Commercial Real Estate Market Property Level Capital Expenditures: An Options Analysis[§]

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Abstract

Option pricing theory predicts that capital improvement expenditures are positively linked with high or increasing market lease rates. Ceteris paribus, when the market lease rate is high, or when there is an expectation of higher lease rates in the future, owners are encouraged to increase investment to capture a larger profit. In contrast, when the market lease rate is low, or when there is an expectation of lower lease rates in the future, owners are encouraged to defer capital improvements, causing a skewness in the cash flows. However, not all capital improvement decisions are made on this basis. Some capital expenditures are defensive investments, made when the market lease rate is low, or when there is an expectation of lower lease rates in the future. Defensive investments can, in theory, improve cash flow, reduce vacancies, reduce leasing and repair costs, and preserve building value. Still, defensive investments can be shared growth options, easily replicated by others with minimal effort. Consequently, it is possible for any routine cost reductions or any economic rent associated with defensive investments to be dissipated over time, or at least so the theory goes. We test these predications using property-level data during the period from 2003 to 2012. The evidence supports the conjecture that capital improvements lead to higher incomes. The evidence does not, however, provide support for the conjecture that capital expenditures are fully capitalized into market values. In point of fact, the evidence argues just the opposite. Nonetheless, despite this result, the same data provide evidence that investors are fully, or more than fully, compensated in terms of overall total return on investment for the differing expenditures. We also find evidence suggesting that defensive capital investments may actually perform better than capital investments made in boom times (i.e., when market lease rate are high or increasing). The latter runs counter to theory and intuition.

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1 Introduction

A vast literature following Dixit and Pindyck (1994), Carlson et al. (2004), Mauer and Ott (2000), Titman, Tompaidis, and Tsyplakov (2004), and Childs et al. (2004) views capital improvement expenses as options. This literature suggests that capital improvement expenditures should be, and are, linked with high or increasing market lease rates. Ceteris paribus, when the market lease rate is high, or when there is an expectation of higher lease rates in the future, owners are encouraged to increase investment to capture a larger profit. In contrast, when the market lease rate is low, or when there is an expectation of lower lease rates in the future, owners are encouraged to defer capital improvements, causing a skewness in the cash flows.

However, not all capital improvement decisions are made on this basis. Some investments are defensive investments, made when the market lease rate is low, or when there is an expectation of lower lease rates in the future. Defensive investments can, in theory, improve cash flow, reduce vacancies, reduce leasing and repair costs, and preserve building value. In these circumstances, the owner's return on investment relative to the lower rate of return that would otherwise be realized on the asset in a period of low or declining market lease rates should be no less than one. Nevertheless, it is not appropriate to think that defensive investments are simple growth options that create a sustainable competitive advantage. Rather, defensive investments might be more realistically thought of as shared growth options that can be replicated easily by others with minimal effort. Consequently, theory is unclear on just what we should expect regarding the market capitalization of defensive capital investments, and whether defensive capital investments lead to normal returns.

Littleevidence exists regarding the effects of capital investment expenditures on investment returns with the possible exception of Mueller and Reardon (1993), and concurrent papers by Peng and Thibodeau (2014), and Ghosh and Petrova (2014). Mueller and Reardon

(1993) outline a methodology that can be used to examine whether owners over- or under-invest in pursuing capital investments. We extend Mueller and Reardon's model to the case of capital improvement expenditures. We test three hypotheses using this methodology. The first hypothesis is whether capital improvement spending confers an overall benefit on owners in terms of a higher cash flow. The second hypothesis is whether capital improvement expenditures are fully capitalized into market values. The third hypothesis is whether capital improvement expenditures generate normal or above-normal returns for investors.

The model is estimated using a multi-level, or hierarchical, structure. The model allows market capitalization effects to vary across properties due to observed and unobserved factors. The covariates that appear in the model are grounded in real options theory. The theory (see Section 2) leads to several interesting questions about times of high or increasing lease rates, times of low or decreasing lease rates, the type of property being renovated, the role of leverage, and so on. As per theory, for example, high quality levels allow owners to capture a larger percentage of the higher lease rates when current lease rates are high or expected to increase. However, a property's depreciation rate can influence the percentage of the higher lease rate captured. Accordingly, income and market capitalization effects should vary from property type to property type. Therefore, it is expected that properties within a property type are likely to be more similar than properties in a different property type. These effects are very important for an understanding of the effects of capital investment expenditures on investment returns. Following on from this, the model is also used to study among other things whether investors receive the same total return on defensive capital investments made when market lease rates are low or decreasing as on capital investments made when market lease rates are high or increasing.

Our main conclusions regarding the effects of capital investment expenditures on investment returns are: (1) The evidence supports the conjecture that capital improvements lead to higher incomes. (2) On the other hand, the evidence suggests that capital expenditures are less than fully capitalized into market values. The findings are consistent with Peng and Thibodeau's (2014) findings that capital expenditures on building improvements have seemingly little effect on property price indices. (3) Despite this result, the same data provide evidence that investors are fully, or more than fully, compensated in terms of overall total return on investment for the differing expenditures. These findings are consistent with the general pattern described by Ghosh and Petrova (2014). (4) The less-than-full market capitalization of capital expenditures can be explained by the fact that in periods of high (low) market lease rates, market values may already be higher (lower) than future returns warrant, which, in turn, explain why market prices adjust less robustly (or more spiritedly) in these two different periods. (5) The results support the conclusion that defensive capital investments actually perform better than capital investments made when market lease rate are high or increasing. The latter runs counter to theory and intuition, but can be explained by the same set of factors as put forth in (4).

The remainder of the paper is set out as follows. The next section contains a brief discussion of the theory of capital expenditures and discusses differences between defensive capital investments made in periods when market lease rates are low or declining and capital expenditures made in periods when market lease rates are high or increasing. Section 3 contains some implications of the theory. Section 4 contains a discussion of the testing strategy. Section 5 contains our empirical results, while Section 6 draws out the implications of the results. A final section concludes.

2 Background and Theoretical Development

2.1 Example 1: Property Improvements Made to Generate Income when Lease Rates are Upward-Sloping

Consider the example of Arbor Park of Alexandria (previously known as Orleans Village), an apartment community in Alexandria, Va. Arbor Park consists of 851 one- and two-bedroom apartments and two- and three-bedroom town houses in 52 buildings. All units are being completely renovated one section at a time and include upgraded kitchens and baths, new appliances, floors, cabinets, and counters, and full-size stackable washers and dryers as well as replacing fences and painting the buildings' exteriors and adding new plantings to individual patios and community courtyards. Wherever possible, floor plans are being reconfigured to add more bedrooms and bathrooms. Renovations to Arbor Park began in January 2010 with a $5.4 million upgrade of the electrical and mechanical infrastructure, allowing for individually controlled, energy-efficient heating and air conditioning (green energy savings). The total redevelopment budget is $25 million and renovations are expected to be complete in 2014.

Arbor Park provides a useful example of the kind of capital improvements investors routinely undertake when market lease rates are high or future lease rates are expected to rise. The expenditures are extensive, taking several quarters (or up 5 to 7 years in special cases) to complete. The expenditures are momentous, allowing lower class units to be turned and repositioned into higher class, higher-valued units. The expenditures are targeted, focusing on high barrier-to-entry, high-growth (non-reproducible) niche markets. The expenditures are with purpose, deliberately designed to go after high yields, high profits.

2.2 Example 2: Property Improvements Made to Maintain a Steady Income when Lease Rates are Downward-Sloping

This example will also refer to multifamily residential housing. Regency Club Apartments in Jackson, NJ were acquired in 2004 for a total purchase price of $36.4 million. Regency Club consists of 372 one- and two-bedroom units in 31 two-story buildings on a total of approximately 24 acres. The property includes a fitness center, a large outdoor swimming pool, tennis court and play area. In the 2001 to 2004 period, market lease rates were declining due to negative job growth. Minor renovations to Regency Club were done in an attempt to reduce vacancies and increase rentability of the units. These renovations costing $1.7 million included work to correct deferred maintenance, improve the property's curb appeal, signage and leasing center.

This example illustrates an important point: defensive capital investments take pretty much no time at all. Defensive investments focus on adding curb appeal and changing perceptions about the property. Defensive investments do not add functionality. Nor do they change spatial quality. Instead, defensive investments tend to focus on painting the inside or outside, installing new floor coverings, installing or refurbishing cabinetry, installing or replacing doors and windows, and making ordinary repairs and improvements. Defensive improvements can be replicated easily by others and therefore do not necessarily create a sustainable competitive advantage.

