Analysis of Economic Depreciation for Multi-Family Property

Authors

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Abstract

This paper uses a hedonic pricing model and National Council of Real Estate Investment Fiduciaries data to estimate economic depreciation for multi-family real estate. The findings indicate that investment grade multi-family housing depreciates approximately 2.7% per year in real terms based on total property value. This implies a depreciation rate for just the building of about 3.25% per year. With 2% inflation, this suggests a nominal depreciation rate of about 5.25% per year. Converted into a straight-line depreciation rate that has the same present value, this suggests a depreciable life of 30.5 years—as compared to 27.5 years allowed under the current tax laws. Thus, these laws are slightly favorable to multi-family properties by providing a tax depreciation rate that exceeds economic depreciation, which is in part due to inflation that has been less than expected during the past decade.

Introduction

The Economic Recovery Tax Act of 1981 (ERTA81) and the Tax Reform Act of 1986 (TRA86) dramatically altered the timeline of returns to real estate by first shortening and then lengthening the tax depreciation rates for multi-family residential and nonresidential (commercial and industrial) real estate. ERTA81 provided a 15-year depreciable life for structures (both residential and nonresidential) and allowed a 175% declining balance depreciation method to be used. Legislation in 1984 and 1985 increased the life to 18 years for residential and 19 years for nonresidential real estate. TRA86 further increased the depreciable life to 27.5 years for residential and 31.5 years for nonresidential real estate—attempting to create a depreciation system for real property structures that would be consistent with the economic depreciation of property in general. Changes to the depreciable life of property and/or leasehold improvements to property are once again being considered. The Tax and Trade Relief Extension Act of 1998 directed the United States Department of Treasury (Treasury) to study and make recommendations on the current recovery periods and depreciation methods under Section 168 of the Internal Revenue Code. At issue is the relationship between market-stimulated economic depreciation and legislated tax depreciation and the potential for inequitable tax burdens due to the inability of tax-based depreciation to match economic depreciation.

In response, the Treasury produced a 130-page report in July 2000 that carefully evaluates current issues in the tax depreciation system and describes potential comprehensive and piece-meal changes that could be made. It also reviews prior research on economic depreciation. The report does not offer specific recommendations, yet it does call for additional analysis and investigation, particularly in the case of real estate.[1]

This need for further research is apparent for at least two reasons. First, as described below, prior research utilizes data compiled decades ago, does not include variables for location and models numerous asset types simultaneously. Real estate markets and construction quality have changed since the earlier research was conducted and it is possible that economic depreciation has changed accordingly. The lack of information on location fails to acknowledge the variation in real estate markets that occurs across local/regional markets and further does not recognize the immobility of real estate and associated structures. Second, while the Treasury has access to annual tax return data, such data are not well suited for inquiries of this type because depreciable real estate acquisitions and improvements in a given year are aggregated on each tax return. In addition, the age of existing properties acquired (as opposed to new construction) is not provided.

The House Ways and Means Committee recently passed the Economic Security and Recovery Act of 2001 (ESRA2001), which provides for a change in the recovery period for leasehold improvements from 39 years to 15 years. Other changes to the depreciable life of property are still under consideration. To shed further light on an issue of critical importance to tax legislation of this type, findings from analysis of rates of economic depreciation of a broad sample of multi-family property are presented in this paper.[2]

A hedonic pricing function model is developed with data provided by the National Council of Real Estate Investment Fiduciaries (NCREIF) to estimate economic depreciation for multi-family residential property. The model estimates the acquisition price as a function of structural, locational and economic factors that serve as explanatory variables.[3] The acquisition price is the amount paid to acquire the property by the investment manager. Age is included as an independent variable and provides the basis for measuring economic depreciation. This research intends to address a number of limitations inherent in previous studies by using the more complete dataset from NCREIF.[4]

After an additional discussion of the motivations for this research, a review of the literature on economic versus tax depreciation with attention to previous modeling efforts is provided. The data, methods and analysis in this research are then described. The article concludes with a summary of the results and their implications for federal tax policy.

