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Capitalization Rates for Commercial Real Estate Investment Decisions

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Abstract

The purposes of the paper are to present a basic model of commercial real estate valuation in which the Capitalization Rate is the critical variable, and to present empirical results for a study of office building Capitalization Rates.

The model is derived from standard economic and financial theories. The empirical study uses data from the sales of office buildings in 37 downtown markets for 2012. The empirical results are then related to concepts of asset market efficiency.

The empirical results show that Capitalization Rates depend on features of the office buildings, the vacancy rate, and recent change in the office building market as captured by the change in the vacancy rate. In other words, investors are using variables implied by standard economic and financial theory and basic economic data from the recent past to determine the capitalization rate.

Keywords – Capitalization Rates, Valuation, Efficient markets, Investment decisions

Introduction

The Nobel Prize in Economics for 2013 was awarded to Eugene Fama, Lars Peter Hansen, and Robert Shiller. As many observers have noted, Professors Fama and Shiller have sharply differing views regarding asset valuation. Fama is the inventor of the theory of efficient markets – the idea that current asset values incorporate all publicly available information (including the asset price history and the best economic forecasts) so that changes in asset values will be the result of new information. In other words, asset values follow a random walk and it is not possible to “beat the market.”

Fama (1970) proposed three forms of market efficiency. The weak form exists if the asset price reflects past prices, so that knowledge of those past prices provides no advantage to a potential investor. The semi-strong form means that asset prices incorporate past prices and any other publicly available information (including available forecasts). The potential investor with all of the publicly available information has no advantage over others. The strong form of market efficiency exists when the current price reflects all information, public or private. In this case, the potential investor with

private information does have an advantage over other potential investors if the price under the strong form differs from the price under the weaker forms of efficiency. Beating the market requires more and better information than anyone else possesses.

In contrast, Shiller (2000) argues that asset markets are subject to bubbles in which asset values increase because values are increasing – even though those values appear to be unhinged from fundamental determinants of value. During asset price bubbles investors downplay or ignore important pieces of information and are caught up in a “social contagion.” Indeed, investors may be using all publicly available information, but using it incorrectly because they are all caught up in the social contagion. If everyone expects asset prices to rise rapidly because prices have been rising rapidly, then asset prices will be set so that no one can “beat the market” without having inside information (i.e., semi-strong efficiency). Real estate assets are one of Shiller’s prime examples. Wyman, Seldin, and Worzala (2011) are among those suggesting that it is time to go beyond the efficient market paradigm for real estate valuation.

The purpose of this paper is to describe empirically how commercial real estate investors actually determine the Capitalization Rate that is used to convert net income into value. The paper begins by specifying a model of Capitalization Rates based on standard economic and financial theory in order to determine the variables that should be included in an empirical model. The model is estimated, and the results are given interpretation based on the concept of asset market efficiency.

Investors who would consider purchasing commercial real estate have a need to know how other investors who have purchased properties determine value. The basic real estate valuation equation is:

$$\text{Value} = \text{Net Operating Income divided by Capitalization Rate.}$$

Typically the potential investor has good information regarding the Net Operating Income of a property because these data are provided by the seller. The critical issue then in determining an offer price is the selection of the Capitalization Rate. As is shown below, the Capitalization Rate is related to the risk-adjusted discount rate chosen by the investor minus one very important factor – the expected percentage change in value. In particular:

$$\text{Capitalization Rate} = \text{Discount Rate minus Expected Percentage Change in Value}$$

The risk-adjusted discount rate is a target rate set by the investor based in part of perceived risk, and is discussed below. The expected percentage change in value is the wild card in the analysis. How do investors adjust their discount rates for anticipated asset price appreciation (or depreciation)? How does this adjustment vary by property type and economic circumstances? If a potential investor can determine how other investors make these decisions, then that investor can gauge the competition and decide whether to make a competitive bid.

This paper reports the results of a study of Capitalization Rates for office buildings that were purchased in 37 downtown markets during 2012. The study finds that Capitalization Rates depend on features of office buildings - Class A versus Class B

versus Class C. These variables capture the real depreciation of the asset. The capitalization rate also depends upon the general state of the market as represented by the vacancy rate. But potentially the most important finding is that recent change in the office building market (change in the vacancy rate over the past year) has strong effects on the Capitalization Rate used by the purchaser. In other words, investors are using basic economic data from the recent past to adjust the Capitalization Rate for expected changes in value. This is a sensible method if these recent trends continue, but not if there is evidence to suggest that a change in trend is likely. In short, if other investors are assuming that recent trends will continue but you think that those trends will be more positive, you can stand to be a very successful investor. However, if you believe that the recent trends will turn negative, then your best course of action is to sit out. Put this way, it seems obvious. This paper provides an empirical estimate of the effect of recent changes in vacancy rates on actual Capitalization Rates.

