How Taxes and Required Returns Drove Commercial Real Estate Valuations over the Past Four Decades*

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Abstract

We document the evolution of U.S. tax law regarding commercial real estate (CRE) since 1975, noting changes in income and capital gains tax rates and tax depreciation methods. The most prominent changes were the 1981 and 1986 changes to tax rates and depreciation methods, but numerous significant changes occurred in the last dozen years. We then compute the present value of tax depreciation per dollar of acquisition price and an effective tax rate for CRE. We explain the quarterly variation in CRE capitalization rates using an error correction framework and find that the long run estimates are statistically significant in the way theory would suggest. Moreover, the required financial asset return and the tax depreciation variable temporally predict ("cause") capitalization rates in the long run, but not vice versa.

JEL codes: H20, H30, G12, R30

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Although commercial real estate (CRE) is a relatively small sector of the economy[1], the damage to the banking system associated with past collapses in CRE prices and loan quality has played a notable role in deepening two of the last three recessions. For example, the CRE boom of the 1980s and the bust that followed led to loan losses that induced a broad credit crunch that helped push the U.S. economy into recession in 1990 (see Bernanke and Lown, 1991, and Browne and Case, 1992). These effects were exacerbated by an ill-advised easing of regulations in the early 1980s on insolvent thrift institutions that expanded into CRE lending (see Hendershott and Kane, 1992). More recently, loan losses on commercial mortgages and construction and land development loans played a very large—if not a leading role—in triggering bank failures in the Great Recession (Antoniades, 2014)—and in inducing a credit crunch that deepened and prolonged that downturn (Duca and Muellbauer, 2014).[2]

A key driver of swings in CRE prices and activity is the required return to investors. This depends on many factors. First is simply how the real estate is expected to perform economically. Second is how property returns are taxed, which includes both how the returns are measured (what expenses are allowed) and what tax rates are applied to them. The measurement and taxation of returns have varied greatly over the last forty years, as has the expected economic performance. A third factor is how alternative investments are taxed and expected to perform.

Scarce capital resources in the economy are allocated across sectors based on expected after-tax rates of return and risk (Bailey, 1974). Capital will move between sectors of the economy, and relative nominal prices will adjust, until real, risk-adjusted after-tax yields are the same at the margin for all capital goods.

[1] Private, investment in nonresidential structures comprised only 2.8 percent of real GDP in 2015.
[2] The collapse in CRE prices was as damaging as the collapse in house prices (Duca and Ling, 2015, Figure 1).

This paper begins by documenting the legislated changes in the taxation of CRE over the 1975-2015 period. We conclude this discussion with the calculation of the present value of tax depreciation allowances per dollar of acquisition price on a quarterly basis. As opposed to tax rates that apply to most assets that are highly correlated across one another—especially bond yields that are often used to track before-tax required rates of return—the present value of tax depreciation provisions for CRE notably diverged from those on other assets in the 1980s. Consequently, the value of CRE tax depreciation provisions likely contains information about capitalization rates (income to price ratios) and CRE valuations beyond that already indirectly embedded in general bond returns.

We then calculate the effective tax rate on CRE as the difference between the before- and after-tax expected internal rates of return (IRRs) on CRE divided by the before-tax IRR. The two most important determinants, beyond the general tax rate applied to the net returns, are the depreciation deduction allowed and the measurement and taxation of capital gains.

Lastly we estimate an error correction model to illustrate how financial asset returns and tax depreciation write-offs affected CRE capitalization rates and thus asset prices over the last four decades. As an example, the large expansion of tax depreciation benefits in 1981 sparked increases in property valuations that were later unwound during the CRE bust of the early 1990s.

I. The Historic Taxation of CRE

Income-producing real estate has received widespread attention as a tax shelter. Like most income producing assets, annual cash inflows net of deductible expenses are taxed. In addition to operating expenses, the periodic interest investors pay for borrowing is generally deductible in the year in which it is paid. Moreover, the allowable annual depreciation deduction is unaffected by the mix of debt and equity financing because the entire acquisition cost (minus the value of the land) is depreciable. Thus, increased leverage magnifies the ratio of allowable depreciation deduction relative to the required equity investment.

In this paper, equity investments in income-producing property are classified as "trade or business" properties (under IRC Section 1231)[3] and as such are permitted a deduction ("allowance"). Because CRE depreciates or "wears out" as the property ages, a depreciation deduction against the rental income generated by the property is reasonable.[4] While tax rates on trade or business income and capital gain income vary significantly by state, allowable deductions are usually calculated in a manner similar to federal law.[5] Our analysis focuses on the federal taxation of real property.

The size of the annual depreciation deduction is prescribed by federal law and depends on three factors: the amount of the depreciable basis, the cost recovery period, and the method of depreciation. The depreciable basis for existing CRE assets equals the total acquisition price of the property, including any expenses directly associated with acquiring the property, minus the estimated value of the land.[6] The minimum cost recovery period over which real property may be depreciated and the allowable method of depreciation has frequently been changed by Congressional legislation. In 2016, residential income producing property (e.g., apartments) may be depreciated over 27.5 years using straight-line depreciation; for nonresidential real property (e.g., shopping centers, office buildings, warehouses, etc.) the period is 39 years.[7] The

[3] For purposes of federal income taxes, real estate is classified into one of four categories. Real estate held as a personal residence and real estate held for sale to others (i.e., "dealer" property) cannot be depreciated.

[4] Estimating true economic depreciation for investment real estate has proven challenging. See, for example, Hulten and Wykoff (1981), Hulten and Wykoff (1996), and Bokhari and Geltner (2014).

[5] In states with high marginal rates of taxation, such as California, Colorado, Oregon, and Arizona, the present value of depreciation deductions will be higher.

[6] For existing properties, Congress specifies in IRC Section 1060 how taxpayers must allocate total acquisition costs between land and property. Section 1060 does allow the basis to be allocated based on the relative fair market values of the nondepreciable land and the depreciable improvements (Manolaksa and Anderson, 1990, p. 76). However, both the buyer and seller must agree on the relative values. One approach is to have an independent real estate appraiser separately estimate the value of the land and non-land components. An alternative is to obtain the relative value of the two components based on assessed values from the local property tax assessor. Another complication is that the depreciable basis may be further segregated into real property and personal property. Personal property is any tangible property not part of the building's core structure. Personal property can generally be depreciated for tax purposes at a faster rate than real property.

[7] An income-producing real property is considered a "residential" property for income tax purposes if at least 80 percent of the property's gross rental income is derived from the leasing of non-transient dwelling units.

latter produces an annual deduction equal to 2.564 percent (1/39) of the depreciable real property basis.[8]

Our study covers the period 1975Q1-2015Q2. Before the Economic Recovery Tax Act (ERTA) in 1981, allowable cost recovery periods for real property were based on the concept of useful life (Robinson, 1984; pp. 6-14). Generally, the IRS allowed a 30 year tax life for used CRE. Accelerated methods of depreciation were available for new residential (200% declining-balance), used residential (125% declining balance), and new non-residential properties (150% declining balance). Used non-residential properties required the use of straight-line depreciation.

ERTA greatly accelerated depreciation allowances. Both residential and nonresidential real property purchased after 1980 could be depreciated over 15 years using 175% declining balance depreciation. This produced a first-year depreciation deduction equal to 11.67 percent [1.75 x (1/15)] of the depreciable real property basis. For property placed in service after March 15, 1984 and before May 9, 1985, the Tax Reform Act of 1984 increased the minimum cost recovery period for both new and used residential and nonresidential real property from 15 to 18 years.[9] For property placed in service after May 8, 1985 and before the end of 1986, the minimum cost recovery period for residential and non-residential real property was extended to 19 years.

The Tax Reform Act of 1986 largely reversed the greater depreciation of CRE during 1981-86. The use of accelerated depreciation was eliminated. The cost recovery period for acquisitions of new and used residential property placed in service after 1986 was increased to 27.5 years; the recovery period for nonresidential property was increased to 31.5 years. The

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[8] Under the Modified Alternative Cost Recovery System (MACRS), both residential and non-residential properties are subject to the mid-month convention to determine the depreciation deduction in the year of acquisition and in the year of sale. Regardless of the date of purchase, current law assumes the property was placed in service on the 15th day of the month. Thus, if an apartment property is purchased on January 10, the depreciation rate applied to the depreciable basis of the real property is 0.03485 = (11.5 months ÷ 12 months) x (1/27.5). The IRS provides tables with these percentages.

[9] For qualified low-income housing, the recovery period remained 15 years.

Omnibus Budget Reconciliation Act of 1993 further extended the cost recovery period for nonresidential real property to 39 years. Cost recovery periods and allowable methods of depreciation over our study period are summarized in the first four rows of Table 1.

The annual depreciation deduction when accelerated depreciation is permitted is potentially comprised of two parts: the straight-line portion ($SLDEP_t$) and the "excess" portion that results from the use of accelerated depreciation ($EXDEP_t$). Both of these can be written off without limit against positive taxable income generated by other Section 1231 (trade or business) assets. We denote this tax rate by τ_{TBI}.

The second four rows in Table 1 contain relevant tax rates. During the early years of our sample, the maximum statutory federal rate applicable to taxable income generated by Section 1231 trade or business assets, or other investment income, was 70 percent. ERTA 1981 reduced the maximum federal tax rate on trade or business income to 50 percent. TRA 1986 reduced this rate to 28 percent, although this reduction was phased in over one year.[10] This represented a 60 percent reduction in the top marginal rate from 70 percent in 1980. Prior to TRA 1986, if the netting of positive and negative taxable income on all of the taxpayer's trade or business assets produced negative taxable income, these "extra" tax losses could be used to directly offset earned (wage and salary) income. Since 1986, these extra deductions have had to be carried forward and used in subsequent years to the extent that sufficient net taxable income is produced by the operation or sale of the taxpayer's trade or business assets.[11]

The maximum rate on trade or business income was raised to 31 percent, effective in 1991 and 1992, and to 39.6 percent in 1993. This rate remained in place through 2000, after

[10] A maximum tax rate of 38.5 percent applied to trade or business income in 1987. The 28 percent rate became effective in 1988. Also, in 1988-90, a 33 percent "rate bubble" applied to taxable income between $71,900 and $149,250 for married couples filing jointly to recapture taxes upper-income taxpayers saved by applying the lower 15 percent rate.

[11] The inability since TRA 1986 of taxpayers to fully use net tax losses from trade or business assets to offset "ordinary" wage and salary income or portfolio income is known as passive activity loss restrictions. See IRS publication 925, Form 8582 and Follain, Hendershott, and Ling (1987) for a discussion of these loss restrictions. All income generated by rental real estate is classified as trade or business income and, for the purpose of Form 8582, as "passive" income.

which it was gradually reduced to 35 percent in 2003, where it remained through 2012. The American Taxpayer Relief Act of 2012 increased the maximum statutory rate to 39.6%.[12] The 2012 Act also introduced a Net Investment Income Tax (NIIT) surcharge under I.R.C. Section 1411 of 3.8 percent that applies to married households with modified adjusted gross income (AGI) in excess of $250,000, effectively raising the maximum to 43.4 percent (39.6% + 3.8%).[13]

The appropriate tax treatment of capital gains is complicated. Under a pure net accretion (Haig-Simons) approach to income taxes, real capital gains would be taxed each year as they accrue and real capital losses would be deducted. This treatment can be crudely approximated by setting lower tax rates on nominal gains at realization the longer the asset is held. Feldstein and Slemrod (1979) make a case for low, or zero, taxation of inflationary gains.

The taxation of nominal capital gains at disposition creates a potential "lock-in" effect. Rather than selling a suboptimal asset with a lower expected before-tax return and reinvesting the proceeds in a more productive (higher expected return) asset, investors with accrued capital gains may choose to continue holding the less productive asset to avoid recognizing the taxable gains.[14] This suboptimal allocation of scarce investment capital exacts a cost on the economy as well as on the taxpayer. If nominal gains are to be taxed, the optimal taxation of

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[12] Since the passage of TRA 1986, the ability of higher income households to benefit fully from Schedule A (itemized) deductions and personal exemptions has been curtailed. The phase out of personal exemptions and itemized deductions increases the effective marginal tax rate for these taxpayers. For more information, see IRS Publication 17, Section 29, pages 202-203 (itemized deductions) and page 38 (personal exemptions).