Renewed Attention to Economic Depreciation[5]

Generally, it has been argued that if income is to be the measure of ability to pay taxes, then income should be defined as broadly as possible to include all resources that contribute to a taxpayer's welfare, and thus the taxpayer's ability to pay taxes (Fisher, 1996). The Haig-Simons definition of income is widely accepted: consumption plus change in net worth over some period of time, typically one year (Haig, 1921; and Simons, 1938). By definition, changes in factors of production or consumption contribute to changes in wealth and ability to pay and are included in economic income. Therefore, to avoid overstating taxable income, tax policy based on economic income should allow deductions when assets decrease in value.

The literature divides depreciation into two components: the decline in value caused by the aging of assets, and the revaluation caused by changes in the quality or technological inputs of newly produced assets or by changes in tastes and demands.[6] For the purpose of assessing the relationship between economic income and tax depreciation, the distinction between cause and effect is immaterial. Samuelson (1964) offers a succinct definition of economic depreciation that serves the purpose of this paper: economic depreciation is the decline in the value of an asset over time. This is consistent with the Haig-Simons description of income as changes in the real value of an asset from all causes.

It is well understood that tax depreciation for every asset should equal its true economic depreciation if the objective is to treat all assets equally with respect to federal income taxation (Hulten and Wykoff, 1996). It is further accepted that tax depreciation seldom matches economic depreciation for at least three reasons: (1) Congress may choose to favor one asset class relative to another for political or economic reasons such as encouraging investment in a particular asset class; (2) economic depreciation is hard to measure for most assets, especially long-lived assets like real estate; and, (3) the matching of tax and economic depreciation should be done in *real* terms requiring tax depreciation to be indexed to economic depreciation in an inflationary environment. Because tax depreciation has historically been based on a fixed (not indexed for inflation) schedule, matching tax and economic depreciation has been very difficult to accomplish.[7]

Inflation complicates things if depreciation is based on nominal dollars rather than real dollars. Auerbach and Jorgenson (1980) argue that inflation results in distortions in depreciation allowances due to the fact that inflation exerts differential impacts on assets with differential useful lives. For this reason, they proposed recovery of capital expenditures for structures and equipment in the year of purchase thereby canceling any inflationary distortions.

Although Congress may have good intentions when it purposely legislates tax depreciation that differs significantly from economic depreciation, the unintended effects can be devastating to financial markets. A good example is the significant overbuilding that occurred in real estate markets during the early 1980s due, at least in part, to ERTA81, which provided tax depreciation benefits for real estate that significantly exceeded any reasonable estimate of economic depreciation. This favorable tax treatment was reversed with TRA86 and the real estate markets once again had to adjust to a new equilibrium. The dilemma faced by Congress in 1986, and continues to confront, is partially due to the limitations of research that hinder accurate predictions of market participants. Each proposed tax reform (including those involving asset depreciation) is met with a cadre of researchers with contradictory claims. Some provide evidence that tax policy reforms can improve the economy while others purport that the tax reform will result in little or no economic effect. Regardless of the motivation for changes to the depreciable life of real estate, it is important to have reasonably accurate estimates of economic depreciation so that tax policy can be set in a way that is consistent with its intended purpose.

Previous Studies

In the analysis that follows, a model is developed to provide an estimate of depreciation for multi-family properties. The model is based on the acquisition price paid and the modeling structure is rooted in the literature on depreciation and service life estimation. The most often-cited work using the vintage price approach is that of Hulten and Wykoff (1981). Using a constant geometric rate derived from a Box-Cox transformation model on price data for industrial and commercial buildings, along with six personal property classes, the authors estimated the depreciation rate at 3.61% for industrial structures and 2.47% for commercial buildings. Jorgenson and Sullivan (1981) relied on an average of estimated service lives and a limited dataset to expand the Hulten and Wykoff list to 35 asset classes. They estimated an annual depreciation rate of 1.5% for residential structures using an expansion model similar to that developed by Casetti (1972).