This paper takes the view that investors in commercial real estate such as office buildings use a lot of information to inform their asset valuations in accordance with Fama's notion of semi-strong efficiency. The evidence in this paper is consistent with the view that the office building market is much more than weakly efficient, and may be almost semi-strong efficient in that investors use publicly available variables that are consistent with economic and financial theory. However, the Capitalization Rate does not follow a random walk because its changes can be predicted using changes in the changes in the vacancy rate.

The Q Theory of Asset Acquisition

This section is a brief presentation of the Q theory of asset acquisition. The focus is on the returns to the marginal unit of asset acquisition by a profit-maximizing firm. The model is a modification of the standard theory of real investment. One of the standard assumptions in the received theory is that there is a cost of acquiring additional assets. The marginal adjustment cost is assumed to be increasing with the size of the adjustment; i.e., with the amount of investment. Following Romer (1996, Chapter 8), a discrete-time version of the theory is presented so that the linkage can be made to the single-period capital asset pricing model.

The firm maximizes the present-discounted value of profits subject to the constraint in each period that the stock of assets in the next period equals the stock in the current period plus the amount of investment undertaken. The Lagrangian for the firm's maximization problem is

$$L = \sum_t [1/(1+r)^t] [\pi(K_t)k_t - I_t - C(I_t)] + \sum_t \lambda_t (k_t + I_t - k_{t+1}), \quad (1)$$

where $\pi(K_t)$ = the marginal revenue product of capital at time t, a function of the total stock of capital K in the industry,

r = the discount rate for the firm,

k_t = the firm's stock of assets at time t,

I_t = asset acquisition during time t,

$C(I_t)$ = the firm's adjustment cost, a function of I_t ,

λ_t = Lagrange multiplier associated with the constraint relating k_t and k_{t+1} .

The summation is over time zero to infinity. The Lagrange multiplier gives the marginal value of relaxing the constraint; i.e., the marginal impact of an exogenous increase in k_{t+1} on the present discounted value of the firm's profits. Define

$$Q_t = (1+r)^t \lambda_t, \quad (2)$$

so the Lagrangian can be written

$$L = \sum_t [1/(1+r)^t] [\pi(K_t)k_t - I_t - C(I_t) + Q_t(k_t + I_t - k_{t+1})]. \quad (3)$$

The first-order condition for investment by the firm at time t is

$$Q_t = 1 + C'(I_t), \quad (4)$$

which states that the marginal value of assets equals its purchase price (equal to 1) plus the marginal adjustment cost. It is assumed that $C' > 0$; i.e., that there is a rising marginal adjustment cost. The first-order condition for the asset stock at time t is

$$[1/(1+r)^t] [\pi(K_t) + Q_t] - [1/(1+r)^{t-1}] Q_{t-1} = 0. \quad (5)$$

This can be rewritten as

$$\pi(K_t) = (1+r)Q_{t-1} - Q_t = rQ_{t-1} - \Delta Q. \quad (6)$$

Here ΔQ is the change in Q from time $t-1$ to time t . If we replace time $t-1$ with 0, then

$$\pi(K_1) = rQ_0 - \Delta Q, \quad (7)$$

which states that the marginal revenue product of capital at time 1 equals the discount rate times the marginal value of capital at time 0 minus the change in the marginal value of assets. Alternatively, the discount rate for the firm is:

$$r = [\pi(K_1) + \Delta Q]/Q_0. \quad (8)$$

And the marginal value of assets at time 0 can be written

$$Q_0 = [\pi(K_1) + \Delta Q]/r = 1 + C'(I_0). \quad (9)$$

Real estate professionals use the capitalization rate version of equation (7), which is:

$$\text{Cap Rate} = \pi(K_1)/Q_0 = r - \Delta Q/Q_0. \quad (10)$$

The Q theory of investment states that asset acquisition is a positive function of Q , which summarizes all of the information needed to determine investment. In equation (9) a higher value for Q_0 means a larger value for C' and therefore a larger amount of asset acquisition I at time 0.

