Depreciation and the Taxation of Real Estate

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Summary

The Tax Reform Act of 1986 set up a depreciation system designed to equalize tax burdens on different types of assets. The recovery period for nonresidential structures was, however, lengthened in 1993. Economic conditions and practices that may bear on this issue have also changed. Lately, there has been some interest in reexamining this depreciation structure. For example, H.R. 4328, The Omnibus Consolidated and Emergency Supplemental Appropriations Act of 1998, mandated the Treasury Department to study current tax depreciation rules and how they relate to tax burdens. This report provides background information relating to tax depreciation of structures, including a discussion of the methods of measuring economic depreciation.

The first section of this report provides a description and history of the treatment of structures under the depreciation system. This analysis indicates that depreciation of nonresidential structures is more restrictive today than at any time since 1953, while depreciation on residential structures is more restrictive than it has been since 1971.

The second section discusses the very complex problems associated with estimating economic depreciation rates and reviews the evidence from the economics literature on these rates.

The third section compares, in light of evidence on economic depreciation, the tax burdens on equipment and alternative types of structures, how that tax burden has changed, and what changes, given economic depreciation estimates, would be necessary to restore equal tax burdens across basic asset categories. These estimates indicate that lengthening the life for equipment by about 4 years, or shortening the tax life for structures to around 20 years would restore equal treatment across assets.

The fourth section of the paper discusses whether the use of debt finance, which has been argued to be greater for structures than for other assets, should be taken into account in setting up depreciation rules. This argument which has been made in the past. This analysis suggests that adjusting depreciation rules to address another tax distortion is less desirable than addressing the distortion directly. Moreover, there are other offsetting tax burdens on structures (such as property taxes), which could justify offsetting more generous rules. At any rate, the available evidence does not support the claim that structures are more leveraged than other assets.

This report will be updated as developments warrant.

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The first section of this report provides a description and history of the treatment of structures under the depreciation system. The second section discusses the very complex problems associated with estimating economic depreciation rates and reviews the evidence from the economics literature on these rates. The third section compares, in light of evidence on economic depreciation, the tax burdens on equipment and alternative types of structures, how that tax burden has changed, and what changes, given economic depreciation estimates, would be necessary to restore equal tax burdens across basic asset categories. The fourth section of the paper discusses whether leverage should be taken into account in setting up depreciation rules (an argument which has been made in the past) and the evidence on leveraging rates across assets. The final section presents a brief conclusion.

Current Depreciation Rules and a Historical Comparison

Under current law, nonresidential structures (such as stores and office buildings) are depreciated at a straight-line rate (equal amounts of the cost of acquiring or constructing the structure deducted in each period) over a period of 39 years. That is, for a building that costs $100,000, $2,564 (or 1/39th) is written off in each of the following 39 years. Residential structures are depreciated over 27.5 years. In both cases, the write-off periods are relatively long and the methods relatively slow by historical standards. Although the depreciable life for new properties was 40 years prior to 1971, during most of that period rapid methods of depreciation were available. These methods included sum-of-years-digits (SYD) and various declining balance (DB) methods. Double declining balance (DDB), for example, allows a first year writeoff that is twice as large as straight line. This same rate is applied to the undepreciated balance (rather than the original cost, as in the case of straight line methods) so that depreciation amounts decline over time. This method would never allow the complete writeoff of assets, and taxpayers were allowed to switch to a straight-line writeoff (of the remaining balance over the remaining years). It was optimal to make this switch at the half-way point for DDB, and earlier for slower DB methods. Sum-of-years digits (where the share written off is the number of years of life remaining divided by the sum of the years in the life) is similar to double declining balance with a switch to straight-line in its pattern.

[1] U.S. Department of Treasury. Report to the Congress on Depreciation Recovery Periods and Methods. July 2000. See also David W. Brazell and James B. Mackie III, "Depreciation Lives and Methods: Current Issues in the U.S. Capital Cost Recovery System." National Tax Journal 53 (September 2000): 531-562.

The value of a depreciation allowance depends on how quickly deductions are made because payments in the future must be discounted to reflect the fact that a payment in the future is less valuable than one currently (since the current payment can be invested at interest). One can compare the value of depreciation allowances with different write-off periods and methods by summing up the present values of all of the payments. These present values depend on the interest rate.