2.3 The Theory of Investment

Our examination of the theory of investment follows that of Dixit and Pindyck (1994), Carlson et al. (2004), Mauer and Ott (2000), Titman, Tompaidis, and Tsyplakov (2004), and Childs et al. (2004). These option-pricing models have typically employed special cases of the following general specification.

2.3.1 Model Set-Up

There are two market lease rates: one corresponding to a short-term market lease rate at time t, l_t, and one corresponding to a longer-term lease contract, L_t, where the short-term lease rate essentially mean-reverts toward the long-term lease level. This assumption adds a degree of realism to the analysis.

Short-term lease rate:

$$dl_t = \kappa(L_t - l_t)dt + \sigma_l \, l_t \, dW_l \quad (1)$$

Long-term lease rate:

$$dL_t = L_t \, \mu \, dt + \sigma_L \, L_t \, dW_L \quad (2)$$

where the parameters of the process are:

κ	=	mean-reversion rate for the lease rate,
σ_l, σ_L	=	instantaneous volatilities of the lease rate and the long-term lease level,
μ	=	growth rate of the long-term lease level, and
W_l, W_L	=	standard Weiner processes, with a correlation coefficient equal to $\rho_{l,L}$.

The cash flow for a specific property is determined by two factors, the quality of space that is occupied by the tenant, q, and the short-term lease rate, l. The quality of space is normalized between 0 (tear-down) and 100 percent (perfect condition). Tenants let space at the property until it ceases to operate. Tenants are assumed to be price-takers in the leasing market, competing with many other tenants in a perfectly competitive rental market. The product of the short-term lease rate for a project in perfect condition, l, and the quality of space, q, gives the effective lease rate for a property with quality q.

The quality of the property is a strictly concave and increasing function of the stock of maintenance, M,

$$q(M) = 1 - e^{-\alpha M} \qquad (3)$$

where α is the rate of incremental improvement per unit of investment in the quality of the property with zero initial quality level. One would expect that as the stock of maintenance, M, tends to infinity (i.e., perfect maintenance), quality approaches 100 percent. In contrast, as the stock of maintenance approaches zero (i.e., abandonment), quality approaches 0 percent.

The stock of maintenance, M, depreciates at a constant rate, γ, so that the change in M is given by

$$dM_t = -\gamma\, M_t\, dt + m_t\, dt \qquad (4)$$

where m_t is the rate of investment in the stock of maintenance. The property owner chooses when (and whether at all) to invest in the stock of maintenance at time t. The decision is made in a manner that maximizes the property value. The optimal rate of investment is assumed to be non-negative and unbounded from above; the latter accounts for situations where large instantaneous improvements in quality are optimal.

2.3.2 The Value Function

The value of the property is simply the expected present value of the discounted future cash flows net of capital investment expenditures. The closed-form solution for the expected present value of the property is

$$E^u(r,l,L,M) = \max_{m \geq 0} \left\{ E_Q \left[\int_0^{\infty} (l_t q(M) - m_t) e^{-\int_0^t r_s ds} dt \right] \right\} \quad (5)$$

where $r_t$is the (non-stochastic) risk-free interest rate in period t, $E_Q$is the expectation under the risk-neutral measure Q, and the other terms are defined as above. The quantity $l_t q(M_t) - m_t$ is the operating profit function for the property at time t. The initial values of r_0, l_0, L_0, and M_0 are $r_0 = r$, $l_0 = l$, $L_0 = L$, and $M_0 = M$, respectively. We are able to discount at the risk-free rate because we assume L_t grows at a risk-neutral rate $\mu - \delta$ rather than at a real drift rate, where $\mu - \delta$ is the equivalent Martingale measure or Q-measure and δ is the spread over the risk-neutral rate (i.e., the premium the market demands for investing in a risky real estate asset). The infinite time horizon structure in (5) implies that there need not be a definite date when the tenant must cease to operate.

Given the value of the short-term interest rate, r, the current lease rate, l, the long-term lease level, L, and the level of the stock of maintenance, M, the value of the property can be uniquely determined by maximizing

$$E^u(r,l,L,M) = \max_{m\geq 0}\{l(t)q(M(t)) - m + e^{-r(t)dt}\, x\, E_Q[E^u(r(t+dt), l(t+dt), L(t+dt), M(t)(1-\gamma dt) + m\,dt)]\} \quad (6)$$

where the term $E_Q[E^u(r(t+dt), l(t+dt), L(t+dt), M(t)(1-\gamma dt) + m\,dt)]$ accounts for all possible quality levels in the future. Knowing the property value at all future times, the choice of optimal capital investment is simple. The decision is to choose the initial value of m that maximizes (6). The solution can be given as the solution to the Hamilton-Jacobi-Bellman equation

$$\frac{\sigma_L^2 L^2}{2} E_{LL}^u + \rho_{l,L}\sigma_l\sigma_L L\, l\, E_{lL}^u + \kappa(L-l)E_l^u + (\mu-\delta)LE_L^u - \gamma M E_M^u + l\, q(M) - rE^u + \max_{m\geq 0}(mE_M^u - m) = 0 \quad (7)$$

where the subscripts denote partial derivatives. The solution is subject to the following boundary condition:

$$E_M^u \leq 1. \qquad (8)$$

This boundary condition incorporates the economic intuition that a capital investment-spending program (e.g., the replacement of an old roof, lighting, or plumbing fixtures with new items) should add to value and that the marginal increase in value should, in equilibrium, equal the amount of the investment. Otherwise, if the marginal increase in value is greater than the amount of the investment, the optimal investment choice is to invest until the capital investment expenditures are just economically justified. On the other hand, if the marginal increase in the value is less than the amount of the investment, then the optimal investment choice is not to invest at all.

This formal model makes clear that capital investments allow the investor to capture higher current lease rates, or the expectation of higher lease rates in the future, $L(t)$, since, ceteris paribus, a higher rate of investment spending leads to a higher M, and a higher M, in turn, implies a higher $q(M)$ and a larger $l(t)q(M(t))$. Further, the model makes clear that the optimal rate of investment depends on the parameters r, μ, γ, σ_l and σ_L.

3 Implications

The above framework has important implications. For instance, the theory suggests that the rate of investment in the stock of maintenance, $m(t)$, in (7) is decreasing in the long-term lease level, $L(t)$. That is, a lower $L(t)$ encourages owners to defer capital improvement expenses and vice versa. This result is driven by the positive relation between M and $q(M)$, which encourages owners to defer investment and reduce quality, $q(M)$, when the market lease rate is low, $L(t)$, or when there is an expectation of lower lease rates in the future, and limits the benefit that accrues to original debtholders. In contrast, when the market lease rate is high, $L(t)$, is high, or when there is an expectation of higher lease rates in the future, owners are encouraged to increase investment to capture a larger $l(t)q(M(t))$. This result leads to our first hypothesis.

Hypothesis 1: Ceteris paribus, the greatest capitalization impact of capital improvements should be when the market lease rate is high or when there is an expectation of higher lease rates in the future.

Our second hypothesis predicts that capital improvements should be put off when the market lease rate is low, or when there is an expectation of lower lease rates in the future.

Hypothesis 2: When the market lease rate is low or when there is an expectation of lower lease rates in the future, a drastic reduction in capital improvements is likely to occur.

This result is a direct consequence of the following two assumptions. First, real estate is simply an asset producing cash flows, with a current lease rate, l, which mean-reverts to the long-term lease level, L, over time. Second, the long-term lease level, L, is set in a competitive market. Thus, without any means to effectuate the arrest in the current lease rate, l, when there is an expectation of lower lease rates in the future, owners allow the quality level, $q(M)$, to decline until such time that capital investments will once again allow the investor to capture higher current lease rates.

Hypothesis 3: Defensive capital investments should have little effect on cash flows or market values where asset values are endogenously determined by market conditions.

Depending on the extent to which the property is levered, we would expect the rate of capital investment to vary considerably. By deferring capital improvements and decreasing quality when the market lease rate is low or declining and by increasing capital improvements and quality when the market lease rate is high or increasing, the cash flow distribution over the full life of the investment becomes skewed. This skewness works in a way to the benefit of owners, but to the detriment of original debtholders. Of course, debtholders anticipate this skewness and the ensuing increase in risk, so it is not clear whether capital improvement spending confers an overall benefit on owners in terms of a higher yield on investment, or in terms of a higher price. The net effect may be a wash, or it may not.