[13] The NIIT surtax of 3.8 percent is imposed on the lesser of: (1) net investment income and (2) the excess of the taxpayer's modified AGI over $250,000 (joint filers), $200,000 (single filers) or $125,000 (married couples filing jointly). This threshold is based on adjusted gross income rather than taxable income, so it's possible that taxpayers paying less than 39.6 percent maximum rate on ordinary and trade or business income could still be subject to the 3.8 percent surtax if their AGI is over the threshold but they have a large amount of itemized deductions. If a taxpayer is in the 35 percent or 39.6 percent bracket on ordinary and trade or business income, see or she will be definitely subject to the surtax. For more information, see the Tax Foundation website: http://taxfoundation.org/article/federal-capital-gains-tax-rates-1988-2013. "Real estate professionals" who spend substantial time working (more than 750 hours per year) in activities related to real estate, broadly defined, may be able to avoid the 3.8 percent surtax.

[14] Papers that address the lock-in effect in non-real estate markets include: Autin and Cordes (1991), Mackie (2002), and Daunfeldt, et al. (2010). Papers that analyze the lock-in effect in real estate markets include Sinai and Gyourko (2004), Ferreira (2010), and Ihlanfeldt (2011). However, behavioral responses associated with capital gain tax rates are complex and empirical studies have produced a wide range of estimates of the responsiveness to changes in capital gain tax rates. See, for example, Autin and Clotfeller (1982), Burman and Randolph (1994), and Gravelle (1994).

deferred capital gains should vary with the rate of inflation; in particular, higher rates of inflation should be accompanied by lower rates of capital gain taxation, all else equal.

In the U.S., nominal capital gains are subject to tax upon the sale of the property. Between 1978 and 1987, a percentage of qualified capital gains was excluded from taxation at the taxpayer's marginal rate of tax on trade or business income. This percentage was approximately 43 during 1975Q1-78Q2 and 60 from then through 1987. Since 1987, capital gain tax rates have been separately specified.

Depreciation deductions written off against the taxpayer's marginal tax rate on trade or business income produce annual tax savings. However, each dollar of depreciation reduces the investor's tax basis in the property by a dollar, thereby increasing the taxable gain on sale by a dollar. Thus, some of these deferred taxes are collected by the Treasury when the property is disposed of in a taxable sale, and the net benefit of depreciation is reduced by the present value of the increased taxes due on sale that result from depreciation recapture.[15]

Cumulative straight-line deductions at the time of sale may be taxed at a different rate than cumulative excess deductions. Thus, the net present value of depreciation deductions, per dollar of acquisition price, over a N-year holding period equals:

$$taxdep = \left(\sum_{t=1}^{N} \frac{(SLDEP_t + EXDEP_t)\tau_{TBI}}{(1+k)^t} - \frac{(\sum_{t=1}^{N} SLDEP_t\, \tau_{SLR} + \sum_{t=1}^{N} EXDEP_t\, \tau_{EXR})}{(1+k)^N}\right)/P_O \qquad (1)$$

where k is the appropriate after-tax discount rate, τ_{SLR} is the rate of tax applicable at sale to cumulative straight-line deductions and τ_{EXR} is the tax rate applicable to the sum of excess deductions over the N-year holding period.

If τ_{SLR} and τ_{EXR} at sale equal τ_{TBI}, the only benefit from annual depreciation deductions is a deferral benefit, amounting to a series of N annual interest-free loans from the U.S. Treasury. This deferral benefit is increasing in the magnitude of the annual deductions, the

[15] See Sirmans (1980) for an extended discussion of depreciation recapture and its effects on commercial real estate.

length of the investment holding period, and the after-tax discount rate. However, if τ_{SLR} and/or τ_{EXR} are below τ_{TBI}, as has been true since 1998, then the tax on depreciation recapture income at sale is less than sum of federal income taxes saved by annual depreciation deductions. Said differently, the effective interest rate on the annual "loans" from the Treasury is negative. Thus, in addition to deferring taxes to the year of sale with annual depreciation deductions, investors can *convert* some annual income that would have been taxed at their marginal tax rate on trade or business income into income taxed at a lower capital gain or depreciation recapture rate.

Before 1962, all taxable gains on the sale of real property were taxed at capital gain tax rates. The first real property recapture rule (Section 1250 of the Internal Revenue Code) was applied in 1964 and was extended by the Tax Reform Act of 1969 to provide for unlimited depreciation recapture of excess depreciation at the taxpayer's marginal rate on trade or business income. However, the straight-line portion of the taxable gain was taxed at capital gain tax rates.[16]

Accelerated depreciation was not available with the acquisition of existing nonresidential properties from 1976 through 1980. Between 1981 and 1986 when accelerated depreciation was available, the excess over straight-line was taxed at a rate of τ_{TBI}.

We assume in our base-case calculations that the marginal investor in CRE faces the maximum statutory federal tax rates on ordinary, capital gain and depreciation recapture income. In a seminal article on investment returns and U.S. income taxation, Bailey (1974) states:

> "Because tax deductions and tax credits associated with particular investments are worth more in equivalent pretax income to a high-bracket taxpayer than to a low-bracket one, tax privileged investments find their way into the hands of high-bracket

[16] See Manolakas and Anderson (1990, pp. 143-146) for more details. Recapture of the excess of accelerated depreciation over straight-line was phased out at a rate of one percentage point per month after 100 months for rental housing not receiving public assistance. If the rental housing was held for 200 months, all of the depreciation could be converted to capital gain income. The one percentage point phased-out for publically assisted rental housing began after just 20 months.

> taxpayers. Their competition with each other and with the next lower brackets drive down pretax rates of return on such investments."

This suggests that CRE assets are likely to be held by high-bracket taxpayers and that competitively determined pretax expected returns are driven by these same taxpayers. In addition to being outbid by higher-bracket taxpayers for the tax sheltering properties associated with CRE assets, low-bracket taxpayers are less likely to have accumulated the significant wealth generally necessary to purchase equity interests in CRE syndications-partnerships-limited liability companies.

Data obtained from the 2014 IRS Statistics of Income (SOI) provide empirical support from the widely-held assumption that real property investments are held primarily by high-bracket taxpayers. CRE can be owned directly (e.g., sole proprietorship) or owned with other investors in a partnership, limited liability company, S corporation, real estate investment trust, or other investment vehicle. The tax consequences of CRE ownership (in non-exchanged-traded securities) are reported on Schedule E of Form 1040 under rents received from direct investments in individual properties (row 3) or income or loss from partnerships and S corporations (row 32).

The relation between AGI and the percentage of taxpayers reporting the receipt of rents from property investments is displayed in Figure 1. For taxpayers with adjusted gross incomes (AGIs) ranging from \$1 to \$200,000, the percentage of returns reporting the receipt of rental income from property investments ranges from just 1.2 to 6.7 percent (shaded bars). In contrast, 14.4 percent of taxpayers with AGI between \$500,000 and \$1,000,000 reported property rents. This percentage exceeds 17 percent for taxpayers with AGI in excess of \$1,000,000. The average dollar amount of rent income per return for households with AGI in between \$1,000,000 and \$10,000,000 ranges from \$79,136 to \$422,931. Clearly, the majority of rents from CRE investments are reported by taxpayers in the highest marginal bracket. Although the income received from partnerships and S corporations reported on Schedule E includes non-real estate related investment activities, the majority of U.S. CRE is owned in the form of partnerships and limited liability companies. The percentage of taxpayers by AGI category reporting income from partnerships and S corporations in 2014 is also displayed in Figure 1 (cross-hatched bars). SOI data reveal such investment vehicles are owned primarily by high-bracket households.

The maximum statutory rate on capital gain income was 36.5 percent in 1975 and 39.875 percent in 1976, 1977, and the first two quarters of 1978. Forty-three percent of gains were excluded from taxation in 1975 through 1978Q2 and sixty percent through 1987. The increase to sixty percent was just part of the reduction in capital gains taxes featured in the 1978 Act (Penick, 1983). The maximum capital gains tax rate was reduced to 33.85 percent in the last half of 1978 and to 28 percent, effective in the first quarter of 1979. The 1981 ERTA cut the maximum capital gain tax rate to 20 percent, effective in the third quarter of 1981, which remained in effect until 1987, when TRA 1986 raised this rate back to 28 percent. This maximum statutory rate was again cut to 20 percent in the second quarter of 1997 and to 15 percent in the second quarter of 2003, before being raised back to 20 percent in the first quarter of 2013. Moreover, for married households with AGI above $250,000, the maximum capital gain rate became the sum of the 20 percent maximum statutory capital gain tax rate and the 3.8 percent NIIT surtax, for a total of 23.8 percent.

From 1975 through 1997, the tax rate applied to the recapture of straight-line depreciation at sale was the capital gain rate, allowing the conversion of unearned income into capital gain income. In 1998 a maximum depreciation recapture tax rate of 25 percent was introduced, remaining in effect through 2015. However, for married households with AGI above $250,000 the maximum depreciation recapture rate since 2013Q1 equaled the sum (28.8 percent) of the 25 percent maximum statutory rate and the 3.8 percent NIIT surcharge.

Maximum federal tax rates on trade or business and capital gain income are displayed in Figure 2. The income tax rate was cut from 70 to 28 percent during the Reagan years but has since risen back to 43.4 percent. For most of the period the capital gains rate (including the exclusion) was roughly half of the regular income tax rate. However, during 1987-96 the gains rate was relatively higher (the gains rate equaled the trade or business rate in 1989).

The net present value of depreciation deductions per dollar of acquisition price varies with the investment holding period and the after-tax discount rate. The value of depreciation deductions also depends on the proportion of the acquisition price that represent non-depreciable land and the portion of the depreciable basis attributable to personal, rather than real, property. In our calculations, land accounts for 20 percent of the acquisition price, there is no personal property, and property is expected to be held for 10 years before being disposed of in a fully taxable sale.[17] The discount rate used each quarter is the after-tax rate on 10-year Baa-rated corporate bonds whose nominal yields ranged from 4.5 to 17.0 percent over the study period and averaged 9.0 percent. The maximum tax rate on trade or business income is used to calculate the after-tax discount rate for net depreciation deductions.

Figure 3 plots this net present value as a percentage of the acquisition price, *taxdep*, for both used non-residential and residential property. In the late 1970s, this percentage was in the eight to ten percent range. In 1981 ERTA increased the percentage to roughly 23 by reducing the cost recovery period to 15 years and accelerating depreciation to 175 percent of straight line. However, the reduction in the maximum tax rate on trade or business income to 50 percent lowered the present value[18] to approximately 15 percent in 1982 and 1983, and TRA 1986 slashed the value to under five percent, where it has remained.[19] The lengthening of the

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[17] Optimal ex ante holdings periods for commercial real estate are discussed in Hendershott and Ling (1984). Empirically, Gau and Wang (1994) find an average holding period of eight years for commercial properties. Fisher and Young (2000) conclude that the typical holding period among intuitional CRE investors is 11 years.
[18] The lower tax rate reduces the tax savings on yearly deductions and also lowers their present value by increasing the after-tax discount rate.
[19] Follain, Hendershott, and Ling (1987) interpreted the lengthened tax depreciation schedules and increased capital gain tax rate introduced by TRA 1986 as a rational response to a decrease in the inflation rate.

cost recovery period for non-residential property to 39 years in 1993 decreased the present value relative to that on residential.

Land value as a percentage of total property value ("land share") varies over time, markets, and property types. As the land share increases, allowable depreciation deductions decrease as a percentage of price. The Lincoln Land Institute publishes a quarterly time series of estimated land share for aggregate U.S. housing. This share averages 33 percent over our sample period and ranges from 25 to 46 percent. On average, land is a larger component of property value in housing markets than in more intensely developed commercial properties. We assume that average CRE land shares equaled 60 percent of quarterly housing shares and re-estimate *taxdep* for office properties. Although not separately displayed, the effects of a time-varying CRE land shares has an almost indiscernible effect on *taxdep*. The mean value of *taxdep* increases from 5.34 percent to 5.46 percent.