Table 1 shows the historical methods, tax lives (either prescribed or based on survey data), and present values of depreciation deductions as a share of investment,

Table 1. Present Value of Depreciation Deductions, 1953-Present, at a Constant 10 % Discount Rate

Years	Commercial Depreciation Rules Life/Method	Commercial Present Value Per Dollar of Investment	Residential Depreciation Rules Life/Method	Residential Present Value Per Dollar of Investment
1953	40/SL	0.245	40/SL	0.245
1954-69	40/DDB,SYD	0.377	40/DDB,SYD	0.377
1969-70	40/150%DB	0.284	40/DDB,SYD	0.377
1971-80	36/150%DB	0.363	31/SYD	0.446
1981	15/175%DB	0.572	15/175%DB	0.572
1982-3	18/175%DB	0.522	18/175%DB	0.522
1984-6	19/175%DB	0.507	19/175%DB	0.507
1987-93	31.5/SL	0.304	27.5/SL	0.340
1994-	39/SL	0.251	27.5/SL	0.340

Note: SL refers to straight line, DDB refers to double declining balance, DB refers to declining balance and SYD refers to sum-of-years-digits.

at a constant 10% discount rate. In the case of commercial real estate, the present values are smaller and the depreciation lives and methods produce writeoffs that are smaller than any time since 1954. A similar results is found for residential real estate. Although tax lives for residential structures tend to be shorter than other periods (except for 1981-86), the straight line method used is less beneficial to owners than previous methods.

This assessment of history is somewhat over-simplified. Since buildings are sold from time to time, the treatment of capital gains and the rules for used buildings also have an effect on the level of tax burden assigned to buildings. For example, under current law, used assets are treated the same as newly constructed buildings, which was not always the case in the past. Component depreciation, which allows different elements of a building to be depreciated over different periods of time made assessment of depreciation rules in the past more difficult. Finally, the value of depreciation depends on the discount rate, which in turn depends on the level of inflation; during periods of high inflation, such as the late seventies and beginning of the 1980s, depreciation tended to be understated, other things equal. (As will be discussed subsequently, however, the effect of inflation on the tax burden on real estate tends to be smaller than the effect on shorter lived assets).

Issues in Tax vs. Economic Depreciation: Measuring Economic Depreciation

Economic depreciation deductions reflect the part of the gross flow of income from an asset that represents the return of principal (since the asset is deteriorating). Economic depreciation also reflects that change in the market value of the asset due to the decline in productivity and/or remaining useful life of the asset. Finally, if tax deductions match economic depreciation deductions (either in each year or in total present value), the effective tax burden on an asset's returns is equal to the statutory tax rate. Determining the tax burden therefore requires an empirical estimate economic depreciation. No empirical method is entirely satisfactory. However, the following discussion outlines three major empirical approaches: vintage price comparisons, comparisons of rents, and perpetual inventory methods. There is also the approach taken by the Bureau of Economic Analysis in the National Income Accounts, which estimates useful life, with a distribution of retirement ages and with each set of assets within that distribution depreciated at a straight line rate. This method has components that are not based on empirical evidence, such as the depreciation method. Note that economic depreciation only fulfills its function of correctly measuring income if it is indexed for inflation.

Vintage Price Comparisons

Depreciation is the change in the value of the asset in each period. If one could directly observe the potential sales price as an asset ages, economic depreciation could be determined. The vintage price approach is based on that fundamental. If assets were homogeneous, or if comparable assets were available, then depreciation could be determined simply by examining the prices of assets of different ages.

Methodological Concerns

There are several important problems and limitations with this approach. Some are more serious with real estate than with other assets, while others are less serious.

Real estate is not a homogeneous asset. Properties can differ many ways that affect their value: number of square feet, number of floors, locations, and many other attributes. Real estate can be maintained well or poorly; properties with major renovations may have different values from those without major renovations. It is not easy to separate the structure from the land. Researchers normally use a hedonic index in which these characteristics are controlled for, although data are not always available for controls. Thus the value of any asset will depend on a whole range of characteristics, one of which is age. The effect of age on the asset value is, therefore, the measure of depreciation.

Several specific problems have been identified with this approach aside from the general complications of heterogeneity.

(1) *Censored Sample Bias*. Using data on used asset prices will generally underestimate depreciation (other things equal) because of a "censored sample bias." All this means is that the assets that have completely depreciated and been scrapped are absent from the sample, and thus true depreciation will be greater than measured by the estimates based on survivors. This effect

can be corrected by multiplying the value of the asset at each age by its probability of survival. Many studies of depreciation have not made this adjustment.

(2) *The Lemons Problem*. The used asset market tends to have a larger share than average of "lemons." This effect is most obvious in the used car markets: owners tend to keep their cream puffs and trade in their lemons. The owners know more about their cars than the buyers. Buyers, without personal knowledge of the characteristics of the cars tend to expect used cars to be lemons, which lowers the price and makes it even more undesirable to sell higher-quality assets.

This lemons problem tends to overstate depreciation; however, it is much less likely to be a problem in markets where there are sophisticated buyers (as is likely in many real estate transactions) or where there are many other reasons for selling than unloading "lemons."