The Capital Asset Pricing Model

The presentation of the CAPM follows standard sources such as Luenberger (1998). Those who are completely familiar with the assumptions of this standard model can skip to equation (11) below. The assumptions used to develop the CAPM are:

- There are perfect capital markets. Information is available to all at no cost, there are no transactions costs, and assets are infinitely divisible and fixed in supply. All investors can borrow and lend at the same rate of interest. The risk of default associated with borrowing is negligible.
- Investors are risk-averse and maximize the expected utility of wealth at the end of the planning horizon, which is one period in length. Portfolios are assessed only by the expected rate of return and the standard deviation of return.
- The planning horizon is the same for all investors, and all portfolio decisions are made at the same time.
- All investors have identical estimates of expected rates of return and standard deviations of returns.

The rate of return of a portfolio or of a risky asset is denoted as random variable r . From the second assumption above, the expected rate of return $E(r)$ and the standard deviation $\sigma(r)$ of portfolios are the objects of choice. This leads to the formation of an efficient set of risky portfolios. Introduction of a riskless asset with rate of return r_f leads to the conclusion that each investor will combine a single risky portfolio m (the market portfolio) with the risk-free asset. Risky portfolio m is combined by all investors in some proportion with the riskless asset. Market equilibrium requires that all risky assets be held in proportion to their market values; this condition determines the composition of the market portfolio m .

Given the above assumptions and in the absence of taxes, it is well known that the following equilibrium condition can be derived for any risky asset i in the market:

$$E(r_i) = r_f + [\sigma(r_i, r_m) / \sigma^2(r_m)] [E(r_m) - r_f] = r_f + \beta_i [E(r_m) - r_f], \quad (11)$$

where

$E(r_i)$ = the expected return for risky asset i ,

r_f = the risk-free borrowing and lending rate,

$E(r_m)$ = the expected return on the market portfolio,

$\sigma^2(r_m)$ = the variance of the returns of the market portfolio,

$\sigma(r_i, r_m)$ = the covariance between the returns for asset i and the market portfolio, and

$\beta_i = \sigma(r_i, r_m) / \sigma^2(r_m)$ = the "beta" of asset i .

This equation specifies a linear relationship between the required expected rate of return for an asset and its systematic risk, measured as β_i . The right-hand side of equation (11) is the conventional risk-adjusted discount rate.

Suppose the expected return for risky asset i can be written

$$E(r_i) = E(e_i) / V_i, \quad (12)$$

where $E(e_i)$ is expected earnings for the next period (including capital appreciation) and V_i is the current market value of the asset;

$$E(e_i) = \pi_i + E(\Delta V/V_i). \quad (13)$$

Equation (13) would then imply that value equals current income divided by the Capitalisation Rate:

$$V_i = \pi_i / \{r_f + \beta_i [E(r_m) - r_f] - E(\Delta V/V_i)\}. \quad (14)$$

Does this result carry over to the Q theory of investment and asset valuation? It does, as we shall see in the next section.

The Q Theory of Asset Acquisition and the Capital Asset Pricing Model

The Q theory of investment and the CAPM can be combined into one model of asset pricing and investment. The development of this combined model follows and extends the presentation of the “fundamentals” method of asset valuation in Tobin and Golub (1998, pp. 159-160). This method is identical to the Q theory presented above where the value of an investment is based on the stream of earnings, rather than on speculative movements in asset prices. Ownership of a unit of real investment is title to one unit of capital at replacement cost, and that unit of real capital produces a stream of real earnings, the stream of marginal revenue products in equation (1) above.

The following definitions are needed:

$$E(e_i) = E[\pi_i(K_i) + \Delta Q_i] \text{ from equation (8), so}$$

$$E(r_i) = E(e_i)/Q_i.$$

$$\text{Note: If } Q_i = 1, E(e_i) = E(r_i).$$

$$V_i^2 = \text{Var}(e_i), \text{ so}$$

$$\sigma_i^2 = V_i^2/Q_i^2, \text{ and}$$

$$V_{im} = E(e_i, e_m), \text{ so}$$

$$\sigma_{im} = V_{im}/Q_i Q_m.$$

$$b_i = V_{im}/V_m^2 = \beta_i Q_i/Q_m.$$

$$\text{Note the obvious equalities if } Q_i = Q_m = 1.$$

Substitution of these terms into the CAPM from equation (11) produces an equation for the expected return to investment i , written as

$$[E(e_i)/Q_i] - r_f = [(V_{im}/Q_i Q_m)/(V_m^2/Q_m^2)] \{ [E(e_m)/Q_m] - r_f \}. \quad (15)$$