Hypothesis 4: Within the context of the model, the rate of capital investment induces skewness in the distribution of future cash flows. Ceteris paribus, if loan-to-value ratios are increased, the skewness increases since debtholders do not benefit from the higher cash flows in the favorable future states of the economy and are hurt by the fact that investment flexibility also tends to decrease the collateral value of the asset in the unfavorable states in which the borrower defaults.

Deferring capital improvements is more valuable the greater the uncertainty, σ_L. Here the option to wait to invest implicitly provides insurance against possible declines in the value of the property. However, it is worth noting that the depreciation rate of the project, γ, will affect the rate of investment. Holding all else constant, higher depreciation rates make investment expenditures less irreversible. As such, as the volatility of lease rates increases, the optimal deferral of investment may or may not increase (at least for some property types). This implication cries out for testing.

Hypothesis 5: Market capitalization effects of capital improvements may vary by property type depending on the rate of property depreciation.

Other implications of the model are as follows. First, deferring investment is costly when current lease rates, $l(t)$, are high, as higher quality levels allow owners to capture a larger percentage of the higher lease rates. Second, an owner of a project with an initial quality level above the efficient level (i.e., $q(M(t)) > q(M^*(t))$) will allow the property to depreciate until it reaches the efficient level. On the other hand, an owner of a project with an initial quality level below the efficient level (i.e., $q(M(t)) < q(M^*(t))$) will immediately invest an amount that brings the property to the efficient quality level, which would be in line with the type of clustering we see (or at least we think we see) in capital improvement spending.

4 Testing the Theory

We turn now to using changes in market values and net incomes over time to test the extent to which the returns on capital expenditures are equal to the cost of capital required to make the investment. Here we follow the methodology set forth in Mueller and Reardon (1993) but appropriately modified to deal with the longitudinal nature of the data. In what follows only capital expenditures on renovations or building improvements are used in the analysis.

4.1 Data Analysis Strategy

4.1.1 The Test for Market Capitalization

The methodology developed by Mueller and Reardon (1993) to measure the extent to which returns on capital expenditures are equal to the cost of capital required to make the investment is as follows. The basic notion is that the market value of the property, M_t, at the end of period t can be defined as the market value of the property at the end of t – 1, M_{t-1}, plus the present value of the investment made in t, PV_t, minus the depreciation of the property over the period, $d_t M_{t-1}$, plus any error the market makes in evaluating the present value of the property at the end of period t, u_t:[1]

$$M_t = M_{t-1} + PV_t - d_t M_{t-1} + u_t. \tag{9}$$

Profit maximization requires that the owner's capital investment I_t in period t should have the same present value PV_t if it earned the return r in perpetuity:

$$PV_t = I_t \times (r_t / i_t) \tag{10}$$

where i_t is the owner's cost of capital. Otherwise, the capital investment should not be made.

Let $c_t = (r_t / i_t)$ be constant. In addition, let d_t be constant. Then

$$(M_t - M_{t-1})/M_{t-1} = -d + c(I_t / M_{t-1}) + u_t' \tag{11}$$

Mueller and Reardon estimate the above equation using pooled cross-section-time series of firms. The coefficient on (I_t / M_{t-1}) yields an estimate of the average c – the return on investment divided by the firm's cost of capital. Mueller and Reardon find that c is 0.74 – i.e., that firms earned a return equal to about ¾ of its cost of capital on total capital investment.

4.1.2 The Test for Higher Cash Flow

Here we extend Mueller and Reardon's analysis to examine whether capital improvements – especially, defensive improvements – may successfully reduce vacancies and improve all lease-up activities and may create relatively higher profits. We start by assuming capital investment, I_t, in period t generates real cash flows, CF_t, in period t by reducing vacancies and improving lease-up activities. We assume

$$CF_t = I_t \times \rho_t \tag{12}$$

[1] Capital investments are assumed to be made at the beginning and returns are realized at the end of the period.

where ρ_t is the cash-on-cash return on capital investment. The cash-on-cash return on capital investment is assumed to be constant.

We assume net operating income at the end of period t can be defined as net operating income at the end of t – 1, NOI_{t-1}, plus the real cash flow generated by investment made in t, CF_t, plus the real increase in net operating income over the period, $\mu_t NOI_{t-1}$, plus an error term:

$$NOI_t = NOI_{t-1} + CF_t + \mu_t NOI_{t-1} + \varepsilon_t \quad (13)$$

The drift in income is assumed to be constant.

Substituting (12) into (13) and rearranging gives

$$(NOI_t - NOI_{t-1})/NOI_{t-1} = \mu_t + (\rho_t I_t)/NOI_{t-1} + \varepsilon'_t \quad (14)$$

We specialize our model by assuming

$$M_t = NOI_t/k_t \quad (15)$$

where k_t is the property's cash-on-cash return. We assume k_t is constant.

From equations (14) and (15), it follows that

$$(NOI_t - NOI_{t-1})/NOI_{t-1} = \mu + b(I_t/M_{t-1}) + \varepsilon'_t \quad (16)$$

where $b = (\rho/k)$. Inspection of equation (16) suggests that $b \gtreqless 1$ if $\rho \gtreqless k$, which is how we test the nature of the income effect emanating from capital improvements.

4.1.3 A Test for Higher Total Return

We are also interested in the ex post returns over periods when capital expenditures are made. We compare market values before capital improvements are made with the amount of net operating income and market value increase immediately after the capital improvements are made, and use this ratio to estimate whether the total return is commensurate with the amount of the capital improvements plus a reasonable return on these invested funds.

The basic logic of the testing strategy can be illustrated as follows. Let $r_t M_{t-1}$ denote the actual return earned over the period when capital improvements are made. In this case, the ex post return is

$$r_t M_{t-1} = NOI_t + \Delta M_t \tag{17}$$

Manipulation of (17) using (9), (10), (12), and (13) yields

$$r_t = NOI_t/M_{t-1} + (M_t - M_{t-1})/M_{t-1} = (NOI_{t-1}/M_{t-1})(1+\mu) - d + [\rho + c](I_t/M_{t-1})$$
$$+u_t' + \varepsilon_t' \tag{18}$$

Or equivalently,

$$(NOI_t - NOI_{t-1})/M_{t-1} + (M_t - M_{t-1})/M_{t-1} = \rho\mu - d + [\rho + c](I_t/M_{t-1})$$
$$+u_t' + \varepsilon_t' \tag{19}$$

With $c = 1$, inspection of equation (17) suggests that the coefficient of (I_t/M_{t-1}) should equal $1 + \rho$ if managers are investing at a rate of return equal to their cost of capital.

4.2 The Sample

The data for this study are from the National Council of Real Estate Investment Fiduciaries (NCREIF) database. The NCREIF database is a proprietary database made up of income-producing properties owned by NCREIF members. NCREIF qualifying-data-contributing members are investment managers and plan sponsors who own or manage U.S. real estate generally in a fiduciary, tax-exempt setting. Data-contributing members report on the level of net operating income as well as the market values of each investment in their portfolio every quarter. The keystone of our analysis is the data on capital expenditures, broken down by initial acquisition costs, recurring capital expenditures, tenant improvements, and leasing commissions. This paper exploits the data on recurring capital expenditures, focusing on building capital improvements and expansions, and other capital improvements.

We use the data from 2003 through 2012, since they are the most reliable figures on capital expenditures. We assemble a large database measuring when the capital expenditures decisions are made (which could occur multiple times for a given property), the total capital expenditures made, and the reported property values and net operating income four quarters before and four quarters after the capital expenditures. By collecting property values and net operating incomes in these two periods and annualizing the percentage change to compare investments with different construction periods, we are able to examine if the market values rise by an amount equal to the investment made and if the net operating incomes adjust to yield a required rate of return.