(3) *Vintage Value*. There may be some unmeasured variable associated with particular year of construction which cannot be disentangled from depreciation. For example, if older structures were constructed more soundly, used asset values will understate depreciation, because the effect of age on value reflects two offsetting effects—a fundamental difference in the old and new structure and the effect of depreciation. Another example is when a particular vintage of structures is in particular demand (e.g. Victorian structures) because of tastes in the marketplace; such anomalies can make it more difficult to interpret the effect of the age variable and produce estimates not suitable for measuring the deterioration of new assets without those features.

(4) *Effect of Tax Rules.* When tax depreciation does not match economic depreciation at every point in time, the tax rules themselves can alter measures of depreciation. The precise effects depend on the tax rules for new versus used assets, which have varied over time. In general, allowing the same tax life for new assets as used assets will cause depreciation to be overestimated. However, most existing depreciation studies covered years in which there were different rules for new and used assets.

(5) *Age-Related Heteroskedasticity*. Heteroskedasticity is a statistical term which refers to greater variations across observations in certain parts of a sample. In real estate, it relates to the fact that variation across assets tends to become larger for older assets (particularly if data is not available to control for renovation, maintenance, etc). Heteroskedasticity may make results appear more statistically reliable than they really are, although there are techniques to correct for this problem.

Empirical Results

The most well known vintage price study, and the one most commonly used, is the one by Hulten and Wykoff,[2] who examined commercial (office) structures and industrial (factory) structures. Using a constant geometric rate, they estimated a 2.47% depreciation rate for offices and 3.61% for factories. Using a 5% real discount rate, these rates translate into a present value of 33 %of the purchase price for office buildings and 42% for factories. Note that current depreciation rules for

[2] Charles R. Hulten and Frank C. Wykoff, "The Estimation of Economic Depreciation Using Vintage Asset Prices: An Application of the Box-Cox Power Transformation." In *Journal of Econometrics*, April, 1981, pp. 367-396. See also, by the same authors, "The Measurement of Economic Depreciation," in *Depreciation, Inflation and the Taxation of Income From Capital*, ed. Charles R. Hulten, The Urban Institute, 1981; "Issues in the measurement of Economic Depreciation," *Economic Inquiry*, V. 34, January, 1996, pp. 10-23.

nonresidential structures produce smaller values than would be appropriate to measure economic depreciation, using these estimates.

Their study also indicates the importance of correcting for censored sample bias; without that correction, depreciation rates were estimated at 1.05% for office buildings and 1.28% for factories. At the same time, arguments have been made that the correction for censored sample bias is too great in the case of real estate. DeLeeuw suggests that an important reason for demolishing a structure is because land use patterns make it more profitable to tear down a structure and replace it with something else.[3] That view, of course, holds up only if there is no separation of the physical structure from the site value. If depreciation is focused on the structure, the existing structure actually has negative value (since there is a cost of tearing it down); it is the site itself that has appreciated. In this case, the current structure has become obsolete. Taubman[4] suggests that some buildings disappear because of fires and similar accidents. This is probably a less important effect, and the owner may not be fully compensated by insurance. For these reasons, it seems that estimates with corrections for censored sample bias are superior. Since the remaining studies discussed in this section and in the next section do not correct for this effect, their estimates are understated, other things equal.

While most other studies are of residential structures, there are two recent studies that included office buildings. Cowell, Munneke, and Trefzger found depreciation rates at about 1% for office buildings in Chicago, but they did not make the correction for censored sample bias; thus, their results are similar to those of Hulten and Wykoff.[5] A recent study by Deloitte and Touch found results similar to those of Hulten and Wykoff.[6] Their estimates were 2.67% for industrial buildings, 4.48% for retail buildings and 3.46% for office buildings. This study also calculated depreciation for residential rental buildings at 3.95%.

The remaining studies of structures depreciation using vintage prices are for housing. Many are for owner-occupied housing which may have a different depreciation rate or pattern from rental properties. Most of the studies up to the mid-1980s are summarized by Malpezzi, Ozanne and Thibodeau,[7] and most showed a range of depreciation rates from less than one percent to slightly over 2%. The estimates were based on geometric rates in some cases and on straight line in others.

Some researchers have tested different patterns of depreciation. For example, Cannaday and Sunderman[8] found a method slower than straight line, similar to a reverse sum-of-years digits. Their results (for owner-occupied housing) indicted a present value of 0.10, which is equivalent in present value to a 0.6% geometric decay rate. By contrast, Goodman and Thibodeau[9] found a

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[3] Frank DeLeeuw, discussion of "The Measurement of Economic Depreciation." in *Depreciation, Inflation and the Taxation of Income From Capital*, ed. Charles R. Hulten, The Urban Institute, 1981.