This equation can be solved for Q_i to produce

$$Q_i = \{ [E(e_i)] - b_i [E(r_m) - r_f] Q_m \} / r_f. \quad (16)$$

Substituting for b_i from above produces the even simpler result that

$$Q_i = E(e_i)/(r_f + \beta_i \theta), \quad (17)$$

where $\theta = E(r_m) - r_f$, the market risk premium. Equation (17) states that the marginal value of capital equals e_i (the expected marginal revenue product plus the expected “fundamental” capital gain), divided by the risk-adjusted discount rate. Equation (17) can also be written as:

$$Q_i = \pi_i/[r_f + \beta_i \theta - E(\Delta Q/Q_i)], \quad (18)$$

current income divided by the capitalization rate.

This result is symmetric with the usual result in the CAPM that the expected rate of return for asset i is positively associated with systematic risk. Note that Q_m drops out of the equation for Q_i , a fact not stated by Tobin and Golub (1998, p. 160). The Q theory of asset acquisition implies that knowledge of the “fundamental” capital gain is central to the simplicity of the valuation formula in equation (18).

Application of the Asset Valuation Model to Real Estate

The income approach to value is often used for commercial real estate. In this method the income concept is net operating income (NOI), which is defined as effective gross income minus operating expenses, maintenance and repair costs, and reserves for replacement. Operating expenses include fixed and variable expenses (those that vary with the occupancy level in the building). Fixed expenses normally include insurance premiums and property taxes.

The general formula for current commercial real estate valuation is:

$$V_1 = \text{NOI}_1/(1+r_1) + \text{NOI}_2/(1+r_1)(1+r_2) + \dots + \text{NOI}_n/(1+r_1)\dots(1+r_n). \quad (19)$$

Here NOI_1 is the net operation income received during the first year, etc., and r_1 is the discount rate applied to the first year, etc. The life of the asset is n years. Income taxation at the business entity level is ignored on the grounds that many real estate investors are exempt from this tax because the investing entity is organized as a limited-liability company (LLC) or as a real estate investment trust.

Multiplication of both sides of the equation by $(1+r_1)$ produces:

$$(1+r_1)V_1 = \text{NOI}_1 + V_2. \quad (20)$$

Here V_2 is the value of the asset at the beginning of the year. This equation can be rewritten as:

$$V_1 = [\text{NOI}_1 + \text{Change in } V]/r_1, \quad (21)$$

or as:

$$\text{Capitalization Rate} = \text{NOI}_1/V_1 = r_1 - (\text{Percentage Change in } V), \quad (22)$$

and so

$$\text{Value} = \text{NOI divided Cap Rate.}$$

Equations (21) and (22) are more general versions of the Gordon valuation model. In the Gordon model net operating income changes by a factor of $(1+g)$ after the first year into perpetuity, so $V = \text{NOI}/(r-g)$ and/or Capitalization Rate = $r - g$. In this study the discount rate is assumed to be a weighted average of the expected rate of return to equity (based on the Capital Asset Pricing Model) and the interest rate on borrowed funds. The expected rate of return to equity can be set by the investor, and the cost of borrowed funds is known. Furthermore, the current net operating income of the property can be estimated with some precision based on existing leases. So the issue is estimating the percentage change in the value of the asset.

This section adds borrowing, capital gains taxation, and property taxation to the fundamental valuation model. Property taxation is not normally included in the CAPM, but virtually all real estate is subject to this tax, denoted τ , and capital gains are taxed at rate c . As noted above, the corporate income tax is not included on the grounds that real estate investment companies often are organized so as to avoid corporate taxation (e.g., as limited liability corporations or as real estate investment trusts). Consider the marginal unit of real estate investment, measured in physical terms. For example, the marginal unit of real estate could be a housing unit with standard features or a standardized amount of commercial real estate. Investment was purchased up to the point at which Q is equal to one plus the marginal adjustment cost, as in equation (4), so Q is the price of the marginal investment.

