have similar effects on effective tax rates for all assets, regardless of durability. In fact, under the assumptions in the model, short-term assets are more sensitive to mismeasurement. This means that inaccuracies for short-term assets matter more than they do for long-term assets.

A. *Tax Neutrality with Perfect Measurement*

[32] Alan Auerbach, Tax Neutrality and the Social Discount Rate, 17 J. Public Economics 355 (1982).

Following Jorgenson,[33] define the rental price of capital as the price one must pay to use a unit of capital of a particular type for a single period. We can derive an explicit expression for the rental price of capital through an arbitrage argument. In a world without taxes, there are two ways of obtaining capital forever. One is renting in each period and the other is purchasing it outright. Setting these equal allows one to solve for the rental price.

For example, suppose that capital experiences geometric decay, which means that depreciation in any period is a constant fraction δ of the current value. Under this depreciation schedule, an asset purchased today will be equivalent to $e^{-\delta t}$ assets at time t. Let r equal the discount rate, q(δ) equal the price of capital goods of type δ, c(δ) the rental price for one unit of the good. Then, the no arbitrage condition requires the price of the good to equal the sum of the present discounted value of the rental price for each period in the future, or:

$$q = \int_0^\infty ce^{-(r+\delta)t}dt \qquad \textbf{(3)}$$

Solving, we get an expression for the rental price of capital:

$$c = q(r + \delta) \qquad \textbf{(4)}$$

For each dollar of capital, the rental price is equal to the return required on that capital plus the depreciation. The rental price per dollar of capital will be greater for short-term assets (they experience rapid depreciation, so δ is high) than for long-term assets (low δ) because renting them for a period uses up a greater portion of the asset. If the discount rate r changes, the rental prices of assets of different durabilities will change by the same absolute amounts but by different percentages.

This formula assumes a world without taxes. To modify the formula to take taxes into account,[34] let r now be the after-tax discount rate, τ be the tax rate and let D(t) equal the depreciation deductions allowed at time t on a one dollar investment. A similar arbitrage relationship requires

$$q = \int_0^\infty (1 - t)ce^{-(r+\delta)t} + tqD(t)e^{-rt}dt \qquad \textbf{(5)}$$

The first term in the integrand represents the present value of the gross rental flows from capital, reduced by the tax on those flows. The second term represents the benefit of tax depreciation deductions, which is the present value of the depreciation deductions on a dollar multiplied by the total amount q and the tax rate τ. This formula is essentially the

[33] Dale Jorgenson, Capital Theory and Investment Behavior, 53 American Economic Review 247 (1963).

[34] See Robert Hall and Dale Jorgenson, Tax Policy and Investment Behavior, 57 American Economic Review 391 (1967).

same as formula (1) above. If we let z equal the present value of the depreciation deductions on a dollar investment, and solve, the rental price of capital can be expressed as:

$$c = q(r + \delta)\left(\frac{1 - tz}{1 - t}\right) \tag{6}$$

The section above considered (and rejected) present values as a possible criteria for neutrality. We can now state this criteria more formally. The present value criteria states that all investments of the same initial cost should have the same present value when their gross returns (i.e., pre-tax) are discounted at r (the after-tax discount rate). The argument for this criteria is that the marginal product of capital is the present value of the contribution of an increment of capital investment now to output in the future. Capital will be allocated efficiently if the value of its marginal product is the same in all uses. The cost of capital multiplied by the amount of capital remaining is the undiscounted contribution to the gross return to a marginal investment for period t. The cost of capital is c and the amount of capital remaining at time t is $e^{-\delta t}$. Therefore, the present value of gross returns for a one dollar investment of type δ is:

$$pv(\delta) = \int_0^\infty ce^{-rt}\left(\frac{e^{-\delta t}}{q}\right)dt = \frac{1 - tz}{1 - t} \tag{7}$$

An alternative criteria considered and also rejected above is that the tax system produce equal proportional changes in the rental price. This means the ratio of the rental price of capital with and without taxes must be constant for all δ, or:

$$\overline{c} = \frac{q(r + \delta)(^{1-tz}/_{1-t})}{q(r + \delta)} = \frac{1 - tz}{1 - t} \tag{8}$$

This expression is the same as the present value criteria (7) and, therefore, the two criteria are the same. Both criteria measure returns gross of depreciation. Assets with a short life will have higher rental costs and taxes will affect their rental costs proportionately less.