We first provide a discussion of the characteristics of the data and then present some stylized facts. In the data, it is possible to observe positive and negative values for capital expenditures. The rational for the negative values is an artifact of the accrual accounting system for reporting to NCREIF. For example, it is possible that spending on capital improvements may be accrued at the time the data are reported, but not spent. Thus, during a recessionary downturn, say, when a manager might defer projects or cut expenditures, negative values can occur to reflect previous allowances for capital expenditures that did not subsequently occur. Alternatively, during an expansionary period negative values might reflect a project that comes under the capital expenditure budget. Lastly, it is possible to observe in the data a one-off negative value from, for example, asset sales. This method of accounting for capital expenditures introduces a degree of arbitrariness into our calculations. When examining the data, we aggregate over all contiguous time periods where there is a string of positive or negative capital expenditures reported. We assume a reported 0 value following a run of positive or negative values (however long the string may be) signals the end of the project and the move directly into the enhanced services phase. If the aggregated sum of expenditures is negative, the observation is deleted from the analysis. Similarly, observations are deleted if they consist of one-off negative values. Changes in market value and NOI are measured across the same contiguous quarters as the capital expenditure spending (we also consider lags to allow for the benefits of the capital expenditures to be recognized in market values or the time it might take to lease improved space). These data are from the

NCREIF database as well. One consequence of our sample design is that we have a sample composition consisting of capital expenditures made over various durations in length. Further, some properties may have a series of observations, while other properties may only have one observation.[2]

Table 1 provides a summary of the number of sample points by property type across the sample period. The large number of industrial properties in the sample is evident from the table. Just over half (53.6%) of the sample is composed of industrial properties. Office is the next largest component of the sample (26.7%), followed by retail (16.2%) and apartments (3.6%).

[Table 1 here]

To describe location, we use the following functional classifications. Our categories are: (1) *Capital Metro Markets*, including Washington, D.C.; (2) *Heartland Markets*, including Chicago, Cincinnati, Cleveland, Detroit, Columbus, Indianapolis, Kansas City, Memphis, Minneapolis, Nashville, and St. Louis; (3) *Lifestyle Centers*, including Southeast Florida,[3] Sacramento, San Antonio, Las Vegas, Orlando, Phoenix, and Tampa; (4) *New York Corridor*, including New York and Philadelphia; (5) *Southern Growth*, including Atlanta, Dallas, Charlotte, Denver, and Houston; (6) Southern California, including Los Angeles and San Diego; (7) *Tech Centers*, including San Francisco Bay Area, Boston, Austin, Portland, Raleigh, and Seattle; and (8) *Opportunistic Markets*, including all remaining domestic markets.

Table 2 provides a summary of the regional dispersion of the sample. The largest collection of properties is located in what we have termed opportunistic markets (62.7%). The next largest grouping is in Southern growth areas (8.2%), and then Heartland markets (7%). The New York corridor has the smallest number of observations at 2.3%.

[2] Properties with no observed capital expenditures (censored or uncensored) are deleted from the analysis. If a property has any missing data, all of that property's data are also deleted form the analysis.
[3] Southeast Florida includes Miami, Fort Lauderdale, and W. Palm Beach.

[Table 2 here]

To investigate the regional and sector breakdown further, a cross-tabulation of the observations in the sample is shown in Table 3. Using a count of the data (not taking into account the market value of the properties), the table revels that the largest segment of the data set is industrial property in Opportunistic markets (33.5% of the sample). Recall that industrial properties as a whole are the most common property type in the sample, followed by office and apartments. Office markets have the highest concentration also in Opportunistic markets (15.6%) followed by Capital Metro markets (3%). Retail properties are also concentrated in Opportunistic markets (11.5%) with the remaining assets evenly spread across most of the other areas.

[Table 3 here]

4.3 Econometric Methodology

We find that it is important to control for observed as well as unobserved individual heterogeneity when estimating equations (11), (16), and (19), and the problem can be overcome by the use of a multi-level or hierarchical model. The level 1 effects are modeled by equation (11), (16), or (19) producing estimates of the ratios of r to i and ρ to k, or $1 + \rho$, respectively, on average. At level 2, between-property differences in these values are examined. The level 2 analysis allows us to examine how differences in property characteristics affect the returns on investment.

To aid interpretation, we rewrite equation (11) as

$$\left(M_{ijt} - M_{ijt-1}\right)/M_{ijt-1} = \pi_0 + \pi_{1ij}\left(I_{ijt}/M_{ijt-1}\right) + \mu_{ijt} \qquad (20)$$

where it should be remembered that π_0 should be the estimated depreciation rate, while π_{1ij} should be close to 1. The subscripts i, j, and t, respectively, denote property i, property type j, and time t.

At level 2, the slope coefficients in (20) become the outcome variables. We assume that

π_{1ij} differs by property characteristics according to

$$\pi_{1ij} = \beta_{10} + \beta_{11} Z_{ij} + v_{1ij} \tag{21}$$

where β_{10} represents the average value of c, β_{11} represents the effect of property characteristic Z_{ij} on the average value of c for property type j, and v_{1ij} represents property i's deviation from the average value of c for property type j due to unobserved individual heterogeneity.

From equations (20) and (21), we have

$$(M_{ijt} - M_{ijt-1})/M_{ijt-1} = \pi_0 + \beta_{10}(I_{ijt}/M_{ijt-1}) + \beta_{11}(I_{ijt}/M_{ijt-1})Z_{ij} + v_{1ij}(I_{ijt}/M_{ijt-1}) + \mu_{ijt} \tag{22}$$

where the first three terms on the RHS in (22) represent fixed effects, while the last two terms (the error terms) represent random effects.

We can also rewrite equations (16) and (19) in the same way. The results are

$$(NOI_{ijt} - NOI_{ijt-1})/NOI_{ijt-1} = \theta_0 + \lambda_{10}(I_{ijt}/M_{ijt-1}) + \lambda_{11}(I_{ijt}/M_{ijt-1})Z_{ij} + \omega_{1ij}(I_{ijt}/M_{ijt-1}) + \varepsilon_{ijt} \tag{23}$$

$$(NOI_{ijt} - NOI_{ijt-1})/M_{ijt-1} + (M_{ijt} - M_{ijt-1})/M_{ijt-1} = \tau_0 + \xi_{10}(I_{ijt}/M_{ijt-1}) + \xi_{11}(I_{ijt}/M_{ijt-1})Z_{ij} + \eta_{1ij}(I_{ijt}/M_{ijt-1}) + \psi_{ijt} \tag{24}$$

where θ_0 is a measure of the drift in net operating income, τ_0 is a measure of the interest earned on the growth in net operating income, λ_{10} represents the average value of b, ξ_{10} represents the average value of $\rho + c$, λ_{11} represents the effect of property characteristic Z_{ij} on the average value of b for property type j, ξ_{11} represents the effect of property characteristic Z_{ij} on the average value of $\rho + c$ for property type j, ω_{1ij} represents property i's deviation from the average value of b for property type j due to unobserved individual heterogeneity, η_{1ij} represents property i's deviation from the average value of $\rho + c$ for property type j due to unobserved individual heterogeneity, and ψ_{ijt} is an error term.

The choice of control variables to represent Z_{ij} in (22), (23), and (24) is decided in part by what is available in the data set and partly by the theory that market capitalization effects of capital improvements may vary by property type (see Hypothesis 5 above). Guided by the theory, one might ask whether the market capitalization effects of capital improvements are time-varying (accepting that the greatest capitalization impact of capital improvements should be when the market lease rate is high or when there is an expectation of higher lease rates in the future, see Hypothesis 1 above). Further, defensive capital investments made when market lease rates are low or when there is an expectation of lower lease rates in the future should have little effect on cash flows or market values where asset values are endogenously determined by market conditions (see Hypotheses 2 and 3 above). Finally, the option characteristics of capital investments must be noted, and this consideration leads to questions as to whether levered properties are managed in the same way as unlevered properties (see Hypothesis 4 above).

The key control variables in this analysis represent property types. Property types are measured using a set of four 0-1 variables representing apartments, industrial properties, office buildings, and retail shopping centers.[4] We include a linear time-trend variable to capture any increases or decreases in market capitalization effects over the test period. A low-or-declining-market-lease-rate-interactive trend variable is included to test whether defensive capital investments are capitalized at a different rate to investments made when market lease rates are high or when there is an expectation of higher lease rates in the future. This interactive trend variable takes on different 0-1 values depending on the property type and if market lease rates within this property type are low or declining.[5] Property location is measured using a set of eight 0-1 variables, representing the eight markets described in

[4] The property types hotels, land, and other (which includes entertainment, healthcare, manufactured housing, parking, self-storage, and senior living) have been excluded from the analysis.
[5] We use a simple dating rule to determine periods of low or declining market lease rates. The dating rule used is to identify the peaks and troughs in market lease rates for each property type. Periods of low or declining market leases rates are those periods from peak to trough year-over-year net operating income growth rates.