A number of studies analyzing the economic depreciation of real property structures rely on single-family housing. Malpezzi, Ozanne and Thibodeau (1987) summarize those studies published in the 1980s and the indications are that straight-line depreciation rates range from less than 1% to just over 2%. Recent housing-focused studies have developed depreciation schedules that are geometric and observed differing levels of depreciation depending on whether the observation was owner or tenant occupied (Shilling, Sirmans and Dombrow, 1991; Knight and Sirmans, 1996; and Clapp and Giacotto, 1998).[8]

In a study by Gravelle (1985), the relative tax advantages or disadvantages of multi-family investing are described by examining the impacts that supply has on the rental housing market. Her findings, relying on a general equilibrium approach, were purposefully inconclusive due to statistical evidence of the period that suggested: ‘‘the characteristics of ownership in multi-family housing indicated a heterogeneous market where there are many types of investors,’’ (*e.g.*, individuals, corporations and tax-exempt entities). This study was, in part, a response to the notion that real estate investment was heavily taxed compared to other assets and the dominant investor type was the commercial enterprise.

A Deloitte & Touche (2000) study utilized both the sales price and income approaches with public data on real estate investment trust holdings. They concluded that the rate of economic depreciation for real estate income property ranged from 2% to 4%. This study, funded by a consortium of real estate associations in response to the Tax and Trade Relief Extension Act of 1998, concludes that real estate should be depreciated for tax purposes over a period as short as 20 years or less.

Previous studies of economic depreciation on real property rely on data sets containing limited tangible information and have not been able to adequately account for the impact of the surrounding community on the rate of depreciation of structures. The NCREIF database provides sufficient information on a fairly broad sample of multi-family residential properties, which that have been acquired over the past 20 years, and in which some of the shortcomings in previous research can be alleviated.

Empirical Analysis

Data

In this analysis, the focus is on the commercial multi-family real estate market. Data for the analysis were obtained from NCREIF, which provide information at the MSA level for each property owned by member organizations.[9] The data represent the compilation of purchases provided to the NCREIF database by institutional members from the first quarter of 1983 through the third quarter 2004 and includes the acquisition price, age, number of units and other characteristics of the property. There were 1,516 observations over the study period.

The database involves only existing properties (not development projects), and only those properties that are non-agricultural, income-producing properties. Data contributors include investment managers and pension funds that own or manage real estate in a fiduciary setting. Summary statistics for the variables incorporated in the model are presented in Exhibit 1. The age of the structures in the database ranges from new or completed and sold to 83 years. The distribution of observations across the observation period is relatively flat with a concentration in the mid to late 1990s. This is not surprising as the number of properties in the database increased over the period of observation as did the number of member institutions.

Model and Results

The empirical analysis estimates the annual economic depreciation of multi-family structures by considering the effects of physical, technological and functional

Exhibit 1 | Data Dictionary and Summary Statistics

Variable	Mean	Std. Dev.	Min	Max	Description
LN Initial Cost	16.69	0.88	0.00	21.70	Natural log of initial cost of the property
Age	7.29	10.22	0.00	83.00	Age in years of property as developed on date of acquisition
High quintile	0.20	0.40	0.00	1.00	Variable coded 1 if the property is in the top 20% or in the fifth quintile in value per square foot
Nonhigh quintile	0.80	0.40	0.00	1.00	Variable coded 1 if the property is not in the top 20% or in the fifth quintile in value per square foot
Number of units	321.96	231.42	18.00	6,624.00	Number of residential units of facility
Units squared	157,177.60	1,173,844.00	324.00	43,900,000.00	Residential units squared
Garden apartment	0.78	0.42	0.00	1.00	Dichotomous variable coded 1 if the property is classified as a garden apartment, else 0
Nongarden type	0.22	0.42	0.00	1.00	Dichotomous variable coded 1 if the property is not classified as a garden apartment, else 0
Acquisition1983	0.00	0.06	0.00	1.00	Acquisition date 1983
Acquisition1984	0.01	0.08	0.00	1.00	Acquisition date 1983
Acquisition1985	0.02	0.14	0.00	1.00	Acquisition date 1984
Acquisition1986	0.01	0.12	0.00	1.00	Acquisition date 1985
Acquisition1987	0.01	0.12	0.00	1.00	Acquisition date 1986
Acquisition1988	0.03	0.17	0.00	1.00	Acquisition date 1987
Acquisition1989	0.03	0.18	0.00	1.00	Acquisition date 1988
Acquisition1990	0.03	0.16	0.00	1.00	Acquisition date 1989
Acquisition1991	0.02	0.15	0.00	1.00	Acquisition date 1990
Acquisition1992	0.03	0.16	0.00	1.00	Acquisition date 1991

Exhibit 1 | (continued)