It is assumed that the investor issues some debt in the amount $D = \mu V$ (where V is the value of the levered investment) at rate b and purchases as much of its equity as it can with the proceeds; i.e., the investor obtains a mortgage loan. Both theory and empirical observation indicate that, at some point, the borrowing rate rises with the ratio of debt to value. McDonald (1999) demonstrated that, in a general equilibrium model of lenders and borrowers with a risk of default, the borrowing rate rises with the proportion borrowed provided that there are no costs of default (other than the unpaid principle and interest payments). If costs of default exist, then the lender can require a recourse loan to defray those costs. If a recourse loan is not used, then the lender can ration credit as shown by Stiglitz and Weiss (1981) and many others. The basic issue is that, if the lender charges a higher interest rate, the probability that the borrower will be unable to pay the debt service increases. In the absence of a recourse loan, the interest rate is an inefficient means for rationing credit and some form of direct rationing may have to be used. Maris and Elayan (1990) provided some empirical evidence that the weighted average cost of capital for real estate investment trusts is positively related to the ratio of debt to equity, and Hendershott and Shilling (1989) found a similar result for residential mortgages. While the capital asset pricing model is based on the assumption of a negligible risk of default, in the remainder of this paper it shall be assumed that the borrowing rate rises with the proportion borrowed so that leverage is not 100%.

The value of the equity in the levered investment is denoted V_e , the proportion of the total value of the investment V that is borrowed is denoted m . The required expected rate of return to equity is denoted $E(r_e)$ and can be written as

$$E(r_e) = E[\{B - \vartheta(V_e + \mu V) - b\mu V\} +]V_e(1-c)]/V_e = r_f + \beta_e\theta, \quad (23)$$

where β_e is the “beta” of the equity portion of the investment and θ is the market risk premium. The solution for the capitalization rate π/V is

$$\pi/V = [(1-\mu)(r_f + \beta_e\theta) + \tau + \mu b] - E(\Delta V_e/V)(1-c). \quad (24)$$

The capitalization rate is a weighted average of the return to equity and the borrowing rate, adjusted for the property tax rate and the expected after-tax capital gain. Normally the entire capital gain (or loss) accrues to equity, so $\Delta V_e = \Delta V$. In addition, the measure of current income that is used in real estate, net operating income (NOI), is computed net of property taxes. Denote the property tax bill as $T = \tau V$, so the capitalization rate used in real estate is

$$\rho = \text{NOI}/V = (\pi - T)/V = [(1-\mu)r_f + (1-\mu)\beta_e\theta + \mu b] - E(\Delta V/V)(1-c). \quad (25)$$

A basic version of equation (25) is the model that is estimated empirically. Furthermore, if the Capitalisation Rate is known (or assumed), then the estimated value of the real estate investment is $V = \text{NOI}/\rho$, net operating income divided by the “cap rate.”

Different estimates of the percentage change in asset value have an enormous impact on current asset valuation. For example, suppose that current NOI is \$100,000 and the current weighted-average discount rate is 10%. Assume percentage changes in asset value of -5%, -2%, 0, +2%, and +5%.

Asset value change	Cap Rate	Current value
-5%	15%	\$667 = 100/(0.1 + 0.05)
-2%	12%	\$833
0	10%	\$1000
2%	8%	\$1250
5%	5%	\$2000

Suppose a modest example in which other investors assume that asset values will increase by 2% over the next year, while you have good reason to think that asset values will be flat (no change). The asset values that you and the others place on the asset differ by 25%! Changes in asset value depend upon two forces; real asset depreciation and asset market forces that cause increases or decreases in assets of a given quality. Variables are included in the empirical study below to capture these two forces.

The conventional methods for the estimation of real estate asset value are of two basic types. Baum, Nunnignton, and Mackmin (2006, p. 91) define these two methods as follows.

The first ... is to assume a level of continuous income flow and to use an overall or all-risks capitalization rate derived from the analysis of sales of comparable properties let on similar terms and conditions (i.e. five year or seven year rent

review patterns) to calculate present value, that is market value. The second method has been named the discounted cash flow (DCF) approach.

Ring and Boykin (1986) state:

... it is the appraiser's duty to study earnings-to-price relationships at which comparable properties have exchanged in the open market and to use rates as well as methods of capitalization which reflect typical market practices and operations.

The empirical study reported in this paper is a version of the first approach.

The other method is a more elaborate procedure that is used in cases of limited market activity in which a table of discounted cash flow is constructed (including a reversion at the end of an assumed holding period). Given the acquisition price, the yield on equity is computed based on the amount and interest rate on the loan taken to finance the acquisition. Much effort is expended to estimate the cash flow to take into account changes in rents, expenses, and amortization. The estimation of value at the time of the reversion also is a critical exercise. Baum, Nunnington, and Mackmin (2006, p. 92) point out the advantages of the DCF method as follows.