The present value of depreciation deductions generally increases with the assumed investment holding period because of the longer deferral of depreciation recapture income. The mean value of *taxdep* increases from 5.3 percent with an assumed holding period of 10 years to 7.4 percent with a 14-year holding period and falls to 3.2 percent with a six-year holding period. However, since the Tax Reform Act of 1986 sharply reduced allowable depreciation deductions, *taxdep* is less sensitive to holding period assumptions.[20]

II. Effective Tax Rates

The present value of net depreciation benefits is a critical component of the federal taxation of real property. However, a more comprehensive measure of the impact of the federal income tax system on real estate investments is the effective tax rate (ETR), calculated as:

$$ETR = \frac{IRR^{BT} - IRR^{AT}}{IRR^{BT}}, \tag{2}$$

[20] Calculations of *taxdep* for varying land share and holding period assumptions are available from the authors.

where IRR^{BT} and IRR^{AT} are, respectively, the before- and after-tax internal rates of return (IRR) on equity over an assumed investment holding period. In addition to depreciation benefits, ETR captures the taxation of expected rental income and nominal price appreciation at sale and also, the time-varying tax advantage of using debt to partially finance the acquisition.

A tool frequently employed to analyze the impact of income taxation on user costs of capital and internal rates of return is the "typical project model."[21] This model begins with assumptions regarding the current and expected future levels of rents and expenses, the expected vacancy and collections losses, the initial loan-to-value ratio, the mortgage interest rate, the expected selling price of the property at the end of an assumed holding period, allowable depreciation, the taxation of gains and losses on the sale of the property, and the marginal tax rates facing the marginal investor. The after-tax internal rate of return is the after-tax discount rate (k) that equates the present value of the after-tax cash inflows and outflows over the N-year holding period with the acquisition price (P_0). That is, equation (3) is solved for k.

$$P_0 = \sum_{t=1}^{N} \frac{(R_t - VC_t - OE_t)(1-\tau_{TBI})}{(1+k)^t} - \sum_{t=1}^{N} \frac{CAPX_t}{(1+k)^t}$$

$$+ \sum_{t=1}^{N} \frac{(SLDEP_t + EXDEP_t)\,\tau_{TBI}}{(1+k)^t} - \frac{(\sum_{t=1}^{N} SLDEP\,\tau_{SLR} + \sum_{t=1}^{N} EXDEP\,\tau_{EXR})}{(1+k)^N}$$

$$+ \frac{P_N - [(P_N - (P_O + \sum_{t=1}^{N} CAPX_t))\tau_{CG}]}{(1+k)^N} + L_0 - \frac{L_N}{(1+k)^N} - \sum_{t=1}^{N} \frac{PMT_t}{(1+k)^t} + \sum_{t=1}^{N} \frac{INT_t \tau_{TBI}}{(1+k)^t}. \tag{3}$$

The before-tax IRR is obtained as the k when all tax rates are set equal to zero.

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[21] For other applications of the typical project model to the taxation of CRE see, for example, Brannon and Sunley (1976), Brueggeman, Fisher, and Stern (1981), Hendershott and Ling (1984) and Follain , Hendershott, and Ling (1987).

The first summation captures the property's NOI, R_t, VC_t, and OE_t are, respectively, potential gross rental income, vacancy and collection losses, and deductible operating expenses in year *t*. Annual rental income net of vacancies and operating expenses is taxed at the investor's marginal tax rate on trade or business property, τ_{TBI}. $CAPX_t$ in the second summation represents expected capital expenditures in year *t*. Such expenditures are not deductible against ordinary income in the year incurred; rather, they are added to the property's tax basis and then depreciated. The third and fourth summations capture the net present value of depreciation deductions over a *N*-year holding period.

The market value of the property net of selling expenses is expected to increase to P_N over the *N*-year holding period. $(P_N - (P_O + \sum_{t=1}^{N} CAPX_t))$ represents the expected net proceed from sale of the property in year *N* after payment of capital gain taxes on the portion of the total gain from sale that exceeds the sum of the original acquisition cost plus subsequent capital expenditures. On the sale of trade or business property held as a long-term investment (generally greater than 12 months), the owner is entitled to treat the taxable gain or loss as a Section 1231 transaction (Manolakas and Anderson, 1990). Accordingly, a positive difference between the selling price in year *N* net of selling expenses and the total amount invested in the property will be taxed at the investor's marginal capital gain tax rate, τ_{CG}, assuming a holding period of at least one year. [22]

The remaining four terms/summations in equation (3) capture the cash flow effects of debt financing. L_o represents the initial amount of the mortgage loan and L_N, the expected remaining mortgage balance at sale year *N*. The two sums are the present value of annual mortgage payments (including principal amortization) and the present value of annual tax

[22] If the taxpayer has more than one Section 1231 transaction in a taxable year, the taxable gains and losses are netted. If the taxable gains exceed the losses, the net gain is taxed as a long-term capital gain. However, if taxable losses exceed the gains, the net loss is fully deductible against ordinary income (Manolakas and Anderson, 1990). This asymmetry is a potential advantage relative to the treatment of net losses on investment property, which are capped at $3,000 per year.

savings from mortgage interest deductions, respectively. Because the assumed unlevered expected IRR exceeds the cost of debt financing, the sum of the four mortgage debt terms is positive. That is, the use of debt financing increases the risk and expected return on equity. Moreover, because the depreciable tax basis is unaffected by the amount of debt used to acquire the property, higher leverage raises the present value of net depreciation deductions relative to the amount of equity capital used to finance the acquisition, all else equal.[23]

An estimate of the gross potential income in the first year of rental operations is obtained using observed cap rate data and assumptions regarding vacancies and expenses. Because the cap rate is defined as the property's estimated net operating income in the first year after acquisition ($R_t - VC_t - OE_t$,) divided by the acquisition price, we multiply the cap rate by the acquisition price. We assume that vacancy and collection losses equal a constant five percent of gross rental income and operating expenses and capital expenditures consume 45 and five percent, respectively, of expected gross income each year. For simplicity and comparability across property types, we assume "gross" leases in which the owner pays all operating expenses. We thus obtain an estimate of effective gross income.[24] Data on quarterly cap rates are from the American Council of Life Insurers (ACLI) Commercial Mortgage Commitments - Historical Database, as are loan-to-value ratios, contract interest rates, and loan maturities for offices and residential properties.[25]

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[23] Section 1031 of the Internal Revenue Code permits taxpayers to defer recognizing some or all of the taxable gain on the disposition of business-use or investment assets by the use of a tax-deferred exchange. In moderately-taxed state and local markets, Ling and Petrova (2015) estimate that the expected use of an exchange when the acquired asset is eventually disposed reduces the ex ante effective tax rate by seven to nine percentage points (depending on the initial expected holding period). In high-tax states, such as California, Colorado, Oregon, and Arizona, the estimated reduction in the effective tax rate associated with the expected use of an exchange at disposition is 12 to 16 percentage points. Thus, our estimated effective tax rate is an upward bound, especially in periods following rapid price appreciation when the tax motivation for using an exchange rather than a fully taxable sale is higher.

[24] For example, with an acquisition price of $1,000,000 and a cap rate of 5.7 percent, effective gross income on our typical investment is equal to $114,000 [(0.057x$1,000,000)/(1-0.45-0.05)]. Potential gross income is therefore equal to $120,000 [$114,000/(1-0.05)].

[25] The ACLI is a Washington, D.C.-based trade association with approximately 300 member companies operating in the United States and abroad. ACLI's Commercial Mortgage Commitments report provides information on the mortgage lending activity of life insurance companies, including property type, contract rate, basis-point spread, debt coverage, loan to value ratio and capitalization rate. The survey includes long-term (over one year) mortgage commitments on commercial properties in the United States and its possessions, including maturing balloon mortgages which have been refinanced for more than one year at current market terms. It excludes construction

Life insurance companies tend to be selective with their CRE lending, generally providing long-term, fixed rate financing only on relatively new, high occupancy properties located in desirable markets. Their maximum loan-to-value-ratio is usually 65 percent. However, in exchange for less leverage, life companies generally offer lower interest rates than their competitors. Unlike commercial banks, CMBS lenders, and other CRE loan originators, the type of property financed and the underwriting of those loans has remained relatively consistent over our sample period. Thus, the ACLI data are well suited to the task of tracking long-term trends in cap rates, CRE mortgage rates, and leverage ratios.

Modeling CRE rent growth expectations is notoriously difficult (Chervachidze et al., 2013, Chervachidze and Wheaton, 2013, Hendershott and MacGregor, 2005). If nominal prices in a local CRE market exceed all-in construction costs (an "under-built" market), new construction will be undertaken by profit-seeking developers that will put downward pressure on real rents due to the increase in the supply of leasable space. Forward-looking market participants should anticipate this reduction in the level of real rents. In contrast, if nominal prices are below all-in construction costs (an "over-built" market), market participants should anticipate a slow down or cessation of new construction and an eventual increase in real rents.

However, if a local CRE space market is in long-run equilibrium—demand for space equals supply—then a reasonable expectation is that real rents will not change and, therefore, nominal rents will grow at the rate of general inflation. We therefore assume nominal rents will grow at the expected (general) inflation rate over the 10-year expected holding period. This assumption is consistent with a long-run equilibrium view of CRE rental markets. It is also driven by a lack of available time series data on long-run rent growth expectations for U.S.

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loans without the permanent mortgage financing, standby loans, loans secured by land only, social responsibility loans, tax-exempt loans, purchases of existing mortgages and acquisitions of mortgage-backed securities. All loan data are aggregated and distributed on a quarterly basis five to six weeks after the end of the quarter.

CRE markets. Our quarterly forecast of the annualized 10-year inflation rate is that used in the Federal Reserve Board's quarterly model of the U.S. economy.[26]

It is standard practice in CRE markets to estimate the selling price in year N by dividing the property's expected net operating income in year N+1 by an assumed going-out (terminal) cap rate. To reflect the economic depreciation and functional obsolescence that occur after the property is acquired, the terminal cap rate for stabilized properties is typically assumed to be 50-100 basis points greater than the cap rate at acquisition. We assume the going-out cap rate is 60 basis points greater than the going-in cap rate reported by the ACLI for each property type in each quarter.

Figure 4 plots before- and after-tax real IRRs (nominal less expected inflation) for office properties (left axis), as well as the average leverage ratio for office properties (right axis). Both returns exhibit sharp negative trends over the study period, the pretax falling from 25 to six percent and the post-tax from 15 (20 in 1981) to four percent. Although not separately displayed, the real IRRs for residential income property display similar patterns. The strong correlation of the holding period rates of return, especially the after-tax, with the leverage ratio is obvious.

Figure 5 plots effective tax rates for existing office and residential properties. The sharp drop in the ETRs from 30 percent in 1980 to 5 percent in 1982 and then the reversal to 20 percent in 1987 are the mirror image of the surge and fall in the present value of tax depreciation in Figure 3. The rise in the rate from the early to middle 1990s reflects the increase in the regular income tax rate from 31 to almost 40 percent. The greater increase for office than residential properties was due to the increase in the minimum cost recovery period for nonresidential real estate from 31.5 years to 39 years in the second quarter of 1993. This opened up a three to five percentage point gap between the office and residential ETRs. ETRs

[26] The ten-year inflation expectations variable from the Federal Reserve Board model is a weighted average of one-year ahead forecasts of PCE inflation for each of the next ten years. The weights sum to one and decline geometrically at a rate based on the average duration of a ten-year bond.

jumped sharply from 2008Q3 to 2009Q2 as mortgage rates increased. For example, office mortgage rates rose from 6.32 percent in 2008Q3 to 7.53 percent in 2009Q2. The increase in ETRs in 2013 reflects increases in tax rates on both trade or business and capital gain income.[27]

Unlike most acquisitions of bonds and stocks, the use of significant debt financing by investors is persuasive in CRE acquisitions. And, as noted above, higher leverage increases *taxdep* relative to the amount of equity capital used to finance the acquisition, thereby raising ETRs. Maximum LTVs allowed by life insurance lenders are generally lower than most competing lenders. Thus, the use of ACLI data to model the leverage decisions of CRE investors tends to understate the effects of leverage on ETRs. As a robustness check, we separate the tax benefit of debt financing, as proxied for by ACLI underwriting terms, from the other aspects of CRE tax treatment. The solid line in Figure 6 reproduces the ETR for office properties assuming ACLI underwriting, while the dashed line is based on all equity financing. Unlevered ETRs always exceed levered ETRs, with the mean difference over our sample period being 8.1 percentage points. However, this large mean difference is driven by the 1975 to 1987 time period. Since 1987, the mean effect of leverage is 4.0 percentage points. In our empirical cap rate analysis below, we include both levered and unlevered ETRs.