Section 4.2. Market capitalization effects may vary depending on property location.

For this study, property-leverage status is simply dichotomized, coded 1 for levered properties and 0 otherwise.[6] Property life cycles are measured using a set of six 0-1 variables representing: (1) conversion (undergoing conversion to another property type); (2) development (property under construction); (3) initial leasing (properties available for occupancy for less than one year that are less than 60% occupied); (4) pre-development properties (raw land or land undergoing property site development); (5) renovation (undergoing substantial rehabilitation or remodeling); and (6) operating (properties in stabilized, operating phase). Trophy properties are measured following Mundy (2002), using a 0-1 variable equal to 1 if the property is represented by market value at the top 2.5 percentile of properties in its particular property class.[7] Trophy properties are measured for each property type. Once so measured, they are re-measured in each quarter over the test period; so once a trophy property, not always a trophy property. It depends on what else comes along.

There are no data on market values of properties between acquisition and disposition. Instead, data-contributing members of NCREIF report an appraised market value for each investment in their portfolio every quarter. We include a set of four 0-1 variables in equation (22) to control for appraisal type, representing: (1) external appraisal by an independent appraiser; (2) internal or in-house appraisal; (3) no appraisal has been performed; and (4) other.[8] A priori expectations would suggest a higher market capitalization associated with external appraisals. The remaining control variables in this study include lease percent, age of building (in years), and relative ease of implementation (measured in terms of time to implement the capital expenditures from start to end). The lease percent is included to account for market conditions. Older properties tend to have higher operating expenses, higher than

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[6] Here leverage may include senior or junior mortgages, participating mortgages, variable-rate mortgages, step-ups, etc.

[7] Trophy properties are unique, as having unique characteristics that allow owners to extract (at least in theory) a premium rent from prospective tenants for use of the space. Thus, weighed against other properties, market capitalization effects may vary depending on trophy property status.

[8] The other category is a heterogenous grouping consisting of less than 4 percent of all observations.

normal vacancy rates, more uncertain capital improvement expenditures, and tend to be located in lower appreciation areas as compared to newer properties. These conditions may reduce market capitalization effects. Holding all else equal, with great ease of implementation, the level of costs may be reduced. With reduced costs, it may be possible that market capitalization effects are greater.

5 The Empirical Results

5.1 Estimates of Market Capitalization Effects

Before reporting the results of the full market capitalization analysis described above, with all the explanatory and controlled variables entered into the model, we first report on the results of the unconditional market capitalization model. These results are shown in Table 4. Here the model is estimated with I_{ijt}/M_{ijt-1} as the only level 1 predictor and no substantive predictors at level 2. The intercept of 0.010 indicates the mean market value drift (net of depreciation) for the sample. The slope coefficient of 0.339 indicates that investors earn an average return equal to about ⅓ of their cost of capital on total capital investment. The error terms reveal significant heterogeneity in the slope coefficients. For apartment buildings, the between-property variance in market capitalization is 0.110 (with a t-statistic of 2.15), implying that the ratio of r to i on apartments reaches about 0.449 (= 0.339 + 0.110). In contrast, the between-property variance in market capitalization for industrial properties is -0.122, implying the ratio of r to i on industrial properties is only about 0.217 (= 0.339 – 0.122).

The results of estimating the full market capitalization analysis are presented in Table 5. The intercept implies a mean market value drift (net of depreciation) of 0.009. This estimate compares with a total capital value annual return on the NCREIF Property Index (NPI) on all properties of 0.0218 during the same time period. The slope coefficient on I_{ijt}/M_{ijt-1} is 0.512 on average with a t-statistic of 7.27. It is apparent from Table X that the control variables yield some noteworthy effects. The interaction term between I_{ijt}/M_{ijt-1} and time trend tells us that the trend is insignificant and that recent market capitalization effects are almost unchanged from earlier effects. The model has time specific fixed effects for defensive investments made when market lease rates are low or declining. The 0-1 variable for low or declining market lease rates interacted with time has a coefficient of 0.012 with a t-statistic of 2.77.

The location variables are statistically significant. Market capitalization effects are higher in the New York Corridor, Southern Growth, and Tech Centers. In contrast, market capitalization effects are lower in Capital Metro Markets. Opportunistic Markets form the omitted reference category. Lease percent is also statistically significant. Every percentage point increase in lease percent decreases market capitalization by about 0.002 (with a p-value < .0001). Having leverage has a negative effect on market capitalization. The coefficient on leverage is -0.163 with a t-statistic of -5.29.

External appraisals lead to higher market capitalization effects by 0.094 with a t-statistic of 3.13. Internal appraisals have a positive effect on market capitalization but the effect is not statistically significant. Trophy properties have a lower market capitalization. The Trophy Property coefficient is -0.273 and statistically significant with a t-statistic of -4.61. As expected, building age has a negative and statistically significant effect on market capitalization as does the relative ease of implementation. The former has a coefficient of -0.0001 with a t-statistic of -6.82, while the latter has a coefficient of -0.018 with a t-statistic of -7.52.

Examining the property life cycle variables reveals some interesting trends as well. On average, property under construction, and raw land or land undergoing property site development have a negative and statistically significant effect on market capitalization. In contrast, properties available for occupancy for less than one year that are less than 60% occupied, and properties undergoing substantial rehabilitation or remodeling have a positive and statistically significant effect on market capitalization. Properties in stabilized, operating phase form the omitted reference category.

We also find that the random inter-property effects are quite important. For example, the random effects coefficient for industrial properties is -0.110 with a t-statistic of -1.99, implying that the ratio of r to i on industrial properties is 0.402 (= 0.512 – 0.110). The random effects coefficients for apartments and office buildings are 0.086 and 0.094, respectively, but only marginally significant (t-statistics between 1.54 and 1.69).

5.2 Estimates of Higher Cash Flow

The regression results and tables in this section are organized in the same way as in Section 5.2. Table 6 provides estimates of the unconditional model for higher cash flows. Several interesting patterns emerge. The intercept of 0.017 indicates the mean drift in net operating income for the sample. The slope coefficient of 0.700 indicates that investors earn an average cash return on total capital investment equal to about 0.700 of the required cash-on-cash return on investment. These results are similar to, albeit higher than, those reported above. Most important, the residuals in Table 6 reveal significant inter-property heterogeneity. For example, the random effects coefficient for industrial properties is 0.311 with a t-statistic of 2.69, implying that the ratio of ρ to k on industrial properties is 1.011 (= 0.700 + 0.311). The random effects coefficients associated with the three other property types are negative, but not statistically significant.

Table 7 provides estimates of the full conditional analysis of higher cash flows. The first striking feature of Table 7 is the estimate of the slope coefficient. The slope coefficient estimate is 1.253 with a t-statistic of 2.19. The null hypothesis that the true value of λ_{1j} equals one on average yields a t-value of 0.44, and so we are unable to reject the null hypothesis that $\lambda_{1j} = 1$, on average. Another point to note is that the time trend is negative and statistically significant. The coefficient of $Low\ x\ I_{ijt}/M_{ijt-1}$ is an indicator variable that denotes whether defensive investments made when market lease rates are low or declining lead to similar increased cash flows as investments made when market lease rates are high or increasing. The coefficient associated with this variable has the correct sign, with a t-statistic of -5.37.

There are significant location effects. These effects are the strongest in the New York Corridor, which is none too surprising. The coefficient for the New York Corridor location variable is 0.876 with a t-statistic of 5.94. The next strongest effects are in the Lifestyle Centers. The coefficient for Lifestyle Centers is 0.452 with a t-statistic of 3.27. The largest negative effects are in Heartland Markets. The coefficient for Heartland Markets is -0.427 with a t-statistic of -3.51.

The control variables for lease percent and leverage also yield some noteworthy effects. The coefficient on lease percent is -0.242 with a t-statistic of -1.82. Having leverage has a negative effect on cash flows. The coefficient on leverage is -0.438 with a t-statistic of -7.36. For trophy properties, however, the effect on cash flows is statistically significant and positive. In fact, trophy properties experience a large increase in cash flows. The coefficient on Trophy Properties is 0.312 with a t-statistic of 2.27.