The strongest criticisms of the normal approach are that it fails to specify explicitly the income flows and patterns assumed by the valuer and, that growth implicit all risk yields are used to capitalize flows of income. The DCF approach requires the valuer to specify precisely what rental income and expenses are expected when, and for how long. The valuer therefore is forced to concentrate on the national and local economic issues likely to affect the value of a specific property as an investment.

The last step in the DCF method is to compare the implied rate of return to equity against the rate of return that equity holders demand. The method does not necessarily produce just one implied rate of return to equity. For example, French and Gabrielli (2005) show how to introduce uncertainty into the DCF method, and therefore produce a range of possible returns to equity.

Now it is time to study some real transactions.

Capitalization Rates for Downtown Office Buildings

The empirical study uses data provided by CBRE (2012, 2013) on Capitalization Rates for 37 downtown office markets for the year 2012. The sample includes the largest downtown markets – New York (Manhattan), Los Angeles, and Chicago – and a sample of large and medium-sized markets. The markets included are evenly distributed by region with 41 in the North, 33 in the South, and 36 in the West. The downtown markets included are listed in the appendix. See McDonald and Dermisi (2009) for a review of earlier empirical studies of Capitalization Rates. The previous studies by Sivitanides and Sivitanidou (1996) and Sivitanidou and Sivitanides (1999) of office buildings across metropolitan areas found that increases in demand had negative effects and the vacancy rate had a positive effect on the average Capitalization Rate. McDonald and Dermisi

(2009), in a study of individual office buildings, found that the (positive) change in the vacancy rate had a positive effect and that an increase in employment had a negative effect on the Capitalization Rate.

CBRE reports ranges for Capitalization Rates by class of building (A, B, or C) for these markets. This study uses the mid points of those ranges. Class A buildings are the best and newest buildings in the market that command the highest rents, Class B buildings are older but generally of good quality, and Class C buildings are the oldest and lowest-quality buildings that command the lowest rents. CBRE also provides vacancy rates in these markets for the third quarter of 2011 and the third quarter of 2012. The year-on-year change in the vacancy rate is used in this study. The means, standard deviations, and ranges of the variables used in the study are as follows.

	Mean	Std. Dev.	Minimum	Maximum
Capitalization Rate	8.17%	1.87	3.75%	13.5%
Vacancy Rate 3Q 2011	17.99%	5.24	7.60%	27.50%
Change in Vacancy Rate	0.51%	1.76	-3.90%	3.70%
Class A Buildings	0.34			
Class B Buildings	0.34			
Class C Buildings	0.32			
North Region	0.37			
South Region	0.30			
West Region	0.33			

Class C has fewer reported capitalization rates because there was no Class C rate reported for Manhattan. The sample size is 110.

The mean Capitalization Rates by class of building and region are:

	Class A	Class B	Class C
North	7.40	8.89	10.35
South	6.65	8.01	9.42
West	7.07	8.04	9.38

Recall that equation (25) is:

$$\rho = \text{NOI}/V = (\pi - T)/V = [(1 - \mu)r_f + (1 - \mu)\beta_e\theta + \mu b] - E(\Delta V/V)(1 - c). \quad (25)$$

All of the data in the study refer to the year 2012, so the risk-free rate and the borrowing rate are assumed to be the same for each market in the study. However, the equity beta can vary by market and by class of building. The expected change in market value also varies by market and by class of building. Therefore this study concentrates on an abbreviated version of equation (25) as follows:

$$\begin{aligned} \rho = \text{NOI}/V = (\pi - T)/V &= [(1 - \mu)r_f + \mu b] + (1 - \mu)\beta_e\theta - E(\Delta V/V)(1 - c). \\ &= \text{Constant} + (1 - \mu)\beta_e\theta - E(\Delta V/V)(1 - c). \end{aligned} \quad (25')$$

Equity beta is proxied by the general state of the market (vacancy rate in the third quarter of 2011) and by building class. A weaker market (higher vacancy rate) and a building of lower class represent greater risk, so the required return to equity should be higher. A higher vacancy rate may signal further greater fluctuations in the market, and a downturn in the market likely will have the larger impact on buildings in lower classes. Class C buildings in particular normally operate with short leases and can lose tenants relatively quickly. The change in the vacancy rate is the proxy for the expected change in building value. A larger reduction in the vacancy rate signals a larger expected increase in market value. In addition, dummy variables for the region of the country are included (North, South, and West) as proxies for past long-term economic growth. The South and West have grown more rapidly than the North for decades, at least since 1970. See McDonald (2014) for a detailed examination of urban growth by region. Empirical results are displayed in Table 1.