While variations in tax law are clearly the dominate cause of variation in IRRs and effective tax rates, other factors also matter. We illustrate this with Figure 7, which plots both the effective tax rate for our prototypical office property from Figure 6 (the solid line) and a calculation of what the ETR would have been assuming the tax variables in place in 1975Q1 remained constant throughout the sample (the constant-tax-law dashed line). Differences in the two lines reflect the extent to which tax law changes have affected the ETR for office properties. The major changes stemmed, of course, from the large, reversing, shifts in tax

[27] Calculations of ETR for varying land share and holding period assumptions are available from the authors.

depreciation methods and cost recovery periods in the 1980s and the largely maintained decline in tax rates in those years.

However, the rise in the constant-tax ETR line during the 1988-92 period and the continued higher level during the last two decades indicate other factors at work. Possible other factors are the capitalization rate, the expected inflation rate (long run income growth rate), the commercial mortgage rate and the degree of leverage because shifts in these variables can alter the effective tax rate even in the absence of tax law changes. Expected inflation, and office market capitalization and mortgage rates are plotted in Figure 8 (LTV is in Figure 4). In the early 1980s, the mortgage rate surged by over four percentage points as Reagan and Volcker waged war on inflation.[28] The capitalization rate rose because of the relatively sharp increase in long-term interest rates. Subsequently, these series have trended downward.

During the key 1988-92 years, the cap rate increased approximately 100 basis points and expected income growth rates fell more than 150 basis points. As a result, a larger portion of the expected total return over the assumed 10-year holding period was in the form of higher taxed regular income and less in the form of lower taxed capital gain income. This shift drove up ETRs. Conversely, office cap rates fell 240 basis points from 2003Q1 to 2007Q4, pushing down effective tax rates.

The sharp increase in the constant-tax ETR in late 2008-2009 (Figure 7) reflected the onset of the recent financial crisis, which pushed up mortgage rates and cap rates and decreased expected rates of inflation and rental growth. These changes combined to shift more of the holding period return to more highly taxed regular income. This shift partially reversed after 2010 when cap rates declined and expected rent growth increased.

[28] The quarterly inflation rate fell by about eight percentage points; the ten-year expected rate fell by two.

III. Illustrating the Usefulness of Our Tax Gauges

Shifts in CRE taxation likely contributed to the large observed swings in CRE prices and activity, and those swings would be difficult to explain without accurate measures of key aspects of taxation, such as our two tax series. As an illustration, we show how our measure of the present value of tax depreciation allowances per dollar of investment can help account for movements in office and apartment cap rates.

Assume that in equilibrium a CRE version of the Gordon Growth model would hold (see, for example, Duca and Ling, 2015). If net operating income (*NOI)* is expected to grow at a constant rate g_t, if the net present value of the mortgage inflows and outflows is zero, if the required return on an all equity financed investment were constant, if the net selling price is expected to remain a constant multiple of *NOI*, then the equilibrium price, P_t^e , in a zero tax world is solely a function of the expected constant rate of growth in *NOI* at time t (g_t) and the property specific risk-adjusted discount rate (r_t):

$$P_t^e = \frac{NOI_1}{r_t - g_t} \tag{4}$$

Property value can be expressed as a multiple of first year *NOI,* and the equilibrium cap rate, $CapRate_t^e$, is the reciprocal of the price-NOI_1 multiple. From equation (4), it follows that:

$$CapRate_t^e = r_t - g_t . \tag{5}$$

Nominal asset prices and pretax required rates of return are determined in competitive markets and are continually adjusting to equate real, risk-adjusted, after-tax expected returns across asset classes. For example, pretax interest rates on, say, 10-year Treasury bonds and therefore real estate discount rates (r_t) must increase when the tax rate on ordinary income faced by the marginal investor increases, all else equal. Thus, changes in r_t capture changes in the ordinary and capital gain tax rates applied to all financial assets. However, the present value of tax depreciation affects the pricing of CRE but not the pricing of benchmark Treasury securities. As seen in equation (3), this present value increases the price by *taxdep**P*. Thus we add $taxdep^* P_t^e$ to the right side of equation (4), and the equilibrium cap rate becomes:

$$CapRate_t^e = (r_t - g_t)(1 - taxdep)\,. \tag{6}$$

For the expected long-run nominal growth in rents we use our annual measure of long-run inflation expectations. For the required rate of return, we draw on Duca and Ling (2015) who find that, using data from 1996Q1-2015Q2, the required unlevered before-tax return on office properties (Real Estate Research Corporation survey data) equals the 10-year Treasury yield plus a risk premium, which they estimate to equal the sum of a constant (1.92), a general risk premium (0.814 x spread between Baa-rated corporate and 10-yr. Treasury yields), and the effective bank capital requirement on commercial real estate (0.27 x effective capital requirement). We backcast this estimate to 1975Q1 and use this as the basis for our required return series for both offices and apartments.

However, there is strong reason to believe that the riskiness of assets declined in the early 1980s. Inflation had been high and volatile in the late 1970s. When market interest rates rose above Regulation Q ("Reg Q") deposit rate ceilings, outflows of deposits occurred that induced depositories to ration credit. The risk premium embedded in investors' required rates of return plausibly shifted down once the Volcker-led Federal Reserve gained credibility in reducing inflation and the risks associated with it. Accordingly, a risk premium shift variable, *InflatEra*, which equals 1 before 1982Q4 and 0 since then, should be added to the above backed-casted estimate of the Duca-Ling risk variable). The "Great Moderation"[29] period of low

[29] This era is generally defined as starting near the end of the Volcker disinflation of the early 1980s through 2007.

inflation likely lowered CRE investment risk, consistent with evidence that the equity risk premium shifted down in the mid-1980s (Blanchard, 1993; Campbell and Vuolteenaho, 2004).

Taking the above considerations into account, we separately estimate the following error-correction model for apartment and office cap rates:

$$CapRate_t^e = \alpha_0 + \alpha_1 (r_t - g_t)(1 - taxdep_t)] + \alpha_2 InflatEra_t (1 - taxdep_t) + \upsilon_t, \tag{7}$$

$$\Delta CapRate_t = \beta_0 + \beta_1 EC_{t-1} + \sum \beta_{2i} \Delta CapRate_{t-i} + \sum \beta_{3i} \Delta[(r_t - g_t)(1 - taxdep_{t-i})]$$
$$+ \sum \beta_{4i} [\Delta InflatEra_{t-i} (1 - taxdep_{t-i})] + X_t \ . \tag{8}$$

$CapRate^*$ is the estimated equilibrium level from equation (7) and $EC_{t-1} = CapRate_{t-1} - CapRate_{t-1}^*$.

According to equation (7), equilibrium cap rate levels are driven primary by the three long-run factors embedded in the product $(r - g)(1 - taxdep)$ -- discount rates that reflect both the risk-free opportunity cost of equity capital and the unlevered equity risk premium, the expected growth rates of rents, and shifts in the taxation of CRE relative to other asset classes. Short-run cap rate changes [equation (8)], in turn, are a function of the extent to which cap rates differ from their equilibrium level in the previous quarter, lagged changes in the cap rate, lagged changes the long-run determinants, and four short run controls included in the vector *X*. The coefficient on the EC term should be negative, implying that any excess of the actual over the equilibrium cap rate would tend to be followed by a negative change in cap rates.

The short-run controls track unusual events that may notably and temporarily affect cap rates, and are plausibly exogenous to the long-run variables. These include the bindingness of ceilings on deposit interest rates which induced credit rationing that temporarily depressed the demand for properties (and pushed up cap rates), as well as dummies for the effects of the

Carter Administration's credit controls and the failures of Continental Illinois Bank in 1984 and of Lehman Brothers in 2008.[30]

We estimate three variants of equations (7) and (8) for both ACLI office and apartment cap rates using data for the 1975Q1:2015Q4 period. The first variant explicitly ignores taxes, setting *taxdep* equal to zero, while the second uses our estimate of *taxdep*. If the marginal investor were a nontaxed institution, the first variant would work better than the second. The third variant multiplies ($r - g$) and *InflatEra* by (1 + *ETR*) instead of by (1-*taxdep*) to gross up general market returns for the effective tax rate on office or apartment CRE property. As noted, ETR mirrors *taxdep* through 1987, but then rises owing to higher tax rates. The question is whether the higher tax rates have an impact (beyond that incorporated in interest rates generally).

The estimation of long-run and short-run relationships is joint following Johansen (1995), and the vector error-correction framework allows for the endogeneity of the long-run variables but also to test which variables Granger-cause the others in the long-run. The number of lags was selected based on minimizing the Akaike Information Criterion. Allowing for some slight differences in lag lengths, the longest common sample period for the apartment cap rates is 1976Q3-2015Q4 and that for office cap rates is 1976Q3-2015Q4. The estimation assumptions allow for a linear trend in the data, as well as an intercept—but not a trend—in the cointegrating vector. These assumptions allow for possible time trends in long-run variables but not an independent time effect in the vector that would pick up, in an ad hoc way, influences outside of those tracked by the long-run factors in each model.

[30] The first (*RegQ*) is Duca and Wu's (2009) measure of the degree to which Regulation Q was binding in the t-1 quarter (which tracks the difference between the market interest rate and the deposit rate ceiling) to reflect a slight lag of how funding shortfalls led to a higher degree of credit rationing. The second (*CreditControl*) is a dummy equal to 1 in 1980Q1 and 1980Q2 (and 0 otherwise) to control for credit rationing induced by the federal government imposing controls on the growth rate of bank lending, which spurred banks to tighten credit standards, thereby depressing asset prices and boosting cap rates. The third control differs in the two equations. In the office equation it reflects event risk from the failure of Lehman (*Lehman* = 1 in 2009Q1); in the apartment equation it reflects event risk from the failure of Continental Illinois (*ContIllFail* = 1 in 1984Q3).

The upper-panel of Table 2 reports the results for the long run equilibrium cap rate relationship. The regressors are a constant and the (*r-g*) and *InflatEra* variables interacted with a tax variable. The columns indicate the three tax variables: unity, (1-*taxdep*) and (1+*ETR*). As for the cointegration results, several patterns emerge. A unique and statistically significant long-run (cointegrating) relationship is identified for each of the models incorporating (1-*taxdep*) (models 2 and 5) and for those without a tax variable (models 1 and 4), implying that there is one significant long-run relationship among the long-run variables that yields stationary residuals. In these cases, the hypotheses of no cointegrating vector or of two or more cointegrating vectors is rejected based on trace and maximum eigenvalue test statistics. On the other hand, the evidence is mixed for the specifications using the effective tax rate (model 3 and 6), with only the trace statistic finding one significant vector in model 3 and the maximum eigen statistic indicating none, whereas two significant vectors were found for model 6 based on both criteria.

Consistent with theory, the office cap model using (1-*taxdep*) has a long-run coefficient on the required unlevered rate of return minus rent growth that is less than a standard deviation from the expected unity value. The 0.06 difference is less than one-third the gap (0.22) from the specification (model 3) using (1+*ETR*). There is also significant evidence that cap rates were higher before the great moderation—as were stock earnings-to-price ratios (see Blanchard, 1993)—as evidenced by the significant coefficient on *InflatEra** (1-*taxdep*).

Results from modeling the changes in cap rates are reported in the lower panel of Table 2. Among the office cap rate models, the estimated quarterly speed of adjustment is insignificant and incorrectly signed in model 1, which omits tax variables. In contrast, the speed of adjustment is highly significant with the expected sign in the models including (1-*taxdep*) and (1+*ETR*), with the speed being a little faster (20 percent per quarter) in the "tax-depreciation" model than in the "effective tax rate" model (17 percent). The model excluding tax terms has a substantially worse fit, with a corrected R^2 nearly 9 percentage points lower than that of the tax depreciation model, which has a corrected R^2 of 0.404, which is slightly higher than that of the effective tax rate model. Accounting for changes in taxation notably improves our ability to explain changes in office cap rates, with the long-run and short-run results favoring the inclusion of the net present value of tax depreciation over including the effective tax rate.