[4] Paul Taubman, discussion of "The Measurement of Economic Depreciation." in *Depreciation, Inflation and the Taxation of Income From Capital*, ed. Charles R. Hulten, The Urban Institute, 1981.

[5] Colwell, Peter F. ; Munneke, Henry J. ; Trefzger, Joseph W. "Chicago's office Market: Price Indices, Location and Time." *Real Estate Economics*, 26 (Spring 1998): 83-106.

[6] Analysis of the Economic and Tax Depreciation of Structures. Deloitte and Touch Llp, Washington, DC, June 2000.

[7] Stephen Malpezzi, Larry Ozanne, and Thomas G. Thibodeau, "Microeconomic Estimates of Housing Depreciation." *Land Economics*, Vol. 63, No. 4, Nov. 1987, pp. 372 - 373.

[8] Roger E. Cannaday and Mark A. Sunderman, "Estimation of Depreciation for Single Family Appraisals." *American Real Estate and Urban Economics Association (AREUEA) Journal* Vol. 14, no. 2, Summer 1986. 255-273.

[9] Allen C. Goodman and Thomas G. Thibodeau. "Age-Related Heteroskedasticity in Hedonic House Price Equations." (continued...)

pattern of much higher depreciation in the near term for owner-occupied housing, with an eventual period of appreciation, followed by another decline. The constant geometric rate estimated was very low (less than 0.2%), but short run rates were quite high, in excess of 6% initially, when a more flexible polynominal estimating form was used. These rates fell to 1.4% after 10 years. Shilling, Sirmans and Dombrow,[10] also found higher rates of depreciation initially; a 1.93 % rate for owner-occupied housing that fell to 1.06 % in the tenth year. Rental housing depreciated more rapidly, by 2.54 % in year 1 to 1.66 % in year 10. Clapp and Carmelo[11] also found some properties appreciated, which they consider to be due to the vintage effect.

Knight and Sirmans[12] found that (for owner-occupied housing) homes that were maintained poorly depreciated at rates 0.87 % faster than average while very well-maintained homes depreciated at 0.17 % slower. The overall depreciation rate at 18 years was 1.9 % (for the average maintenance house).

Some of these studies indicate that rental housing depreciates at a faster rate than owner-occupied housing, so that depreciation rates for owner-occupied housing may not be relevant; Gatslaff, Green and Ling,[13] however find no difference between tenant versus owner-occupied housing.

Rental Data Approaches

If one knew the pattern of rents for a property, then that cash flow could be used to determine depreciation. Examining rents has many of the problems of vintage price studies, although it does avoid the lemons problem. At the same time, the pattern of depreciation may be affected by the tendency to have long term leases that fix the gross rent over a period of time. That is a criticism of a well known study of office buildings by Taubman and Rasche,[14] which found a depreciation pattern that was slower than straight line. However, that effect should not affect the present value of depreciation deductions, which, based on a formula presented in their paper, amount to 20 % of original price at a 5% real discount rate. That also translates into a geometric depreciation rate of 1.25%. That number is slightly higher than the Hulten and Wykoff estimate above without correction for censored sample bias.

Some studies of residential rental structures have examined the patterns of gross rent over time, and these numbers tend to be smaller, typically less than one percent. In the survey data reported by Malpezzi, Ozanne and Thibodeau,[15] one study found a decline for 0.7 % for renters and

(...continued)

Journal of Housing Research Vol. 6, No. 1, 1995 pp. 25-42.

[10] James D. Shilling and C. Sirmans, and Jonathan F. Dombrow, "Measuring Depreciation in Single-Family Rental and Owner-Occupied Housing." *Journal of Housing Economics*, December 1991, pp. 368-383.

[11] John M. Clapp and Giacotto Carmelo. "Residential Hedonic Models: A Rational Expectations Approach to Age Effects." *Journal of Urban Economics*, vol. 44, November 1998, pp. 415-437.

[12] John R. Knight and C.F. Sirmans.. "Depreciation, Maintenance, and Housing Prices." *Journal of Housing Economics*, vol. 5, No. 4, December 1996, pp. 369-389.

[13] Dean H, Gatzlaff, Richard K. Green and David C. Ling. "Cross-Tenure Differences in Home Maintenance and Appreciation." In *Land Economics*, vol. 74, No.3, August 1998., pp. 328-342.

[14] Paul Taubman and Robert Rasche. "Economic and Tax Depreciation of Office Buildings." *National Tax Journal*., Vol. 22, September 1969, pp. 334.