Capital expenditures improve cash flows on older buildings much more so than on younger buildings. The coefficient on building age is 0.0003 with a t-statistic of 4.23. Regarding the relative ease of implementation, it has a coefficient that is negative and highly statistically significant, so that doubling the implementation period from 4 quarter to 8 quarters reduces the ratio of ρ to k by 0.252.

It is noteworthy that property life cycle affects the ratio of ρ to k. We find a positive and highly statistically significant coefficient on both raw land or land undergoing property site development and properties undergoing substantial rehabilitation or remodeling. None of the other property life cycle coefficients is close to standard levels of significance.

In Table 7, the random inter-property differences are quite small. The coefficient on office buildings is 0.187 with a t-statistic of 1.81. This coefficient is highest. The other coefficients are insignificant.

5.3 Estimates of Higher Total Return

Table 8 reports the results from estimating the unconditional relationship between the returns over periods when capital expenditures are made and I_{ijt}/M_{ijt-1}. The results indicate that, perhaps not surprisingly, the coefficient of I_{ijt}/M_{ijt-1} is lower than expected if one postulates a world in which managers make decisions to maximize wealth. This finding is consistent with the results shown in Tables 4 and 6. The coefficient estimate of I_{ijt}/M_{ijt-1} is 0.821 with a t-statistic of 3.63. The residuals in Table 8 reveal significant inter-property heterogeneity. With no other controls for property characteristics, the between-property variance in total returns for apartments is 0.657, implying a value of $1+\rho$ on apartments of 1.478 (= 0.821 + 0.557). The random effects coefficients associated with the three other property types are not statistically significant.

Table 9 reports the results from estimating the conditional relationship between the returns over periods when capital expenditures are made and I_{ijt}/M_{ijt-1}. The controls represent important key/important explanatory variables. The coefficient estimate of I_{ijt}/M_{ijt-1} is 0.752 with a t-statistic of 2.95. The time trend is positive and marginally significant. The coefficient on time trend is 0.012 with a t-statistic of 1.72 $(p < 0.10)$. The coefficient of $Low\ x\ I_{ijt}/M_{ijt-1}$ has the incorrect sign, with a t-statistic of 1.71 $(p < 0.10)$. Finding a positive and significant coefficient on $Low\ x\ I_{ijt}/M_{ijt-1}$ presents a subtle problem, since the theory developed in this paper says that capital expenditures should be undertaken only when current lease rates are high or expected to increase.

Five of the location variables are statistically significant. Returns are higher and statistically significant in Southern California and Tech Centers. In contrast, returns are lower and statistically significant in Capital Metro Markets, Heartland Markets, and New York Corridor. The sign on lease percent is positive, with a t-statistic of 5.73. The coefficient on leverage indicates that managers who undertake leverage are in fact more likely to have a high return on capital investments, as the theory above would suggest. The coefficient on leverage is 0.091 with a t-statistic of 2.92.

Interestingly, the coefficient on Trophy Properties is positive, with a t-statistic of 2.03. Older buildings are less likely to have a high total return. The coefficient on building age is -0.0007, with a t-statistic of -19.60. The coefficient on the relative ease of implementation variable has the incorrect sign, with a t-statistic of 1.82.

Three of life cycle variables are statistically significant. We find a positive and statistically significant coefficient on both property under construction and property undergoing substantial rehabilitation or remodeling. We find a negative and statistically significant coefficient on property undergoing conversion to another property type.

In Table 9, the random inter-property differences are positive and statistically significant for office building. The coefficient on office buildings is 0.123 with a t-statistic of 2.11. The other coefficients are insignificant.

6 Discussion

One explanation of the above results is that high capital investment levels coincide with high or rising market lease rates. Similarly, low capital investments levels coincide with low or declining market lease rates. Holding the discount rate constant, high or rising market lease rates imply high or rising prices. By the same token, low or declining market lease rates imply low or declining prices. Now suppose that the market overenthusiastically discounts the future by paying exaggerated (understated) multiples of present or prospective earnings when market lease rates are high (low) – a fact not captured in the options theory developed here. Note that, in this account, a value of c less than 1 is easily understood if investment levels occur when market lease rates are high or increasing, but while market values are already excessive.

Likewise, the observed market changes from defensive investments – the positive coefficient on our 0-1 variable for low or declining market lease rates interacted with time in Table 7 – is consistent with the economic tenet that prices are below true value when market lease rates are low or declining.

The above interpretation also explains why, throughout the sample, the estimated b's are in excess of 1 – investments are made to capitalize on high or rising market lease rates. These results are consistent with Hypotheses 1 and 2. Perhaps the most striking result from the above is that market capitalization and income effects do vary by property type as well as by location. Apartments come out on top in terms of total return over our sample periods (the return on investment is well above $1 + \rho$, see Table 8), while the best performing markets are Southern California and Tech Centers. These results are consistent with Hypothesis 5.

The results reported here indicate that there is a real options effects, capital investment induces a high rate of return on levered properties compared to unlevered properties, which, in turn, increases skewness in the distribution of returns on levered properties. These results are consistent with Hypothesis 4. We also find a great deal of heterogeneity in the results across properties. There appears to a negative correlation market capitalization effects and trophy properties, even though incomes and returns to trophy properties are substantially higher than incomes and returns to non-trophy properties. There also appears to be a positive correlation between returns and lease percent (i.e., properties more fully let appear to earn higher returns than properties less fully occupied). Regarding older properties, they appear to benefit from higher incomes but suffer in terms of market capitalization effects, and this latter effect causes older properties to have lower returns than new properties. These results hold in general after controlling property type as well as life cycle.

Finally, regarding whether investors receive the same total return on defensive capital investments made when market lease rates are low or decreasing as on capital investments made when market lease rates are high or increasing, our empirical results suggest that defensive investments have, ceteris paribus, higher returns. Here the findings are contrary to Hypothesis 3. The result may be driven by market values that are lower than future returns warrant in periods of low or declining market lease rates. Other things equal, these materially lower-than-prices should lead to higher-than-normal returns.

7 Conclusion

In this paper we investigate the implications of a theoretical model based on a real options framework which suggests a connection between capital improvement expenditures and high or increasing market lease rates. According to standard real options theory, when rental rates are high or there is an expectation of future rental increases, owners are incentivized to increase capital expenditure to maximize profit. However, in times of low or decreasing lease rates, owners are likely to defer capital improvements. This result has one strong implication – levels of capital investment will vary depending upon a variety of factors, including whether rents are high and changes are expected to increase. Holding returns constant, with higher rents, market values should rise too.

We test these two propositions using cross-sectional data and find strong evidence supporting the proposition that capital improvements lead to higher incomes, but weak evidence for the proposition that the amounts invested are fully capitalized into market values. The latter result is found to hold across different property types and regions as well as within the "Trophy Property" category. We use property-level data that are available from NCREIF to examine changes in profits and market values over periods in which capital investment were made, and then we relate these changes to the amounts invested. We also estimate whether total returns increase commensurately by regressing the return earned over these periods onto the amounts invested. The latter can be thought of as a direct test of whether managers overinvest in properties by undertaking unprofitable capital investments.

We find that it is important to control for observed as well as unobserved individual heterogeneity when comparing changes in profits and market values and returns earned to the amounts invested following this technique. In effect, what we have is a problem of unobserved or omitted variables. To resolve this problem, parameters are estimated using a multi-level, or hierarchical, modeling framework. Our results imply, for example, that income and market capitalization effects vary by property type just as the theory would predict. We also discuss how the rate of capital investment should induce skewness in the distribution of future cash flows when properties are leveraged by a mortgage loan, and, ultimately, how income and market capitalization effects should vary if properties are leveraged. The data on this score provide weak support of the theory.

Our analysis also investigates the extent to which defensive capital investments made during periods of low or declining lease rates are as profitable as capital investments made during periods of high or increasing lease rates, which theory says is not probable. Yet we find evidence suggesting otherwise. One explanation of these results is that when market lease rates are high (low), prices are higher (lower) than future returns warrant. Hence, market capitalization effects are lower (higher) than predicted by real options theory when market leases are high (low).