Coefficients on the added short-run variables are significant and positive, indicating that cap rates are elevated by government regulations that restrict the supply of credit (the 1980 credit controls and Regulation Q) and by the failures of major financial institutions. These findings are plausible because both types of effects tend to lower the effective demand for underlying property, thereby raising cap rates. Furthermore, these effects are economically substantial; these fits are 0.1 to 0.2 higher than those of corresponding models (not shown) that omit them.[31]

The apartment cap rate models are quite similar to those for offices. Accounting for taxes improves to a lesser extent the performance of modeling changes in apartment cap rates. As with the office cap rate results, the estimated speed of adjustment is both incorrectly signed and statistically insignificant in the model omitting tax variables. By contrast the speed of adjustment is significant and correctly signed in the tax models, with a slightly faster quarterly speed for the tax depreciation model (19% in model 5) than for the effective tax rate model (15% in model 6). The fit of the model omitting taxes is a little worse than the tax models, with the fit of the specification (model 6) including effective tax rates a little better

[31] It is reassuring that omitting the short-run variables (1) does not appreciably alter the estimated coefficient on the required rate of return minus expected rent growth, (2) does not weaken the cointegration results for the tax depreciation or no tax models, and (3) strengthens cointegration results for models using effective tax rates. Excluding these short-run variables results in slower estimated speeds of adjustment, which plausibly reflects omitted variable bias. This interpretation may also account for why larger estimated inflation risk coefficients also arise because that coefficient can be biased if the variable for the credit controls of 1980 is omitted given that that episode is a very large outlier in many macroeconomic and financial series.

than that of model 5, which accounts for tax depreciation effects. Nevertheless, estimates of model 6 do not arise from a model with a unique cointegrating vector, which when compared to model 5, also has a slower speed of error-correction and unlike model 5 has residuals that show some evidence of serial correlation according to VEC auto (LM) statistics. Thus, taking into account both the short- and long-run results for multi-family cap rates, the tax-depreciation model is once again a more satisfactory error-correction model than the alternatives tested.

Figure 9 plots the actual office cap rate and the implied equilibrium cap rate from the preferred office specification (model 2) in Table 2, with adjustments for the effect of the short-run control variables. The estimated equilibrium series tracks most of the major trends in the observed cap rate for office space. These include the rise in 1979-82, the decline in 1982-87, and the long slide from 1994 to the present.

Results also imply that required returns and the tax depreciation variable Granger cause office cap rates in the long-run, but not vice versa (see Granger and Lin, 1995). The significant EC term implies that the cap rate is not weakly exogenous to the tax depreciation-adjusted spread between the required rate of return and the proxy for rent growth. The insignificant error-correction terms (not shown) in the short-run VECM models for this required rate of return spread imply that this fundamental valuation driver is weakly exogenous to the cap rate, but the cap rate is not weakly exogenous to the driver. (Details are available upon request.) These results are consistent with two fundamental assumptions in deriving the cap rate equations; the main component of required returns is determined in the general capital markets and tax policy matters to pricing.

IV. Conclusion

Our study begins by documenting the evolution of U.S. tax law regarding CRE since 1975, noting changes in income and capital gains tax rates and tax depreciation methods. The most prominent changes were the 1981 and 1986 tax acts, but numerous significant changes have occurred in the last dozen years.

We then compute the present value of tax depreciation per dollar of acquisition price, a seemingly important driver of CRE cycles. This percentage of value leaped from about 10 percent in the second half of the 1970s to over 20 percent in 1981 and remained above 12 percent through 1986. It then plunged to two percent in 1988 and has stayed below five percent since.

We also compute an effective tax rate for CRE that we define as the difference between the before and after tax expected internal rates of return, divided by the before-tax return. This series mirrored the present value of tax depreciation variable during the 1975-87 period, falling from 35 to five percent before rebounding to 18 percent. Since then it has risen back to the 35 percent level, reflecting higher tax rates.

The major difference between CRE and financial assets is the tax depreciation deduction allowed the former. Thus we might expect this to be a significant determinant of CRE pricing relative to that of financial assets. And we find that it is. We explain the capitalization rate of CRE, the inverse of the income multiplier (the income-to-price ratio) using an error correction framework. We find that the long run estimates are statistically significant in the way theory would suggest. Moreover, required financial asset returns and the tax depreciation variable temporally predate ("cause") capitalization rates in the long run, but not vice versa. These findings—namely that required rates of return are primarily determined in capital markets and that tax changes can matter a great deal—are consistent with the underlying assumptions we use to motivate what drives long-run CRE valuations.

Our study's main contribution is to provide time series evidence by empirically modeling tax variables and office and apartment capitalization rates over the past four decades.

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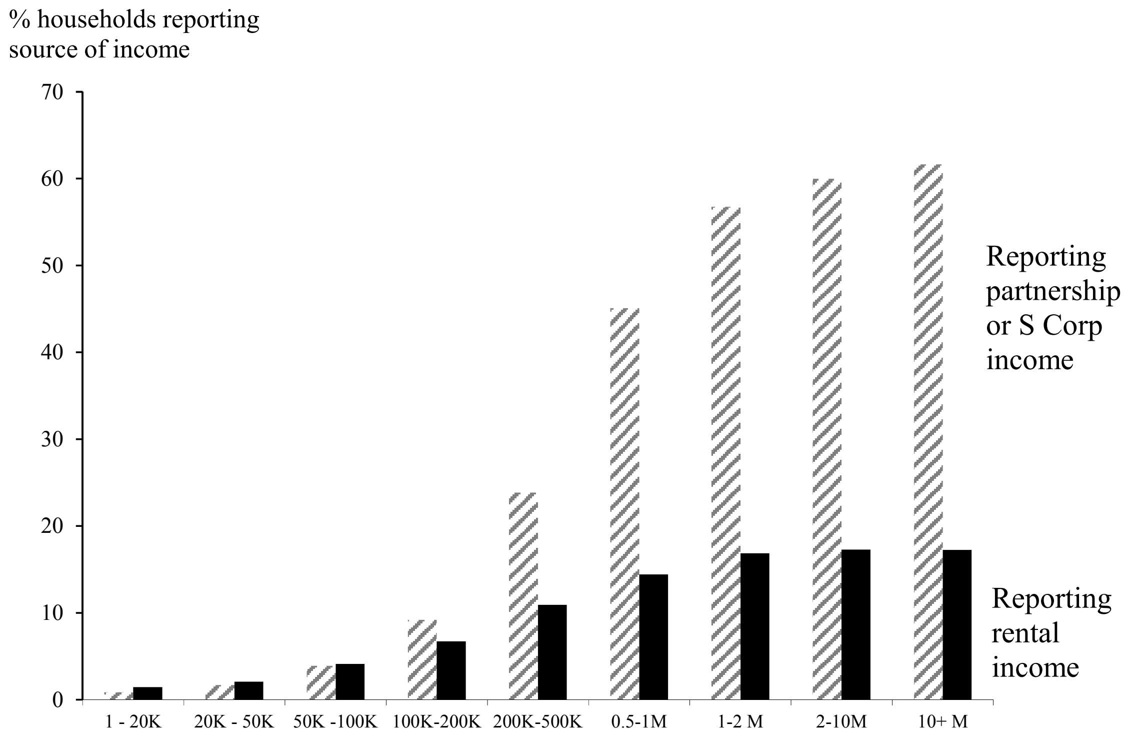
Figure 1: **Commercial real estate income reported by adjusted gross income**

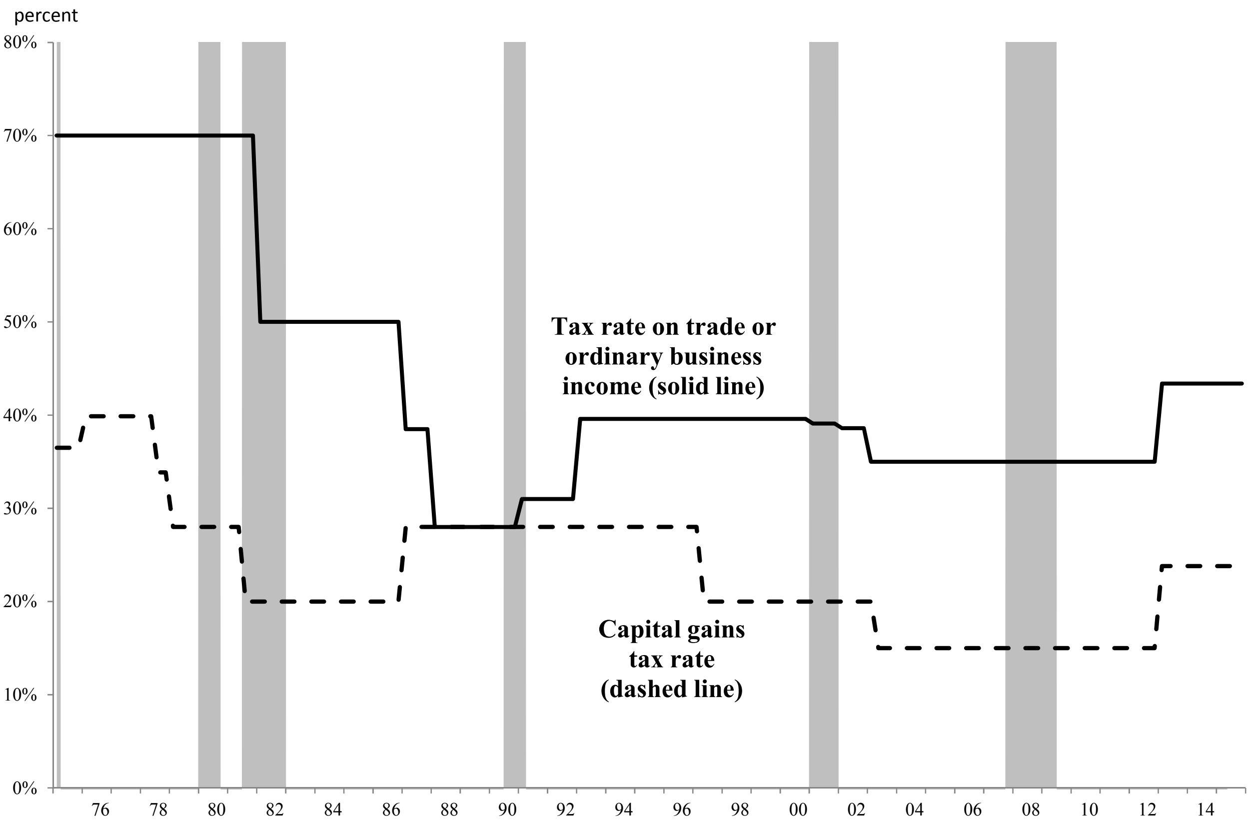
Data obtained from the 2014 IRS Statistics of Income (SOI). The tax consequences of CRE ownership in non-exchanged-traded securities are reported on Schedule E of Form 1040 under rents received from direct investments in individual properties (solid bars) or income or loss from partnerships, including limited liability companies, and S corporations (cross-hatched bars). The vertical axis displays the percent of taxpayers reporting each time of income.



Sources: 2014 Statistics of Income and authors' calculations. The tax consequences of CRE ownership (in non-exchanged-traded securities) are reported on Schedule E of Form 1040 under rents received from direct investments in individual properties (row 3) or income or loss from partnerships and S corporations (row 32).