Data Dictionary and Summary Statistics

Variable	Mean	Std. Dev.	Min	Max	Description
Acquisition1993	0.05	0.21	0.00	1.00	Acquisition date 1992
Acquisition1994	0.05	0.22	0.00	1.00	Acquisition date 1993
Acquisition1995	0.08	0.27	0.00	1.00	Acquisition date 1994
Acquisition1996	0.09	0.29	0.00	1.00	Acquisition date 1995
Acquisition1997	0.06	0.24	0.00	1.00	Acquisition date 1996
Acquisition1998	0.08	0.27	0.00	1.00	Acquisition date 1997
Acquisition1999	0.10	0.31	0.00	1.00	Acquisition date 1998
Acquisition2000	0.11	0.31	0.00	1.00	Acquisition date 1999
Acquisition2001	0.06	0.24	0.00	1.00	Acquisition date 2000
Acquisition2002	0.05	0.21	0.00	1.00	Acquisition date 2001
Acquisition2003	0.05	0.21	0.00	1.00	Acquisition date 2002
Acquisition2004	0.02	0.13	0.00	1.00	Acquisition date 2003
ZIPs~[a]	*				ZIP code location coded 1 if property is located in specified zip code area, else 0

Note: Summary statistics for those variables are available on request.
[a]762 ZIP code variables are included in the model.

Exhibit 2 | Model Results

Variable	Coefficient	*t*-value	P > t
Constant	15.184	25.21	0.00*
Age	−0.027	−6.58	0.00*
Garden apartment	0.171	2.40	0.02*
High quintile	0.383	4.21	0.00*
Number of units	0.002	12.16	0.00*
Units squared	0.000	−8.69	0.00*
Acquisition1983	0.636	0.64	0.52
Acquisition1984	0.843	0.93	0.35
Acquisition1985	0.989	1.14	0.26
Acquisition1986	1.616	1.86	0.06
Acquisition1987	0.997	1.13	0.26
Acquisition1988	1.188	1.39	0.17
Acquisition1989	1.016	1.19	0.24
Acquisition1990	1.181	1.37	0.17
Acquisition1991	0.975	1.13	0.26
Acquisition1992	1.048	1.22	0.22
Acquisition1993	1.120	1.31	0.19
Acquisition1994	1.226	1.43	0.15
Acquisition1995	1.305	1.53	0.13
Acquisition1996	1.236	1.45	0.15
Acquisition1997	1.148	1.35	0.18
Acquisition1998	1.360	1.60	0.11
Acquisition1999	1.490	1.75	0.08
Acquisition2000	1.611	1.89	0.06
Acquisition2001	1.545	1.83	0.07
Acquisition2002	1.614	1.89	0.06
Acquisition2003	2.380	2.77	0.01*
Acquisition2004	1.916	2.21	0.03*
ZIPs~	#		

Notes: The Adj. R^2 is .55., n = 1,516,
*Significance level ≥ 95%.

obsolescence that occur with aging. The linear regression model is employed on the individual property data provided by NCREIF. The model is a transaction-based model that estimates depreciation based on differences in acquisition costs for properties with different ages, and is similar to the vintage price model attributed to Hulten and Wykoff (1981). Hulten and Wykoff derived depreciation rates for different asset classes by regressing the price of the asset its age on the date when the asset was sold. The natural log of the acquisition price serves as the dependent variable. By incorporating structural and environmental characteristics into the equation, the resulting model is estimated as:

$$\text{Ln}P_{it} = C_i + S_t + L_i + A_i + e_{it}, \quad (1)$$

where:

- $\ln P_{it}$ = The natural log of the acquisition price per square foot of observation i sold at time t;
- $\boldsymbol{C}_i$ = A vector of characteristics of the individual observations including number of units, development type (*e.g.*, garden, high-rise, etc.) and a variable representing quality of construction determined by the initial cost per square foot (properties are divided into quintiles);
- $\boldsymbol{S}_t$ = A set of dichotomous variables indicating the year of acquisition from 1983 through 2004;
- $\boldsymbol{L}_i$ = A set of dichotomous variables representing fixed effects and coded 1 for the ZIP code in which the observed property is listed and zero otherwise;
- $\boldsymbol{A}_i$ = A structural age variable; and
- $\boldsymbol{e}_{it}$ = A normally distributed error term with mean 0 and variance σ^2.