Examine the results in column 1. The Capitalization Rates for Class B buildings are greater than Capitalization Rates for Class A buildings by 1.22 percentage points, and the rate for Class C buildings is greater by 2.56 percentage points over Class A buildings (and 1.34 percentage points over Class B buildings). These results line up as expected. The effect of the vacancy rate in the third quarter of 2011 is strongly positive; a percentage point higher vacancy rate produced a Capitalization Rate that was 0.18 percentage points greater (18 basis points). Recall that vacancy rates had a standard deviation of 5.09%, so a variation of one standard deviation meant a difference in the capitalization rate of 92 basis points. The effect of the change in the vacancy rate is even larger. A reduction in the vacancy rate of one percentage point produced a reduction in the capitalization rate of 24 basis points. Recall that the change in the vacancy rate varied from -3.90 to +3.70, a range that produced a variation in the Capitalization Rate of 1.82 percentage points (182 basis points). Results not shown investigated whether these effects of the vacancy rate and its change varied by building class. They did not.

Predicted Capitalization Rates evaluated at the mean values of the vacancy rate in the third quarter of 2011 (17.99%) and the change in the vacancy rate to the third quarter of 2012 (0.51%) by class of building and region are:

	Class A	Class B	Class C
North	7.97%	9.28%	10.55%
South	6.83%	8.09%	9.41%
West	6.51%	7.77%	9.09%

Column 2 in the table displays empirical results that omit the regional dummy variables to examine whether the coefficients of other variables are sensitive to their omission. As it turns out, these coefficients are not sensitive to the omission of regional dummies, and that the inclusion of region increases the explanatory power of the equation.

Conclusion

This empirical study of Capitalization Rates for downtown office buildings in 37 metropolitan areas is based on standard economic and financial models. Variables that

capture the extent of physical and functional depreciation of the asset (class of building) have the expected effects. And strength of and recent changes in the rental market for office space, and measured by the vacancy rate and the recent change in the vacancy rate, are found to have large impacts on Capitalization Rates. These results show that investors use a great deal of information in the formulation of the Capitalization Rates used in winning bids for building acquisition. The results suggest Fama's weak-form efficiency. However, the use of recent changes in the rental market indicates a rather naïve form of forecasting, and suggests (but does not prove) that all of the publicly available information may be used. According to the results presented in this paper, Capitalization Rates used by investors are predictable because changes in the recent change in the vacancy rate will be reflected in the Cap Rate. Further studies are needed to discover whether the findings of this study carry over to other time periods, markets, and property types.

Table 1
 Regression Analysis of Capitalization Rates:
 Downtown Office Buildings: 2012

Variable	Column 1 Coefficient (T value)	Column 2 Coefficient (T value)
Constant	3.146 (7.50)	3.933 (8.37)
Class A Buildings	Omitted Category	Omitted Category
Class B Buildings	1.262 (5.08)	1.222 (4.19)
Class C Buildings	2.579 (10.30)	2.538 (8.65)
Vacancy Rate 3 rd Qtr. 2011	0.180 (8.66)	0.172 (7.28)
Change in Vacancy Rate, 3Q11-3Q12	-0.241 (3.94)	-0.211 (3.08)
North Region	1.462 (5.90)	---
South Region	0.325 (1.18)	---
West Region	Omitted Category	---
R-square	0.690	0.566
R-square (adj.)	0.672	0.549
Sample Size	110	110

Appendix: Downtown Office Markets Included in the Study

North	South	West
NY (Manhattan)	Atlanta	Los Angeles
Chicago	Charlotte	Albuquerque
Baltimore	Jacksonville	Las Vegas
Boston	Miami	Phoenix
Philadelphia	Nashville	Portland
Pittsburgh	Orlando	Sacramento
Washington, DC	Tampa	Salt Lake City
Cincinnati	Austin	San Diego
Columbus	Dallas	San Francisco
Detroit	Houston	San Jose
Indianapolis	San Antonio	Seattle
Kansas City		Denver
Minneapolis		
St. Louis		

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