Lastly, it is noteworthy that having found strong evidence that capital improvements lead to higher incomes but weak evidence that the amounts invested are fully capitalized into market values, we obtain overall evidence suggesting that total returns increase with the amount of investment as the theory forecasts. The fact driving this result is high incomes in periods of high or rising rents, but at the same time higher market values in periods of low or declining rents. To our knowledge, these findings have not been discussed previously in the literature and suggest promising areas for further research.

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Table 1
Sample Composition by Property Type
(2003-2012)

Property Type	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Apartments	74	3.6	74	3.6
Industrial	1100	53.6	1174	57.2
Office	548	26.7	1722	83.8
Retail	332	16.2	2054	100.0

Table 2

Regional Distribution of Sample

(2003-2012)

Region	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Capital metro markets	95	4.6	95	4.6
Heartland markets	143	7.0	238	11.6
Lifestyle centers	74	3.6	312	15.2
New York corridor	47	2.3	359	17.5
Southern growth	168	8.2	527	25.7
Southern california	133	6.5	660	32.1
Tech centers	107	5.2	767	37.3
Opportunistic markets	1287	62.7	2054	100.0

Notes: Capital metro markets - includes Washington, D.C.; Heartland markets - Chicago, Cincinnati, Cleveland, Detroit, Columbu, Indianapolis, Kansas City, Memphis, Nashville, St Louis; Lifestyle centers - includes Southeast Florida, Sacramento, San Antonio, Las Vegas, Orlando, Phoenix, Tampa; New York corridor - includes New York and Philadephia; Southern growth - Atlanta, Dallas, Charlotte, Denver and Houston; Southern California - includes Los Angeles and San Diego; Tech centers - San Francisco Bay Area, Boston, Austin, Portland, Raleigh and Seattle; and Opportunistic - all remaining domestic markets

Table 3

Table of Property Type by Region									
Property Type	Region(Region)								
	Capital metro markets	Heartland markets	Lifestyle centers	New York corridor	Southern growth	Southern california	Tech centers	Opportunistic markets	Total
Apartments	5	2	9	8	2	2	6	40	74
	0.2	0.1	0.4	0.4	0.1	0.1	0.3	2.0	3.6
	6.8	2.7	12.2	10.8	2.7	2.7	8.1	54.1	
	5.3	1.4	12.2	17.0	1.2	1.5	5.6	3.1	
Industrial	11	80	28	15	127	91	59	689	1100
	0.5	3.9	1.4	0.7	6.2	4.4	2.9	33.5	53.6
	1.0	7.3	2.6	1.4	11.6	8.3	5.4	62.6	
	11.6	55.9	37.8	31.9	75.6	68.4	55.1	53.5	
Office	62	37	26	16	28	24	33	322	548
	3.0	1.8	1.3	0.8	1.4	1.2	1.6	15.7	26.7
	11.3	6.8	4.7	2.9	5.1	4.4	6.0	58.8	
	65.3	25.9	35.1	34.0	16.7	18.1	30.8	25.0	
Retail	17	24	11	8	11	16	9	236	332
	0.8	1.2	0.5	0.4	0.5	0.8	0.4	11.5	16.2
	5.1	7.2	3.3	2.4	3.3	4.8	2.7	71.1	
	17.9	16.8	14.9	17.0	6.6	12.0	8.4	18.3	
Total	95	143	74	47	168	133	107	1287	2054
	4.6	7.0	3.6	2.3	8.2	6.5	5.2	62.7	100.0

Note: Each cell contains the frequency count, then the percentage of total sample, the row percentage, and the column percentage. Capital metro markets - includes Washington, D.C.; Heartland markets - Chicago, Cincinnati, Cleveland, Detroit, Columbu, Indianapolis, Kansas City, Memphis, Nashville, St Louis; Lifestyle centers - includes Southeast Florida, Sacramento, San Antonio, Las Vegas, Orlando, Phoenix, Tampa; New York corridor - includes New York and Philadephia; Southern growth - Atlanta, Dallas, Charlotte, Denver and Houston; Southern California - includes Los Angeles and San Diego; Tech centers - San Francisco Bay Area, Boston, Austin, Portland, Raleigh and Seattle; and Opportunistic - all remaining domestic markets.

Table 4
Unconditional Hierarchical Model for Capital Expenditures on Market Values

Fixed Effects	Estimate	Standard Error	t-statistic
Intercept	0.010	0.001	12.1
I_{ijt}/M_{ijt-1}	0.339	0.050	6.76
Random Effects			
Slope, Apartments	0.110	0.051	2.15
Slope, Industrial	-0.122	0.050	-2.41
Slope, Office	0.033	0.051	0.64
Slope, Retail	-0.021	0.052	-0.41
Number of observations		2724	
-2 log-likelihood		-2500	

Dependent variable: $(M_{ijt}-M_{ijt-1})/M_{ijt-1}$. M_{ijt} = market value of property at time t. Iijt = capital investment in period t. Sample period is 2003-2012.

Table 5

Conditional Hierarchical Model for Capital Expenditures

Fixed Effects	Estimate	Standard Error	t-statistic
Intercept	0.009	0.001	10.73
I_{ijt}/M_{ijt-1}	0.512	0.138	3.72
Interaction terms with I_{ijt}/M_{ijt}-1			
Time	-0.004	0.003	-1.21
Time*Low(I_{ijt}/M_{ijt}-1)	0.012	0.004	2.77
Location 1	-0.115	0.047	-2.42
Location 2	0.012	0.040	0.30
Location 3	0.002	0.032	0.05
Location 4	0.146	0.034	4.34
Location 5	0.137	0.040	3.47
Location 6	-0.016	0.029	-0.56
Location 7	0.219	0.038	5.72
Lease Percent	-0.163	0.024	-6.84
Leverage	-0.163	0.031	-5.29
Appraisal Type 1	-0.403	0.659	-0.61
Appraisal Type 2	0.094	0.030	3.13
Appraisal Type 3	0.031	0.018	1.75
Trophy	-0.273	0.059	-4.61
Age	0.000	0.000	-6.82
Time to implement	-0.018	0.002	-7.52
LifeCycle 1	-0.005	0.090	-0.06
LifeCycle 2	-0.059	0.028	-2.10
LifeCycle 3	0.146	0.041	3.61
LifeCycle 4	-0.162	0.055	-2.95
LifeCycle 5	0.568	0.066	8.57
Random Effects			
Slope, Apartments	0.086	0.056	1.54
Slope, Industrial	-0.110	0.055	-1.99
Slope, Office	0.094	0.055	1.69
Slope, Retail	-0.070	0.057	-1.24
Number of observations		2603	
-2 log-likelihood		-2500	

Dependent variable: $(M_{ijt}-M_{ijt-1})/M_{ijt-1.}$ M_{ijt} = market value of property at time t. Iijt = capital investment in period t. Sample period is 2003-2012.We include a linear time-trend variable. A low-or-declining-market-lease-rate-interactive trend variable is included. Property location is measured using a set of eight 0-1 variables representing: (1) Capital Metro Markets, including Washington, D.C.; (2) Heartland Markets, including Chicago, Cincinnati, Cleveland, Detroit, Columbus, Indianapolis, Kansas City, Memphis, Minneapolis, Nashville, and St. Louis; (3) Lifestyle Centers, including Southeast Florida, Sacramento, San Antonio, Las Vegas, Orlando, Phoenix, and Tampa; (4) New York Corridor, including New York and Philadelphia; (5) Southern Growth, including Atlanta, Dallas, Charlotte, Denver, and Houston; (6) Southern California, including Los Angeles and San Diego; (7) Tech Centers, including San Francisco Bay Area, Boston, Austin, Portland, Raleigh, and Seattle; and (8) Opportunistic Markets, including all remaining domestic markets. The left-out category is Opportunistic Markets. Property-leverage status is simply dichotomized, coded 1 for levered properties and 0 otherwise. Property life cycles are measured using a set of six 0-1 variables representing: (1) conversion (undergoing conversion to another property type); (2) development (property under construction); (3) initial leasing (properties available for occupancy for less than one year that are less than 60% occupied); (4) pre-development properties (raw land or land undergoing property site development); (5) renovation (undergoing substantial rehabilitation or remodeling); and (6) operating (properties in stabilized, operating phase). The left-out category is stabilized properties. Trophy properties are measured following Mundy (2002), using a 0-1 variable equal to 1 if the property is represented by market value at the top 2.5 percentile of properties in its particular property class. We include a set of four 0-1 variables in equation (22) to control for appraisal type, representing: (1) external appraisal by an independent appraiser; (2) internal or in-house appraisal; (3) no appraisal has been performed; and (4) other. The left-out category is other. The remaining control variables in this study include lease percent, age of building (in years), and relative ease of implementation (measured in terms of time to implement the capital expenditures from start to end).