Independent variables include the number of units, and dichotomous variables representing each of the ZIP code areas in which an observation is located providing a fixed effects variable difference in value associated with location. To account for the influence of inflation, a set of dichotomous variables indicating the year of purchase of the property is included and spans the period 1983 to 2004. A proxy for quality is derived from the acquisition price per square foot of the property. The data set is stratified in quintiles with the variable coded one for the highest 20% of the total observations, on a price per square foot basis, and zero otherwise. The dependent variable is the acquisition price of the property. Land is generally unaffected by economic depreciation.

The variables of greatest interest are those representing the age of the property and the influence of age on transaction value. Hulten and Wykoff (1981) found that the rate of depreciation for assets was not linear. To avoid constraining the depreciation estimate and to recognize the nonlinearity in age, an age-squared variable is included as suggested by Malpezzi, Ozanne and Thibodeau (1987) and Fletcher, Gallimore and Mangan (2000).[10] These depreciation proxy variables capture the pattern, or concave shape, of property value changes over time, as well as the uniqueness and proven ability for some real estate structures to survive over long periods of time (*i.e.*, 30–50 years or longer).[11] Exhibit 2 presents the results from the model. The straight-line depreciation rate estimated in the model is 2.7%. Exhibit 3 provides a visual example of the useful life estimate with 2.7% as the estimate of depreciation. This is a compound rate and does not include the impacts of inflation. Keep in mind that this is the depreciation in the total property value, not just the building. As the value in Exhibit 3 approaches the 20% to 30% range, the remaining value is probably almost all land value.

This study, as with the previously cited studies on economic deprecation of real estate, does not separate land and building values. Thus, the coefficient of the age variable is the percentage change in the total value due to depreciation. To obtain the change in just the building value, assuming land value is not affected by depreciation, the age coefficient can be adjusted by the ratio of total value to building value. This ratio was obtained for a sample of 59 multi-family properties in the NCRIEF dataset where the acquisition price was allocated between land and structures. The ratio for that sample was 1.205, indicating the economic depreciation for buildings only in the dataset would be approximately 2.7*1.205 = 3.25%.[12] Exhibit 4 shows what the decline in building value looks like using this depreciation rate.