An alternative criteria is to keep social rates of return equal for all assets. We can use the internal rate of return to formalize this criteria. The internal rate of return for capital of type δ, ρ(δ), is the discount rate that makes the gross cash flows equal the price. It is implicitly defined by the equation:

$$q = \int_0^\infty ce^{-(\rho(\delta)+\delta)t}dt \tag{9}$$

Solving, we get:

$$\rho(\delta) = \frac{c}{q} - \delta = \frac{(r+\delta)(1-tz)}{1-t} - \delta \qquad \textbf{(10)}$$

If social rates of return are to be the same for all assets, ρ(δ) must be constant for all δ. Note that the internal rate of return criteria is the same as the rental cost of capital criteria except that depreciation is subtracted. That is, the choice between the criteria is solely a question of whether neutrality should be measured gross or net of depreciation.

We can express the same idea using marginal effective tax rates. Define the marginal effective tax rate to be ETR = (ρ - r)/ρ where, as before, r is the after-tax discount rate common to all investments and ρ is the internal rate of return or "pre-tax discount rate." If ρ is the same for all assets, the effective tax rate must be the same for all assets.[35]

The effective tax rate can be thought of as the tax rate which if applied to perfectly measured income would produce the same return as the combination of the nominal tax rate and the mismeasurement. To see this, note that a tax rate ETR applied to accurately measured income would produce a rental price of r/(1-ETR) + δ. If this tax rate is equivalent to some combination of nominal rate τ and depreciation z, we can set the respective rental prices equal.

$$\frac{r}{1-ETR} + \delta = (r+\delta)\left(\frac{1-\tau z}{1-\tau}\right) \qquad \textbf{(11)}$$

If we normalize q to 1, and solve for ETR, we get ETR = (ρ-r)/ρ, which is the formula for the effective tax rate. To verify this with some simple examples, note that if tax depreciation exactly matches economic depreciation, it can be shown that z = δ/(r+δ).[36] The effective tax rate becomes τ, as it should be. If, alternatively, immediate expensing is allowed, z equals 1, which means that the internal rate of return is r, and the effective tax rate is zero.

The two sets of criteria, the internal rate of return or ETR criteria and the present value or rental cost criteria, produce different recommendations for depreciation policy. For example, economic depreciation, in which the tax depreciation allowances match the actual decline in asset value, is neutral under the internal rate of return criteria but not under the rental cost of capital criteria. This can be seen by recalling that under the cost

[35] There are a number of different measures of effective tax rates, and the different measures are not equal. For a discussion of the various measures, see Don Fullerton, Which Effective Tax Rate? 37 National Tax Journal 23 (1984). The measure used here is the marginal effective tax rate, introduced by Alan Auerbach and Dale Jorgenson, Inflation-Proof Depreciation of Assets, 58 Harvard Business Review 113 (1980).

[36] The present value of depreciation at rate δ is $\int_0^\infty \delta e^{-(r+\delta)t}\,dt$. Integrating give the expression in the text.

of capital criteria, $\bar{c} = {}^{1-\tau z}\!/_{1-\tau}$ must be equal for all assets. With economic depreciation and exponential decay in asset prices, z = δ/(r+δ), which means that this ratio will vary with δ, making economic depreciation non-neutral according to the rental price criteria. Internal rates of return with economic depreciation, however, reduce to r/(1-τ) for all δ and effective tax rates equal τ for all δ. Therefore, economic depreciation looks neutral when measured by effective tax rates and not neutral when measured by present value. The two sets of criteria produce different policy recommendations and, therefore, we must decide which criteria is more appropriate.