[15] Stephen Malpezzi, Larry Ozanne, and Thomas G. Thibodeau, "Microeconomic Estimates of Housing Depreciation." *Land Economics*, Vol. 63, No. 4, Nov. 1987, pp. 372 - 373.

another a decline of 0.8%. Randolph[16] finds a decline of 0.63%; his article stresses the problems with separating age and vintage effects. The decline in gross rent would be a correct measure only if maintenance costs were a fixed share of gross rent and lives were infinite. Since neither of those is likely to be true, the depreciation rate is probably higher.

For example, if maintenance costs are fixed, as gross rents decline, net rents will decline even faster. Calculating the present value of the change in market price (depreciation) yields about 45 cents on the dollar for a 0.6 % decline in gross rent, even assuming that net rents decline to zero only after a very long period of time (90 years). At that point, the building would be replaced. This present value converts to a geometric depreciation rates of slightly over 4%. Thus, unless one expects maintenance costs to be very small initially or to decline, a small depreciation in gross rent can lead to a significant overall economic depreciation rate, and these studies tend to be consistent with evidence of depreciation rates larger than 2%.

The recent study by Deloitte and Touche also estimated depreciation in gross rents, but found significantly higher decline rates: 1.9%, 1.7% and 2.5% respectively.[17] They also estimated depreciation rates that were from almost one to over two percentage points higher.

Polynomial Benchmark Approach

The third type of study examines replacement costs over a period of time. This approach has only been applied to housing. One can determine, in theory, how much replacement occurs if there are measures of the capital stock in two different points in time and the intervening investment is known. This approach does not suffer from the censored sample bias problem that plagues the other approaches, and provides an aggregate overall depreciation rate. However, such an approach assumes that economic depreciation is of the geometric type. The main sources of error in this approach are the disparity between replacement costs and depreciation measured as a change in market value if constant declining geometric decay does not occur, along with potential inaccuracy in measurement of the real capital stock at different periods in time. Leigh[18] reports a variety of depreciation rates for the housing stock as an aggregate, and by type. The results vary across techniques and time. Tenant housing is estimated to depreciate at 1.3 % for 1950-1970, 2.2 % for 1950-1960, and 0.6 % from 1960-1970, when adjustments are made to account for conversions to the stock and losses from the stock. Without these adjustments, depreciation rates are 2.3 % for 1960-1970, 3.1 % for 1950-1960 and 1.8 % for 1970-1980. The adjustment is theoretically correct for geometric decay (where buildings have infinite lives) but not necessarily for finite lives (where true losses from the stock would occur). Making no adjustment, however, means that there is a failure to account for the transformation of owner-occupied units into rental (and vice versa).

An aggregate housing depreciation rate that combines tenant and owner-occupied housing yields estimates that are very similar over the three time periods: 1.6 % for 1950-1970, 1.8 % for 1950-1960 and 1.5 % for 1960-1970. These are similar to another benchmark study reported by

[16] Randolph, William C. "Estimation of Housing Depreciation: Short Term Quality Change and Long-Term Vintage Effect." *Journal of Urban Economics.* Vol. 23, March 1988, pp. 162-178.

[17] Deloitte and Touche, Analysis of the Economic and Tax Depreciation of Structures. Washington, D.C., June 2000.

[18] Wilhelmina A. Leigh, "The Estimation of Tenure-specific Depreciation/Replacement Rates Using Housing Quantity Measures for the U.S., 1950-1970." *The Quarterly Review of Economics and Business*, vol. 19, Autumn 1979, pp. 49-60.

Malpezzi, Ozanne and Thibodeau.[19] (Owner-occupied rates are smaller in both cases). This aggregate measure does not suffer from the correction for additions and losses and the results are more consistent over time. In a subsequent paper,[20] however, Leigh reports a somewhat lower rate of depreciation by adjusting benchmarks to reflect differing productive efficiencies by age, and obtains a lower estimate of about 1%.

The variations in estimates, depending on time period and technique, make it difficult to assess structures depreciation from the polynominal benchmark approach, although if tenant-occupied structures depreciate at higher rates than owner-occupied structures, these results are not inconsistent with the vintage price and rental study results discussed above.

In short, none of the approaches to measuring depreciation are without limitations, and the range of estimates indicates not only the empirical challenges to estimating depreciation but also the problem of heterogeneity. Taking into account the potential importance of the censored sample bias in vintage and other studies, structures probably depreciate at rates in excess of 2%, but probably less than 4%.

Effective Tax Rates on Structures and Equipment

To compare effective tax rates across assets, estimates of economic depreciation rates for equipment as well as structures are needed. For obvious reasons, it is difficult to rely on either rental data or benchmark asset data. Most machinery is not rented and an independent aggregate source of asset value is not available. Thus, these depreciation estimates tend to be based on the vintage price approach. The most extensive study of equipment depreciation was made by Hulten and Wykoff. [21] Estimates by Oliner[22] of machine tools depreciation tend to be generally compatible with Hulten and Wykoff's estimates, although somewhat lower. Estimates by Beidleman[23] for capital used in the machine tool industry, which mostly included machine tools, were higher.