Table 6
Unconditional Hierarchical Model for Capital Expenditures on NOI Growth

Fixed Effects	Estimate	Standard Error	t-statistic
Intercept	0.017	0.004	4.41
I_{ijt}/M_{ijt-1}	0.700	0.113	6.19
Random Effects			
Slope, Apartments	-0.126	0.119	-1.06
Slope, Industrial	0.311	0.115	2.69
Slope, Office	-0.099	0.117	-0.84
Slope, Retail	-0.086	0.126	-0.68
Number of observations		773	
-2 log-likelihood		-1474.4	

Table 7
Conditional Hierarchical Model for NOI Growth

Fixed Effects	Estimate	Standard Error	t-statistic
Intercept	0.017	0.003	5.05
I_{ijt}/M_{ijt-1}	1.253	0.572	2.19
Interaction terms with I_{ijt}/M_{ijt}-1			
Time	-0.102	0.019	-5.37
Time*Low(I_{ijt}/M_{ijt}-1)	0.072	0.013	5.45
Location 1	-0.173	0.240	-0.72
Location 2	-0.427	0.122	-3.51
Location 3	0.452	0.138	3.27
Location 4	0.876	0.148	5.94
Location 5	0.087	0.092	0.95
Location 6	-0.055	0.131	-0.42
Location 7	-0.376	0.256	-1.47
Lease Percent	-0.242	0.133	-1.82
Leverage	-0.439	0.060	-7.36
Trophy	0.312	0.137	2.27
Age	0.000	0.000	4.23
Time to implement	-0.063	0.009	-7.03
LifeCycle 1	0.027	0.144	0.19
LifeCycle 2	0.034	0.165	0.21
LifeCycle 3	0.689	0.216	3.20
LifeCycle 4	0.880	0.170	5.17
Random Effects			
Slope, Apartments	-0.194	0.109	-1.79
Slope, Industrial	0.047	0.098	0.48
Slope, Office	0.187	0.104	1.81
Slope, Retail	-0.039	0.108	-0.36
Number of observations		761	
-2 log-likelihood		-1686.8	

Dependent variable:NOI growth. M_{ijt} = market value of property at time t. Iijt = capital investment in period t. Sample period is 2003-2012.We include a linear time-trend variable. A low-or-declining-market-lease-rate-interactive trend variable is included. Property location is measured using a set of eight 0-1 variables representing: (1) Capital Metro Markets, including Washington, D.C.; (2) Heartland Markets, including Chicago, Cincinnati, Cleveland, Detroit, Columbus, Indianapolis, Kansas City, Memphis, Minneapolis, Nashville, and St. Louis; (3) Lifestyle Centers, including Southeast Florida, Sacramento, San Antonio, Las Vegas, Orlando, Phoenix, and Tampa; (4) New York Corridor, including New York and Philadelphia; (5) Southern Growth, including Atlanta, Dallas, Charlotte, Denver, and Houston; (6) Southern California, including Los Angeles and San Diego; (7) Tech Centers, including San Francisco

Bay Area, Boston, Austin, Portland, Raleigh, and Seattle; and (8) Opportunistic Markets, including all remaining domestic markets. The left-out category is Opportunistic Markets. Property-leverage status is simply dichotomized, coded 1 for levered properties and 0 otherwise. Property life cycles are measured using a set of six 0-1 variables representing: (1) conversion (undergoing conversion to another property type); (2) development (property under construction); (3) initial leasing (properties available for occupancy for less than one year that are less than 60% occupied); (4) pre-development properties (raw land or land undergoing property site development); (5) renovation (undergoing substantial rehabilitation or remodeling); and (6) operating (properties in stabilized, operating phase). The left-out category is stabilized properties. Trophy properties are measured following Mundy (2002), using a 0-1 variable equal to 1 if the property is represented by market value at the top 2.5 percentile of properties in its particular property class. The remaining control variables in this study include lease percent, age of building (in years), and relative ease of implementation (measured in terms of time to implement the capital expenditures from start to end).

Table 8

Unconditional Hierarchical Model for Capital Expenditures on Total Return

Fixed Effects	Estimate	Standard Error	t-statistic
Intercept	0.003	0.000	5.62
I_{ijt}/M_{ijt-1}	0.821	0.226	3.63
Random Effects			
Slope, Apartments	0.657	0.227	2.89
Slope, Industrial	-0.221	0.226	-0.97
Slope, Office	-0.088	0.227	-0.39
Slope, Retail	-0.348	0.227	-1.54
Number of observations		2724	
-2 log-likelihood		-2500	

Dependent variable: Total Return. M_{ijt} = market value of property at time t. Iijt = capital investment in period t. Sample period is 2003-2012.

Table 9
Conditional Hierarchical Model for Total Return

Fixed Effects	Estimate	Standard Error	t-statistic
Intercept	0.002	0.000	4.91
I_{ijt}/M_{ijt-1}	0.752	0.255	2.95
Interaction terms with I_{ijt}/M_{ijt}-1			
Time	0.012	0.007	1.72
Time*Low(I_{ijt}/M_{ijt}-1)	0.010	0.006	1.71
Location 1	-0.171	0.092	-1.85
Location 2	-0.208	0.059	-3.51
Location 3	0.086	0.074	1.16
Location 4	-0.761	0.136	-5.60
Location 5	0.069	0.055	1.26
Location 6	0.129	0.039	3.33
Location 7	0.248	0.062	4.00
Lease Percent	0.235	0.041	5.73
Leverage	0.091	0.031	2.92
Trophy	0.134	0.066	2.03
Age	-0.001	0.000	-19.60
Time to implement	0.006	0.004	1.82
LifeCycle 1	-0.670	0.081	-8.24
LifeCycle 2	0.188	0.049	3.81
LifeCycle 3	0.043	0.055	0.78
LifeCycle 4	0.002	0.234	0.01
LifeCycle 5	0.174	0.084	2.06
Random Effects			
Slope, Apartments	-0.094	0.065	-1.44
Slope, Industrial	0.019	0.055	0.34
Slope, Office	0.123	0.058	2.11
Slope, Retail	-0.048	0.060	-0.8
Number of observations		2503	
-2 log-likelihood		-2500	

Dependent variable: Total Returns. M_{iit} = market value of property at time t. Iijt = capital investment in period t. Sample period is 2003-2012.We include a linear time-trend variable. A low-or-declining-market-lease-rate-interactive trend variable is included. Property location is measured using a set of eight 0-1 variables representing: (1) Capital Metro Markets, including Washington, D.C.; (2) Heartland Markets, including Chicago, Cincinnati, Cleveland, Detroit, Columbus, Indianapolis, Kansas City, Memphis, Minneapolis, Nashville, and St. Louis; (3) Lifestyle Centers, including Southeast Florida, Sacramento, San Antonio, Las Vegas, Orlando, Phoenix, and Tampa; (4) New York Corridor, including New York and Philadelphia; (5) Southern Growth, including Atlanta, Dallas, Charlotte, Denver, and Houston; (6) Southern California, including Los Angeles and San Diego; (7) Tech Centers, including San Francisco Bay Area, Boston, Austin, Portland, Raleigh, and Seattle; and (8) Opportunistic Markets, including all remaining domestic markets. The left-out category is Opportunistic Markets. Property-leverage status is simply dichotomized, coded 1 for levered properties and 0 otherwise. Property life cycles are measured using a set of six 0-1 variables representing: (1) conversion (undergoing conversion to another property type); (2) development (property under construction); (3) initial leasing (properties available for occupancy for less than one year that are less than 60% occupied); (4) pre-development properties (raw land or land undergoing property site development); (5) renovation (undergoing substantial rehabilitation or remodeling); and (6) operating (properties in stabilized, operating phase). The left-out category is stabilized properties. Trophy properties are measured following Mundy (2002), using a 0-1 variable equal to 1 if the property is represented by market value at the top 2.5 percentile of properties in its particular property class. The remaining control variables in this study include lease percent, age of building (in years), and relative ease of implementation (measured in terms of time to implement the capital expenditures from start to end).