The argument that the effective tax rate criteria is more appropriate is essentially the same as made above. Because the issue involves investment in durable assets, we must define production efficiency over time. In particular, we can say that production efficiency is violated only if it is possible to replace a given production plan with one which allows more consumption in some periods with at least as much in all others.

Consider an individual who wants to maintain a consumption pattern over time. The individual has a choice of investment programs that give this pattern in after-tax dollars. For ease of exposition and without loss of generality, assume the pattern is level indefinitely. In addition, assume that all assets experience geometric depreciation.[37]

Suppose that tax depreciation equals economic depreciation, so that effective tax rates are equal across all assets. In each period, the individual must reinvest δ and can consume the rest. The reason is that to maintain level consumption in future periods, the individual must maintain the existing capital level. This leaves r available for consumption in each period.[38] The government, in each period gets a flow equal to the tax on the gross return less the tax value of the depreciation deductions granted to the taxpayer, or:

$$R(\delta) = \tau\left(\frac{c(\delta)}{q(\delta)} - \delta\right) = \left(\frac{\tau}{1-\tau}\right)r \qquad \textbf{(12)}$$

This number is constant over δ. As a result, regardless of the individual's choice of investments, his cash flows and the government's flows are the same. There is, therefore, no better investment program and production efficiency must be satisfied.

Suppose, alternatively that effective tax rates differed across assets (because, for example, depreciation does not equal economic depreciation). Then the government

[37] These assumptions can easily be relaxed. See Auerbach, Tax Neutrality, note _ for a demonstration that the result holds with any pattern of depreciation.

[38] To verify this, note that the amount available for consumption equals the gross return, less taxes, plus tax depreciation deductions, less reinvestment, or

$$[c(\delta)/q(\delta)](1-\tau) + \tau\delta - \delta = (r/(1-\tau) + \delta)(1-\tau) + \tau\delta - \delta = r$$

would get higher revenue in each period for the asset with the higher effective tax rate. The investor, however, would be indifferent, still receiving r in each period. Production efficiency is violated because it is possible to replace some program with another getting the same consumption in all periods but higher government revenue. Therefore, such a depreciation regime and schedule of effective tax rates violates production efficiency. Only economic depreciation and equal effective tax rates satisfy production efficiency.[39]

B. *Accuracy When Measurement is Imperfect*

Commentators who developed the above arguments about neutrality of tax incentives assumed that the choice of incentives was in a world where depreciation could be perfectly measured. Therefore, they never squarely faced the question of the appropriate test when there is mismeasurement. Measurement of depreciation, however, is expensive and it cannot be measured perfectly. We want to know whether the cost of inaccuracy varies with durability and in particular, whether the deadweight loss from inaccuracy are lower for short-term assets.

While the theoretical literature never addressed the question of the appropriate criteria for measuring deadweight loss from capital income taxation, there have been empirical estimates. In making these estimates, commentators have used both the internal rate of return and the rental price criteria. As noted above, the rental price is the most commonly used criteria to estimate the change in aggregate investment when rental prices change while estimates of the deadweight loss from differential capital income taxation vary, sometimes using effective tax rates and sometimes using rental prices.[40] These two criteria, however, will produce inconsistent estimates. Patterns of depreciation that would produce no deadweight loss under one criteria will produce deadweight loss under the other and, therefore, only one of the measures is accurate.

As argued in Section II, only the effective tax rate criteria is appropriate for measuring the effect of inaccurate depreciation. The argument is essentially the same as made above. Production efficiency must be defined over time. To measure the deadweight loss caused by a mismeasurement of capital income, we must, therefore, assume a pattern of consumption over time. In the level consumption pattern used here for convenience, all depreciation is reinvested, leaving only the net return r. Mismeasurement does not affect this after-tax amount r because prices will adjust to eliminate any benefits from differential investment patterns. Mismeasurement will, however, affect asset prices, as taxpayer shift toward tax-favored assets. This deviation in prices and the associated shift in capital stocks cause deadweight loss.