There are alternative approaches that rely on observations of investment combined with output (rather than benchmark assets). These are generally in broad aggregates, for either investment as a whole or a particular industry. Thus, these measures (which are summarized by Jorgenson[24]) are conceptually similar to studies of depreciation rates for structures based on rents. They are not very useful for identifying depreciation rates for particular assets, however.

[19] Stephen Malpezzi, Larry Ozanne, and Thomas G. Thibodeau, Microeconomic Estimates of Housing Depreciation, *Land Economics*, Vol. 63, No. 4, Nov. 1987, pp. 372 - 373.

[20] Wilhelmina A. Leigh, Economic Depreciation of the Residential Housing Stock of the United States, 1950-1970, *The Review of Economics and Statistics*, vol. 62, May 1980, pp. 200-206.

[21] Charles R. Hulten and Frank C. Wykoff, "The Estimation of Economic Depreciation Using Vintage Asset Prices: An Application of the Box-Cox Power Transformation." In *Journal of Econometrics*, April, 1981, pp. 367-396.

[22] Stephen D. Oliner, "New Evidence on the Retirement and Depreciation of Machine Tools." *Economic Inquiry*, Vol. 34, January 1996., pp. 57-78.

[23] Carl R. Beidleman. "Economic Depreciation in a Capital Goods Industry." *National Tax Journal*, vol. 29, 1976, pp. 379-390.

[24] Dale W. Jorgenson. Empirical Measures of Depreciation. *Economic Inquiry*, Vol. 34, January 1996., pp. 57-78.

While recognizing the uncertainty attached to depreciation estimates, it is still useful to compare effective tax rates on structures and equipment.

In the Tax Reform Act of 1986, efforts were made, within the limits of current information about economic depreciation rates and the practicalities of tax administration, to set economic and tax depreciation roughly equal. The methods adopted were accelerated (based on empirical evidence), but depreciation was not indexed for inflation. These tax benefits and penalties for most assets were roughly offsetting.

Since 1986, several changes have altered those relationships. In 1993, the depreciation life for nonresidential structures was lengthened from 31.5 to 39 years. This increase was adopted in part to finance revenue losses associated with liberalizing passive loss restrictions for certain investors. Tax rates were also increased at that time, for corporations and for high income individuals. These changes had the effect of raising tax burdens. At the same time, the expected inflation rate fell, changes that had the effect of lowering tax burdens.

The net results of these effects did not have equal effects on all assets, as demonstrated in **Table 2**, which reports effective tax rates.

These calculations suggest that while equipment had a somewhat more favorable treatment in 1986 than structures, the gap between the two has widened. This effect is only partly due to an explicitly longer depreciation period as can be seen from comparing the effects for apartment buildings where depreciation did not change. It also reflects the effects of lower inflation. Inflation, other things equal, tends to penalize short lived assets more than long lived ones.[25] To offset this effect required more accelerated depreciation, and equipment was given relatively short lives and more rapid methods of depreciation (generally 150% declining balance). Structures were subject to relatively long periods. When inflation fell, the tax burdens on equipment fell more than on structures, and that effect is responsible for more than half the change in the difference between tax burdens on equipment versus structures.

Table 2. Effective Tax Rates, by Asset Type

(Effects of Law Changes and Inflation)

Year	Equipment	Factory	Office Building	Apartment
1986	32	38	35	34
1993 (fixed inflation)	33	41	38	35
1993, low inflation	27	38	35	31

Note: The tax rate is 34% in 1986 and 35% in 1993. Expected inflation is assumed at 5 % initially; low inflation is assumed at 2%. Economic depreciation is based on Hulten and Wykoff estimates; apartment buildings are assumed to have the same economic depreciation rate as office buildings (2.47% using a geometric rate). Factory buildings are assumed to have a 3.61 % geometric depreciation rate. Note that these particular buildings may not be representative of all industrial or commercial structures. The average depreciation rate (weighted by capital stock shares) for equipment is 15%. Effective tax rates are based on calculating the internal rate of return with and without taxes, and dividing the difference by the pretax return. See Jane G. Gravelle, *The Economic Effects of*

[25] This differential effect of inflation on assets of different durabilities has been established for some time. See, for example, Jane G. Gravelle, "Effects of the 1981 Depreciation Revisions on the Taxation of Income from Business Capital," *National Tax Journal* 35 (March 1982), pp. 1-20.

Taxing Capital Income, MIT Press, 1994, for details of these types of calculations. The effective tax rate for equipment is based on estimating the pretax return for each of 21 asset types and then weighting those, assuming a uniform after-tax return.