Exhibit 3 | The Erosion in Total Property Value Over Time

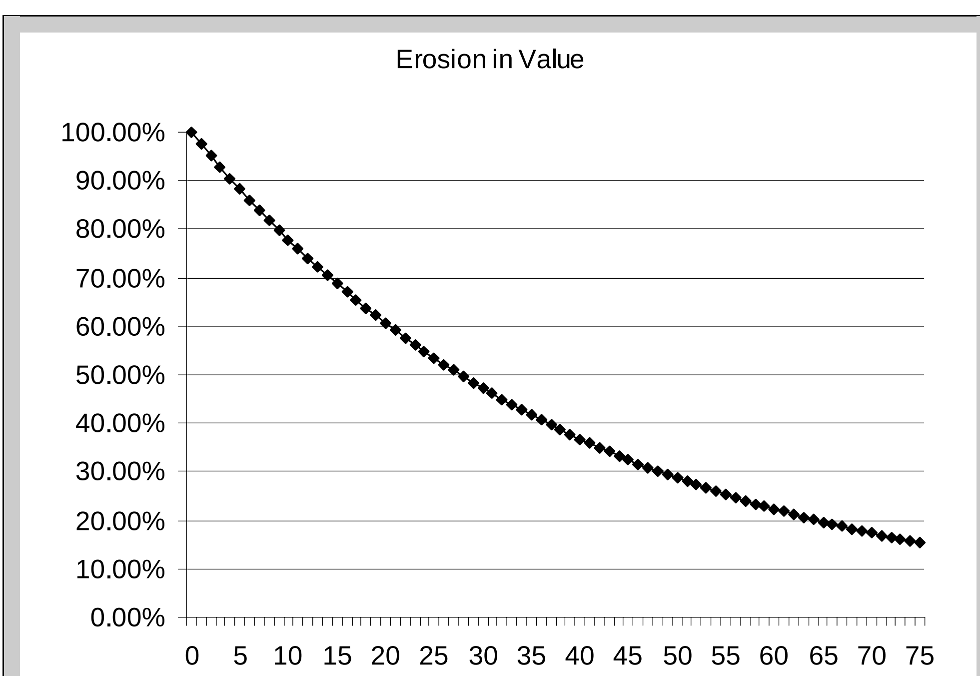
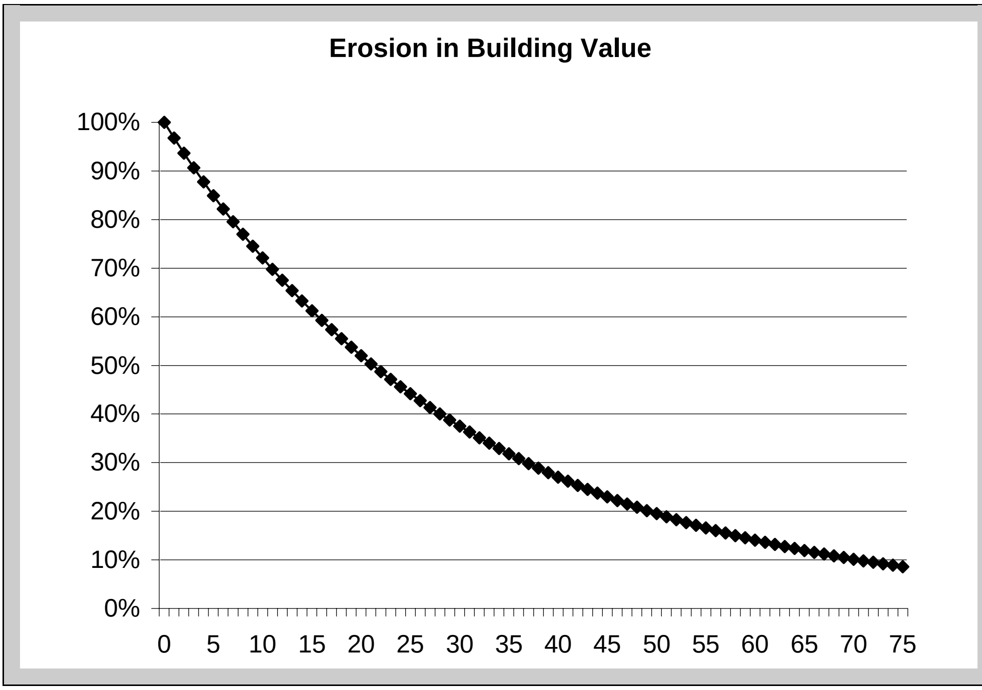


Exhibit 4 | The Erosion in Building Value Over Time



The relationship between age and value suggests a concave relationship exists in the pattern of economic depreciation with asset values declining more rapidly in the early years of an asset's service life with the decline in value tapering off in later years. Indeed, with the exception of Taubman and Rasche (1969), and some of the automobile studies, the general conclusion from all economic depreciation studies is that the age-price pattern of various assets has a concave-to-the-origin shape, represented by a constant depreciation pattern of geometric form (Dixon, Crosby and Law, 1999).

Conclusion

The results of this study suggest that the economic depreciation of multi-family residential properties in real terms is approximately 2.7% based on total value and about 3.25% based on just building value. This is a compound rate applied to the prior year's value, not a rate that would be applied to the initial value.

As noted previously, this depreciation rate is in real (not nominal) terms. In an inflationary environment, the real value of depreciation decreases each year. If the real rate of depreciation should be 3.25% per year based on the building value, then with 2% inflation an indexed deprecation rate to offset the declining real value of depreciation would have to be 3.25% plus 2% or 5.25% per year.