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[39]Note that this does not mean that investment incentives cannot satisfy production efficiency or that tax rates on capital have to be equal to the nominal tax rate. Any system that allows an immediate deduction of x% of the cost of an asset and depreciations the remaining (1-x) using economic depreciation will also satisfy production efficiency. See Auerbach, Tax Neutrality, note _.

[40]See note __.

How much will individuals shift their investment patterns? Individuals will pay the same amount for patterns of investment that produce the same after-tax consumption. This means that they only care about the effect of taxation on the return net of reinvestment. Asset prices and usage will shift only to the extent taxes affect this amount. The effective tax rate or internal rate of return criteria measure this because they implicitly assume reinvestment at the same rate as the initial investment. That is, they give a net of reinvestment measurement. The rental price criteria does not.

C. *Effect of Mismeasurement on Effective Tax Rates*

Knowing that we should use the effective tax rate criteria does not by itself tell us whether long-term or short-term assets are more sensitive to inaccuracy. We also need to know how effective tax rates for long and short-term assets respond to mismeasurements.[41]

For exponential depreciation, short-term assets are *more* sensitive to mismeasurement than are long-term assets, which means that accuracy matters more for short-term assets than for long-term assets. This is simply the converse of the well-known proposition that we must have more relative acceleration for long-term assets than for short-term assets to create a neutral investment incentive.[42] If we think instead, of relative inaccuracy, the same relative inaccuracy has a smaller effect on effective tax rates for long-term assets. More formally, recall that the internal rate of return can be expressed as:

$$\rho(\delta) = \frac{(r+\delta)(1-tz)}{1-t} - \delta \qquad \textbf{(13)}$$

If we want the change in ρ to be roughly equal for all assets, dρ must be constant over δ. We can express dρ as $d\rho = (\partial\rho/\partial z)dz$. But $\partial\rho/\partial z = -t(r+\delta)/(1-t)$, which is not constant over δ. For dρ to be constant, therefore, dz must not be constant over δ. In particular, dz must be larger for long-term assets (assets with low δ). Similarly, to keep dρ within some range, we can tolerate larger errors for long-term assets.

We can also demonstrate this by deriving a formula for the required pre-tax rate of return for a given default life. Suppose D is the default depreciation rate, measured using geometric depreciation. Then we can express the internal rate of return as

[41] We also need to know the relevant elasticities. While the overall elasticity of capital investment in response to changes in the tax rate is a subject of great interest and much study, there is little or no information about the particular elasticities of asset of different durabilities and no reason to believe that in the long run that they vary systematically.

[42] See, Department of the Treasury, Report to the Congress on Depreciation Recovery Periods and Methods (July 2000) at 34.

$$\rho = \left(\frac{r}{1-t}\right)\left(1 - t\left(\frac{D-\delta}{D+r}\right)\right) \qquad \textbf{(14)}$$

The first term in the equation is the rate of return if depreciation were measured accurately and the second term is the adjustment caused by the inaccuracy. The key variable is the difference between D and δ. Thus, the fraction will roughly have the same value if D is 10 and δ is 5 and if D is 200 and δ is 100.

The same argument applies if we instead use effective tax rates instead of internal rates of return. If the mismeasured exponental rate of depreciation is D given an actual rate of δ, the effective tax rate can be expressed as follows:

$$ETR = \frac{t(\delta + r)}{(1-t)(D-\delta) + (\delta + r)} \qquad \textbf{(15)}$$

As δ increases (asset life gets shorter), the effective tax rate becomes more sensitive to equal percentage errors of mismeasurement. For example, if D is always twice δ, the effective tax rate will go up with δ ($\partial ETR/\partial\delta > 0$). So estimating a depreciation rate that is twice the actual rate will produce a relatively higher effective tax rate for short-term assets than for long-term assets. If we care about effective tax rates, we may actually care *more* about accuracy for short-term assets.