Note that the effective tax rate could be different based on the estimates of Deloitte and Touche, which found lower depreciation rates for industrial structures, higher rates on other structures and also considerably higher rates for a new category, retail structures. **Table 3** reports the effective tax rates using these depreciation rates.

Table 3. Effective Tax Rates, by Asset Type, Using Deloitte and Touche Estimates of Economic Depreciation

(Effects of Law Changes and Inflation)

Year	Retail Building	Industrial Structure	Office Building	Apartment
1986	39	33	37	36
1993 (fixed inflation)	43	36	41	37
1993, low inflation	39	33	37	33

Note: Assumptions are the same as those in **Table 2** except for the economic depreciation rate. Retail buildings are added.

If effective tax rates on structures were to be brought into line with those on equipment, one could either raise the tax burden on equipment by lengthening lives or lower the tax rate on structures by shortening lives. For example, using the economic depreciation numbers in **Table 2**, if the 7 year life that is most typical for equipment were increased by one year—to 8 years—and all other lives subject to the same percentage increase, the tax burden would rise by two percentage points, from 27 % to 29%. If the life were increased by 2 years, to 9 years, the tax burden would rise to 31%; if the life were increased by 3 years, to 10 years, the tax burden would rise to 33%; if the life were increased by 4 years to 11 years, the burden would rise to 35%.

Because of the smaller present values and depreciation methods, it would take a much larger absolute change to lower the tax burden on structures to 27%. In the case of office buildings and apartments, a life of 20 years would be required. In the case of factory buildings, a life of 17 years would be required.

Changes in effective tax rates could also be achieved by changing the method. For example, substituting double declining balance methods for straight-line would cause effective tax rates on factory buildings to fall from 38% to 34%, on office buildings to fall from 35% to 31%, and on apartments to fall from 31% to 28% . This change would bring apartment tax rates in line with equipment, but not accomplish the full effect for other structures. If all structures were given a tax life of 27.5 years (with double declining balance methods), tax burdens on office buildings would fall to 28%, and tax burdens on factories to 30%. To further lower the tax burdens to 27 % for factories, not only would double declining balance be needed but the recovery period would need to be shortened to about 21 years; the recovery period for apartments and office buildings would need to be about 26 years.

Of course, there are many other types of structures, and there would still be some equipment assets that are taxed more heavily than structures and some less heavily because many equipment assets that vary somewhat in durability are placed in the same tax depreciation category, for purposes of simplicity. Moreover, there is still considerable uncertainty about many aspects of this issue, in particular, economic depreciation rates. As a general rule, however, depreciable lives for structures would need to be reduced. Shortening tax lives for structures to 20 years, or perhaps a little less, or adopting double declining balance and shortening all tax lives to the current life allowed for residential structures (or perhaps a little less) would bring effective tax rates on structures and equipment into line, based on the Hulten and Wykoff depreciation rates.

Tax Burdens on Structures and Leveraging

When the Treasury studied tax reform in 1984, one of the criticisms it made of the current tax structure was that the system favored equipment over structures. The argument has been made, however, that structures are favored because it is easier to obtain financing for a structure than for other assets, and debt finance is favored over equity finance.[26]

This type of argument can be challenged for several reasons. The first is that altering depreciation practices is an inefficient way to address other tax distortions that exist, particularly since there are an array of problems. It is true that our tax system favors debt finance and individual investment over corporate equity investment. It may also favor debt finance for individual investments when the borrower is in a high tax bracket and the lender in a low one, because of inflation (although that effect is probably relatively modest with current inflation rates).[27] But the primary favoritism is towards investments outside the corporate sector, not investments in interest bearing assets. Any investment in the noncorporate sector is favored over corporate investment, but does that mean that we should apply less beneficial depreciation to all assets owned by proprietorships and partnerships? A more appropriate method would be to relieve the double taxation of corporate equity income. One could also argue that structures should be given beneficial treatment, because they are more likely to be subject to local property taxes than is the case with equipment and inventories. Finally, the use of debt finance has been constrained through the passive loss rules and other restrictions aimed at tax shelters in the 1986 Tax Reform Act.[28]

A more straightforward objection to this argument is that there is no evidence that structures are more leveraged than other assets; this notion appears to be a perception that originates from an error in earlier studies.[29]

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[26] This argument was made in a working paper in 1986, during discussion of the tax reform legislation; this paper was subsequently published in a book of collected articles.. Roger H. Gordon, James R. Hines, Jr. and Lawrence Summers. “Notes on the Tax Treatment of Structures.” In *The Effects of Taxation on Capital Accumulation*, ed. Martin Feldstein, University of Chicago Press, 1987. This paper also argued that structures were benefitted due to the churning of assets; however this argument depended on the assumption that assets were sold on an installment sales basis, which the evidence does not support.