Figure 2: Maximum tax rates on Section 1231 trade or business income & capital gain income

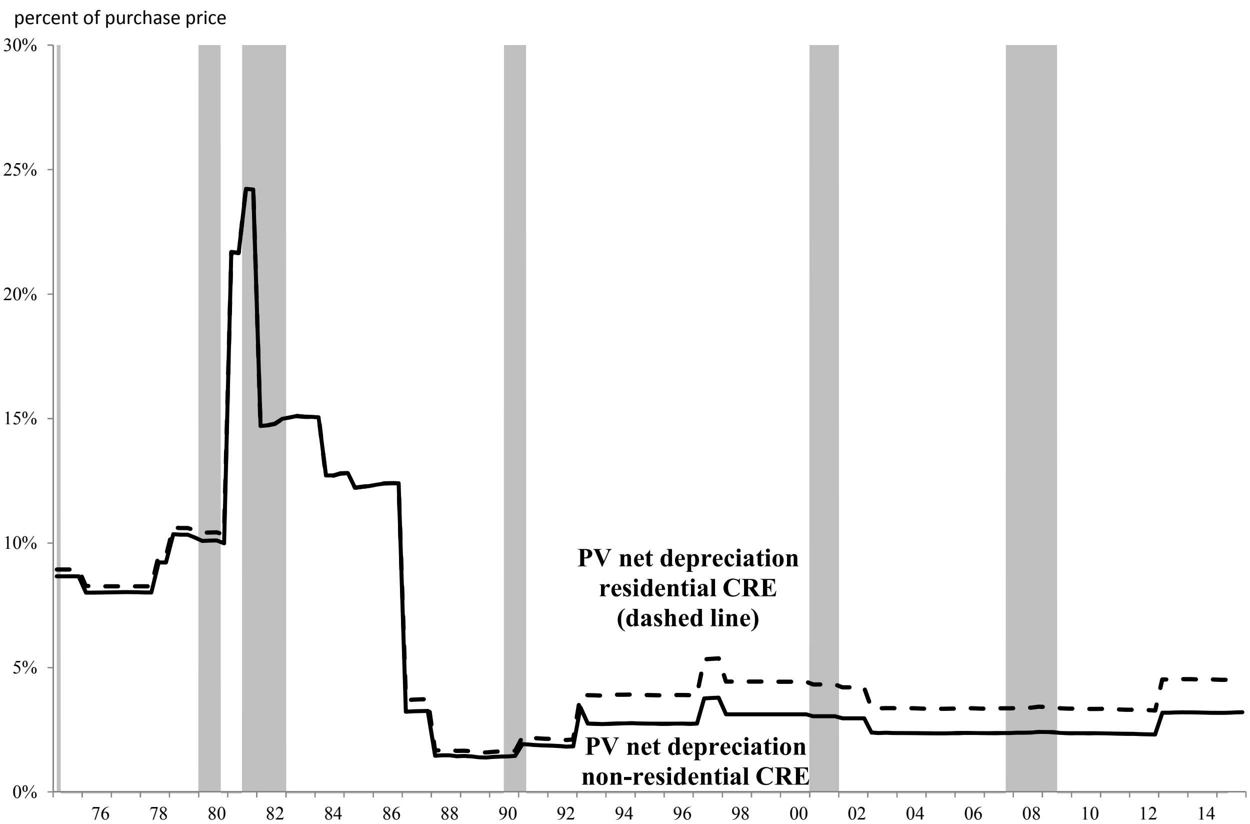
This figure plots maximum statutory tax rates on trade or business income and capital gain income. These rates do not include state income taxes or the effects of phasing out, since 1986, the itemized deductions and personal exemptions for higher income households. The rates do include the effects of the Net Investment Income Tax surcharge that has applied to higher income households since the passage of the American Taxpayer Relief Act of 2012.



Shaded areas denote recessions.

Figure 3: Present value of net depreciation deductions as a percentage of acquisition price

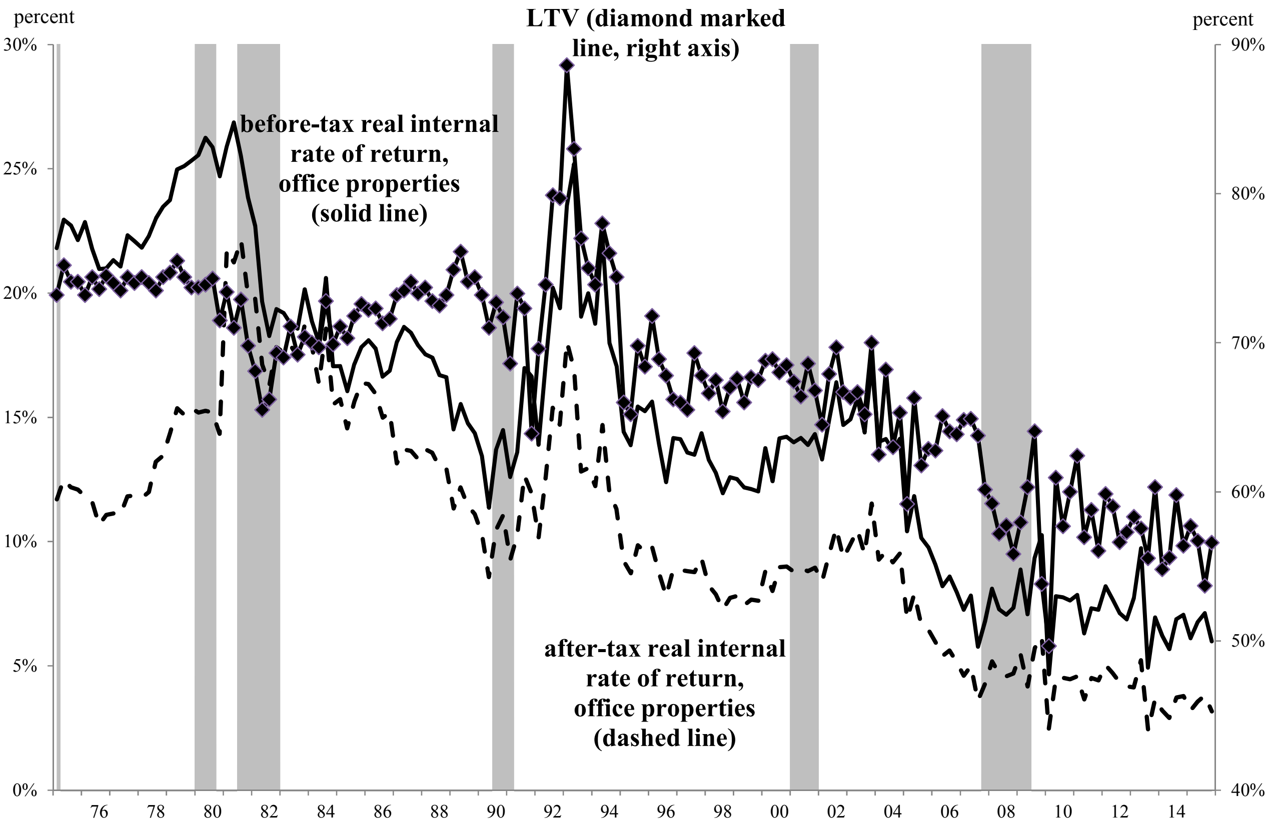
This figure plots the present value of net depreciation deductions as a percentage of the acquisition price for both used commercial and residential property. Land accounts for 20 percent of the acquisition price, there is no personal property, and the property is expected to be held for 10 years before being disposed of in a fully taxable sale. The discount rate used each quarter is the after-tax yield (IRR) on 10-year Baa-rated corporate bonds. The tax rate on trade or business income is used to calculate the after-tax discount rate for net depreciation deductions.



Shaded areas denote recessions. Sources: authors' calculations.

Figure 4: Real before and after-tax internal rates of return

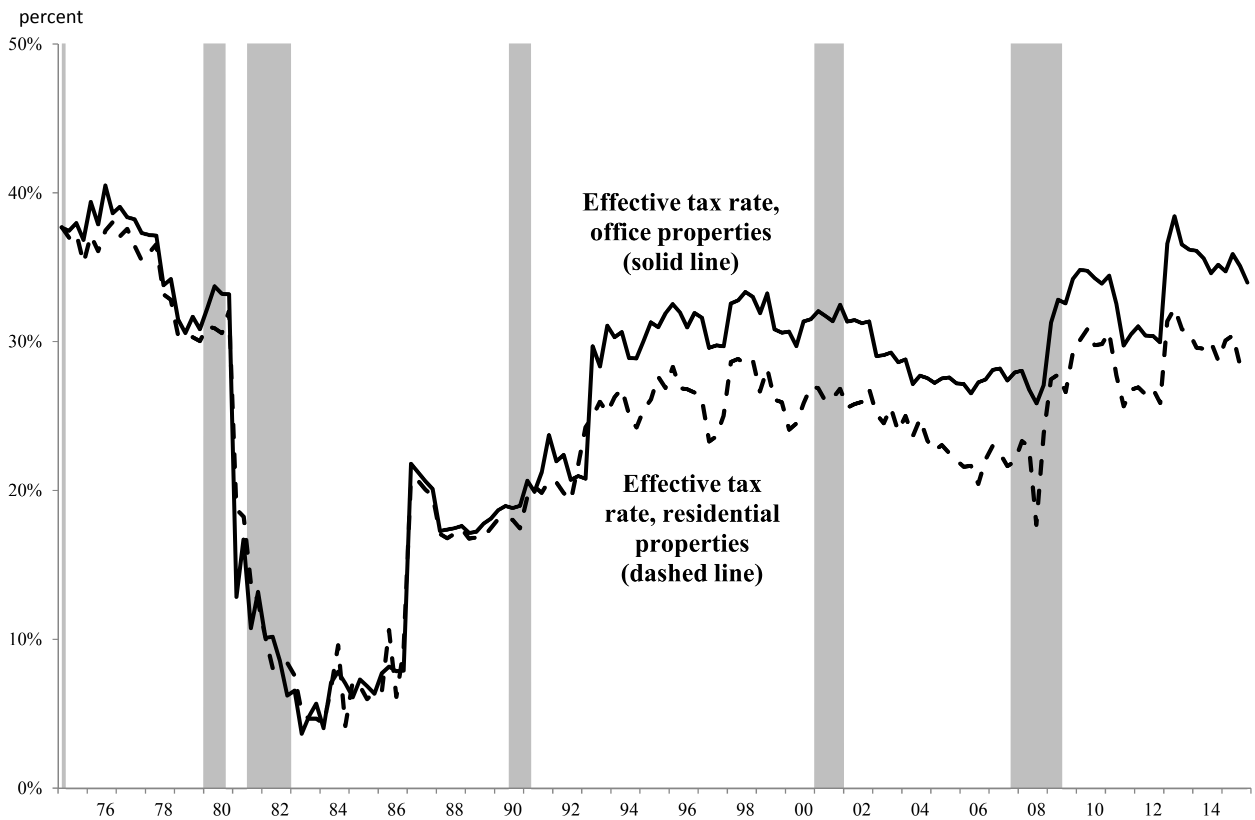
Vacancy and collection losses equal a constant five percent of gross rental income and operating expenses and capital expenditures consume 45 and five percent, respectively, of expected gross income each year. An estimate of the gross potential income in the first year of rental operations is obtained using observed cap rate data. Data on quarterly cap rates are from the American Council of Life Insurers (ACLI) Commercial Mortgage Commitments - Historical Database, as are loan-to-value ratios, contract interest rates, and loan maturities. Nominal rents grow at the expected (general) inflation rate over the 10-year expected holding period (that used in the Federal Reserve Board's quarterly model of the U.S. economy. The selling price in year N is obtained by dividing the property's expected net operating income in year N+1 by an assumed going-out (terminal) cap rate. The going-out cap rate in each quarter is 60 basis points greater than the going-in cap rate reported by the ACLI.



Shaded areas denote recessions. Sources: authors' calculations.