D. *Summary*

The argument so far has three steps. First, the appropriate measure of tax neutrality is the effective tax rate or internal rate of return. Only if effective tax rates are the same across assets is production efficiency satisfied. Second, the effect of inaccuracy should be measured based on effective tax rates. That is, we should be concerned about the deadweight loss caused by deviations from equal effective tax rates rather than equal rental costs of capital for essentially the same reasons effective tax rates are the proper measure of a neutral tax sytem. The central reason is that effective tax rates assume reinvestment while the rental price criteria does not. Third, effective tax rates for short-term assets are more sensitive to mismeasurement than long-term assets. Therefore, we should care more about accuracy for short-term assets.

IV. Measurement and Accuracy for Short-Term Assets

While the economics of depreciation suggest that accuracy in depreciation schedules is at least as important for short-term assets as it is for long-term assets, measurement costs may vary with durability. There are three related problems with measurement of depreciation for short-term assets. First, it may be difficult to measure depreciation accurately for short-term assets. Second, the pattern of errors for short-term assets may be expected to be asymmetric. Finally, even if short-term asset lives could be estimated accurately and without bias, it would be difficult to coordinate depreciation of short-term assets with the one-year accounting period of current law. This section considers how these measurement costs of depreciation for short-term assets affect the desirable tax rules.

A. *The Costs of Accuracy for Short-Term and Long-Term Assets*

Accuracy is likely to be more expensive for short-term than long-term assets for three related reasons.

1. Relative v. Absolute Mismeasurement

As argued above, we care about equal percentage errors in measurement, regardless of durability. The problem is that to maintain equal percentage deviations, measurements must become more precise in an absolute sense as lives become shorter. For example, compare a 20-year asset to a two-month asset. To maintain equal accuracy for each asset, the tax life must be within the same percentage range around each. Thus, to measure life within 50% of actual life, we need only know that the 20-year asset has a life between 10 and 30 years. For the two-month asset, we must know that the asset has a life between one and three months. The scope of allowable error in an absolute sense is much less.

Measurement costs, however, most likely relate more to the absolute difference in the actual and estimated depreciation than the relative difference. It is likely easier to be accurate within 10 years for the 20 year assets than to be accurate within one month for the two-month asset. It is likely to be even more expensive to be accurate within one day for a two-day asset. That is, as the life of an asset gets shorter, it will be more difficult to achieve the same relative accuracy because the requirement of absolute accuracy becomes more stringent. Flipping this around, we are likely to have large errors for short-term assets because, as life gets shorter, to achieve the same percent accuracy, the measurement has to become increasingly precise on an absolute basis.

2. Secondary Markets

Accurately predicting depreciation depends on information about used good prices. It is, however, less likely that there will be secondary markets in short-term assets than in long-term assets, which means that there will be less information about used good prices. The reason is that the costs of trading will become relatively more significant as the remaining useful life of an asset gets shorter. Consider, for example, two assets, each worth $100 and each producing a 10% return. One asset lasts for 10 years and the other for only one year. If the transactions costs of purchasing are similar in absolute amounts, we are much more likely to see secondary markets develop in the 10 year asset. It will not be worth incurring those costs for the one year asset because they must be incurred again to replace the asset next year.

The assumption of equal transactions costs is probably not correct. We might expect higher transactions costs for more durable assets as the purchase is more significant. Moreover, the likelihood of secondary markets will vary by the type of asset as well as the durability. Even so, many elements of purchasing costs cannot be avoided even for short-term assets and in general we should expect fewer secondary markets.

If there are fewer secondary markets for short-term assets, we have less information about their expected future price paths. This means that our estimates are likely to be worse for short-term assets than for long-term assets, or, said another way, it will be more expensive to get equally accurate estimates.