[27] The lender is able to deduct the inflation premium, which is not a real cost; the borrower includes it in income, but his or her tax rate is lower. This effect is less important at low inflation rates.

[28] Some have argued that the popularity of tax shelters in real estate was a sign of their favorable treatment. This popularity was, however, much more likely due to restrictions on equipment leasing which had made that other potential source of tax shelters limited in availability and also to the familiarity with real estate investments. Moreover, other tax shelters, such as oil and gas, while small as a share of tax shelters were large relative to their overall presence in the economy.

[29] The Gordon, Hines, and Summers paper, op cit., assumed a debt to asset share for structures that was almost 80 % while the industry average was 40%. These data were taken from another study, Don Fullerton and Roger Gordon, A Reexamination of Tax Distortions in General Equilibrium Models, In *Behavioral Simulation Methods in Tax Policy Analysis*, ed. Martin Feldstein, Chicago, University of Chicago Press, 1983, which relied on compustat data (on (continued...)

While some initial mortgages are large relative to asset value, the debt to asset value declines over time as the mortgage is paid off; moreover, the property may appreciate in nominal value because of inflation or because of a real appreciation in land value. The only way to compare assets is to look not at initial borrowing rates but at the average debt-to-asset ratio.

Data exists for residential rental structures from the housing census, and are shown in **Table 3**.

These debt to asset shares can be compared with data from the Federal Reserve Flow of Fund Accounts. It is not always clear how a comparable debt-to-asset ratio should be calculated, since firms have financial assets and financial liabilities that include items (such as accounts payable and receivable) which are incidental to business rather than explicit borrowing or acquisition of financial assets. Two measures are shown in **Table 4**: total liabilities divided by total assets (physical and financial) and credit market liabilities as a percent of tangible physical assets. Because there is only a single year benchmark for residential rental properties, **Table 4** reports these ratios for the most recent year, for the year comparable to the data in **Table 3** (1991), and for 10 years ago.

Table 4. Distribution of Properties and Mortgage as a Percent of Property Value, Residential Rental Property

Type of Property	Property Type as a Percent of Total Residential Rental Property (by value)	Outstanding Mortgage as a Percent of Property Value
1-4 Units	22	28
5-49 Units	33	34
50+ Units	46	39
Total	100	35

Source: Department of Commerce, Bureau of the Census, 1990 Census of Housing: Residential Finance, Tables 1a, 1b.

(...continued)

corporations). There appears to be some problem with these data, which were inconsistent with tax data that showed a 71 debt to asset share for lessors of buildings, a share that is known to be overstated because assets on the tax books are understated due to valuation at historical prices and accelerated depreciation. The most likely reason for this discrepancy is that the particular data set used by Fullerton and Gordon was heavily weighted with subdividers and developers who do tend to have large debt shares (84 % according to the corporate sourcebook).

Table 5. Corporate Debt-to-Asset Ratios, Flow of Funds Accounts

Year	Total Liabilities as Percent of Total Assets	Credit Market Liabilities as a Percent of Tangible Assets
1988	46	38
1991	49	40
1998	50	47

Source: Federal Reserve Board, Flow of Funds Account, March 12, 1999, Table B100, p. 102.

Regardless of the measure used, these data indicate that the debt to asset ratio for residential rental real estate is not above that for the corporate sector in general.

Finally, comparisons of debt to asset ratios from the corporate tax statistics tend to confirm this impression. Lessors of buildings have a total liabilities divided by total assets share of 61%, while all nonfinancial corporations have a share of 66 % (Internal Revenue Service Statistics of Income, *Corporate Source Book 1995*). Both of these debt shares are overstated, because assets are valued at historical prices and subject to accelerated depreciation. Structures tend to be understated because they are longer lived and their historical values are more understated; equipment is not as affected by historical costs but may be understated due to accelerated depreciation; inventories tend to be accurately stated. However, even when assets are measured by adding back depreciation, the debt to asset ratios remain lower for lessors of buildings than for other assets—47% compared to 54%. This evidence, therefore, suggests that debt to asset ratios for structures are not higher than for owners of other assets.

Conclusion

Measuring economic depreciation is a difficult task, and our information on economic depreciation rates will always be somewhat imperfect. Nevertheless, based on the evidence available on economic depreciation, structures appear to be overtaxed relative to equipment. Either a lengthening of equipment lives or a shortening of structures lives would be required to bring the effective tax rates back into line. Arguments that structures should be taxed more heavily because they can more easily be measured, in addition to being questionable on conceptual grounds, are inconsistent with the evidence on leveraging.

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