Figure 5: Effective tax rates for used office and residential properties

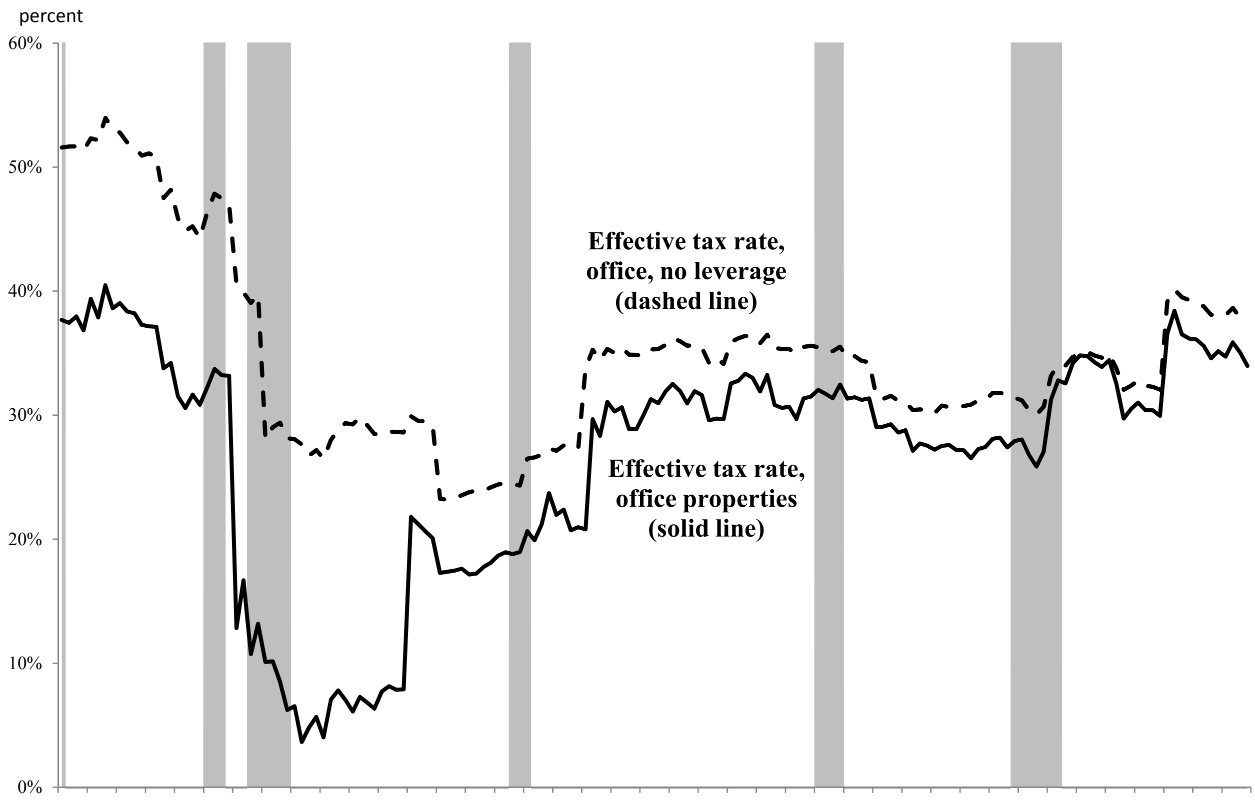
The effective tax rate on is the difference between the before and after-tax expected internal rates of return (IRRs) divided by the before-tax IRR. Vacancy and collection losses equal a constant five percent of gross rental income and operating expenses and capital expenditures consume 45 and five percent, respectively, of expected gross income each year. An estimate of the gross potential income in the first year of rental operations is obtained using observed cap rate data. Data on quarterly cap rates are from the American Council of Life Insurers (ACLI) Commercial Mortgage Commitments - Historical Database, as are loan-to-value ratios, contract interest rates, and loan maturities for each of the major property types. Nominal rents grow at the expected (general) inflation rate over the 10-year expected holding period. Our quarterly forecast of the annualized 10-year inflation rate is that used in the Federal Reserve Board's quarterly model of the U.S. economy. The selling price in year N is obtained by dividing the property's expected net operating income in year N+1 by an assumed going-out (terminal) cap rate. The going-out cap rate in each quarter is 60 basis points greater than the going-in cap rate reported by the ACLI for each property type.



Shaded areas denote recessions. Sources: authors' calculations.

Figure 6: Leverage and Effective Tax Rates

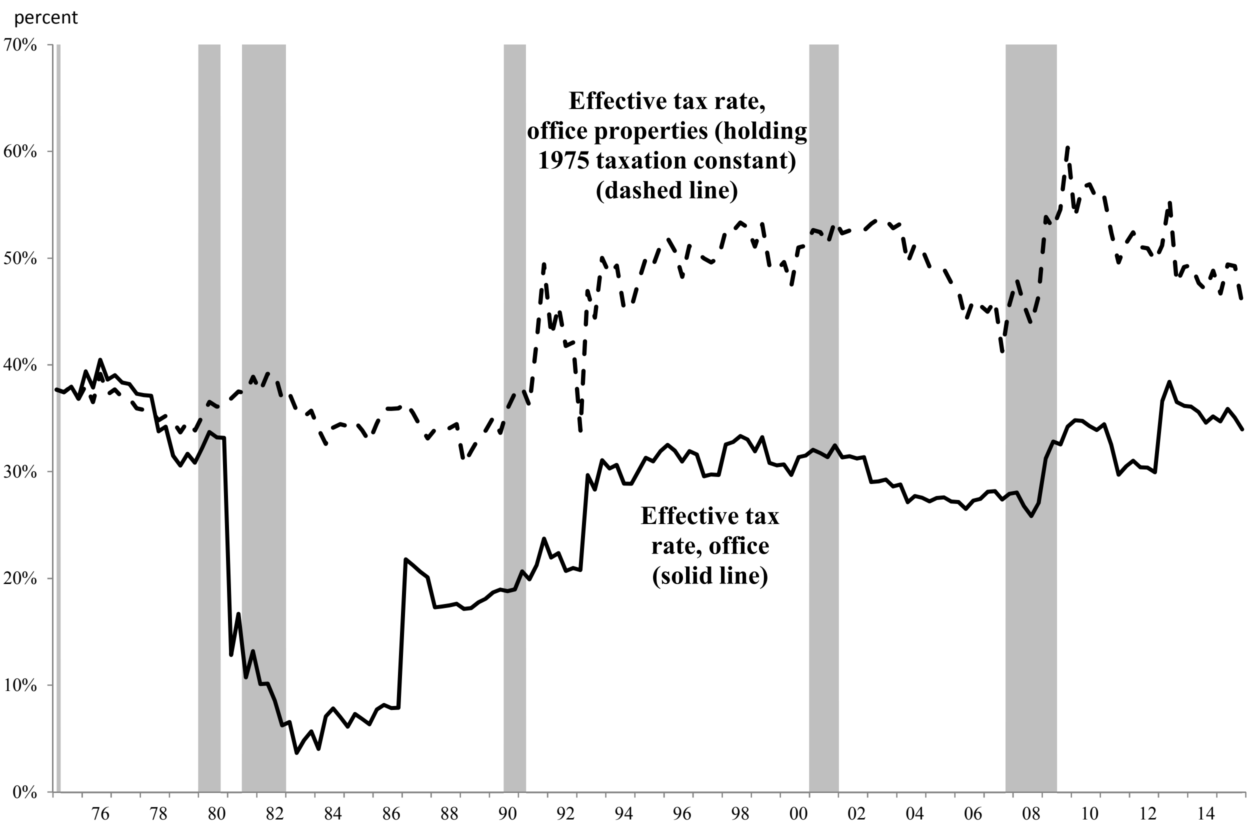
The solid line reproduces the ETR for office properties assuming ACLI underwriting; the dashed line is based on all equity financing.



Shaded areas denote recessions. Sources: authors' calculations.

Figure 7: Isolating nontax changes in ETRs-office properties

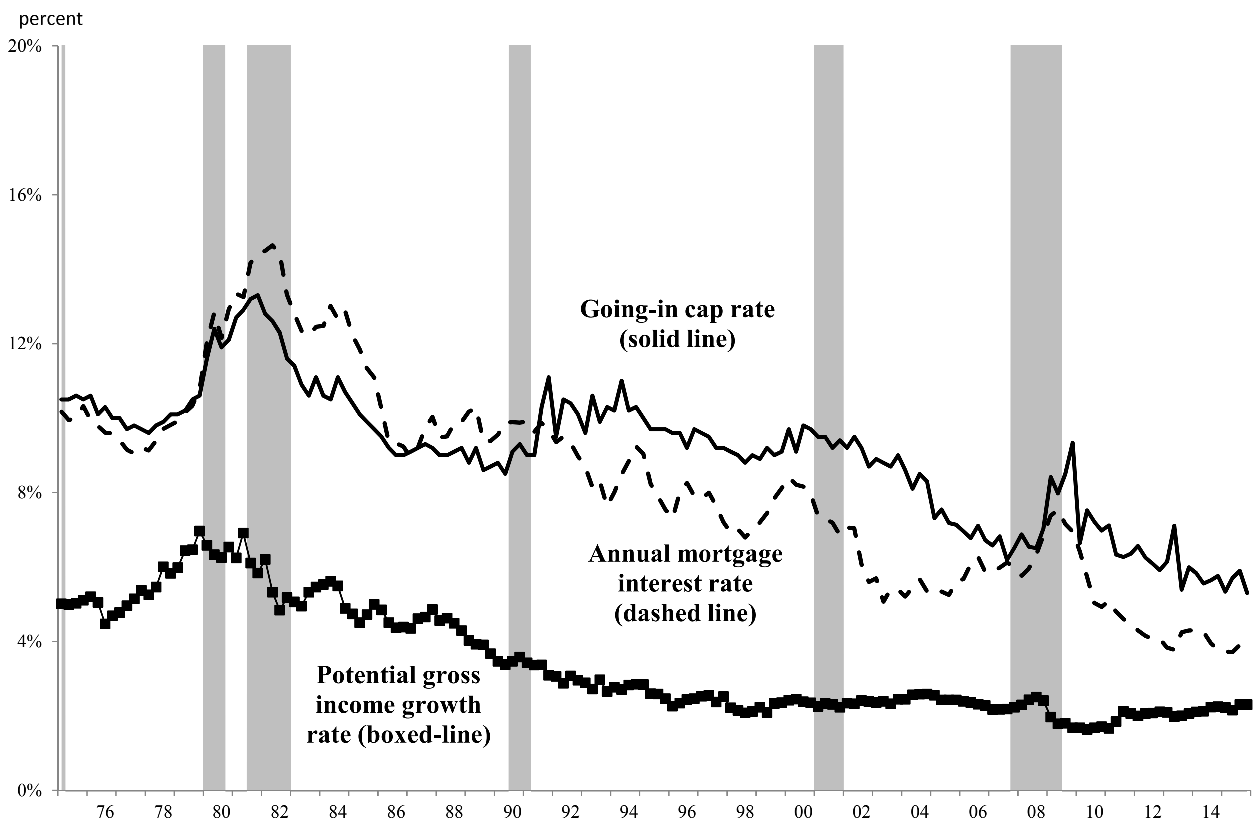
The solid line represents the effective tax rate for office properties (reproduced from Figure 5). The dashed line is the ETR for office properties assuming the tax variables in place in 1975Q1 remain constant throughout the sample. Differences in the two lines therefore capture the extent to which tax law changes over time have affected the ETR for office properties. Other assumptions include: vacancy and collection losses equal a constant five percent of gross rental income; operating expenses and capital expenditures consume 45 and five percent, respectively, of expected gross income each year. Gross potential income in the first year of rental operations comes from cap rate data obtained from the American Council of Life Insurers (ACLI) Commercial Mortgage Commitments-Historical Database. Loan-to-value ratios, contract interest rates, and loan maturities are also from ACLI. Nominal rents grow at the expected (general) inflation rate over an assumed 10-year expected holding period. The quarterly forecast of the annualized 10-year inflation rate is from the Federal Reserve Board. The selling price in year N is obtained by dividing the property's expected net operating income in year N+1 by an assumed going-out cap rate, which is assumed to be 60 basis points greater than the going-in ACLI cap rate.



Shaded areas denote recessions. Sources: authors' calculations.