3. Short-Term Intangibles

Measuring the useful lives of intangible assets has been difficult for the tax system and this problem has been particularly acute for intangibles with mostly short-term benefits. There are generally no secondary markets in most short-term intangibles. Moreover, very similar expenditures on intangibles can produce assets with very different lives making measurement all but impossible. The tax system's response has often been to allow an immediate deduction for these types of costs rather than even attempting a measurement.

Consider, for example, customer service. Customer service provides an immediate benefit to the firm in terms of increased sales. It also creates longer-term benefits, such as customer goodwill and firm reputation. It is very difficult to sort out the useful life of any given expenditure for customer service. Moreover, it is difficult to even identify the costs of customer service. Employees engaged in customer service may also be involved in a variety of other activities, and indirect costs, such as the costs of heating the building may be difficult to allocate. Accounting methods designed to track these costs are complex and expensive and yet still rely on crude compromises.[43] Often the response is simply to allow an immediate deduction.

B. *Asymmetry in Error*

Not only are we likely to see significant error in the measurement of depreciation for short-term assets, the error is likely to be asymmetric. The reason is that the shortest life we can estimate is zero (which means we allow an immediate deduction). But the longest reasonable estimate might be many times the actual life, creating an asymmetric pattern where error on the high side has a much greater possibility of being large than does error on the low side. While this problem exists for all assets, it is likely to be worse for short-term assets.

[43] See, for example, I.R.C. §263A.

One way to think of this is to think of inaccuracy as variance of the estimated life around the actual life. The variance gets cut off at zero because zero is the shortest possible estimate. To the extent the distribution would otherwise go below zero, the pattern of errors becomes asymmetric. This asymmetry is likely to be greater for short-term assets. The reason is that measurement error will likely be greater for short-term assets. As variance in measurement goes up, the likelihood of the zero limit on estimates creating asymmetry goes up. Another way to see this is to hold absolute error constant. Then, as life gets shorter, the problem of asymmetry becomes greater. Therefore, if measurements costs relate to absolute rather than relative error, we should expect more asymmetry for short-term assets.

C. *The One year Accounting Period*

Even if we knew the depreciation schedules for short-term assets with perfect accuracy, we would still not be able to depreciate these assets on this schedule because of the one-year accounting period. The one year accounting period, as a general matter, aggregates all transactions within the tax year, often without regard to when the transaction occurs. Accurate depreciation for short-term assets, may involve tracking the decline in the value of the asset over periods much shorter than a year. Aggregation completely defeats this tracking.

For example, consider a six-month asset. Ideally, cost recovery for the asset would be spread out over six months. The present value of these deductions should be lower than if the taxpayer were given an immediate deduction. If, however, the asset is purchased during the first half of the year, the deductions will all show up on the same tax return and will have the same present value as an immediate deduction. Even if the asset is purchased in the second half of the year, there is no easy way to ensure that the deductions have the correct present value. Some portion of the cost recovery might be deferred until the second year, but it would only be happenstance that the numbers worked out to have the correct present value.

We can imagine schemes that fix this problem. For example, we could try to track payments during an accounting period more closely, say by month or week. This approach means, effectively, that the one year accounting period would be shortened. But shortening the accounting period has costs. The one year accounting period can be thought of as a compromise between the administrative costs of measurement and the deadweight loss costs of mismeasurement, but it is a compromise involving many aspects of the tax system, not just depreciation. Shortening the accounting period, therefore, may not be viable.

Another possibility is to allow taxpayers to immediately deduct the portion of the costs of an asset equal to the present value of the costs were they spread accurately over the recovery period. This approach has promise, but it too would cause complications. For example, there are a wide variety of rules in the tax system that depend on the basis system – a system in which cost recovery approximately matches declines in value. The capital gains provisions are an example. They offer a preferential tax rate for appreciation in an investment. If costs were immediately deductible on a percentage basis, the capital gains rules as well as a variety of other rules would have to be revised. Once again, the question is whether this is worth the trouble.