Tax depreciation is currently based on a straight-line depreciation rate rather than a compound rate. To convert the compound rate of 5.25% into a straight-line depreciation rate requires determining the depreciable life that results in a straight-line (same dollar amount each year) depreciation amount that has the same present value as implied by the compound rate. For illustration, a 5% discount rate is used under the assumption that depreciation deductions are relatively risk-free. This results in a depreciable life of 30.5 years, which is about 3 years longer than the current tax law allows, which is 27.5 years for multi-family properties. This depreciable life should be shorter at higher rates of inflation and longer at lower rates of inflation. One interpretation of the current tax law would be that it is calibrated under the assumption of a higher rate of inflation than has occurred during the past decade. This is not surprising since the current depreciation schedules were set after a period of higher inflation than what has been experienced since that time. Exhibit 5 shows the effect of different inflation rates on the straight-line depreciation necessary to have the same present value as a compound depreciation rate that is indexed for inflation. The exhibit also shows a range of discount rates to indicate the sensitivity of the results to the discount rate used to find the present value of the depreciation deductions. Note that a depreciable life of 27.5 as allowed under the current tax law is more consistent with an inflation rate of just less than 3% using a 5% discount rate. Also note that a much shorter depreciable life, *e.g.*, approaching 19 years is suggested if inflation rates were to be in the 5% range.

The importance of accurately estimating the economic depreciation for long-lived assets should be clear. If the goal of Congress is a tax policy that is relatively neutral with respect to its impact on real estate investment incentives, then tax depreciation would have to equal economic depreciation. Tax depreciation that is unfavorable (slower) relative to economic depreciation discourages investment in real estate, at least by taxable investors. Similarly, tax depreciation that is favorable (faster) relative to economic depreciation leads to investment for non-economic reasons and ultimately results in overbuilding. Regardless of the goal of tax policy,

Exhibit 5 | Straight Line Depreciable Life (years) for Different Inflation and Discount Rates

	Discount Rate		
Inflation Rate	3%	5%	7%
1%	38.89	36.47	34.49
2%	32.42	30.42	28.75
3%	27.43	26.24	25.06
4%	24.21	22.58	21.68
5%	19.75	19.72	19.47

an accurate measure of economic depreciation is a necessary gauge. The results presented here provide a gauge against which tax policies can be evaluated to determine whether real estate is tax favored or tax disadvantaged when setting the depreciable life for multi-family real estate.

Endnotes

[1] Treasury Report (2000), pp. 3 and 4. On page 1, the report states that it is ''... intended to serve as a starting point for a public discussion of possible general improvements,'' to the current tax depreciation system.

[2] A companion study on the economic depreciation of nonresidential property is currently underway.

[3] Properties were acquired and entered into the NCREIF database throughout the 1983–2004 time period.

[4] NCREIF is best known for its index based on quarterly appraisals, which are often criticized for being smoothed, but this study uses the acquisition price and not the quarterly appraisal values.

[5] For the purposes of this paper, the definition for economic depreciation is taken from Hotelling's (1925) generally accepted definition of depreciation as a decrease in the discounted value of future returns, or stated another way, inclusive of all factors that reduce the present value of real property (see Arrow, 1987: 160).

[6] Ambiguity in the discussion arises in the placement of obsolescence as a cause of economic depreciation or as a distinct result of revaluations. Hulten and Wykoff (1981, 1996) suggest obsolescence is one cause of depreciation unique to revaluation, while Fraumeni (1997) views obsolescence as a function of revaluation.

[7] In theory it is only necessary for the present value of the tax depreciation to equal the present value of the economic depreciation. With uncertain inflation and a fixed tax depreciation schedule, it is virtually impossible for this to occur in practice. For further discussion see Aaron (1976), Samuelson (1964) and Gravelle (1979, 1994).

[8] There are mixed results in studies exploring the depreciation differential between rental and owner occupied housing. Gatslaff, Green and Ling (1998) provide a summary of comparisons in this area with the results of their own.

[9] The NCREIF database includes quarterly data on the performance of properties that have been acquired on behalf of tax-exempt institutions and held in a fiduciary environment. See www.NCREIF.org for further information.

[10] Malpezzi, Ozanne and Thibodeau (1987) also includes the variable age cubed. The models were tested with the inclusion of both age squared and age cubed. Age cubed consistently failed to exhibit a significant relationship to the dependent variables. Further, the small size of the coefficient on age squared rendered it meaningless to interpretation over a relevant range of age (the impacts did not begin until the property was over 60 years old).

[11] Age cubed was also tested per Fletcher, Gallimore and Mangan (2000) and Smith (2004) along with interaction variables for age and age squared with the year of sale, but there were few significant variables for the individual years and the coefficient values were extremely small and immaterial to the estimate of depreciation.

[12] The land was estimated at 17% of the total value. The calculation for the total value ratio is $(1/(1 - 0.17)) = 1.205$.

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