Figure 8: Nontax determinants of IRR and ETR of office properties

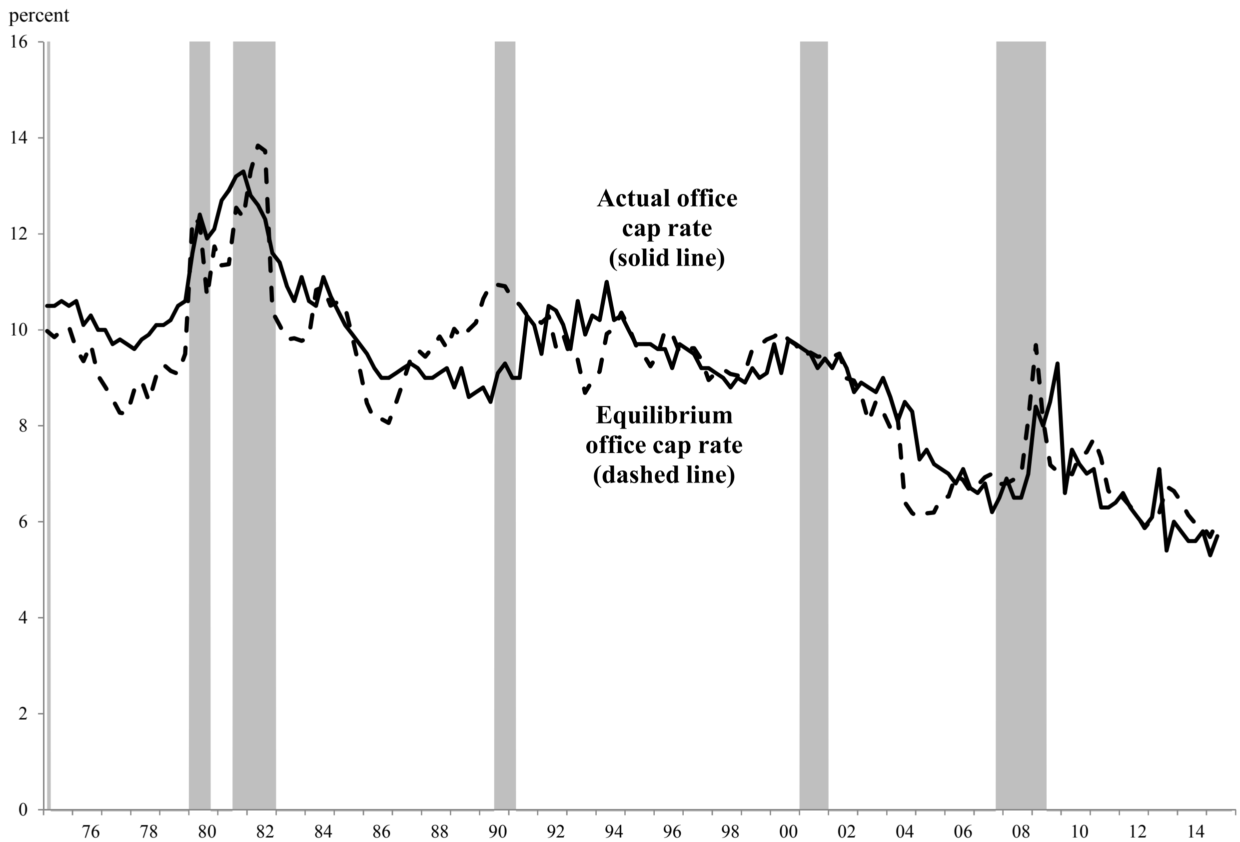
Capitalization rates and office mortgage rates are from the American Council of Life Insurers (ACLI) Commercial Mortgage Commitments-Historical Database. The growth rate in potential gross income is the forecast of the 10-year inflation rate used in the Federal Reserve Board's quarterly model of the U.S. economy. The discount rate used to determine the present value of net depreciation deductions is the after-tax yield in 10-year Baa rated corporate bonds.



Shaded areas denote recessions. Sources: ACLI, Moodys, and authors' calculations.

Figure 9: Estimated equilibrium cap rate tracks office cap rates since the 1970s

Capitalization rates are from the American Council of Life Insurers (ACLI) Commercial Mortgage Commitments-Historical Database. The equilibrium office cap rate is the long-run estimated equilibrium cap rate from model 2 in Table 2, equal to *CapRate* = 1.307 + 0.927 (r-g)(1 – *taxdep*) + 1.835 *InflatEra* (1 – *taxdep*), where r is the proxy for the required rate of return on CRE office investments from Duca and Ling (2015), g is the proxy for expected long-run growth rate of rents (the 10-year expected future inflation rate from the Federal Reserve Board's econometric model of the U.S. economy), *InflatEra* is a shift dummy to account for risk premia associated with uncertainty before the psot-1982 era of low inflation equal to 1 before 1982Q4 and 0 since then, and *taxdep* is our estimate of the present value of net depreciation tax benefits.



Shaded areas denote recessions. Sources: ACLI, Federal Reserve Board, and authors' calculations.

Table 1: Depreciation Methods and Tax Rates

Panel A: 1975-1987

	1975-1978	1979-1980	ERTA 1981	1982-1984Q1	1984Q2-1985Q1	1985Q2-1986	TRA 1987
Allowable method of depreciation: used residential	125% declining balance[a]	125% declining balance[a]	175% declining balance	175% declining balance	175% declining balance	175% declining balance	Straight-line
Allowable method of depreciation: used non-residential	Straight-line[b]	Straight-line[b]	175% declining balance	175% declining balance	175% declining balance	175% declining balance	Straight-line
Cost recovery period: used residential	About 30 yrs.	About 30 yrs.	15 yrs.	15 yrs.[c]	18 yrs.[c]	19 yrs.[d]	27.5 yrs.
Cost recovery period: used non-residential	About 30 yrs.	About 30 yrs.	15 yrs.	15 yrs.[c]	18 yrs.[c]	19 yrs.[d]	31.5 yrs.
Maximum tax rate on Section 1231 income (τ_{TBI})	70%	70%	70%	50%	50%	50%	38.5%
Maximum tax rate on capital gain income (τ_{CG})	33.9%-39.9%[e]	28%	20%	20%	20%	20%	28%
Maximum tax rate on straight-line depreciation recapture income (τ_{SLR})	33.9%-39.9%[e]	28%	20%	20%	20%	20%	28%
Maximum tax rate on excess depreciation recapture income (τ_{EXR})	70%	70%	70%	50%	50%	50%	NA

[a] New residential property could be depreciated using 200% declining balance depreciation.
[b] New nonresidential property could be depreciated using 150% declining balance depreciation.
[c] For property placed in service after March 15, 1984 and before May 9, 1985, the Tax Reform Act of 1984 generally increased the minimum cost recovery period for both residential and non-residential real property from 15 to 18 years.
[d] For property placed in service after May 8, 1985 and before 1987, the minimum cost recovery period for residential and non-residential real property was 19 years.
[e] See discussion in text for details.

Table 1: Depreciation Methods and Tax Rates, continued

Panel B: 1988-2015

	1988-1990	1991-1992	1993-1996[e]	1997	1998-2003Q1	2003Q2-2012	2013-2015Q2
Allowable method of depreciation: used residential	Straight-line	Straight-line	Straight-line	Straight-line	Straight-line	Straight-line	Straight-line
Allowable method of depreciation: used non-residential	Straight-line	Straight-line	Straight-line	Straight-line	Straight-line	Straight-line	Straight-line
Cost recovery period: used residential	27.5 yrs.	27.5 yrs.	27.5 yrs.	27.5 yrs.	27.5 yrs.	27.5 yrs.	27.5 yrs.
Cost recovery period: used non-residential	31.5 yrs.	31.5 yrs.	39 yrs.	39 yrs.	39 yrs.	39 yrs.	39 yrs.
Maximum tax rate on Section 1231 income (τ_{TBI})	28%	31%	39.6%	39.6%	39.6%,39.1% 38.6%, 35%	35%	43.4%
Maximum tax rate on capital gain income (τ_{CG})	28%	28%	28%	20%	20%	15%	23.8%
Maximum tax rate on straight-line depreciation recapture income (τ_{SLR})	28%	28%	28%	20%	25%	25%	28.8%
Maximum tax rate on excess depreciation recapture income (τ_{EXR})	NA	NA	NA	NA	NA	NA	NA

[e] The Tax Reform Act of 1986 required 27.5 year straight-line depreciation for acquisitions of both new and used residential property and 31.5 year straight-line for nonresidential property. This tax treatment remained in effect until May 12, 1993. As a result of the Omnibus Budget Reconciliation Act of 1993, the cost recovery period for non-residential real property placed in service after May 13, 1993 is 39 years.

Table 2: Explanation of Capitalization Rates on Commercial Property

Equil. $CapRate_t = \alpha_0 + \alpha_1 (r_t - g_t) x (1-taxdep_t)$ or $x(1+ETR_t) + \alpha_2\ InflatEra_t x (1-taxdep_t)$ or $x(1+ETR_t) + \mu_t$

Variables	Office (1976:Q3-2015:Q4			Multi-Family (1976:Q1-2015:Q4		
Model No.	1	2	3	4	5	6
	interaction variables			interaction variables		
Tax Treatment	unity	(1-*taxdep*)	(1+*ETR*)	unity	(1-*taxdep*)	(1+*ETR*)
Constant	0.460	1.227	-0.677	0.884	0.966	0.0104
$(r_t - g_t)$	0.928**	0.939**	0.778**	0.865**	0.939**	0.817**
	(0.102)	(0.091)	(0.089)	(0.054)	(0.066)	(0.063)
$InflatEra_t$	3.885**	1.696**	0.296	3.592**	2.923**	1.433**
	(0.760)	(0.588)	(0.465)	(0.367)	(0.439)	(0.350)
unique cointegrating trace/max eigen	Yes*/Yes*	Yes*/Yes*	Yes*/No	Yes**/Yes**	Yes**/Yes**	No/No
# lags in vector	2	5	5	4	3	3
trace, no vector	31.62*	33.70*	31.76**	49.92**	48.62**	47.26**
trace, 1 vector	6.49	11.45	13.68	10.62	14.92	16.50*

Short-Run: $\Delta CapRate_t = \beta_0 + \beta_1 EC_{t-1} + \Sigma\beta_{2i}\Delta CapRate_{t-i} + \Sigma\beta_{3i}\Delta\ [(r_t - g_t) \text{ x } (1-taxdep_{t-i})$ or x $(1+ETR_{t-i})]$

$+ \Sigma\beta_{4i}\Delta\ [InflatEra_{t-i} \text{ x } (1-taxdep_{t-i})$ or x $(1+ETR_{t-i})] + X_t + \varepsilon_t$

	1	2	3	4	5	6
$EC_{t-1,}$	0.010	-0.198**	-0.166**	0.032	-0.189**	-0.140*
'adjustment speed'	(0.033)	(0.050)	(0.048)	(0.047)	(0.046)	(0.075)
$\Delta CapRate_{t-1}$	-0.551**	-0.335**	-0.383**	-0.247**	-0.065	-0.140+
	(0.079)	(0.080)	(0.082)	(0.085)	(0.075)	(0.075)
$\Delta[(r-g_t)x(1-taxdep)]_{t-1}$	-0.070	-0.168	-0.084	0.315**	0.097	0.147*
$\Delta[(r-g_t)x(1-+ETR)]_{t-1}$	(0.082)	(0.088)	(0.066)	(0.077)	(0.079)	(0.059)
Δ[*InflatEra x (1-tax*	0.387	0.091	0.088	0.527	-1.144**	-0.639+
Dep]$_{t-1}$ or x(1+*ETR*)]$_{t-1}$	(0.446)	(0.509)	(0.388)	(0.406)	(0.441)	(0.337)
$CreditControl_t$	0.977**	1.190**	1.176**	0.589*	0.754**	0.625**
	(0.313)	(0.301)	(0.304)	(0.270)	(0.268)	(0.267)
$RegQ_{t-1}$	0.165*	0.299**	0.302**	0.180**	0.264**	0.220**
	(0.067)	(0.068)	(0.071)	(0.055)	(0.055)	(0.052)
$Lehman_t$	1.669**	1.627**	1.642**	1.479**	1.362**	1.491**
	(0.417)	(0.396)	(0.399)	(0.343)	(0.338)	(0.334)
$ContIllFail_t$				1.186**	1.227**	1.211**
				(0.259)	(0.256)	(0.252)
Adj. R^2	0.316	0.404	0.393	0.426	0.438	0.451
S.E.	0.399	0.373	0.376	0.340	0.337	0.333
VEC Auto (1)	9.48	11.83	17.01*	5.28	10.00	12.39
VEC Auto (2)	13.85	4.24	4.56	11.97	13.66	18.69*
VEC Auto (4)	6.91	13.99	12.61	15.42+	8.82	11.67
VEC Auto (6)	10.99	7.75	7.61	21.27*	11.08	11.82

Notes: (i) Standard errors in parentheses. ** (*,+) denotes significant at the 99% (95%, 90%) confidence level. (ii) Lag lengths chosen to based on minimizing the AIC. (iii) First difference terms of elements in the cointegrating vector lagged more than one quarter are omitted to conserve space. (iv) Maximum likelihood estimates of the equilibrium relationship using a three equation system with (at most) one cointegrating vector. (v) The VEC auto (LM) statistics are systems Lagrange Multiplier tests statistics for 1st through 6th order autocorrelation. (vi) *RegQ* controls for Regulation Q induced credit rationing. *CreditControl* equals 1 in 1980Q1 and 1980Q2 (0 otherwise) to control for credit rationing from government credit controls that depressed cap rates. *Lehman* is a dummy for Lehman's failure (= 1 in 2009Q1 in the office models and = 1 in 2008Q4 in the multi-family models) and *ContIllFail* is a dummy for the failure of Continental Illinois Bank (= 1 in 1984Q3).