D. *Implications*

Current law often allows the costs of short-term assets, particularly intangibles, to be deducted immediately rather than attempting to estimate the useful life. The most commonly cited examples are the cost of advertising and research and development, but there are a wide variety of similar expenses, such as the everyday costs of customer service, business planning, and management, that are also commonly deducted. Case law allows these sorts of expenses to be immediately deducted unless they have a significant future benefit, and most of the time, the future benefit is treated as too contingent to be significant.[44] The proposed regulations will have the general effect of allowing more expenditures that have only short-term intangible benefits to be deducted.[45]

The first part of this paper suggests that we cannot readily allow deductions for these types of expenditures. The losses from inaccuracy are likely to be of similar or greater magnitude to the losses from inaccuracy for long-term assets. This section of the paper has suggested, however, that the costs of accuracy may be greater for short-term assets and the likelihood of asymmetry may be greater.

The question is how we balance these effects. While any such decision would depend on estimates of the magnitude of measurement costs and deadweight losses, it is conceivable that allowing immediate deductions for many short-term assets is an appropriate balance. It saves the administrative costs of measurement and coordinating depreciation of short-term assets with the one-year accounting system. Moreover, given the problem of asymmetry, estimates should be biased toward zero. On balance, a zero life (immediate deduction) may not be that much worse in relative terms than the life we would get after attempts to measure.

IV. Conclusion

This paper makes two points. First, accuracy matters roughly equally regardless of durability. The costs of inaccuracy are equal or greater for short-term assets as for long-term assets. Second, the costs of measuring depreciation for short-term assets are likely to be greater for short-term assets and the measurement for short-term assets may face a serious asymmetry where error is more likely to be on the high side than on the low side.

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[44] See INDOPCO v. Commissioner, 503 U.S. 79 (1992); Thomas Evans and Gregory Gallagher, INDOPCO–The Treasury Final Acts, 80 Taxes 47 (2002).

[45] See Prop. Reg. §1.263(a)-4.

The greater additional measurement costs and the potential for asymmetry may justify the approach taken under current law of allowing an immediate deduction for many short-term assets.

There are many avenues for further exploration of the issues discussed here. The analysis here of how to balance the costs of accuracy for short-term assets with the deadweight loss from mismeasurement was quite perfunctory. There are any number of potential proposals to resolve this dilemma that might be worth exploring. One approach might be to attempt to harness information held by taxpayers about likely depreciation schedules. For example, default lives should be set to be longer than actual lives but taxpayers could be able to "prove out" of the default life by presenting information about actual lives. This information could eventually be used to construct more accurate schedules.

Another set of issues worth further exploration is the interaction of the analysis here with risk. If future lives are stochastic and taxpayers have the option of selling assets, they can choose to sell assets when the default life is too long and hold assets when the life is too short. Jeff Strnad has published an extensive study of this issue, although he does not discuss durability.[46] Jane Gravelle has suggested that over-estimates of useful lives is relatively unimportant for short-lived assets because when their life is over they can be abandoned and the remaining tax basis recovered.[47] Gravelle was discussing computer equipment and this may be true for these assets. But it is not obviously true in general. Many expenditures with short lives do not create an asset than can be abandoned. For example, one cannot readily abandon the goodwill created by advertising (it can be squandered, but it would be hard to abandon it for tax purposes). There is also a long line of literature arguing that income taxes do not tax returns to risk, instead taxing only the return to waiting.[48] If this risk-free return is relatively low, the costs of accuracy may substantially exceed the benefits.

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[46]Strnad, note __.

[47]Gravelle, Whither Depreciation, note __.

[48]See, e.g., Louis Kaplow, Taxation and Risk-Taking: A General Equilibrium Perspective, 47 National Tax Journal 789 (1994).

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